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Abstract:

This paper attempts to measure the extent of inter-regional economic interdependence between primary and redistribution incomes. This means that any change in final demand for goods and services in one region does not only lead to the change in output and income in that region but also leads to the change in redistribution income in that region as well as in the other regions. The change in income redistribution in the other regions is due to their changes in output and income, which, in turn, induces impacts on the final demands (household consumption and capital formation) and so on. A vicious cycle of intra- and inter-spatial economic flows can thus be observed.
Demonstrate

In the demographic-economic model presented by Miyazawa (1976), income from redistribution is treated as exogenous and it therefore appears as an exogenous variant. The difference of this study is that income received from redistribution is treated as endogenous variant. So, in this model, the totality of production income is not only induced by production income but also by redistribution of income among institutional units, intra-regionally and inter-regionally.

I. Introduction.

This paper attempts to measure the extent of inter-regional economic interdependence between primary and redistribution incomes. This means that any change in final demand for goods and services in one region does not only lead to the change in output and income in that region but also leads to the change in redistribution income in that region as well as in the other regions. The change in income redistribution in the other regions is due to their changes in output and income, which, in turn, induces impacts on the final demands (household consumption and capital formation) and so on. A vicious cycle of intra- and inter-spatial economic flows can thus be observed.

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In the demographic-economic model presented by Miyazawa (1976), income from redistribution is treated as exogenous and it therefore appears as an exogenous variant. The difference of this study is that income received from redistribution is treated as endogenous variant. So, in this model, the totality of production income is not only induced by production income but also by redistribution of income among institutional units, intra-regionally and inter-regionally.

The paper is structured as follows: section II provides a brief survey of the development of input output tables. The accounting framework used to develop the IRIO demographic-economic (IRIODE) model for Vietnam is outlined in section III. The methods and data used to compile IRIDEM are described in section IV and main results and discussed in section V.

II. Literature Review.

Input-output framework analysis has its antecedents in the tableau Economique developed by French economist Francois Quesnay nearly 250 years ago. Quesnay's tableau describes the relationships between sales and purchases of the various industries in an economy. More than a hundred years later, Leon Walras adapted his model to provide a more concise theoretical formulation of an economic system including consumer purchases and economic representation of technology. However, it was not until the 20th century that Leontief greatly simplified Walras's theoretical formulation by assuming the fixity of both technology and trading patterns over time to develop an input output model of the 1919 United State (US) economy to estimate the effects of the end of the First World War on national employment.

The field of input-output analysis was advanced further when Isard (1951) extended the work of Leontief to analyze IO tables at the sub-national level by publishing a seminar paper on the theoretical structure of inter-regional input-output framework under the assumption that the sect oral and geographical origin of each delivery can be specified. Richardson (1972) justified this model as ideal because identical sectors in different regions are treated as distinctly separate industries, so that inter-regional trade flows by region of origin and destination and by industry source and purchasing sector are fully specified. However, data at this very detailed level of desegregation are mostly not readily available. Thus, detailed and comprehensive surveys to collect data on regional purchases by sector and regional sales by sector will need to be undertaken.

Inter-regional input output models have been applied in many empirical studies to address a wide range of policy issues and to analyze their impacts on other regions. For example, the benchmark report of State of Hawaii (2007) applied a multi inter-county input output model in order to analyze the economic impacts between counties of Hawaii State. Bui et al (2007) applied a multi inter-regional input output model for 7 regions of Vietnam in order to estimate impacts of income between regions. Brian et al (2006) described current uses of inter-county input-output model and their applications to understanding a range of policy issues, such as global value chains and production fragmentation, technology flows, productivity and determinants of growth, industrial ecology and sustainable development. Fernando and Urena (2006) introduced a new method of regionalization and desegregation which takes into account the gross value

