



Using available National Input-Output tables in the construction of a Multicountry Input-Output table:

the case of FIGARO

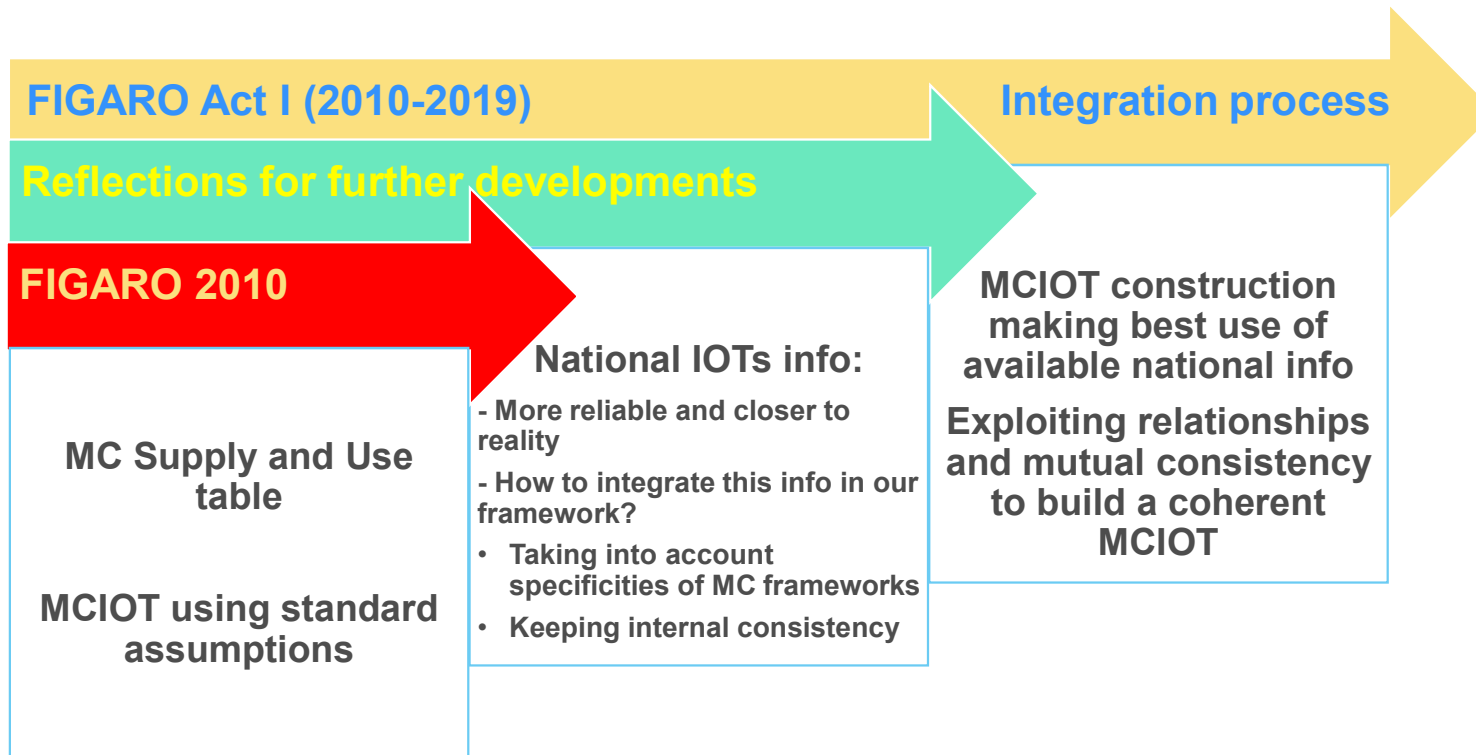
Juan M. VALDERAS-JARAMILLO, Alexis BOLÍVAR,
Agustín VELÁZQUEZ, José M. RUEDA-CANTUCHE*

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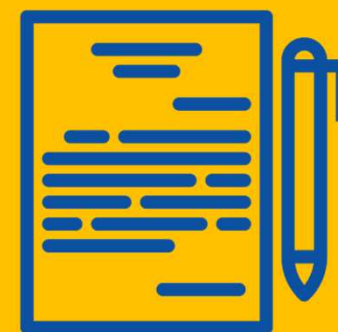
In this presentation...

