Annex 2

Economy-wide Cost Estimation Approach

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One of direct cost of violence is loss of work days leading to loss of income. Income loss leads to a reduction in private consumption expenditure, with subsequent negative impacts on commodity demand and supply of goods and services. As production of goods and services depend on purchases of other goods and services, as well as factors of production, loss of female works days (a direct impact of violence) may lead to further of loss of incomes indirectly due to the economy-wide effect. The researcher needs to use an economy-wide database or model to capture these indirect impacts of the direct cost of violence.

As argued in the main text, this can most conveniently be done utilising a social accounting matrix (SAM) framework. The SAM is a macroeconomic data set which captures the key interdependence between product markets (activities/commodities); factor markets (labour, capital, land etc.); and institutions (households, corporations, government etc.). The SAM is based on an input-output matrix (IOM); a SAM or IOM is available for most countries. The present researchers proposed to use a readily available country SAM or IOM or their modified versions to estimate the indirect/induced cost of VAW. A stylised SAM structure is provided in Figure A2.2: this is abridged version of basic SAM structure shown above.

As indirect and induced costs would mainly be transmitted via loss of female work (productive) days, a SAM (as shown here) is a suitable framework to capture the indirect and induced cost of VAW. The highlighted cells are accounts which are affected by the loss of female work (productive) days. Loss of female days is denoted by 'Lf'. This leads to a reduction in domestic outputs. Households are the sole recipient of labour income. Thus, a reduction in labour income leads to a reduction in household income and their consumption possibilities. A reduction in household expenditure (which is a major component of effective domestic demand) leads to fall in effective demand for commodities. This in turn triggers reduced supply, with the transmission mechanism continuing until it reaches a new steady start equilibrium.

Input-output matrix and social accounting matrix

A social accounting matrix (SAM) is an extension (or generalisation) of the input-output matrix by incorporating other parts of the economy – namely

Figure A2.1 Personal income loss to GDP loss transmission mechanism

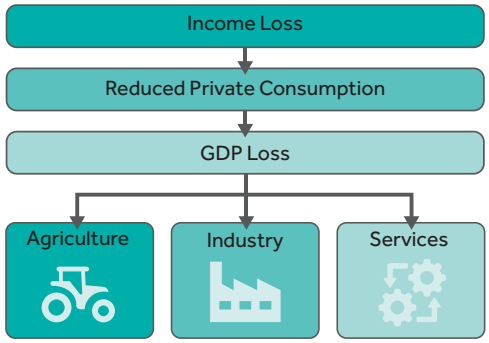


Figure A2.2 Stylised SAM framework

A stylised SAM framework								
		ACT/COM	LAB		OF	HH	OI	Total
			Male	Female				
ACT/COM		W	0	0	0	Cp	Coi	Y
LAB	Male	Lm	0	0	0	0	0	Yml
	Female	*Lf*	0	0	0	0	0	Yfl
OF		OF	0	0	0	0	0	Yfo
HH		0	Lmy	Lfy	OF	0	Troi	*Yh*
OI		0	0	0	OF	Ty	0	Yoi
Total		Y	Yml	Yfl	Yfo	Yh	Yoi	
ACT: activities; COM: commodities; W: inter-industry transaction matrix; Y: income LAB: labour factor; OF: other factors; HH: households; OI:other institutions.								

primary and secondary income distribution and institutions of an economy. More specifically, Input-output analysis involves constructing a table in which each horizontal row describes how one industry's total product is divided among various production processes and final consumption. Each vertical column denotes the combination of productive resources used within one industry. A table of this type (Figure A2.3) illustrates the dependence of each industry on the products of other industries: for example, an increase in

Figure A2.3 Input-output table

		Activity					Final demand				Total use
		A1	...	...	...	A16	C_p	C_g	I	Ex	
Commodity	C1	Technology matrix (16 x 16)					Final demand				
	...										
	...										
	...										
	C16										
Value added	Compensation	GDP (Income Approach)					GDP (Expenditure Approach)				
	Operating surplus										
	Indirect taxes										
	Import										
	Total supply										