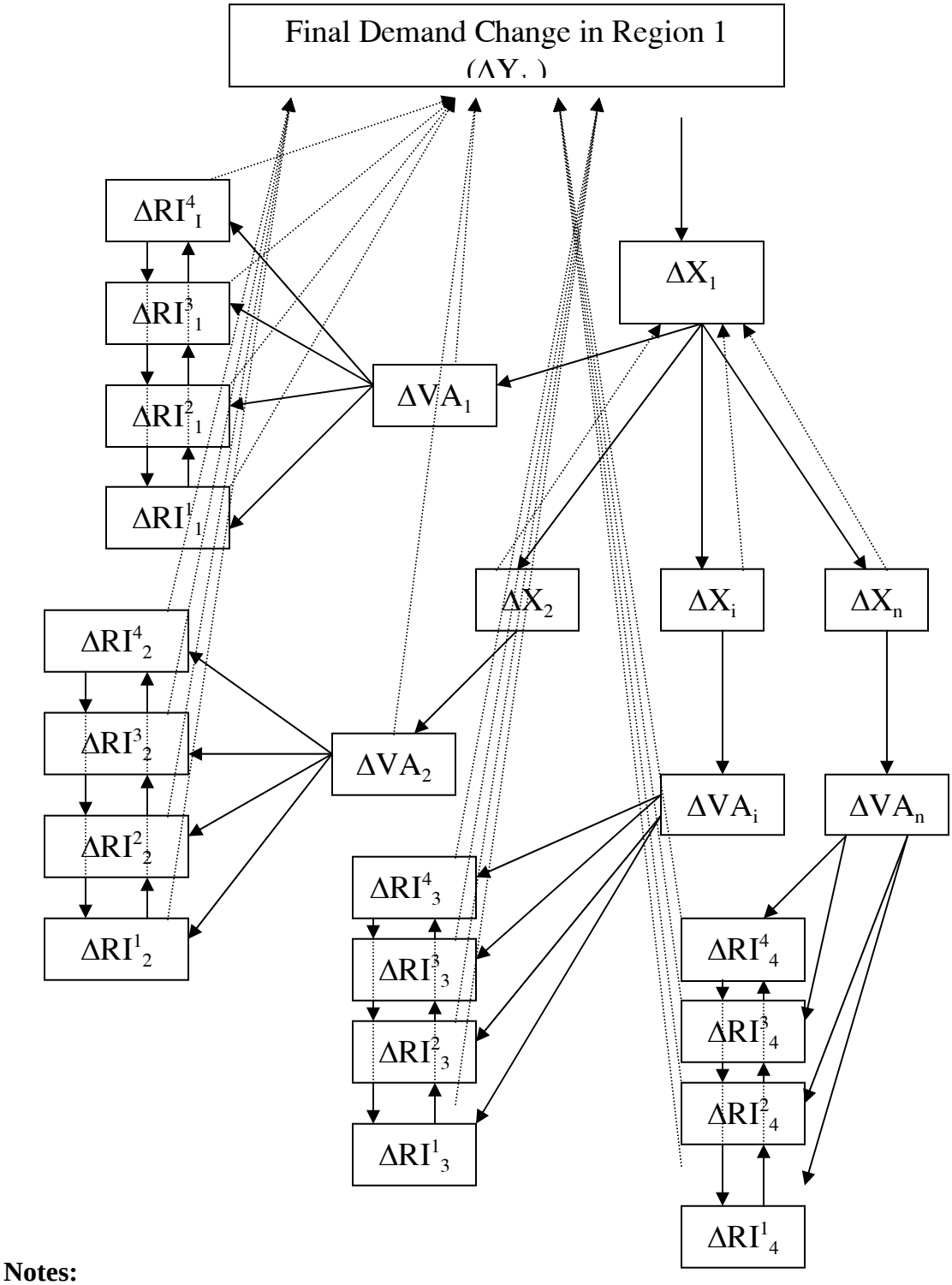
added of each sector in every region and the transport infrastructure used by these regions.