- 1 National and Multicountry SUIOT tables
- 2 The construction of a MCIOT (FIGARO 2010)
- 3 One step further: using available National IOTs in construction of MCIOTs
- 4 Implementation of the process in FIGARO Act I (2010-2019)
- 5 Conclusions

In a nutshell



1. National and Multicountry tables



National vs Multicountry SUTs

National supply matrix

		Ctry 1				Total
		Industry A01	Industry A02	...	Industry U	
Ctry 1	CPA_A01	S				q
	CPA_A02					
	...					
	CPA_U					
Total		g'				

MC supply matrix (block diagonal)

		Ctry 1				Ctry 2				...	Ctry n				Total
		Industry A01	Industry A02	...	Industry U	Industry A01	Industry A02	...	Industry U	...	Industry A01	Industry A02	...	Industry U	
Ctry 1	CPA_A01	S^{Ctry1}								...					q^{Ctry1}
	CPA_A02														
	...														
	CPA_U														
Ctry 2	CPA_A01					S^{Ctry2}				...					q^{Ctry2}
	CPA_A02														
	...														
	CPA_U														
...
Ctry n	CPA_A01									...	S^{Ctryn}				q^{Ctryn}
	CPA_A02														
	...														
	CPA_U														
Total		g^{Ctry1'}				g^{Ctry2'}				...	g^{Ctryn'}				

National vs Multicountry SUTs

National use matrix

		Intermediate Demand			Final Demand				EXP	Total	
		Industry A01	Industry A02	...	Industry U	P3_S14	P3_S15	...	P5M		P6
		Industry A01	Industry A02	...	Industry U	P3_S14	P3_S15	...	P5M		P6
Domestic uses	CPA_A01										
	CPA_A02										
	...										
	CPA_U										
Imported Uses	CPA_A01										
	CPA_A02										
	...										
	CPA_U										
CIF-FOB adjustment											
Direct Purchases Abroad											
Non-resident purchases in the territory											
Taxes less subsidies											
Gross Value Added components	D1										
	D29X39										
	B2A3G										
GVA	B1G										
Total											

MC use matrix

		Intermediate Uses										Final Uses										Total Intermediate Use	Total Final Use	Total	
		AT			BE			...	US			AT			BE			...	US						FIGX
		Industry A01	Industry A02	...	Industry U	Industry A01	Industry A02	...	Industry U	Industry A01	Industry A02	...	Industry U	P3_S14	P3_S15	...	P5M	P3_S14	P3_S15	...	P5M				P3_S14	P3_S15	...	P5M	P6
AT	CPA_A01	U^{CTRY1}_{dom}			$\leftarrow X^{CTRY1}$			\rightarrow	Y^{CTRY1}_{dom}			$\leftarrow X^{CTRY1}$			\rightarrow										
	CPA_A02																								
	...																								
	CPA_U																								
BE	CPA_A01	$\uparrow U^{CTRY1}_{imp}$							$\uparrow Y^{CTRY1}_{imp}$																
	CPA_A02																								
	...																								
	CPA_U																								
US	CPA_A01	$\downarrow U^{CTRY1}_{imp}$							$\downarrow Y^{CTRY1}_{imp}$																
	CPA_A02																								
	...																								
	CPA_U																								
FIGX																									
CIF-FOB adjustment																									
Direct Purchases Abroad																									
Non-resident purchases in the territory																									
Taxes less subsidies																									
Gross Value Added components	D1	TLS							GVA																
	D29X39																								
	B2A3G																								
GVA	B1G																								
Total																									

From SUT to IOT

National Use table

		Intermediate Demand			Final Demand				EXP	Total
		Industry A01	Industry A02	Industry U	P3_S14	P3_S15	...	P5M	P6	
Domestic uses	CPA_A01	U_{dom}	Y_{dom}	X	q					
	CPA_A02									
	...									
	CPA_U									
Imported Uses	CPA_A01	U_{imp}	Y_{imp}	X	m					
	CPA_A02									
	...									
	CPA_U									
Taxes less subsidies		t_{ID (ind)}	t_{IF}		t					
Gross Value Added components	D1									
	D29X39									
	B2A3G									
GVA	B1G	GVA (ind)								
Total		g'	y'							

National IOT p_xp

		Intermediate Demand			Final Demand				EXP	Total
		CPA_A01	CPA_A02	CPA_U	P3_S14	P3_S15	...	P5M	P6	
Domestic uses	CPA_A01	S_{dom}	Y_{dom}	X	q					
	CPA_A02									
	...									
	CPA_U									
Imported Uses	CPA_A01	S_{imp}	Y_{imp}	X	m					
	CPA_A02									
	...									
	CPA_U									
Taxes less subsidies		t_{ID (prod)}	t_{IF}		t					
Gross Value Added components	D1									
	D29X39									
	B2A3G									
GVA	B1G	GVA (prod)								
Total		q'	y'							

