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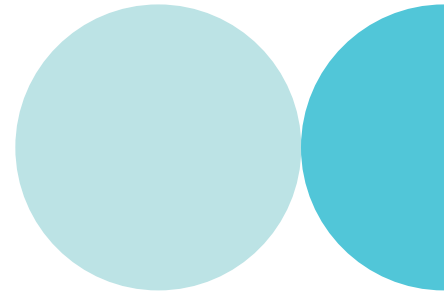
Macroeconomic Modelling Tool for Malaysia (MMT)

Macroeconomic Modelling using an Updated SAM Framework

REPORT 1

Acknowledgements

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Executive Summary

This report presents the Malaysian Macroeconomic Modelling Tool for Malaysia, documenting its development and technical characteristics.

Sponsored by the United Nations (UN), and delivered by a small consultant team , the MMT aims to provide a basic macroeconomic policy analysis tool for independent and non-governmental researchers. Its target user groups include NGOs/CSOs, think tanks, academic institutions, and UN agencies. This modelling framework has also been developed in consultation with the Department of Statistics Malaysia (DOSM).

The report majors on work to update the Malaysia Social Accounting (SAM) from 2015 to 2019, alongside further innovations to allow for more detailed distributional analyses.

The SAM is a standard data framework used to analyze income, expenditure, and other flows within the economy, and their distribution between income and key population groups. Notably the later was expanded to provide an analysis by income group and locality, in additional to the recognized Malaysian ethnic classification.

Work included development of a SAM-based multiplier model (the MMT 1.0)

This was delivered by designating the SAM accounts as either exogenous (and therefore independent) or exogenous (and therefore dependent), then applying the multiplier relations embedded in the SAM and differencing the outputs on the base values.

Additionally, the MMT's design includes two supplementary sub-models allowing for analysis of poverty and un/employment outcomes, providing a comprehensive analytical framework.

However, while the employment sub-model was completed, it was not possible able to fully finalize the poverty sub-model, and this will be updated during the next iteration of the work . In the interim, the team will also seek to develop an alternative poverty estimation approach.

It is envisaged in the longer term that the MMT would be further sophisticated to provide a more throughgoing Computable General Equilibrium (CGE) modelling capacity allowing for price changes and behavioral responses, and for temporal effects.

This would take place over the next two years subject to the interest of the key user groups and partners.

A counterpart report provides a full worked example, employing the MMT to analyze the impacts of the major COVID-19 recovery measures adopted in the 2022 budget.

This offers both an exemplification of the value of the MMT and a research output in itself.

Ongoing work will focus on making improvements to the existing (MMT 1.0) framework.

This specifically includes development of a user-friendly interface, alongside familiarization and capacity building.

Acronyms and abbreviations used in this report

MMT	Macroeconomic Modelling Tool for Malaysia
COVID-19	Disease caused by SARS corona virus 2
CSO	Civil Society Organization
DOSM	Department of Statistics Malaysia
FP	Factors of Production
GE/ CGE	General Equilibrium/Computable GE
ILO	International Labour Organization
IOM	Input-Output Model
LFS	Labour Force Survey
MIC	Middle Income Country
MOF	Ministry of Finance
MY	Malaysia
NGO	Non- Governmental Organization
PA	Production Accounts
SAM	Social Accounting Matrix
SIM 1/2/3	Simulation 1st/2nd/3rd
SNA	System of National Accounts
UN	United Nations
UNCT	UN Country Team

1. Introduction

This report, which is one of two, documents and explains the development of the Macroeconomic Modelling Tool for Malaysia (MMT) , as part of a longer initiative sponsored by the United Nations Country Team. The MMT aims to offer a basic well-grounded and open-source framework for economic policy analysis by non-governmental actors, such as NGOs and CSOs, think thanks, UN agencies and individual researchers. Offered an entry level General Equilibrium (GE) modelling tool, it is also envisaged that the MMT will be sophisticated over time, working in consultation with the Department of Statistics Malaysia (DOSM).

This first report provides a technical account of the initial modelling approach and the various stages of the MMT's development, it majors on the updating and use of Malaysia's Social Accounting Matrix (SAM) as bedrock of the approach. The second report, which will be published separately, offers an illustration of the approaches' value and utility via a worked example of the likely impacts of the 2022 budget choices.

The report has six main parts. The first provides essential background; the second documents Malaysian SAM framework developed by DOSM in 2015; the third and fourth parts explain the steps taken to update the SAM to 2019 and its key features; the fifth sets out how a multiplier model was crafted from the new SAM; sixth and finally, the report outlines the next steps.

Figure 1: Depiction of the circular flow of income

2. Background

A Social Accounting Matrix (SAM) is a systematic data and classification system that records the circular flow of income and expenditures within the economy as captured within the System of National Accounts (SNA) (see Figure 10). But crucially also, a SAM records the distribution of these flows between key population (i.e., by income, social and ethnic) groups.
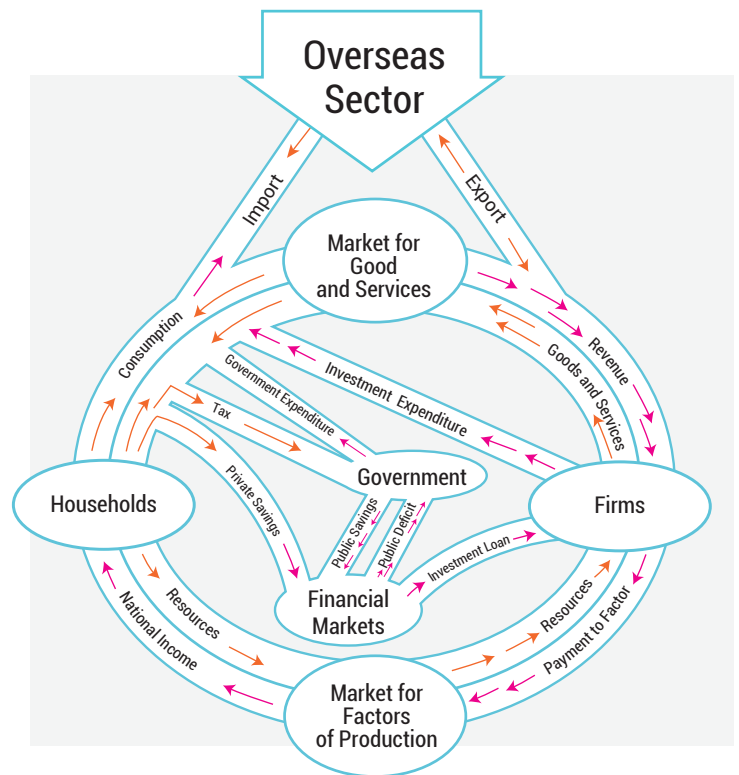
As a data framework, SAM is a snapshot of a country at a point in time[1]. A particular innovation of the SAM approach is to bring together macroeconomic data (such as national accounts) and microeconomic data (such as household surveys) within a consistent framework. This aims to provide as comprehensive a picture of the structure of the economy as possible. A SAM is a generalization of the production relations, and extends this information beyond the structure of production to include: i) the distribution of value-added to institutions generated by production activities; ii) formation of household and institutional income; iii) the pattern of consumption, savings and investment; iv) government revenue collection and associated expenditures and transactions; and v) the role of the foreign sector in the formation of additional incomes for household and institutions. SAMs usually serve two basic purposes: (a) as a comprehensive and consistent data system for descriptive analysis of the structure of the economy and (b) as a basis for macroeconomic modelling[2].

The move from a SAM data framework to a SAM model (also known as a multiplier framework) requires decomposing the SAM into 'exogenous' and 'endogenous' accounts, such as those determined outside the modelling framework, and hence independent or causal, and those determined within the model, and hence dependent or caused. As such, accounts intended to be used as policy instruments (for example, government expenditure including social protection, investment, and exports) are made exogenous and accounts specified as objectives or targets must be made endogenous (for example, output, commodity demand, factor returns, and household income or expenditure). For any given injection into the exogenous accounts of the SAM, influence is transmitted through the interdependent SAM system among the endogenous accounts. The interwoven nature of the system implies that the incomes of factors, households and production are all derived from exogenous injections into the economy via a multiplier process. The multiplier process is developed here on the assumption that when an endogenous income account receives an exogenous expenditure injection, it spends it in the same proportions as shown in the matrix of average propensities to spend (APS).

A SAM for Malaysia is available for 2015. However, it is advisable to use a recent SAM for modelling and hence policy simulation. As the initial purpose was to assess the impacts of COVID-19 and policy responses on Malaysia (see second report), it was decided to update the 2015 SAM to a 2019 SAM (i.e., as 2019 was the last "normal" year before the COVID 19 pandemic). Accordingly, a SAM updating exercise was carried out and the main purpose of the remaining parts of the report is to present the methodology and key results of the updating exercise.