Figure A2.4 Basic structure of a SAM

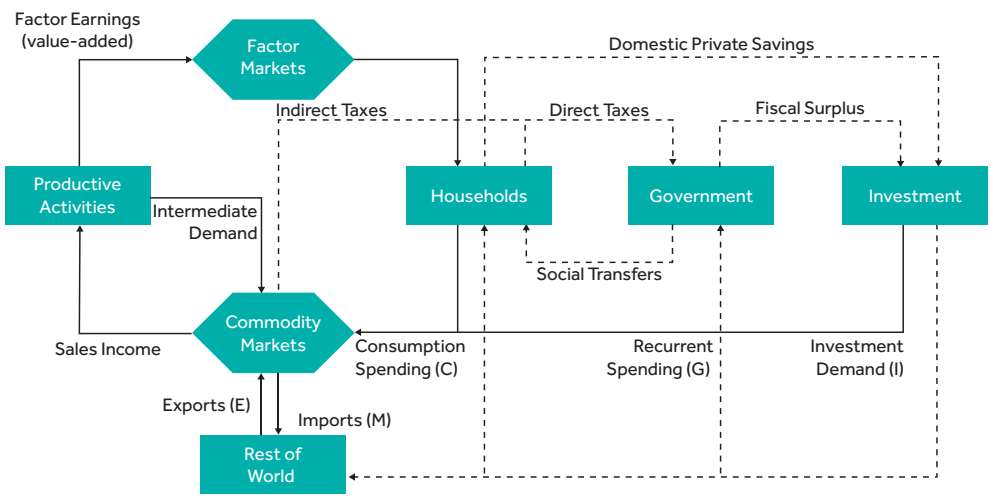
		Expenditure columns							
		Activities C1	Commodities C2	Factors C3	Households C4	Government C5	Investment C6	Rest of world C7	Total
Income rows	Activities R1		Domestic Supply						Activity income
	Commodities R2	Intermediate demand			Consumption spending (C)	Recurrent spending (G)	Investment demand (I)	Export earnings (E)	Total demand
	Factors R3	Value-added							Total factor income
	Households R4			Facto payments to householdsr		Social transfers		Foreign remittances	Total household income
	Government R5		Sales taxes and import tariffs		Direct taxes			Foreign grants and loans	Government income
	Savings R6				Private savings	Fiscal surplus		Current account balance	Total savings
	Rest of world R7		Import payments (M)						Foreign exchange outflow
	Total	Gross output	Total supply	Total factor spending	Total household spending	Government expenditure	Total investment spending	Foreign exchange inflow	

manufacturing output is also seen to require an increase in the production of power.

SAM is a square matrix which captures all the main circular flows (Figure A2.5) within an economy in a given period.

The input-output part of SAM captures production linkages between sectors that are determined by those sectors' production technologies. These linkages can be differentiated into backward and forward linkages. Stronger forward and backward production linkages lead to larger multipliers.

Figure A2.5 Circular flow in an Economy



Backward production linkages are the demand for additional inputs used by producers to supply additional goods or services. For example, when electricity production expands, it demands intermediate goods like fuel, machinery and construction services. This demand then stimulates production in other sectors to supply these intermediate goods. The more input intensive a sector's production technology is, the stronger its backward linkages are.

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 that 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 energy sector, as it provides key input into the majority of other sectors in the economy.

Methodology – description of social accounting matrix model

The move from a SAM data framework to a SAM model (also known as a multiplier framework) requires decomposing the SAM accounts into 'exogenous' and 'endogenous'. 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. 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). The elements of the APS matrix are calculated by dividing each cell by the sum total of its corresponding column.

The economy-wide impacts of personal income loss are examined by changing the household consumption vector.

The shift from a 'data' SAM structure to a SAM multiplier module requires the introduction of assumptions and the separation of the SAM accounts into 'exogenous' and 'endogenous' components.[1]

The separation is needed to enter the system, allowing some variables within the SAM structure to be manipulated exogenously (via injection

Table A2.1 Description of the endogenous and exogenous accounts and 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, *i* 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*.	Intervention into through activities (x = c + i + g + e), where i = GFC + ST (GFCF) Household Consumption (c) Exports (e) Government Expenditure (g) Investment Demand (i) Inventory Demand (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.	

instruments) to assess the subsequent impacts on the endogenous accounts, as well as on the exogenous accounts.

Generally, accounts intended to be used as policy instruments are classified as exogenous and accounts specified a priory as objectives (or targets) are classified as endogenous. Two accounts are designated as endogenous accounts: 1) Production (production activities and commodities) account; 2) and Factors of Production account.