In recent years, inter-regional input output tables have been developed for European countries such as Spain (Verdura 2000), Finland (Piispala. 2000), Italy (Benvenuti and Panicia 2003) and Austria (Fritz et al. 2006). In the Asian context, inter-regional input output models are also used to estimate the damages and losses by unscheduled events, such as earthquakes, flood and other major nature disasters. Okayama et al (1999) estimated the inter-regional impacts of the Great Hanshin earthquake in Kobe, Japan in 1995 using a two-region inter-regional input-output model. Secretario (2001) pioneered the construction of a multi-region inter-regional IO table for the Philippines to serve as an appropriate and effective database for inter-regional economic and environmental impact analysis. Other recent studies using the inter-regional input output model include Allan et al (2004), Zhang (2005), Patrick and Wang (2005) and Rey (1999).

To analyze the inter-regional feedback effects and the degree to which change originating in one region has capacity to influence levels in another region, Bui Trinh et al (2000) applied an inter-regional input output model on a case study of HoChiMinh city and the rest of Vietnam. Harries et al (1998) separated the Lincoln County into the Calient area and rest of Lincoln County. Following procedures outlined by Robinson (1997), Holland (1991) and Harries et al (1998), inter-regional IO models were applied to give local decision makers an idea of potential socio-economic and fiscal impacts from changes in local economic activity. These ideas were also incorporated in the familiar social accounting systems developed by Stone (1961), Pyatt and Rose (1977) and in the parallel developments of demographic-economic modeling by Batey and Madden (1983).

III. The Inter-Regional Demographic-Economic Model

The framework on inter-regional demographic-economic modeling adopted in this study is an extended form of input-output analysis conceptualized by Miyazawa (1976). As shown in the diagram below, Miyazawa's concept of inter-relation income multipliers was designed to analyze the structure of income distribution.



Notes:

Direct and indirect effects

Spillover effect

Where: Y is final demand matrix; X_i is gross output vector of region i; VA_i is matrix of production income of region i; RI_i^j is production income of region i and institutional sector j.

Some of Miyazawa's empirical analyses made use of Japan's interregional input-output tables provided by the Ministry of International Trade and Industry.

A. The ideal IRIO demographic-economic model.

Miyazawa's system may be considered the most parsimonious in terms of the way it extends the familiar input-output formulation. Miyazawa considered the following system:

$$\begin{bmatrix} X \\ Y \end{bmatrix} = \begin{bmatrix} A & C \\ V & 0 \end{bmatrix} \begin{bmatrix} X \\ Y \end{bmatrix} + \begin{bmatrix} f \\ g \end{bmatrix} \qquad (1)$$

where X is a vector of output; Y is a vector of total income for some r-fold division of income groups; A is a matrix of direct input coefficients, V is a matrix of value added ratios for r-fold income groups, C is a corresponding matrix of consumption coefficients; f is a vector of final demands except household consumption, and g is a vector of exogenous income for r-fold income groups. Solving this system yields:

$$\begin{bmatrix} X \\ Y \end{bmatrix} = \begin{bmatrix} 1-A & -C \\ -V & 1 \end{bmatrix}^{-1} \begin{bmatrix} X \\ Y \end{bmatrix} + \begin{bmatrix} f \\ g \end{bmatrix} \qquad (2)$$

So:

$$\begin{bmatrix} X \\ Y \end{bmatrix} = \begin{bmatrix} B.(I+CKVB) & BCK \\ KVB & K \end{bmatrix} \begin{bmatrix} f \\ g \end{bmatrix} \qquad (3)$$

Where:

$B = (I-A)^{-1}$ is the Leontief inverse matrix
BC is a matrix of production induced by consumption.
VB is a matrix of endogenous income earned from production
VBC is a matrix of endogenous income from production that induced by expenditure
$K= (I-VBC)^{-1}$ is a Keynesian multiplier matrix or matrix of the Miyazawa interrelation income multipliers. K is a matrix that presents the total increase of direct, indirect and induced impacts; the increase of direct and indirect impact in the income of one income group as a result of the expenditure from an additional unit of income by another group.