Column reallocation of intermediate blocks by means of post-multiplication of transformation matrix

$$IO_j = USE_j \times T \text{ (intermediate parts blocks)}$$

Final demand blocks unchanged

Eurostat (2008): Model A (product technology), Model B (industry technology)

From SUT to IOT

National Use table

		Intermediate Demand				Final Demand				EXP	Total
		Industry A01	Industry A02	...	Industry U	P3_S14	P3_S15	...	P5M	P6	
Domestic uses	CPA_A01	U_{dom}				Y_{dom}				X	q
	CPA_A02										
	...										
	CPA_U										
Imported Uses	CPA_A01	U_{imp}				Y_{imp}				X	m
	CPA_A02										
	...										
	CPA_U										
Taxes less subsidies		t_{ID (ind)}				t_{IF}				t	
Gross Value Added components	D1										
	D29X39										
	B2A3G										
GVA B1G		GVA (ind)									
Total		g'				y'					

National IOT ix_i

		Intermediate Demand				Final Demand				EXP	Total
		Industry A01	Industry A02	...	Industry U	P3_S14	P3_S15	...	P5M	P6	
Domestic uses	Industry A01	B_{dom}				F_{dom}				N	g
	Industry A02										
	...										
	Industry U										
Imported Uses	Industry A01	B_{imp}				F_{imp}				N	m (ind)
	Industry A02										
	...										
	Industry U										
Taxes less subsidies		t_{ID (ind)}				t_{IF}				t	
Gross Value Added components	D1										
	D29X39										
	B2A3G										
GVA B1G		GVA (ind)									
Total		g'									

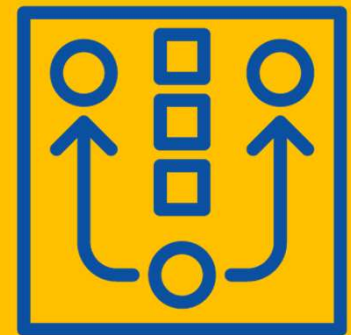
Row reallocation of domestic and imported blocks by means of pre-multiplication of transformation matrix

$$IO_i = T \times USE_i \text{ (domestic and imported uses blocks)}$$

GVA, TLS blocks unchanged

Eurostat (2008): Model C (fixed industry sales structure), Model D (fixed product sales structure)

2. The construction of a MCIOT



FIGARO 2010 MCIOT

Chapter 15 (Eurostat, 2019)...<https://ec.europa.eu/eurostat/web/products-statistical-working-papers/-/KS-FT-19-002>



Intermediate uses

Final uses

Bulk exports

		Intermediate Uses												Final Uses												FIGX	Total																												
		AT				BE				...				US				AT				BE				...				US				P6																					
		Industry A01	Industry A02	...	Industry U	Industry A01	Industry A02	...	Industry U	...	Industry A01	Industry A02	...	Industry U	P3_S14	P3_S15	...	P5M	P3_S14	P3_S15	...	P5M	...	P3_S14	P3_S15	...	P5M																												
‘extended’ domestic part	AT	CPA_A01	U_d^{AT}												$U_m^{AT \rightarrow BE}$												$U_m^{AT \rightarrow US}$												Y_d^{AT}				$Y_m^{AT \rightarrow BE}$				$Y_m^{AT \rightarrow US}$				$X_m^{AT \rightarrow FIGX}$				
		CPA_A02																																																					
		...																																																					
		CPA_U																																																					
Bulk imports	BE	CPA_A01	$U_m^{BE \rightarrow AT}$												U_d^{BE}												$U_m^{BE \rightarrow US}$												$Y_m^{BE \rightarrow AT}$				Y_d^{BE}				$Y_m^{BE \rightarrow US}$				$X_m^{BE \rightarrow FIGX}$				
		CPA_A02																																																					
		...																																																					
		CPA_U																																																					
GVA block...	US	CPA_A01	$U_m^{US \rightarrow AT}$												$U_m^{US \rightarrow BE}$												U_d^{US}												$Y_m^{US \rightarrow AT}$				$Y_m^{US \rightarrow BE}$				Y_d^{US}				$X_m^{US \rightarrow FIGX}$				
		CPA_A02																																																					
		...																																																					
		CPA_U																																																					
FIGX	P7	$M_m^{FIGX \rightarrow AT}$				$M_m^{FIGX \rightarrow BE}$				...				$M_m^{FIGX \rightarrow US}$				$Y_m^{FIGX \rightarrow AT}$				$Y_m^{FIGX \rightarrow BE}$				$Y_m^{FIGX \rightarrow US}$																													
CIF-FOB adjustment		C_u^{AT}				C_u^{BE}				...				C_u^{US}				C_y^{AT}				C_y^{BE}				C_y^{US}				C_y^{FIGX}																									
Direct Purchases Abroad Non-resident purchases in the territory														D^{AT}				D^{BE}				D^{US}																																	
Taxes less subsidies		t_u^{AT}				t_u^{BE}				...				t_u^{US}				t_y^{AT}				t_y^{BE}				t_y^{US}				t_y^{FIGX}																									
Gross Value Added components	D1	W^{AT}				W^{BE}				...				W^{US}																																									
	D29X39																																																						
	B2A3G																																																						
GVA	B1G																																																						
Total																																																							