The exogenous accounts comprise: 3a Household (consumption), Government (expenditure, transfer, remittances); 4 Capital account of institutions (savings

Table A2.2 General SAM modular structure

		1a-PA	*1b-CM*	*2-FP*	*3a-HH-OI*	*4-KHH-OI*	*5-ROW*	*TDD*
1a	PA		$T_{1a,\,1b}$		0			Y_{1a}
1b	CM	$T_{1b,\,1a}$			$T_{1b,\,3}$	$T_{1b,\,4}$	$T_{1b,\,5}$	Y_{1b}
2	FP	$T_{2,\,1a}$					$T_{2,\,5}$	Y_2
3	HH-IO	$T_{3,\,1a}$	$T_{3,\,1b}$	$T_{3,\,2}$	$T_{3,\,3}$		$T_{3,\,5}$	Y_3
4	KHH-OI	$T_{4,\,1a}$			$T_{4,\,3a}$		$T_{4,\,5}$	Y_4
5	ROW		$T_{5,\,1b}$	$T_{5\,2}$	$T_{5,\,3}$	0	0	Y_5
	TSS	E_{1a}	E_{1b}	E_2	E_3	E_4	E_5	

Note: Where: by definition $Y_i = E_j$ and 1 Production (1a PA = Production activities and 1b CM = Commodities); 2 FP = Factors of Production; 3 HH-IO = Households and Other Institutions (incl. Government); 4 KHH-OI = Capital Account Households and Other Institutions (including government); 5 ROW = Rest of the World (current and capital account). Blank entries indicate that there are no transactions by definition.

and demand for houses, investment demand, infrastructure and machinery and equipment); and 5 ROW transfers, remittances, export demand and capital. The SAM flows and the categorisation into endogenous and exogenous accounts are shown in Table A2.3.

SAM coefficients (A_{ij}) are derived from payment flows by endogenous accounts to themselves (T_{ij}) and other endogenous accounts as to the corresponding outlays ($E_i = Y_j$); similarly, the leak coefficients (B_{ij}) are derived from flows reflecting payments from endogenous accounts to exogenous accounts. They are derived in Table A2.5.

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

$$Y(t) = A\,Y(t) + X(t) = (I - A)^{-1} X(t) = M_a X(t)$$

Where:

t is time

Y is a vector of incomes of endogenous variables

X is a vector of expenditures of exogenous variables

A is the matrix of average expenditure propensities for endogenous accounts

$M_a = (I - A)^{-1}$ is a matrix of aggregate accounting multipliers (generalised Leontief inverse).

Table A2.3 Endogenous and exogenous accounts

		1a-PA	*1b-CM*	*2-FP*	*3a-HH-OI*	*3b-Gov*	*4-KHH-OI*	*5-ROW*	*TDD*
1a	PA		$T_{1a,\,1b}$		0				Y_{1a}
1b	CM	$T_{1b,\,1a}$			$T_{1b,\,3a}$	$T_{1b,\,3b}$	$T_{1b,\,4}$	$T_{1b,5}$	Y_{1b}
2	FP	$T_{2,\,1a}$						$T_{2,\,5}$	Y_2
3a	HH-OI			$T_{3a,\,2}$	$T_{3a,\,3a}$	$T_{3a,\,3b}$		$T_{2,\,5}$	Y_3
3b	Gov	$T_{3b,\,1a}$	$T_{3b,\,1b}$		$T_{3b,\,3a}$	$T_{3b,\,3b}$		$T_{3a,\,5}$	
4	KHH-OI	$T_{4,\,1a}$			$T_{4,\,3}$			$T_{4,\,5}$	Y_4
5	ROW		$T_{5,\,1b}$	$T_{5,\,2}$	$T_{5,\,3a}$	$T_{5,\,3b}$	$T_{5,\,4}$	0	Y_5
	TSS	E_{1a}	E_{1b}	E_2	E_{3a}	E_{3b}	E_4	E_5	

Note: Where Endogenous: 1 Production (1a PA = Production Activities and 1b CM = Commodities); 2 FP = Factors of Production; 3a HH = Households and Other Institutions (excluding Government). Where Exogenous: 3b Government; 4 KHH-OI = Capital Account of Households and of Other Institutions (incl. government); 5 ROW = Rest of the World (current and capital account).Blank entries indicate that there are no transactions by definition.