Sonis and Hewings (1993) extended the framework using the following perspective:

$$\begin{bmatrix} B.(I+CKVB) & BCK \\ KVB & K \end{bmatrix} = \begin{bmatrix} \Delta & \Delta C \\ V\Delta & I+V\Delta C \end{bmatrix} \quad (4)$$

Where:

$\Delta = (I\text{-}A\text{-}CV)^{-1}$ is an enlarged Leontief inverse matrix. And the following presentation of the Miyazawa interrelation multiplier matrix can be revealed as:

$$K = I+V\Delta C = (I\text{-}V.(I\text{-}A)^{-1}.C)^{-1} \quad (5)$$

This study attempts to extend the Miyazawa model by the following system:

$$\begin{bmatrix} A & c_1 & g_1 & e_1 \\ h & c_2 & g_2 & e_2 \\ g & c_3 & 0 & e_3 \\ e & c_4 & g_3 & e_4 \end{bmatrix} . \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} + \begin{bmatrix} f_1 \\ f_2 \\ f_3 \\ f_4 \end{bmatrix} = \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} \quad (6)$$

Or,

$$\begin{bmatrix} A & c_1 & g_1 & e_1 \\ h & c_2 & g_2 & e_2 \\ g & c_3 & 0 & e_3 \\ e & c_4 & g_3 & e_4 \end{bmatrix} = \begin{bmatrix} A & c \\ v & B \end{bmatrix} \quad (7)$$

Where:

A – direct input coefficients matrix; x_1 is a vector of output; x_2 is total income for r-fold divisions of household groups; x_3 is total income of Government institution; x_4 is total income of enterprises; *h* is a matrix (vector) of income by household groups from production; *g* is a vector of Government income from production (indirect taxes less subsidies); *e* is a matrix of income by enterprise groups from production (operating surplus and consumption of fixed capital); c_1 is a corresponding matrix of household consumption coefficients; g_1 is a vector of Government consumption coefficients; c_2 is a vector on income redistribution between groups of households; c_3 is a vector on income redistribution between household groups and Government institutions; c_4 is a matrix on income redistribution between household institution and enterprise groups; g_2, g_3 are expenditure of Government to households and enterprises, respectively; e_1 is a vector of accumulation; e_2, e_3, e_4 are matrixes on income redistribution from enterprises to

household, government and other groups of enterprises, respectively; f is a vector for the rest of the world transactions, in which, f_1 is a vector of export, f_2 f_3 f_4 are vectors of rest of the world with corresponding institutions. That means total of household income include production income and re-distributional income from other institutions, it is resource for household consumption and property payment and transfer to other institutions. Similar for other institutions.

Regarding equation (7) the vector v, c and B can identify as below:

$$\mathrm{v} = \begin{bmatrix} h \\ g \\ e \end{bmatrix} \tag{8}$$

$$\mathrm{c} = \begin{bmatrix} c_1 & g_1 & e_1 \end{bmatrix} \tag{9}$$

$$\mathrm{B} = \begin{bmatrix} c_2 & g_2 & e_2 \\ c_3 & 0 & e_3 \\ c_4 & g_3 & e_4 \end{bmatrix} \tag{10}$$

$$\mathrm{x'} = \begin{bmatrix} x_2 \\ x_3 \\ x_4 \end{bmatrix} \tag{11}$$

$$\mathrm{f'} = \begin{bmatrix} f_2 \\ f_3 \\ f_4 \end{bmatrix} \tag{12}$$

We can re-write equation (6) the following system:

$$\begin{bmatrix} A & c \\ v & B \end{bmatrix} . \begin{bmatrix} x_1 \\ x' \end{bmatrix} + \begin{bmatrix} f_1 \\ f' \end{bmatrix} = \begin{bmatrix} x_1 \\ x' \end{bmatrix} \tag{13}$$

In the case inter-regional demographic-economic model matrixes A and C has sub-matrix as domestic trade for production and final consumption and accumulation.