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[1]Pyatt G and Thorbecke E, Planning Techniques for a Better Future, Geneva, ILO, 1976.
[2]There are three widely used approaches to capture economy wide impacts: (i) fixed price multiplier model based on an input-output table or matrix (IOM); (ii) fixed price multiplier model using a social accounting matrix (SAM) – which is a super set of IOM encompassing activities, commodities, factors of production along with institution; and (iii) flex price computable general equilibrium (CGE) model – invoking markets (e.g. product market and labour market etc.), behavioral specifications of all agents (e.g. producers and consumers etc.) and closure rules (e.g. defining how the accounts are balanced).
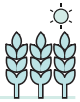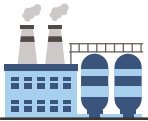
3. Overview of the 2015 SAM for Malaysia

The latest Social Accounting Matrix (SAM) available for Malaysia is for 2015. It is composed of 33 activities; 33 commodities; 14 factors of production; and 4 current institutions - such as government, households, corporations and the rest of the world. The household, which is a key institution representing 72 percent of institutional accounts, has been represented by 13 households classified according to location, income, and ethnicity. Unlike many other SAMs, the Malaysia SAM 2015 has several interesting, important, and innovative features through comprehensive representation of the corporate institution and as well as the inclusion of the financial account.

3.1 SAM Accounts

The 2015 SAM identifies the economic relationships through four types of accounts: (i) production accounts for 33 activities and commodity accounts for the 33 products and services; (ii) 14 factors of production with 13 different types of labour, 1 type of capital (including land and mixed income); (iii) current account transactions among the 4 main institutional agents; household-members and unincorporated capital, corporations, government and the rest of the world; and (iv) one consolidated capital account capturing flows of savings and investment. The disaggregation of activities, commodities, factors and institutions in the SAM is given in Table 1 below.

Table 1: Description of Malaysia SAM 2015

SAM Accounts	Detailed account classification
Activities (33)	
	Crops, animal production and hunting, forestry and logging, and fishing and aquaculture (03)
	Extraction of crude petroleum and natural gas, mining of metal ores, mining of coal and lignite, other mining and quarrying, food products, beverages and tobacco products, textiles, wearing apparel and leather products, wood, furniture, paper products and printing, petroleum, chemical and rubber products, metal and other non-metallic mineral products, electrical, electronic and optical products, transport equipment and other manufacturing, construction of buildings, civil engineering, specialized construction activities, and utilities (16)
	Wholesale and retail trade, food & beverage and accommodation, transportation and storage information and communication, finance, real estate, rental and leasing, research and development, business services, education, health, government services, NPISHs and other services activities (14)
Commodities (33)	
	Crops, animal production and hunting, forestry and logging, and fishing and aquaculture (03)

SAM Accounts	Detailed account classification
Commodities (33)	
	Extraction of crude petroleum and natural gas, mining of metal ores, mining of coal and lignite, other mining and quarrying, food products, beverages and tobacco products, textiles, wearing apparel and leather products, wood, furniture, paper products and printing, petroleum, chemical and rubber products, metal and other non-metallic mineral products, electrical, electronic and optical products, transport equipment and other manufacturing, construction of buildings, civil engineering, specialized construction activities, and utilities (16)
	Wholesale and retail trade, food & beverage and accommodation, transportation and storage information and communications, finance, real estate, rental and leasing, research and development, business services, education, health, government services, NPISHs and other services activities (14)
Factors of Production (14)	
	Labour factors (13): Urban High Income Bumiputera, Urban High Income non-Bumiputera, Urban Medium Income Bumiputera, Urban Medium Income non-Bumiputera, Urban Low Income Bumiputera, Urban Low Income non-Bumiputera; Rural High Income Bumiputera, Rural High Income Non-Bumiputera, Rural Medium Income Bumiputera, Rural Medium non-Bumiputera, Rural Low Income Bumiputera, Rural Low Income, and Non-citizen
	Capital factor
Institutions (19)	
	Households (13): Labour factors (13): Urban High Income Bumiputera, Urban High Income non-Bumiputera, Urban Mid Income Bumiputera, Urban Mid Income non-Bumiputera, Urban Low Income Bumiputera, Urban Low Income non-Bumiputera, Rural High Income Bumiputera, Rural High Income Non-Bumiputera, Rural Mid Income Bumiputera, Rural Mid non-Bumiputera, Rural Low Income Bumiputera, Rural Low Income, and Non-citizens
	Corporations
	Financial
	Government
	Rest of the World (3): Rest of the World Goods and Services, Rest of the World Income Transfer, and Rest of the World Capital.
	Savings or Gross fixed capital (consolidated capital)

Source: SAM 2015

3.2 Malaysia SAM for 2015

A description of the Macro SAM accounts is provided in Tables 2 and 3 below. The complete Macro SAM for 2015 containing the national accounts and other data including transfers, taxes and foreign transactions is shown in Table 4. The Malaysia Macro SAM is "anchored" primarily to the 'production accounts 2015 or Input-Output Table 2015', 'National Accounts' data and their macro aggregates. Savings of households and enterprises have been adjusted to ensure the macroeconomic balance of the SAM. Government saving is computed as the difference between total government receipts and total government spending.

Table 2: Account Description of Malaysia Macro SAM (2015 & 2019)

	ACT	FAC	HH	COR	GOV	S_I	FIN	RoW1	RoW2	RoW3	Total
ACT	Raw materials		Consumption of domestic goods and services		Final consumption	GCF for domestic goods		Exports of domestic goods and services			Total domestic use
FAC	Value added								Factor income from abroad Social benefits from abroad		Total factor income
HH		Compensation of employees & unincorporated business profits Operating surplus	Current transfers	Distributed Profits	Social transfer		Household borrowing				Total HH income
COR				Current transfers			Corporate borrowing		Non-Factor income from abroad		Total COR income
GOV	Commodity tax		Income tax	Corporate tax		Tax on capital goods	Government borrowing	Exports tax	Non-Factor income from abroad		Total GOV income
S_I			HH Savings	COR Savings Lending	COV Savings						Total Savings
FIN											Total Lending
RoW1	Import Raw material		Consumption of imported goods and services		Consumption of imported goods and services	Imports of capital goods				Balance of goods and services	Total Imports
RoW2		Factor income paid abroad	Non-Factor income paid abroad	Non-Factor income paid abroad	Non-Factor income paid abroad						Total income and transfers paid abroad
RoW3						Balance of capital and financial ACs			Balance of income and transfers		Total capital paid abroad
Total	Gross output	Total Factor Payment	Total HH Expenditure	Total COR Expenditure	Total GOV Expenditure	Total Investments	Total Borrowing	Total Exports	Total income and transfers from abroad	Total capital from abroad	

Table 3: Account Description of Malaysia Macro SAM 2015 (Million MYR)

	ACT	FAC	HH	COR	GOV	S_I	FIN	RoW1	RoW2	RoW3	Total		
ACT	1,221,227	0	556,670	0	152,053	193,648	0	638,834	0	0	2,762,431	2,762,431	0.00000
FAC	1,119,618	0	0	0	0	0	0	0	48,674	0	1,168,293	1,168,293	0.00000
HH	0	501,465	2,347	91,998	62,177	0	36,065	0	9	0	694,062	694,062	0.00000
COR	0	586,042	0	53,082	0	0	62,408	0	7,941	0	709,472	709,472	0.00000
GOV	26,042	0	37,884	110,422	0	4,826	33,689	6,677	623	0	220,163	220,163	0.00000
S_I	0	0	8,324	318,135	3,689	0	0	0	0	0	330,148	330,148	0.00000
FIN	0	0	0	132,162	0	0	0	0	0	0	132,162	132,162	0.00000
RoW1	395,544	0	59,985	0	1,518	99,572	0	0	0	88,892	645,511	645,511	0.00000
RoW2	0	80,786	28,852	3,672	726	0	0	0	0	0	114,037	114,037	0.00000
RoW3	0	0	0	0	0	32,103	0	0	56,789	0	88,892	88,892	0.00000
Total	2,762,431	1,168,293	694,062	709,472	220,163	330,148	132,162	645,511	114,037	88,892	6,865,171	6,865,171	0.00000

*Sources: Based on Malaysia SAM 2015*

4. Updating of the SAM for 2019

The construction/updating of 2015 SAM accounts to 2019 is based on several data sets drawn from diverse but also authoritative and official sources. These are listed below.