Table A2.4 Endogenous and components of exogenous accounts

	PA	CM	FP	EXO	INCOME	Exogenous Accounts (EXO) used as injections Column Vectors
1a PA		$T_{1a\,1b}$		X_{1a}	Y_{1a}	$X_{1a} = 0$
1b CM	$T_{1b\,1a}$			X_{1b}	Y_{1b}	X_{1b} = Government Consumption Subsidies - Taxes + Exports + Gov. Investment (capital formation in infrastructure and machinery and equipment) + Gross Capital Stock formation
2 FP	$T_{2\,1a}$			X_2	Y_2	X_2 = Factor Remittances from ROW
3b-5 Leaks	L_{1a}	L_{1b}	L_2	$L_{3b\text{-}5} = X_{3b\text{-}5}$	$Y_{3b\text{-}5}$	3b = Aid to Government from ROW
EXPN	E_{1a}	E_{1b}	E_2	$E_{3b\text{-}5}$		Where $E_i = Y_j$
L_{1a} = Activity Tax					L_{3a} = Income Tax + Household Savings + Corporate Savings	
L_{1b} = Commodity Tax + Import Duty + Imports					$L_{3b\text{-}5}$ $X_{3b\text{-}5}$ and $Y_{3b\text{-}5}$ falls out of the model	
L_2 = Factor Remittances to ROW					Blank entries indicate that there are no transactions by definition.	

Note on injection: *For any given injection into the exogenous accounts* X_i *(i.e., instruments) 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, institutions and production are all derived from exogenous injections into the economy via a multiplier process. Multiplier models may also be built on the input-output frameworks. The main shortcoming of the IO model is that the feedback between factor income generation (value-added) and demand by private institutions (households) does not exist. In this case, the circular economic flow is truncated. The problem can be partly tackled by endogenising household consumption within the I-O framework; this is typically referred to as a 'closed I-O model'. In this case, the circular economic flow is only partially truncated. A better solution is to extend the I-O to a SAM framework, which captures the full circular economic flow* derivation of SAM multipliers.

The aggregate accounting multiplier (M_a) is then further decomposed to separately examine the direct and induced effect. In order to generate the direct and induced effects, the M_a multiplier is decomposed using both multiplicative and additive forms.

Table A2.5 Coefficient matrices and vectors of the SAM model

Account	1a – PA	1b – CM	2 - FP	3a ... 5 EXO	Income
1a – PA		$A_{1a,1b} = T_{1a,1b}/Y_{1b}$		X_{1a}	Y_{1a}
1b – CM	$A_{1b,1a} = T_{1b,1a}/Y_{1a}$			X_{1b}	Y_{1b}
2 – FP	$A_{2,1a} = T_{2,1a}/Y_{1a}$			X_2	Y_2
3a ... 5 Leaks	$B_{1a} = L_{1a}/Y_{1a}$	$B_{1b} = L_{1b}/Y_{1b}$	$B_2 = L_2/Y_2$		
Expenditure	$E_{1a} = Y_{1a}$	$E_{1b} = Y_{1b}$	$E_2 = Y_2$		

From the above, it logically follows that the SAM model mainly provides answers to following basic issues: The model helps to assess:

i. the impacts on the endogenous and exogenous accounts in a clear and differentiated manner;
ii. the technological structure of the sectors oriented towards the production of basic intermediate and final goods and services;
iii. the expenditure structures of factors of production, institutions and demand for goods and services of domestic and foreign origin;
iv. the identification of key sectors, commodities, factors of production, institutional accounts and basic needs in the economy and quantification of the main linkages (total and partial);
v. the dynamics of the production structure, factorial and institutional income formation;
vi. the effects of incomes of institutions and their impact on production via their corresponding demand;
vii. the intra, across or extra and inter-circular group effects, both in additive and multiplicative manner;
viii. how matching labour and investment requirements can be calculated;
ix. price changes on endogenous accounts arising out of endogenous account price changes, as well as exogenous account price changes;
x. design simulations and alternative scenario and perform analysis; and
xi. it serves as the basis for development of computable general equilibrium.

Note

1 This methodology follows Pyatt, G and JI Round (1977), 'Social Accounting Matrices for Development Planning', *Review of Income and Wealth*, Series 23 No.4; Pyatt, G and JI Round (1979), 'Accounting and Fixed Price Multipliers in a SAM Framework', *Economic Journal*, No. 89; and Pyatt, G and A Roe (1987), (eds.). The layout follows Alarcon, JV et al. (1984), *La Matriz de Insumo-ProductoAdaptadapara la Planificación de lasnecesidadesbásicas,* Ecuador 1975 y 1980, ISSPREALC, Quito; and Alarcon, JV et al. (1991), *The Social Accounting Framework for Development*, Gower House, Avebury.