		Intermediate Uses						Final Uses						FIGX	Use	Total											
		AT		BE		US		AT		BE		US															
		Industry A01	Industry A02	Industry U	Industry A01	Industry A02	Industry U	Industry A01	Industry A02	Industry U	Industry A01	Industry A02	Industry U	P3_S14	P3_S15	PSM	P3_S14	P3_S15	PSM	P3_S14	P3_S15	PSM	FIGX				
AT	CPA_A01																										
	CPA_A02																										
	CPA_U																										
BE	CPA_A01																										
	CPA_A02																										
	CPA_U																										
US	CPA_A01																										
	CPA_A02																										
	CPA_U																										
FIGX	P7																										
CIF-FOB adjustment																											
Direct Purchases Abroad																											
Non-resident purchases in the territory																											
Taxes less subsidies																											
Gross Value Added components	D1																										
	D29X39																										
	B2A3G																										
GVA	B1G																										
Total																											

		Intermediate Uses						Final Uses						FIGX	Use	Total
		BE		US		AT		BE		US		AT				
Industry A02	28 EU-MS + US industries	28 EU-MS + US products						28 EU-MS + US final use						FIGX-P6 Exports		Total
	28 EU-MS + US products	U_d						Y_d						X		q
	FIGX-P7 imports	U_m						Y_m								m
	CIF-FOB adj	C_u						C_y								c
	DPA and NRPT							D								d
	TLS	t_u						t_y								t
Value Added	W														w	
Total	g'						y						x			

		Intermediate Uses						Final Uses						FIGX	Use	Total
		BE		US		AT		BE		US		AT				
Transformation matrix	28 EU-MS + US intermediates	28 EU-MS + US products						28 EU-MS + US final use						FIGX-P6 Exports		Total
	FIGX-P7 intermediate imports	S_d						Y_d						X		q
	CIF-FOB adj	S_m						Y_m								m
	TLS	H_u						C_y								c
	Value Added	trt_u						D								d
		E						t_y								t
broad $T = (\hat{g})^{-1} \cdot V$		$S_d = U_d \cdot T$						C_y								c
		$S_m = U_m \cdot T$						D								d
		$H_u = C_u \cdot T$						t_y								t
		$trt_u = top_u \cdot T$														w
		$E = W \cdot T$														

	28 EU-MS + US industries	28 EU-MS + US final use	FIGX-P6 Exports	Total
28 EU-MS + US products	U_d	Y_d	X	q
FIGX-P7 imports	U_m	Y_m		m
CIF-FOB adj	C_u	C_y		c
DPA and NRPT		D		d
TLS	t_u	t_y		t
Value Added	W			w
Total	g'	y	x	

	MODEL D Fixed product sales structure Industry-by-industry Input-Output table
Transformation matrix	$T = V \cdot (\hat{q})^{-1}$
28 EU-MS + US intermediates	$B_d = T \cdot U_d$
28 EU-MS + US final demand	$F_d = T \cdot Y_d$
FIGX-P6 exports	$N = T \cdot X$

	28 EU-MS + US industries	28 EU-MS + US final use	FIGX-P6 Exports	Total
28 EU-MS + US industries	B_d	F_d	N	g
FIGX-P7 imports	U_m	Y_m		m
CIF-FOB adj	C_u	C_y		c
DPA and NRPT		D		d
TLS	t_u	t_y		t
Value Added	W			w
Total	g'	y	x	