Miyazawa suggested an innovative way of partitioning the system of regions and the developments of demographic – economic modeling associated with Batey and Madden (1983); the other innovative way for linking of sectorial and institutional units, it is also referred as internal and external multipliers and relation (13) may be obtained:

$$\begin{bmatrix} x_1 \\ x' \end{bmatrix} = \begin{bmatrix} \Delta_1 & \Delta_1.c.(I-B)^{-1} \\ \Delta_2.v.(I-A)^{-1} & \Delta_2 \end{bmatrix} . \begin{bmatrix} f_1 \\ f' \end{bmatrix} \qquad (14)$$

Where: Δ_1 is interpreted as enlarged Leontief inverse, the elementary of Δ_1 includes direct impact, indirect impact and induce effects by household expenditure (includes household consumption and other expenditure[4]), enterprise expenditure (includes accumulation of enterprise and other expenditure) and government expenditure (includes government consumption and other expenditure), they contain elements which are larger than those of the $(I-A)^{-1}$ matrix, because they include extra output required to meet the consumption groups and investment output effects. Δ_2 is interpreted as *enlarged Miyazawa matrix multipliers*, the Δ_1 and Δ_2 can be decomposed as follow:

$$\Delta_1 = (I-A-c.(I-B)^{-1}.v)^{-1} \qquad (15)$$

$$\Delta_2 = (I-(I-B)^{-1}.v.(I-A)^{-1}.c)^{-1}.(I-B)^{-1} \qquad (16)$$

$\Delta_2.v.(I-A)^{-1}$ is the interrelation income multiplier Δ_2.post-multiplied by the coefficient matrix of induced income $v.(I-A)^{-1}$, that results was the direct, indirect and induced incomes impact of each income group by initial export f_1. So, when structures of export changed will lead to the change on value of incomes. $\Delta_1 .c.(I-B)^{-1}$ are multiplier matrix of household groups, Government and capital formation induced by expenditure of household, Government and enterprise for consumption, investment, property and transfer expenditures

In the case: B=”0”

Δ_1 is a normally enlarged Leontief inverse and Δ_2 is a matrix of the Miyazawa inter-relational income multipliers. And the equations (15), (16) come back as follows:

$\Delta_1 = (I-A-c.v)^{-1}$ and $\Delta_2 = (I-v.(I-A)^{-1}.c)^{-1}$

[4] Other expenditure includes property payment and transfer outlay

B. Framework of enlarged interregional demographic-economic model

B1. Inter-regional input-output framework.

In this study we compiled an IRIO framework of three sectors and three regions as follows:

Sector 1: Agriculture, fishing and forestry
Sector 2: Manufacturing, electricity, water supply and construction
Sector 3: Services

Region 1: North of Vietnam
Region 2: Center of Vietnam
Region 3: South of Vietnam

Fig. 1. GENERAL CONFIGURATION OF 3-REGION VIRIO TABLE

FROM \ TO			INTERMEDIATE DEMAND			FINAL DEMAND			M	GROSS OUTPUT
			Region 1	....	Region 3	Region 1	....	Region 3		
			1 2 ... j ... n		1 2 ... j ... n	C G I E		C G I E		
INTERMED IN	REG 1	1 : i : n	Intra-regional Flows of Inter-mediate Prods X^{11}	....	Inter-regional Flows of Inter-mediate Prods X^{13}	Intra-regional Flows of Final Prods F^{11}	....	Inter-regional Flows of Final Prods F^{13}	0	$X^{1.}$
	:	:	:	:	:	:	:	:	:	:
	REG 3	1 : i : n	Inter-regional Flows of Inter-mediate Prods X^{31}	....	Intra-regional Flows of Inter-mediate Prods X^{33}	Inter-regional Flows of Final Prods F^{31}	....	Intra-regional Flows of Final Prods F^{33}	0	$X^{3.}$
PUTS	ROW	1 : i : n	Imports of Intermediate Products X^{W1}	....	Imports of Intermediate Products X^{W3}	Imports of Final Products F^{W1}	....	Imports of Final Products F^{W3}	Total Imports F^{W3}	0
PRIMA-RY INPUTS		CE PT-S D OS	Value Added V^{P1}	....	Value Added V^{P3}	Value Added 0	....	Value Added 0	Value Added 0	GVA $V^{P.}$
GROSS INPUT			$X^{.1}$	....	$X^{.3}$	$F^{.1}$	....	$F^{.3}$	(M)	

ABBREVIATIONS:

CE: Compensation of Employees
PT-S: Production Tax less Subsidies
D: Depreciation
OS: Operating Surplus
GVA: Gross Value Added

C: Private Consumption Expenditures
G: Government Consumption Expenditures
I: Investment (Gross Domestic Capital Formation)
E: Exports
M: Imports

NOTATIONS:

$\mathbf{X^{11}}$: Matrix of intra-regional flows of intermediate products within Region 1;
$\mathbf{X^{13}}$: Matrix of inter-regional flows of intermediate products between Regions 1 & 3;
$\mathbf{F^{11}}$: Matrix of intra-regional flows of final products within Region 1;
$\mathbf{F^{13}}$: Matrix of inter-regional flows of final products between Regions 1 and 3;
$\mathbf{X^{W1}}$: Matrix of imports of intermediate products consumed in Region 1;
$\mathbf{F^{W1}}$: Matrix of imports of final products consumed in Region 1;
(M) : Vector of total imports of national economy, (negative entries)
$\mathbf{V^{P1}}$: Matrix of primary inputs in production (=GVA) in Region 1
$\mathbf{V^{P.}}$: Vector of GVA of national economy, where ∑GVA = national GDP
$\mathbf{F^{.1}}$: Vector of total final demand in Region 1
$\mathbf{X^{1.} = X^{.1}}$: Vector of gross outputs in Region1 = vector of gross inputs in Region 1;

B2. The inter-regional Demographic-Economic model (IRDEM) compilation

Again, the building of inter-regional demographic-economic framework 2000 requires a certain source of data, namely:

1) The inter-regional input-output framework
2) Vietnam SAM, 2000 (published by CIEM)
3) Balance of Payment
4) State budget by province
5) Result of household survey by province (published by Vietnam GSO)

In this IRDEM 2000, while the main attribute of a classical IRDEM remains the same. There in addition some changes. The detailed elements of the IRDEM 2000 are in the following table.