• Activity wise Value-added data for 2019 supplied by the Department of Statistics Malaysia (DOSM)
• Labour market data (i.e. employed population and earnings) for 2019 supplied by DOSM
• Export of Commodities by 4-digit level, ITC comtrade
• Import of Commodities by 4-Digit level, ITC comtrade
• General Government Consumption Expenditure in 2019 current price supplied by DOSM
• Final consumption expenditure in 2019 current price supplied by DOSM
• Gross Fixed Capital Formation in 2019 current price supplied by DOSM
• Fiscal outlook, 2019, Ministry of Finance (MOF)
• Macro-economic framework for Malaysia (2019), MOF
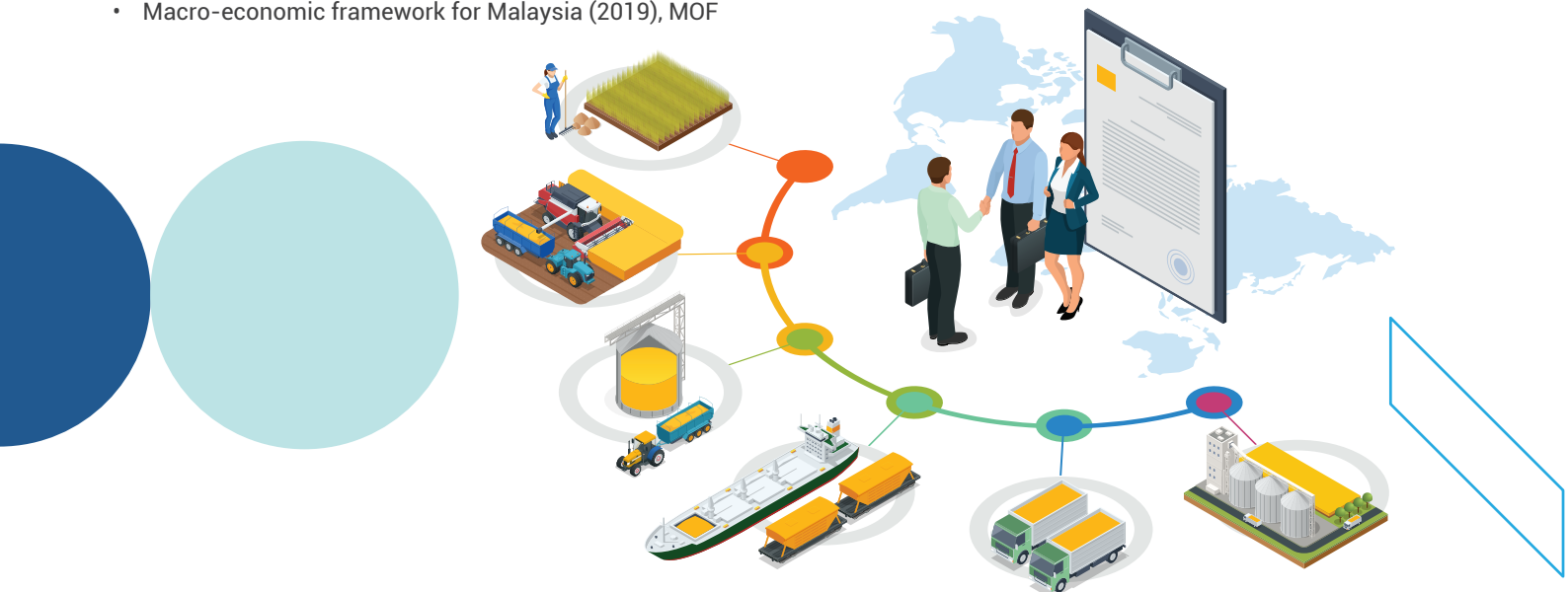
The update procedure went forward in two steps. In the first step, a 'Macro SAM' and set of accounts were constructed using the data collected from diverse but authoritative sources. Since the data came from different sources as well as for different years, in line with expectations, the estimated 'Macro SAM accounts' is unbalanced. In the second step, the Macro SAM accounts are balanced by adjusting the activity and commodity (i.e., private consumption) accounts as explained below.

More specifically, in this current exercise, the first step to generate a consistent and balanced production account is to build a Macro SAM. The main objective of the Macro SAM is to summarize and to show the circular flow in the economy in general and the inter-dependence between commodity and activity in particular.

Once the balanced Macro SAM for 2019 is obtained, the next step was to develop a preliminary disaggregated SAM accounts for 2019 using available disaggregated information drawn from various data producing agencies. Subject to data availability, the disaggregated SAM accounts segregates most of the Macro SAM accounts to desired sectoral breakdowns. While ensuring balance between the demand (or outflows/expenditures) and supply (or inflows/incomes) for all accounts, the disaggregated SAM accounts must reproduce the control totals of the Macro SAM 2019. Moreover, the correspondence between accounts of the aggregated production accounts (PA) and the macro PA thus ensure the desired consistency with the national account data.

4.1 Malaysia Macro SAM 2019 Compilation

The Malaysia Macro SAM is "anchored" primarily to the National Accounts data and other macro aggregates provided by DOSM and data obtained from other sources including via web searches. Table 4 below shows the macro totals for the Malaysian economy based on information obtained from the above sources.

Table 4: Unbalanced Macro SAM for 2019 (Million MYR)

	ACT	FAC	HH	COR	GOV	S_I	FIN	RoW1	RoW2	RoW3	Total		Errors
ACT	1,631,867		903,720		176,673	346,844		985,283			4,044,387	3,789,150	255,238
FAC	1,496,092								64,851		1,560,943	1,560,943	0
HH		671,302	2,347	91,998	62,177		36,065				863,889	1,067,666	-203,776
COR		784,523		53,082			62,408		7,941		907,954	427,352	480,603
GOV	40,912		38,680	146,437		0	33,689	1,126	623		261,467	241,957	19,510
S_I			0	0	0						0	535,092	-535,092
FIN				132,162							132,162	132,162	0
RoW1	620,278		94,066		2,381	156,146				88,892	961,763	986,409	-24,646
RoW2		105,118	28,852	3,672	726						138,369	73,415	64,953
RoW3						32,103					32,103	88,892	-56,789
Total	3,789,150	1,560,943	1,067,666	427,352	241,957	535,092	132,162	986,409	73,415	88,892	8,903,037	8,903,037	

Data Legend:
- NA 2019
- NA x Share 2015
- BOP   Economic Review 2021 Table 3.10 page 101
- FISCAL   Fiscal outlook 2021 Table 2.1 Page 110 (Corporation pays license and permits)
- SAM 2015

The data sources for the unbalanced Macro SAM 2019 (see Table 4) are shown by different colours under the 'Data legend'. Light blue accounts refer to the data for 2019 obtained directly from the system of national accounts (SNA).The data in darker blue accounts denote the generation of data using SNA statistics and 2015 shares (i.e., derived from SAM 2015). Pink accounts indicate data compiled from Balance of Payments data (BOP). Tax information has been obtained from the fiscal outlook and put in light green accounts. At this stage, statistics on savings were not available.

As expected, the compilation of preliminary Macro SAM produced an unbalanced SAM.The following steps have been adopted to ensure a balanced SAM for 2019 [3] (see Table 5).

1. Generation of Savings by institutions automatically produced balances for three institutions – households, corporations, and government.

2. The demand and supply imbalance (i.e., MYR 255,238 million or 6.3% of total demand) have been balanced through downward adjustment of the household consumption vector.

3. The unbalanced accounts of 'rest of the world' institution have been ensured through the adjustment of foreign savings and foreign capital.

Table 5: Balanced Macro SAM for 2019 (Million MYR)

	ACT	FAC	HH	COR	GOV	S_I	FIN	RoW1	RoW2	RoW3	Total		
ACT	1,631,867		648,482		176,673	346,844		985,283			3,789,150	3,789,150	0.000
FAC	1,496,092								64,851		1,560,943	1,560,943	0.000
HH		671,302	2,347	91,998	62,177		36,065				863,889	863,889	0.000
COR		784,523		53,082			62,408		7,941		907,954	907,954	0.000
GOV	40,912		38,680	146,437			33,689	1,126	623		261,467	261,467	0.000
S_I			51,461	480,603	19,510						551,574	551,574	0.000
FIN			132,162								132,162	132,162	0.000
RoW1	620,278		94,066		2,381	156,146				113,538	986,409	986,409	0.000
RoW2		105,118	28,852	3,672	726						138,369	138,369	0.000
RoW3						48,585			64,953		113,538	113,538	0.000
Total	3,789,150	1,560,943	863,889	907,954	261,467	551,574	132,162	986,409	138,369	113,538	9,305,455	9,305,455	0.000

adjustments for balancing

[1] Macro SAM 2019 reflects changes from 2015. This is expected over the 4 years period between 2015 and 2019, that the economic structures have changed. Moreover, the SAM 2019 updating has been based on partial data (i.e. around 70% of the data were for 2019). Where there was a gap, we tried to use the SAM 2015 structure. However, since the supply side was not fully balanced with the demand side (according to 2019 NA data), the adjustments were needed to balance the Macro SAM and Micro SAM for 2019.

4.2   Malaysia Micro SAM 2019 Compilation

Once a balanced Macro SAM had been derived, efforts were made to compute the counterpart micro-SAM. This involved several stages.