An important fact

$$S = \begin{bmatrix} S^{AT} & \mathbf{0} & \dots & \mathbf{0} \\ \mathbf{0} & S^{BE} & & \mathbf{0} \\ \vdots & \vdots & \ddots & \vdots \\ \mathbf{0} & \mathbf{0} & \dots & S^{US} \end{bmatrix} \longrightarrow T = \begin{bmatrix} T^{AT} & \mathbf{0} & \dots & \mathbf{0} \\ \mathbf{0} & T^{BE} & & \mathbf{0} \\ \vdots & \vdots & \ddots & \vdots \\ \mathbf{0} & \mathbf{0} & \dots & T^{US} \end{bmatrix}$$

Product by product *MCIOT* can be obtained using independent national *IOTs* transformations matrices by block columns (by trading partner)

$$MCIOT = MCUSE \times T = \begin{bmatrix} Col_Block^{AT} & Col_Block^{BE} & \dots & Col_Block^{US} \end{bmatrix} \times T = \begin{bmatrix} Col_Block^{AT} \times T^{AT} & Col_Block^{BE} \times T^{BE} & \dots & Col_Block^{US} \times T^{US} \end{bmatrix}$$

Industry by industry *MCIOT* can be obtained using independent national *IOTs* transformations matrices by block rows (by exporting country)

$$MCIOT = T \times MCUSE = T \times \begin{bmatrix} Row_Block^{AT} & Row_Block^{BE} & \dots & Row_Block^{US} \end{bmatrix} = \begin{bmatrix} T^{AT} \times Row_Block^{AT} & T^{BE} \times Row_Block^{BE} & \dots & T^{US} \times Row_Block^{US} \end{bmatrix}$$

3. Using National IOTs in the MCIOT construction

National IOTs advantages

IOTs represent technical-economic relationships

Product-by-product IOTs

Local KAUs in pxp IOTs

Secondary activities reallocation

Inputs associated to 2ry outputs are transferred by columns keeping row sum constant

Also share of GVA and other factors

Industry-by-Industry IOTs

It is analogous but with a transposed view

Inputs associated to secondary outputs are transferred by rows, keeping column sum constant using sales structures

Business surveys

National IOTs are much closer to real technical and economic transactions thanks to fully information availableness and work of NSOs

Product-by-product mutual consistency

Use table	Industries	Final demand	Total
Domestic products	U_d	Y_d	q
Imported products	U_m	Y_m	m
TLS	t_u	t_y	t
Value Added	W		w
Total	g'	y	

pxp I-O table	Products	Final demand	Total
Domestic products	S_d	Y_d	q
Imported products	S_m	Y_m	m
TLS	trt_u	t_y	t
Value Added	E		w
Total	q'	y	

$$U_d \cdot l = S_d \cdot l$$

$$U_m \cdot l = S_m \cdot l$$

$$t_u \cdot l = trt_u \cdot l$$

$$W \cdot l = E \cdot l$$

Industry-by-industry mutual consistency

Use table	Industries	Final demand	Total
Domestic products	U_d	Y_d	q
Imported products	U_m	Y_m	m
TLS	t_u	t_y	t
Value Added	W		w
Total	g'	y	

ixi I-O table	Industries	Final demand	Total
Domestic industries	B_d	F_d	g
Imported industries	B_m	F_m	$m (ind)$
TLS	t_u	t_y	t
Value Added	W		w
Total	g'	y	

$$t \cdot U_d = t \cdot B_d$$

$$t \cdot U_m = t \cdot B_m$$

$$t \cdot F_d = t \cdot Y_d$$

$$t \cdot F_m = t \cdot Y_m$$

Mutual consistency of MCIOT with Nat Use tables

MODEL B Industry technology	Use table	Product-by-product Input-Output table
Transformation matrix	$T_B = (\hat{q})^{-1} \cdot V$	
Domestic intermediate uses block	U_d	$S_d = U_d \cdot T_B$
Imported intermediate uses block	U_m	$S_m = U_m \cdot T_B$
TLS intermediate demand	t_u	$trt_u = t_u \cdot T_B$
TLS final demand	t_y	t_y
Domestic final demand block	Y_d	Y_d
Imported final demand block	Y_m	Y_m
Value Added	W	$E = W \cdot T_B$

$$T_B \cdot \iota = \iota \quad \longrightarrow$$

$$S_d \cdot \iota = U_d \cdot T_B \cdot \iota = U_d \cdot \iota$$

$$S_m \cdot \iota = U_m \cdot T_B \cdot \iota = U_m \cdot \iota$$

$$trt_u \cdot \iota = t_u \cdot T_B \cdot \iota = t_u \cdot \iota$$

$$E \cdot \iota = W \cdot T_B \cdot \iota = W \cdot \iota$$

MODEL D Fixed product sales structure	Use table	Industry-by-industry Input-Output table
Transformation matrix	$T_D = V \cdot (\hat{q})^{-1}$	
Domestic intermediate uses block	U_d	$B_d = T_D \cdot U_d$
Imported intermediate uses block	U_m	$B_m = T_D \cdot U_m$
TLS intermediate demand	t_u	t_u
TLS final demand	t_y	t_y
Domestic final demand block	Y_d	$F_d = T_D \cdot Y_d$
Imported final demand block	Y_m	$F_m = T_D \cdot Y_m$
Value Added	W	W