Fig. 2. Demographic-Economic modeling 2005

	Reg 1	Reg 2	Reg 3	R	U	I	G	R	U	I	G	R	U	I	G	Row	Total
Reg 1	X^{11}	X^{12}	X^{13}	FR^{11}	FU^{11}	FI^{11}	FG^{11}	FR^{12}	FU^{12}	FI^{12}	FG^{12}	FR^{13}	FU^{13}	FI^{13}	FG^{13}	E^{1}	$X^{1.}$
Reg 2	X^{21}	X^{22}	X^{23}	FR^{21}	FU^{21}	FI^{21}	FG^{21}	FR^{22}	FU^{22}	FI^{22}	FG^{22}	FR^{23}	FU^{23}	FI^{23}	FG^{23}	E^{2}	X^{2}
Reg 3	X^{31}	X^{32}	X^{33}	FR^{31}	FU^{31}	FI^{31}	FG^{31}	FR^{32}	FU^{32}	FI^{32}	FG^{32}	FR^{33}	FU^{33}	FI^{33}	FG^{33}	E^{3}	$X^{3.}$
R	RI^{1}				RU^{1}	RI^{1}	RG^{1}	RR^{12}	RU^{12}	RI^{12}	RG^{12}	RR^{13}	RU^{13}	RI^{13}	RG^{13}	RE^{1}	TRI^{1}
U	UI^{1}			UR^{1}		UI^{1}	UG^{1}	UR^{12}	UU^{12}	UI^{12}	UG^{12}	UR^{13}	UU^{13}	UI^{13}	UG^{13}	UE^{1}	TUI^{1}
I	CI^{1}			IR^{1}	IU^{1}		IG^{1}	IR^{12}	IU^{12}	II^{12}	IG^{12}	IR^{13}	IU^{13}	II^{13}	IG^{13}	IE^{1}	TCI^{1}
G	GI^{1}			GR^{1}	RU^{1}	GI^{1}		GR^{12}	GU^{12}	GI^{12}	GG^{12}	GR^{13}	GU^{13}	GI^{13}	GG^{13}	GE^{1}	TGI^{1}
R		RI^{2}		RR^{21}	RU^{21}	RI^{21}	RG^{21}		RU^{2}	RI^{2}	RG^{2}	RR^{23}	RU^{23}	RI^{23}	RG^{23}	RE^{2}	TRI^{2}
U		UI^{2}		UR^{21}	UU^{21}	UI^{21}	UG^{21}	UR^{2}		UI^{2}	UG^{2}	UR^{23}	UU^{23}	UI^{23}	UG^{23}	UE^{2}	TUI^{2}
I		CI^{2}		IR^{21}	IU^{21}	II^{21}	IG^{21}	IR^{2}	IU^{2}		IG^{2}	IR^{23}	IU^{23}	II^{23}	IG^{23}	IE^{2}	TCI^{2}
G		GI^{2}		GR^{21}	GU^{21}	GI^{21}	GG^{21}	GR^{2}	RU^{2}	GI^{2}		GR^{23}	GU^{23}	GI^{23}	GG^{23}	GE^{2}	TGI^{2}
R			RI^{3}	RR^{31}	RU^{31}	RI^{31}	RG^{31}	RR^{32}	RU^{32}	RI^{32}	RG^{32}		RU^{3}	RI^{3}	RG^{3}	RE^{3}	TRI^{3}
U			UI^{3}	UR^{31}	UU^{31}	UI^{31}	UG^{31}	UR^{32}	UU^{32}	UI^{32}	UG^{32}	UR^{3}		UI^{3}	UG^{3}	UE^{3}	TUI^{3}
I			CI^{3}	IR^{31}	IU^{31}	II^{31}	IG^{31}	IR^{32}	IU^{32}	II^{32}	IG^{32}	IR^{3}	IU^{3}		IG^{3}	IE^{3}	TCI^{3}
G			GI^{3}	GR^{31}	GU^{31}	GI^{31}	GG^{31}	GR^{32}	GU^{32}	GI^{32}	GG^{32}	GR^{3}	RU^{3}	GI^{3}		GE^{3}	TGI^{3}
W	M^{1}	M^{2}	M^{3}	MR^{1}	MU^{1}	MI^{1}	MG^{1}	MR^{2}	MU^{2}	MI^{2}	MG^{2}	MR^{3}	MU^{3}	MI^{3}	MG^{3}		M
otal	$X^{1.}$	X^{2}	$X^{3.}$	$R^{1.}$	U^{1}	$I^{1.}$	$G^{1.}$	$R^{2.}$	U^{2}	$I^{2.}$	G^{2}	R^{3}	U^{3}	I^{3}	G^{3}	E	

-

Table below explains each cell in the IRIO-DEM 2005 table

X^{ij}	Matrix of inter-regional flows of intermediate products between Regions i & j.
FR^{IJ}	Matrix of rural household consumption of region j for products of region i

FG^{IJ}	Matrix of rural Government consumption of region j for products of region i
Cells 9x1, 10x1, 11x1	Operating surpluses and depreciations of the enterprises
Cell 13x1	Total foreign imports to industry use or payments to imports
Cell 1x2	Payments made by household to commodities or total final consumption of household
Cell 6x2, 7x2, 8x2	Taxes paid by household to government
Cell 12x2	Household saving
Cell 13x2	Imports to household final demand
Cell 12x3	Government saving
Cell 1x8	Transfers made by government to state commodities
Cell 2x8	Transfers made by government to household
Cell 9x8, 10x8	Transfers made by government to state and non-state enterprises
Cell 7x9, 7x10, 7x11	Payments in terms of Direct taxes made by enterprises to government
Cell 9x9, 10x9, 11x9, 0x10, 10x10, 11x10, 9x11, 10x11, 11x11	Inter-institutional transfers by enterprises to enterprises and property incomes
Cell 13x11	Transfers made by the FDI enterprises to the rest of the world
Cell 6x12	Import duties paid to the government
Cell 13x12	Import of investment goods
Cell 1x13	Export

Cell 2x13	Payments from the rest of the world to household
Cell 7x13, 8x13	Tax payments and transfers from the rest of the world to the government
Cell 12x13	Foreign transfers

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ANNEX (Excel file)