(A) Activity and Commodity Accounts

Activity and commodity accounts deal with the supply and demand components of the economy. Derivation of activity-commodity accounts thus implies generation of each element of supply and demand by the representative activity-commodity classification. In the context of the current exercise, it entails derivation of supply and demand components by 33 representative activities and 33 representative commodities.

(B) Supply Component

<u>Value Added:</u> according to the 'National Accounts' of Malaysia, estimates of value added are provided for activities (this is referred to as 'NA sector'). Value added data by the 33 NA sectors has been provided by DOSM. This information has been used directly to define the value-added vector of the 33 activities. The value-added account may be symbolized as: VAj^{19}, where j represents the 33 activities.

<u>Intermediate Input Use:</u> an updated inter-industry transaction matrix for 2019 is not available from which input use by the 33 activities can be obtained. Activity level input usages to value added shares (i.e. ∂) as observed in 2015 IOT (i.e. production account of the SAM 2015) have used with the activity level value added for 2019 to derive the initial input use values by the 26 activities.

$$IUj^{19} = \partial j^{15} \; x \; VAj^{19}$$

<u>Outputs or Domestic Supply:</u> input use and value added together define gross output (Qj^{19}) by 33 activities for 2019.

$$Qj^{19} = IUj^{19} \; x \; VAj^{19}$$

The next is to convert the value added by 33 activities to 33 commodities through a mapping between the 33-activity classification and 33 commodity classification. One to one correspondence between activity and commodity level has been found for all 33 activities and commodities. This implies that each of these 33 activities produce one single commodity.

<u>Indirect Tax:</u> information of total indirect tax mobilized from the domestic and import bases for 2019 is obtained from the fiscal outlook. The shares for 2015 are combined with the total indirect tax revenues to generate indirect tax vectors by the 33 commodities (ITj^{19}).

Imports of Goods and Services: information on imports of goods for 2019 ($ITCM_m^{19}$) is acquired from the ITC trade data. Again, the commodity classification (i.e. denoted as m) used by ITC varies from the SAM commodity classifications (i.e. g). Hence a mapping scheme linking the ITC classification to 33 SAM commodity classification is used to derive imports by SAM commodities for 2019 ($Mj^{19} = ITCM_m^{19}$). Revenue from import bases (dm^{19}) for 2014 has been based on DOSM information.

<u>Total Supply:</u> the main components of the supply side of an economy are domestically produced goods and services or outputs (Qj^{19}) and imports of goods and services (Mj^{19}). Total supply of goods and services (SSj^{19}) by 31 SAM commodities is generated by adding outputs to imports. Total supply is given as:

$$SS^{19} = Qj^{19} + ITj^{19} + M_j^{19} + DMg_g^{19}$$

(C)   Demand Component

<u>Private or Household Consumption:</u> the vector of private or household consumption for 2019 has been obtained from the information on 'final consumption expenditure', provided by DOSM. Commodity classification of DOSM is different from the SAM commodity classification. Hence in the first step, DOSM consumption ($_{DOSM}pCj^{19}$) are mapped to 33 SAM commodities classification (pCj^{19}). Derivation of private consumption vector for 2019 is shown below.

$$pCj^{19} = {}_{DOSM}pCj^{19}$$

Government Consumption: government consumption is usually confined to three sectors such as 'public administration', 'education'and 'health'. The rationale is that different purchases by government (e.g. agriculture, commodities and services) are included under the sector public administration data. Information of government expenditure for 2019 ($_{NA}gCj^{19}$) is thus used to derive government consumption by SAM commodities for 2019 (gCj^{19}= $_{NA}gCj^{19}$).

Exports of Goods and Services: information on exports of goods for 2019 ($ITECj^{19}$) is obtained from export of Commodities by 4-digit level from the ITC trade data. Again, the sector classification of ITC is different from the 33 SAM commodity classification. Hence a mapping scheme linking the ITC classification to SAM goods classification is used to derive exports by 33 SAM commodities for 2019 (Eg^{19} = $ITECj^{19}$).
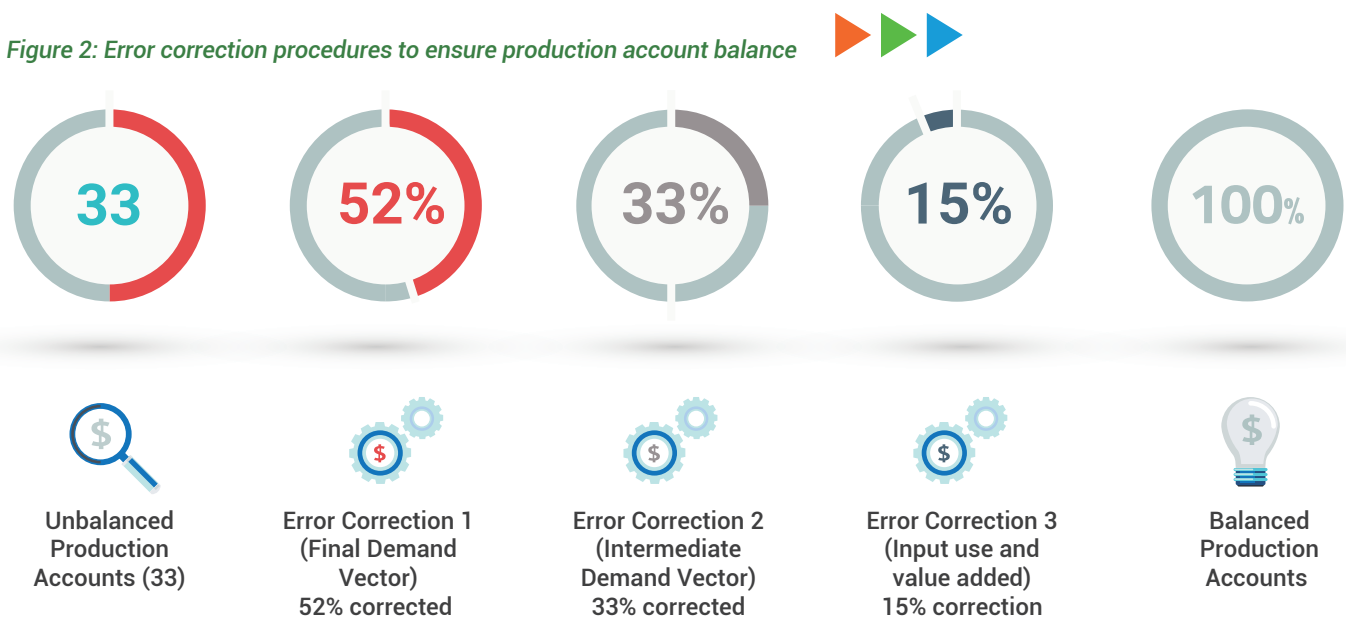
Investment: national account experts and SAM builders are well conversant with the special treatment of goods and services with respect to capital formation and stock changes. It is well known that only goods can be stored. On the other hand, services must be consumed instantaneously implying that they cannot be stored and hence cannot last for longer time duration to be able to form capital. Furthermore, only some specific goods can generate investment or form capital which assists further production. Therefore, in SAM 2019, stocks and capital formations are recorded only against goods and not against services. Using this information, investment for 2019 (Ij^{19}) was generated.

Final Demand: above estimates of consumption, exports and investment have been added together to derive final demand vector for the 33 SAM commodities (FDj^{19}). This is specified as:

$$FDj^{19} = pCj^{19} + gCj^{19} + Ei^{19} + Ij^{19}$$

Intermediate Input Demand: final demand (FDj^{19}) has been deducted from the total supply (SSj^{19}) to derive initial intermediate input demand by 33 SAM commodities ($IDj^{19} = SSj^{19}$ - FDj^{19}). Using the information of final demand and intermediate demand a vector of initial total demand (DDj^{19}) for 33 SAM commodities has been derived.

The resulting demand and supply in the first instance do not produce equality between supply and demand vectors. In other words, these discrepancies may be denoted "errors". Hence an iterative balancing technique has been used to re-estimate some of the initial values of the supply and demand components to ensure the equality between sectoral supply and demand. It is an accepted practice in IOT or SAM balancing techniques that errors are absorbed in larger accounts or values of accounts which are not firm. The larger accounts are input demand; input use; private consumption and value added. The value-added vector is not usually adjusted on the ground that it is estimated better than the other three accounts mentioned above. Following this principle, specific elements of the input demand vector and input use vector have been adjusted in the first step of this error correction procedure. In the last step, only a few elements of consumption vector have been modified ensuring consumption control total specified in Macro SAM 2019. The three-steps error correction process not only ensures supply-demand equality but also restricts significant deviation of the technical coefficients from the observed realities. In order to verify the degree of deviation of the technical coefficients, the estimated backward linkages are reported below. The final estimates of the intermediate input demand; input use and private consumption are inserted in place of the initial estimates to ensure demand and supply balance for all the sectors.