$$\iota \cdot T_D = \iota \quad \longrightarrow$$

$$\iota \cdot B_d = \iota \cdot T_D \cdot U_d = \iota \cdot U_d$$

$$\iota \cdot B_m = \iota \cdot T_D \cdot U_m = \iota \cdot U_m$$

$$\iota \cdot F_d = \iota \cdot T_D \cdot Y_d = \iota \cdot Y_d$$

$$\iota \cdot F_m = \iota \cdot T_D \cdot Y_m = \iota \cdot Y_m$$

Multicountry pxp IOT (Model B)

		Intermediate Uses				Final Uses																									
		Ctry 1		Ctry 2		...	Ctry n		Ctry 1		Ctry 2		...	Ctry n		Total															
		CPA A01	CPA A02	...	CPA U	CPA A01	CPA A02	...	CPA U	...	CPA A01	CPA A02	...	CPA U	CPA A01	CPA A02	...	CPA U	CPA A01	CPA A02	...	CPA U	CPA A01	CPA A02	...	CPA U	CPA A01	CPA A02	...	CPA U	Total
Ctry 1	CPA A01	$S_{(1,1)} = U_d^1 \cdot T^1$		$S_{(1,2)} = U_m^{1 \rightarrow 2} \cdot T^2$...	$S_{(1,n)} = U_m^{1 \rightarrow n} \cdot T^n$		Y_d^1		$Y_m^{1 \rightarrow 2}$...	$Y_m^{1 \rightarrow n}$																	
	CPA A02																														
	...																														
	CPA U																														
Ctry 2	CPA A01	$S_{(2,1)} = U_m^{2 \rightarrow 1} \cdot T^1$		$S_{(2,2)} = U_d^2 \cdot T^2$...	$S_{(2,n)} = U_m^{2 \rightarrow n} \cdot T^n$		$Y_m^{2 \rightarrow 1}$		Y_d^2		...	$Y_m^{2 \rightarrow n}$																	
	CPA A02																														
	...																														
	CPA U																														
...	
Ctry n	CPA A01	$S_{(n,1)} = U_m^{n \rightarrow 1} \cdot T^1$		$S_{(n,2)} = U_m^{n \rightarrow 2} \cdot T^2$...	$S_{(n,n)} = U_d^n \cdot T^n$		$Y_m^{n \rightarrow 1}$		$Y_m^{n \rightarrow 2}$...	Y_d^n																	
	CPA A02																														
	...																														
	CPA U																														
CIF-FOB adjustment		$H_u^1 = C_u^1 \cdot T^1$		$H_u^2 = C_u^2 \cdot T^2$...	$H_u^n = C_u^n \cdot T^n$		C_y^1		C_y^2		...	C_y^n																	
Direct Purchases Abroad						...			D^1		D^2		...	D^n																	
Non-resident purchases in the territory																							
Taxes less subsidies		$trt_u^1 = t_u^1 \cdot T^1$		$trt_u^2 = t_u^2 \cdot T^2$...	$trt_u^n = t_u^n \cdot T^n$		t_y^1		t_y^2		...	t_y^n																	
Gross Value Added components	D1	$E^1 = W^1 \cdot T^1$		$E^2 = W^2 \cdot T^2$...	$E^n = W^n \cdot T^n$...																		
	D29X39																														
	B2A3G																														
GVA		B1G																							
Total																							