Figure 2: Error correction procedures to ensure production account balance

33	52%	33%	15%	100%
Unbalanced Production Accounts (33)	Error Correction 1 (Final Demand Vector) 52% corrected	Error Correction 2 (Intermediate Demand Vector) 33% corrected	Error Correction 3 (Input use and value added) 15% correction	Balanced Production Accounts

4.3　Factor Accounts

Factors of production (FP) play an important role in the process of producing and distributing the fruits of growth and development, i.e., by providing factor services to production activities and in return factors receive value-added in the form of wages and salaries, profits and rents. The level of distribution is in accordance with the level and kind of endowments; hence, the income subsequently transferred to household groups (i.e., as owners of labour and capital) will be heavily influenced by their endowments, thereby typifying household behaviour.

The FP can be classified into three main categories of factor ownership (a) labour, (b) fixed assets and (c) capital services. Unlike the first, the last two are not straightforward. It must be considered that only households provide labour services, whereas fixed assets, land and capital services are provided both by households and other institutions (i.e., corporations and government). Classifications of labour types should aim at grouping individuals into homogeneous groups of income earners. For the grouping, differences regarding average factor incomes and gender within or between labour groups must be considered. Among others, the most important could be labour skills reflecting different occupational categories or different income groups of earners using gender as an additional criterion. More concretely, for most production activities the factor labour can be distinguished according to highly skilled professionals, managers, traders, government employees, personal services employees, blue-collar labourers or street vendors. For agricultural activities these could be agricultural farm owners, farm administrators and land workers of distinct labour types: landless farmers, subsistence farmers, etc. It should be clear that all or most could be classified according to gender.

Information from other Middle-Income Countries (MICs) as well as Malaysia appears to be the same, inevitably showing a high incidence of self-employed or family-based activities; hence, differences according to the ownership of fixed assets and capital incomes generated by unincorporated and corporates should be considered. Incomes from unincorporated capital (mainly family enterprises) can additionally distinguish imputed wages for self-employed workers and the remaining capital income. A desirable classification of factors of production is presented in Table 6 below.

Table 6: Desirable Factor Classification

Labour		Capitalists and Others	
1.	Self-employed Labour	1.	Unincorporated or mixed income
2.	High Skilled Professionals and Managers	2.	Corporate
3.	Medium Skilled Professionals and Technicians	3.	Rentiers
4.	Government and non-Government Office Clerks (employees)		
5.	Workers (Transport Workers, Mechanics and Other Industrial Workers)		
6.	Artisans and Handicraftsmen		
7.	Informal (Street-vendors and non-economic services n.e.s.)		
8.	Agricultural Owners/Administrators		
9.	Agricultural Workers		
10.	Agriculture Subsistence farmers		

Even though the above classification of factors appears to be desirable, SAM 2015 adopted a classification based on location, income level and ethnicity. Thus, following the 2015 SAM classification, in the present version of the SAM 2019, the factors are classified into 13 types of labour and one type of capital.

Factor Income by Activities: detailed information on sectoral employment for the different factor categories has been extracted from the 2015 SAM for Malaysia. This information is used to define a factor-sector share matrix ($shyF_{Fj}$). Derived value-added vector by 33 SAM activities for 2019 (VAj^{19}) is distributed among 14 factor types using the factor-activity share matrix ($shyF_{Fj}$) to update the factorial income matrix by activity for 2019 (yF_{Fj}^{19}). The derivation is shown below.

$$yF_{Fj}^{19} = shyF_{Fj} \cdot VAj^{19}$$

4.4 Institutional Accounts

Current account transactions are captured by 4 institutional agents: households and unincorporated capital; corporations, government; and the rest of the world. Household account includes 13 representative groups (6 rural, 6 urban and non-citizen). One consolidated capital account is also defined to capture the flows of savings and investment by institutions and the rest of the world, respectively.

(A) Household Accounts

Households (HHs) should be conceptualized as consumption units, different from income earning agents (e.g. labourers, rentiers and capitalists), which receive "transfers" from the factor of production which they own and "sell" to production activities. This distinction is important because the income sources of earning agents can be diverse (as many as the activities which use the factor(s) owned by the agents), while 'income' to households (viewed as a group of income earning agents) may come from the different factor endowments which the members of the household possess and may simultaneously come from several factor endowments.

Generally, in specifying household classifications the following criteria are considered:
1) Regional differences, i.e. urban and rural households;
2) Education levels of the head of the households;
3) Gender of the head of the household; and
4) Access to productive forms of material wealth, particularly agricultural land and land rights.

The above criteria can be justified on the grounds that:
a) Urban-rural income differentials are usually large. The average per capita disposable income of urban households is considerably higher than that of rural households. And often female headed households are more vulnerable;
b) Among the factors that can help to generate homogeneity, the most relevant appear to be classifications according to homogeneity in consumption expenditure or savings patterns;
c) In urban areas differences in household income levels and consumption patterns are closely related to the educational level of the household head, while for rural households the size of farm landholdings appears to be the most significant determinant; and
d) Significant differences in consumption pattern and in income generating capacity are found between those rural households primarily engaged in agricultural activities and those whose main income source is derived from non agricultural activities.

The 2019 SAM distinguishes between 13 household types, classified according to location, income level and ethnicity of the household's head. Household classifications contained in SAM 2019 are based on SAM 2015 classifications. The details are provided in the table below.

Main sources of household income are factor returns and various transfers from domestic and external institutions. Generation of household income from these sources is discussed below.

Household Income from Factors: direct factor income (i.e., wages and mixed income) constitutes the major source of household income. Compensation to employees or labour factor payments is paid entirely to the household groups, as they are the only suppliers of labour factor. Control totals for labour incomes by the 13 factor types are already estimated above which must be distributed among the 13 representative households according to their factor endowments. Factor endowment information ($shfY_{FH}$) is contained in SAM 2015. Control totals for factor income (yF_{Fk}^{19}) are applied on the factor endowment shares to generate household's income from factors ($yY_{FH}^{19} = shfY_{FH} \cdot \Sigma_k yF_{FK}^{19}$). This procedure ensures that the observed factor endowment structure (i.e. reflecting the factor income distribution) of 2019 as well as the factor control totals for 2019 are preserved.

Household Receipts from Other Sources: besides labour and mixed incomes, households also receive income from other sources, namely remittances or factor incomes from abroad, dividends from corporation, and government transfers. Information on foreign remittances for 2019 ($rowR^{19}$) is obtained from the Macro SAM 2019. Remittance share information by household groups ($shfR_H$) is contained in SAM 2015. Control totals for remittances ($rowR^{19}$) are applied on the remittance shares to generate household income from remittance ($rowY_H^{19} = shfR_H \cdot_{row} R^{19}$). This procedure ensures that the observed remittance structures of 2019 as well as the remittance control totals are preserved

Information on foreign remittances for 2019 ($\cdot_{CR}gTr^{19}$) is obtained from the Macro SAM 2019. Again, institutional transfer (i.e. by government) share information by the representative household groups are obtained from SAM 2019. Control totals for the institutional transfers are applied on these shares to generate household income from government transfers ($rowY_H^{19}=shfR_H\cdot_{row}R^{19}$). The data for corporate dividend and loan from the financial account for 2015 have also been used for 2019 (assuming no changes between 2015 and 2019). Total receipts by household groups are derived from all the above sources and this is defined as:

$$R_H^{19}=\sum_F fY_{FH}^{19}+rowR_H^{19}+gTr_H^{19}$$

Household Expenditure Patterns: consumption expenditure constitutes the major component of their (i.e. household) outlays. Consumption expenditures by the 13 representative household groups on the 33 SAM commodities are estimated by using the expenditure structures provided by DOSM 2019. In particular, the product classifications adopted in DOSM which are different are mapped to 33 SAM commodity groups. Household consumption by 33 SAM commodities (pCj^{19}) has already been derived using the private consumption control total and the private consumption structure for the 33 SAM commodities. The derived consumption vector is then distributed among the 13 household groups using their derived expenditure structures ($shpC_{HK}$). The procedure generates a consumption matrix for 2019 by 13 representative household groups and 33 SAM commodities ($pCj_{Hk}^{19}=shpC_{HK}\cdot pC_K^{19}$).

Household Outlays: other notable expenditures incurred by household groups are income tax payments. Income tax payment shares contained in SAM 2015 ($shdT_H$) and income tax payment control total ($\cdot_{FO}dT^{19}$) are used to derive income tax payments by household groups ($gdT_H^{19}=shdT_H\cdot_{FO}dT^{19}$).
Total outlays by household groups are defined as:

$$p_{Hk}^{19}=\sum_k pC_{Hk}^{19}+dT_H^{19}$$

Household savings are determined by deducting household payments from household income.

(B) Other Institutions' Accounts
Receipts and outlays of other three current institutions are discussed below.

Government Account: sources of government income include tax revenues. The main sources of tax revenue are (i) indirect taxes on imports and domestic production and (ii) direct taxes in the form of corporate and personal (household) income taxes. Amounts for all of the four elements of tax revenues (i.e.ITj^{19}, dmj^{19}, and dTH^{19}) are already defined in the supply-demand section. Total government receipt (gR^{19}) is thus defined as:

$$gR^{19}=\sum_F fY_{FH}^{19}+rowR_H^{19}+gTr_H^{19}$$

Government spends most of its income on purchase of goods and services (gC_k^{19}) and transfer programmes (gTr_H^{19}). Rest of the income constitutes government savings. Government savings (gS^{19}) act as the balancing factor between its receipts and outlays. The balancing condition envisages that receipt must equate the outlay. This is specified as:

$$gR^{19}-\sum_j gC_j^{19}+\sum_H gTr_H^{19}+gS^{19}=0$$

Rest of the World Account: rest of the world account records inflows and outflows of foreign resources in a country in a fiscal year. The major sources of inflows are: imports of goods (Mj^{19}) and services and foreign assistance (i.e. rowS^19 also known as foreign savings). Major form of outflow includes exports of goods and services (Ej^{19}), and net current transfer (remittances). Amounts for all of these four elements which are defined above are assembled in this account to complete the account as well as to verify its balance. The balancing condition envisages that sum of inflows must equate the sum of the outflows. This is specified as:

$$\sum_j M_j^{19}+_H rowS^{19}-\sum_j E_j^{19}+\sum_{FK} y_{FK}^{19}+\sum_H rowR_H^{19}=0$$

Sectoral values of production account; factor account and institutional account are put together in the SAM matrix format to produce the SAM for 2019.
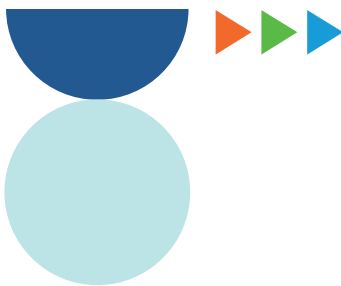
5. Key Features of the (derived) 2019 SAM

5.1 Production Structure – SAM 2019

Production structures for Malaysia in 2019 are provided in Table 7 below. Structures are discussed in terms of three broad sector classifications as well as the activity classification adopted in SAM 2019.

Table 7: Production Structure – Malaysia SAM 2019

Activity Classification	Gross Output	Input Use	Value added
Broad Activity Classification (Share in total)	**100.00**	**100.00**	**100.00**
Agriculture	4.42	1.80	7.32
Industry	52.30	65.31	37.89
Services	43.28	32.89	54.78
SAM Activity Classification (share in total)	**100.00**	**100.00**	**100.00**
Crops, animal production and hunting	3.60	1.52	5.90
Forestry and logging	0.31	0.13	0.51
Fishing and aquaculture	0.51	0.15	0.92
Extraction of crude petroleum and natural gas	4.72	1.46	8.33
Mining of metal ores	0.07	0.07	0.07
Mining of coal and lignite	0.37	0.40	0.33
Other mining and quarrying	0.05	0.05	0.04
Food products	7.47	12.40	2.02
Beverages and tobacco products	0.69	0.75	0.61
Textiles, wearing apparel and leather products	0.47	0.54	0.41
Wood, furniture, paper products and printing	2.28	2.98	1.51
Petroleum, chemical and rubber products	10.09	13.17	6.69
Metal and other non-metallic mineral products	3.95	5.17	2.59
Electrical, electronic and optical products	10.10	13.98	5.80
Transport equipment and other manufacturing	2.86	3.63	2.01
Construction of buildings	2.89	3.64	2.06
Civil engineering	2.62	3.32	1.84
Specialized construction activities	1.37	1.84	0.85
Utilities	2.30	1.91	2.73
Wholesale and retail trade	12.67	8.78	16.97
Food & beverage and accommodation	3.89	3.96	3.80
Transportation and storage	4.05	4.27	3.82
Information and communication	5.23	4.78	5.73
Finance	4.60	3.02	6.35
Real estate	2.44	1.21	3.80
Rental and leasing	0.15	0.11	0.18
Research and development	0.11	0.08	0.14
Business services	2.42	1.91	2.98
Education	2.16	0.35	4.16
Health	1.68	0.83	2.62
Government Services	2.76	2.55	3.00
NPISHs	0.03	0.04	0.03
Other services activities	1.10	1.01	1.20
Total in Billion MYR at current prices	**3,152**	**1,656**	**1,496**
Share (%)		**52.5**	**47.5**

Source: Author's own calculation based on derived Malaysia SAM 2019

It is noted specifically that:
- The largest income (i.e., GDP or Value added) generating activity in Malaysia is services contributing about 54.8 of total income in 2019. This is followed by industry activity with a contribution of about 37.9 percent of total income. Contribution of agricultural activity is lowest with 7.3 percent of total income.

- Industrial activity is composed of manufacturing activity, utilities, and construction.The contribution of manufacturing activity in total income generation in 2019 was 21.7 percent. This suggests that more than 57 percent of the industrial sector's income (or GDP) was due to the performance of the manufacturing activity.

5.2   Demand Structure – SAM 2019

Total demand is composed of intermediate demand and final demand.The distribution of demand structure by the 33 SAM commodity classification is shown in Table 8 below.

Table 8: Demand Structure – Malaysia SAM 2019

Commodity	Inter demand	Household consumption	Government consumption	Investment	Export
Total (%)	100.00	100.00	100.00	100.00	100.00
Crops, animal production and hunting	4.40	5.45	0.00	1.95	0.91
Forestry and logging	0.46	0.02	0.00	0.00	0.29
Fishing and aquaculture	0.42	1.39	0.00	0.00	0.06
Extraction of crude petroleum and natural gas	5.24	0.00	0.00	-2.57	7.61
Mining of metal ores	0.07	0.00	0.00	-0.36	0.29
Mining of coal and lignite	0.74	0.00	0.00	0.00	0.06
Other mining and quarrying	0.05	0.00	0.00	0.19	0.01
Food products	6.05	9.84	0.00	0.00	11.64
Beverages and tobacco products	0.24	2.77	0.00	0.00	0.41
Textiles, wearing apparel and leather products	0.39	1.63	0.00	0.00	0.73
Wood, furniture, paper products and printing	2.03	3.30	0.00	0.00	3.40
Petroleum, chemical and rubber products	14.48	7.34	0.00	0.00	13.03
Metal and other non-metallic mineral products	6.44	0.33	0.00	7.52	4.04
Electrical, electronic and optical products	5.18	1.92	0.00	30.67	29.97
Transport equipment and other manufacturing	5.02	3.49	0.00	1.66	2.30
Construction of buildings	0.00	0.00	0.00	29.99	0.63
Civil engineering	0.28	0.00	0.00	25.94	0.00
Specialized construction activities	2.61	0.00	0.00	3.61	0.00
Utilities	3.80	3.10	0.00	1.04	0.00
Wholesale and retail trade	14.72	7.64	0.00	0.00	14.38
Food & beverage and accommodation	3.78	11.09	0.00	0.00	0.00
Transportation and storage	5.16	2.37	0.00	0.00	4.52
Information and communication	5.16	8.94	0.00	0.00	3.64
Finance	6.47	7.10	0.00	0.00	0.44
Real estate	0.77	11.09	0.00	0.00	0.00
Rental and leasing	0.16	0.21	0.00	0.00	0.19
Research and development	0.00	0.00	0.38	0.37	0.22
Business services	3.96	2.02	2.97	0.00	0.94
Education	0.17	1.86	31.99	0.00	0.00
Health	0.69	2.58	16.39	0.00	0.00
Government Services	0.72	0.00	46.98	0.00	0.06
NPISHs	0.00	0.18	0.00	0.00	0.00
Other services activities	0.37	4.34	1.29	0.00	0.24
Total (Billion MYR)	**1,656**	**648**	**177**	**347**	**985**
Share in Total Demand (%)	**43.43**	**17.00**	**4.63**	**9.09**	**25.84**

Source: Author's own calculation based on derived Malaysia SAM 2019

Three noticeable demand components in terms of values are intermediate demand – accounting for about 43 % of the total demand; private consumption with 17 % share, and exports of goods with almost 25% of the total demand.

▶▶▶

6. SAM Multiplier Model

6.1 Methodology of the SAM Model

The move from a SAM data framework to a SAM model (also known as a 'multiplier framework') requires decomposing the SAM into 'exogenous' and 'endogenous' accounts. Generally, accounts intended to be used as policy instruments (for example, government expenditure including social protection, investment, and exports) are made exogenous, and accounts specified as objectives or targets must be made endogenous (for example, output, commodity demand, factor return, and household income or expenditure). For any given injection into the exogenous accounts of the SAM, influence is transmitted through the interdependent SAM system among the endogenous accounts. The interwoven nature of the system implies that the incomes of factors, households and production are all derived from exogenous injections into the economy via a multiplier process (see Figure 3). The multiplier process is developed here on the assumption that when an endogenous income account receives an exogenous expenditure injection, it spends it in the same proportions as shown in the matrix of average propensities to spend (APS).