MCIOT excerpt Ctry 1

		Ctry 1				Ctry 2				...	Ctry n				Ctry 1				Ctry 2				...	Ctry n				Total						
		CPA A01	CPA A02	...	CPA U	CPA A01	CPA A02	...	CPA U	...	CPA A01	CPA A02	...	CPA U	P3_S14	P3_S15	...	P5M	P3_S14	P3_S15	...	P5M	...	P3_S14	P3_S15	...	P5M	Total						
Ctry 1	CPA A01	$S_{(1,1)}$				$S_{(1,2)}$				$S_{(1,n)}$				Y_d^1				$Y_m^{1 \rightarrow 2}$				$Y_m^{1 \rightarrow n}$				q								
	CPA A02																																	
	...																																	
	CPA U																																	
Ctry 2	CPA A01	$S_{(2,1)}$				$Y_m^{2 \rightarrow 1}$				$Y_m^{n \rightarrow 1}$				C_y^1				D^1				t_y^1												
	CPA A02																																	
	...																																	
	CPA U																																	
Ctry n	CPA A01	$S_{(n,1)}$				H_u^1				Direct Purchases Abroad				Non-resident purchases in the territory				trt_u^1				E^1				q'								
	CPA A02																																	
	...																																	
	CPA U																																	
CIF-FOB adjustment		H_u^1																																
Direct Purchases Abroad																																		
Non-resident purchases in the territory																																		
Taxes less subsidies		trt_u^1																																
Gross Value Added components	D1	E^1				GVA				GVA				GVA				GVA				GVA				q'								
	D29X39																																	
	B2A3G																																	
	B1G																																	
GVA		$B1G$																																
Total		q'																																

Country 1 pxp IOT

		Intermediate				Final Demand				EXP	Total
		CPA_A01	CPA_A02	...	CPA_U	P3_S14	P3_S15	...	P5M	P6	Total
Domestic uses	CPA_A01	S_{dom}^{***}				Y_{dom}				X	q
	CPA_A02										
	...										
	CPA_U										
Imported Uses	CPA_A01	S_{imp}^{***}				Y_{imp}					
	CPA_A02										
	...										
	CPA_U										
Taxes less subsidies		trt_u^{***}				t_y^{***}					
Gross Value Added components	D1	E^{***}									
	D29X39										
	B2A3G										
	B1G										
GVA		$B1G$									
Total		q'									

$$S_{(1,1)} \neq S_{dom}$$

$$trt_u^1 \neq trt_u^{***}$$

$$E_1 \neq E_1^{***}$$

$$S_{(1,1)} \cdot \iota = S_{dom} \cdot \iota$$

$$trt_u^1 \cdot \iota = trt_u^{***} \cdot \iota$$

$$E^1 \cdot \iota = E^{***} \cdot \iota$$

$$\sum_{i=2}^n S_{(i,1)} \neq S_{imp}$$

$$\sum_{i=2}^n Y_m^{i \rightarrow 1} \neq Y_{imp}$$

$$\left(\sum_{j=2}^n S_{(1,j)} \right) \cdot \iota + \left(\sum_{j=2}^n Y_m^{1 \rightarrow j} \right) \cdot \iota = X$$

$$Y_d^1 = Y_{dom} \quad t_y^1 = t_y^{***}$$

MCIOT Model B with National pieces inserted

		Ctry 1				Ctry 2				Ctry n				Ctry 1				Ctry 2				Ctry n				Total									
		CPA A01	CPA A02	...	CPA U	CPA A01	CPA A02	...	CPA U	CPA A01	CPA A02	...	CPA U	P3_S14	P3_S15	...	P5M	P3_S14	P3_S15	...	P5M	P3_S14	P3_S15	...	P5M										
Ctry 1		CPA A01	CPA A02	...	CPA U	$S_{dom}^{1(Nat)}$				$S_{(1,2)}$				$S_{(1,n)}$				Y_d^1				$Y_m^{1 \rightarrow 2}$				$Y_m^{1 \rightarrow n}$				q^1					
Ctry 2		CPA A01	CPA A02	...	CPA U	$S_{(2,1)}$				$S_{dom}^{2(Nat)}$				$S_{(2,n)}$				$Y_m^{2 \rightarrow 1}$				Y_d^2				$Y_m^{2 \rightarrow n}$				q^1					
...		
Ctry n		CPA A01	CPA A02	...	CPA U	$S_{(n,1)}$				$S_{(n,2)}$				$S_{dom}^{n(Nat)}$				$Y_m^{n \rightarrow 1}$				$Y_m^{n \rightarrow 2}$				Y_d^n				q^1					
CIF-FOB adjustment		H_u^1				H_u^2				H_u^n				C_y^1				C_y^2				C_y^n													
Direct Purchases Abroad														D^1				D^2				D^n													
Non-resident purchases in the territory																																			
Taxes less subsidies		$trt_u^{1(Nat)}$				$trt_u^{2(Nat)}$				$trt_u^{n(Nat)}$				t_y^1				t_y^2				t_y^n													
Gross Value	D1	$E^{1(Nat)}$				$E^{2(Nat)}$				$E^{n(Nat)}$																									
Added components	D29X39																																		
	B2A3G																																		
GVA	B1G																																		
Total		$q^{1'}$				$q^{2'}$				$q^{n'}$																									