Figure 3: Endogenous and Exogenous accounts of a SAM model
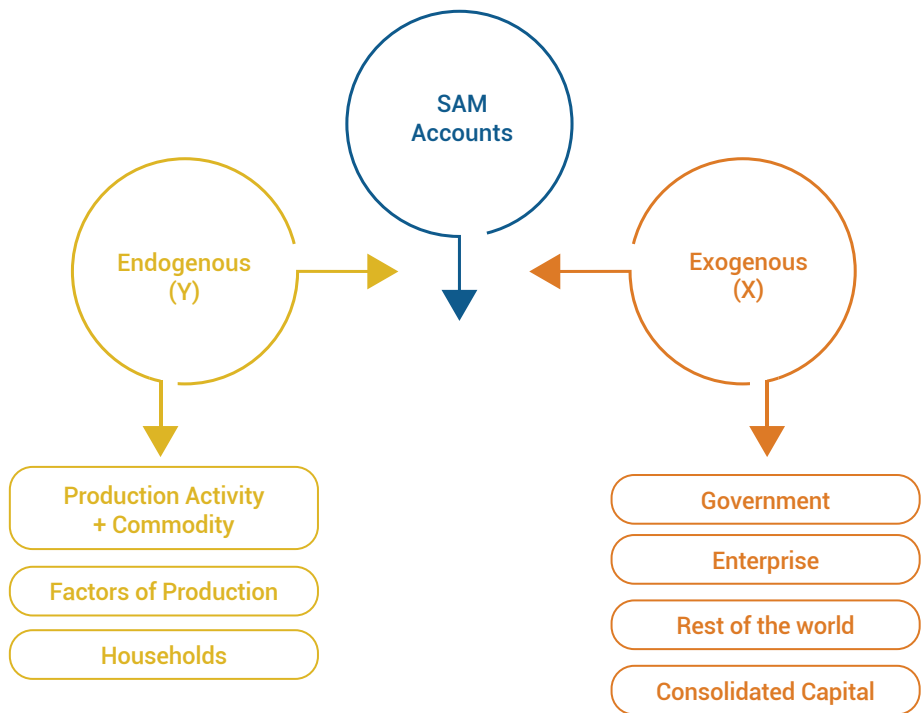
Source: Authors' own specification

6.2 Conversion of the 2019 SAM into a SAM Model

The SAM 2019 is composed of 71 accounts – 33 accounts for activities and commodities; factor account composed of 14 accounts; 13 accounts for households; and other accounts consists of 11 accounts. To convert the SAM 2019 into a SAM model, these 71 accounts are decomposed into 'exogenous' and 'endogenous' accounts. Following the general practice, endogenous accounts include activity, commodity, factor and household (i.e., four endogenous accounts). Exogenous accounts consist of government, enterprises, the rest of the world and investment accounts. The endogenous and exogenous accounts of the 2019 SAM model are provided in Table 9 below.

Table 9: Endogenous and exogenous accounts of 2019 SAM model

Endogenous Accounts		Exogenous Accounts		
Activity/Commodity	33	Government	1	Expenditure and Investment
		Investment	1	Transfers
		Rest of the World	3	Export demand and remittances
Factor	14	Corporation	1	
Household	13	Financial	1	
		Taxes	3	
Total	60		11	

Source: Authors' own specification

More specifically, the SAM for 2019 has been converted into a SAM multiplier model to determine the multipliers. By convention, a SAM needs to be decomposed into four blocks to specify the SAM model (as specified in the figure below).

Figure 4: 2019 SAM model specification

Source: Authors' own specification

For any given injection into the exogenous accounts of the SAM, for instance transfers to the household groups, influence is transmitted through the interdependent SAM system among the endogenous accounts. The interwoven nature of the system ensures that the incomes of factors, households and production are all generated from exogenous injections into the Malaysian economy via a multiplier process (please see Table below)

Table 10: Description of the endogenous and exogenous accounts and the multiplier effects

Endogenous (y)	Exogenous (x)
The activity (gross output multipliers), indicates the total effect on the sectoral gross output of a unit-income increase in a given account, ® in the SAM, and is obtained via the association with the commodity production activity account i. The consumption commodity multipliers, which indicates the total effect on the sectoral commodity output of a unit-income increase in a given account i in the SAM, is obtained by adding the associated commodity elements in the matrix along the column for account i. The value-added, or GDP multiplier, giving the total increase in GDP resulting from the same unit-income injection, is derived by summing up the factor-payment elements along account i's column.	Intervention into through activities (x = i + g + e), where i= GFC + ST (GFCF) Exports®) Government Expenditure (g) Investment Demand (i) Inventory Demand (i)
Household income multiplier shows the total effect on household and enterprise income and is obtained by adding the elements for the household groups along the account i column.	Intervention via Households (x = r + gt + ct), where Remittances (r) Government Transfers (gt) Enterprise Transfers (ct)

The multiplier analysis using the SAM framework helps to understand further the linkages between the different sectors and the institutional agents at work within the economy. Accounting multipliers have been calculated according to the standard formula for accounting (impact) multipliers, as follows:

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

where:
- y is a vector of endogenous variables (which is 60 according to 2019 SAM with all accounts showing number with no zero)

- x is a vector of exogenous variables (which is also 60 according to 2019 SAM with lots of zero suggesting that policy options are not large)

- A is the matrix of average expenditures propensities for endogenous accounts, and $M_a = (I - A)^{-1}$ is a matrix of aggregate accounting multipliers (also known as generalized Leontief inverse).

The present multiplier framework has four endogenous accounts, and, hence, for each account in the SAM we can calculate four types of multiplier measures due to changes in any one of the various exogenous accounts.

6.3   Linkages and Multipliers

One key advantage of the SAM data base that it captures important element of interdependence of activities and commodities in their production system. There are three measures of interdependence: (i) degree of endogeneity; (ii) backward linkages and (iii) forward linkages. Review of activity level input structure (or which is more widely known as the technology structure) identifies the level of linkages[4]. An activity with a larger number of inputs would have higher linkages compared to an activity that uses a smaller number of inputs in production. These linkages can be differentiated into backward and forward linkages. Stronger forward and backward production linkages lead to larger multipliers.

The "*endogeneity*" of an activity captures the relationship between input shares and activity level output. In simple terms it describes the extent to which an activity is self-contained or, conversely, relies on other activities. The formula for degree endogeneity (DE) for an activity (i) is the ratio of raw materials (RM) (or intermediate inputs) to gross output (GQ):

$$DE_i = \frac{RM_i}{GQ_i} \times 100$$

By definition this must be less than 1 or 100%. A higher endogeneity value suggests that either the activity is highly integrated in terms of input structure or that the contribution to the value of that activity's output of raw materials and input costs from within the activity is relatively high compared to remuneration and capital payments. For practical purposes, a high level of endogeneity indicates that the activity is more "self-contained", that is, it does not require significant inputs from other activities.

Backward production linkages are the demand for additional inputs used by producers to supply additional goods or services. For example, when agricultural crop production expands, it demands intermediate goods and services like seed, fertilizer, electricity, irrigation (water), machine parts, and extension services. This demand then stimulates production in other sectors to supply these intermediate goods and services. The more input intensive a sector's production technology is, the stronger its backward linkages are. The backward linkages provide valuable information about the degree of integration of an activity with the rest of the economy. Using this measure, it is possible to determine which activities contribute most to economic growth as a result of an exogenous increase in final demand, for instance exports demand.

Forward production linkages account for the increased supply of inputs to upstream industries. For example, when electricity production expands, it can supply more power to the economy, which stimulates production in all the sectors which use power. Thus, the more important a sector is for upstream industries, the stronger its forward linkages will be. Forward linkages are particularly important for the activities (such as trade, transportation, energy etc.) that provides key input into the majority of other activities in the economy. In other words, forward linkages help us to understand the importance of a commodity for the rest of the economy in terms of intermediate demand. Therefore, a commodity that exhibits high forward linkages is said to be important to growth since growth in that activity will have knock-on effects in other sectors.

Table 11: Degree of endogeneity and linkages in 2019

| Activity Classification	Degree of Endogeneity	Backward Linkages	Forward Linkages
Crops, animal production and hunting	22.17	3.22	4.90
Forestry and logging	22.77	2.97	1.33
Fishing and aquaculture	14.94	2.91	1.83
Extraction of crude petroleum and natural gas	16.21	2.88	3.12
Mining of metal ores	53.69	3.41	1.02
Mining of coal and lignite	57.37	3.68	1.18
Other mining and quarrying	61.81	3.86	1.04
Food products	87.18	3.87	7.66
Beverages and tobacco products	57.52	3.40	2.13
Textiles, wearing apparel and leather products	59.19	2.98	1.79
Wood, furniture, paper products and printing	68.54	3.70	3.08
Petroleum, chemical and rubber products	68.56	3.17	10.43
Metal and other non-metallic mineral products	68.83	3.26	2.73
Electrical, electronic, and optical products	72.72	3.04	2.58
Transport equipment and other manufacturing	66.72	2.96	4.52
Construction of buildings	66.17	3.85	1.00
Civil engineering	66.69	4.08	1.07
Specialized construction activities	70.45	3.73	2.84
Utilities	43.62	3.16	3.83
Wholesale and retail trade	36.42	3.53	9.36
Food & beverage and accommodation	53.57	3.96	7.56
Transportation and storage	55.32	3.71	3.98
Information and communication	47.98	3.69	7.94
Finance	34.52	3.58	6.72
Real estate	26.03	3.03	5.23
Rental and leasing	40.27	3.16	1.14
Research and development	37.82	3.32	1.00
Business services	41.50	3.48	3.83
Education	8.50	4.85	1.61
Health	25.97	4.61	2.35
Government Services	48.42	4.71	1.18
NPISHs	62.62	4.24	1.05
Other services activities	48.21	3.70	2.63
Median	**53.57**	**3.53**	**2.63**

Source: Author's own calculation based on derived Malaysia 2019 SAM Model

[4]*To proceed with the analysis of multipliers and backward and forward linkages it is necessary to calculate the matrix of technology coefficients. Backward linkages are measured by the total column sum of the multiplier matrix.*

6.4   Satellite Models for Employment and Poverty

In addition, the assignment aimed to augment the macro modelling framework with two satellites (sub-models), using official secondary data sources: one, to simulate unemployment levels; and two to simulate any poverty impacts (see Figure 4). This required linking the SAM model via micro-simulation techniques to Malaysia's Labour Force Survey (LFS) and the Household Income and Expenditure Survey data, respectively.

Figure 5: Model hierarchy
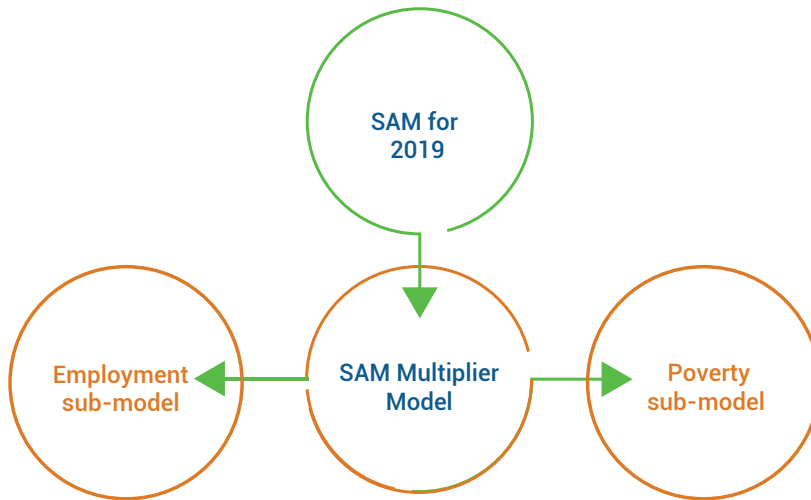
We engaged with DOSM extensively to enable this, however, while we were able to simulate the employment effects, were not able to build an adequate poverty simulation. This was due to the complexity of Malaysia's poverty estimation process, and this task is held over until the next stage of the project (see Section 6 below). In the interim, the team will also seek to develop an alternative elasticity-based estimation approach.

7. Next Steps

7.1   Policy simulations

Following development of the SAM multiplier model, simulations were carried out to exemplify the key features of Computable General Equilibrium (CGE)-type modelling: the specification of policy simulations, using a base year, as opposed to projections; and use of a business-as-usual (BAU) scenario, a form of counterfactual, to record the outcomes associated with the actual or non-policy intervention position. Moreover, this exercise aimed to provide a real-world example to demonstrate the practicality, applicability, and the policymaking value of the approach.

Four simulations were conducted to examine the impact of the key recovery measures included in the 2022 budget, on macro and socioeconomic outcomes. These were applied in the 2020 fiscal year, as the given base year. While in principle, any year may be selected, 2020 was chosen as all of the outcome data was known, enabling easy validation of the BAU, and because 2020 is likely to be the most severely COVID-impacted year, offering strong evidence of policy impacts. The simulations were:

- The first, a base simulation to generate the BAU scenario to reflect the pandemic affected outcomes, with this calibrated in such a way that generate an overall GDP reduction of minus 5.6 per cent (in 2020).

- Three policy simulations reflecting key measures adopted in the 2022 budget, effectively modelling their adoption in 2020:
  (a) Increased direct income support (cash transfers) of an additional MYR 3.2 billion (over the 2020 value) provided to low- and middle-income families (SIM1), here allocated to four low-income categories of household.
  (b) Employment package of MYR 5.3 billion, a wholly new measure, without counterpart in 2020 (SIM2), here shared across 12 employment categories.
  (c) Vastly expanded development (i.e., capital) expenditure, with the addition over 2020, of MYR 26.2 billion (SIM3), here allocated to four activities.

In specifying these scenarios, in line with CGE modelling practice, the changed values above the base year (2020) have been used, not the absolute values. This is because the approach involves a different process. Modelling also took account of their distributional characteristics as best possible within the SAM framework. Modelling allocations for each simulation are given in Table 12 below.

Table 12: Degree of endogeneity and linkages in 2019

Code	Household Group Description	Million MYR
SIM1: Direct cash transfers of an additional MYR 3.2 billion		
HHLD1	Urban High Income Bumiputera	
HHLD2	Urban High Income non-Bumiputera	
HHLD3	Urban Mid Income Bumiputera	
HHLD4	Urban Mid Income non-Bumiputera	
HHLD5	Urban Low Income Bumiputera	1,502.8
HHLD6	Urban Low Income non-Bumiputera	725.4
HHLD7	Rural High Income Bumiputera	
HHLD8	Rural High Income Non-Bumiputera	
HHLD9	Rural Mid Income Bumiputera	
HHLD10	Rural Mid non-Bumiputera	
HHLD11	Rural Low Income Bumiputera	845.1
HHLD12	Rural Low Income non-Bumiputera	126.7
	Total	**3,200.0**

Code	Household Group Description	Million MYR
SIM2: Employment package totalling MYR 5.2 billion		
LAB1	Urban High Income Bumiputera	516
LAB2	Urban High Income non-Bumiputera	620
LAB3	Urban Mid Income Bumiputera	976
LAB4	Urban Mid Income non-Bumiputera	835
LAB5	Urban Low Income Bumiputera	879
LAB6	Urban Low Income non-Bumiputera	581
LAB7	Rural High Income Bumiputera	65
LAB8	Rural High Income Non-Bumiputera	29
LAB9	Rural Mid Income Bumiputera	222
LAB10	Rural Mid non-Bumiputera	58
LAB11	Rural Low Income Bumiputera	353
LAB12	Rural Low Income non-Bumiputera	66
	Total	**5,200**

Code	Household Group Description	Million MYR
SISIM3: Expanded development budget (uplift of MYR 26.2 billion)		
LAB1	Urban High Income Bumiputera	516
AC14	Electrical, electronic, & optical products	7,860
AC15	Transport equipment & other manufacturing	
AC16	Construction of buildings	13,100
AC17	Civil engineering	5,240
	Total	**26,200**

Simulation outcomes (the macro aggregates and their distribution, and un/ employment levels) will be set out in the second report on the MMT, which offers a policy analysis of the COVID-19 recovery measures adopted in the 2022 budget. This serves both as a research input in itself, but also as a worked example of the modelling approach and its utility.

7.2 Further Development of the Model

As has been outlined, it is envisaged that the MMT would be sophisticated over time with its current incarnation (MMT 1.0) updated in later years to provide a full CGE-type capacity allowing for price changes (a static CGE, version 2.0) and later, one allowing for temporal changes (a dynamic CGE, version 3.0).This will however be dependent on the demands of the MMT's primary users (notably, independent researchers), the ongoing partnership with DOSM and the availability of resources.

In the near term, the research team is expected to focus on making improvement to the existing model three areas:
- Refining the existing modelling approach, and specifically to enable completion of the poverty sub-model fully allowing for poverty simulations.

- Customization of the MMT, to deliver a more user-friendly user-interface, in spreadsheet and/ or a data base format, and, if possible, via an online portal.

- Training and capacity building to enable users to fully exploit the MMT's potential.

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