MCIOT Model B with National pieces inserted

		Ctry 1				Ctry 2				...	Ctry n				Ctry 1				Ctry 2				...	Ctry n				Total		
		Industry A01	Industry A02	...	Industry U	Industry A01	Industry A02	...	Industry U	...	Industry A01	Industry A02	...	Industry U	P3_S14	P3_S15	...	P5M	P3_S14	P3_S15	...	P5M	...	P3_S14	P3_S15	...	P5M			
Ctry 1	Industry A01	$S_{dom}^1(Nat)$				$S_{(1,2)}$				$S_{(1,3)}$				Y_{dom}^1				$Y_m^{1 \rightarrow 2}$				$Y_m^{1 \rightarrow n}$				q^1	OK			
	Industry A02																													
	...																													
	Industry U																													
Ctry 2	Industry A01	$S_{(2,1)}$				$S_{dom}^2(Nat)$				$S_{(2,3)}$				$Y_m^{2 \rightarrow 1}$				Y_{dom}^2				$Y_m^{2 \rightarrow n}$				q^2	OK			
	Industry A02																													
	...																													
	Industry U																													
...
Ctry n	Industry A01	$S_{(n,1)}$				$S_{(n,2)}$				$S_{dom}^3(Nat)$				$Y_m^{n \rightarrow 1}$				$Y_m^{n \rightarrow 2}$				Y_{dom}^n				q^n	OK			
	Industry A02																													
	...																													
	Industry U																													
CIF-FOB adjustment		H_u^1				H_u^2				H_u^n				C_y^1				C_y^2				C_y^n								
Direct Purchases Abroad														D^1				D^2				D^n								
Non-resident purchases in the territory																														
Taxes less subsidies		$trt_u^1(Nat)$				$trt_u^1(Nat)$				$trt_u^n(Nat)$				t_y^1				t_y^2				t_y^n								
Gross Value Added components	D1	$E^1(Nat)$				$E^2(Nat)$				$E^n(Nat)$																				
	D29X39																													
	B2A3G																													
GVA B1G																														
Total		$q^{1'}$				$q^{2'}$				$q^{n'}$																				



Possible approaches



- Unrestricted global GRAS with additional info
 - Keeping constant what it comes from National IOTs
 - It will modify bilateral BVT
- Country-wise independent 2D-GRAS
 - Keeping constant what it comes from National IOTs
 - Respecting existing row totals (preservation of bilateral BVT)
- Add a third dimension (3D-GRAS) using National aggregated Imported Block from National IOT
 - Asymmetries, re-exports
 - Different valuations

For each trading partner (Country j)

- GRAS balancing by trading partner (vertical blocks of MCIOT)
- Domestic intermediate block, TLS and GVA blocks coming from Nat IOTs are kept constant
 - We set these blocks to 0
 - Recalculation of targets
 - Row targets equal to original row sum
- After balancing, reintegration of Nat IOTs blocks
- Fully consistent result with MCIOT targets and preservation of bilateral BVT

		Ctry j				Target
		CPA A01	CPA A02	...	CPA U	
Ctry 1	CPA A01	0				0
	CPA A02					
	...					
	CPA U					
Ctry 2	CPA A01	S_(2,j)				S_(2,j)'l
	CPA A02					
	...					
	CPA U					
...	
Ctry n	CPA A01	S_(n,j)				S_(n,j)'l
	CPA A02					
	...					
	CPA U					
CIF-FOB adjustment		0				0
Direct Purchases Abroad		0				0
Non-resident purchases in the territory		0				0
Taxes less subsidies		0				0
Gross Value Added components	D1	0				0
	D29X39					
	B2A3G					
GVA	B1G					
Target		q^{j,l} - l'S_{dom}^{j(Nat)} - H_u^j - trt_u^{j(Nat)} - E^{j(Nat)}				

Multicountry ixi IOT (Model D)

		Intermediate Uses												Final Uses														
		Ctry 1				Ctry 2				...	Ctry n				Ctry 1				Ctry 2				...	Ctry n				Total
		Industry A01	Industry A02	...	Industry U	Industry A01	Industry A02	...	Industry U	...	Industry A01	Industry A02	...	Industry U	P3_S14	P3_S15	...	P5M	P3_S14	P3_S15	...	P5M	...	P3_S14	P3_S15	...	P5M	Total
Ctry 1	Industry A01	$B_{(1,1)} = T^1 \cdot U_d^1$				$B_{(1,2)} = T^1 \cdot U_m^{1 \rightarrow 2}$...	$B_{(1,3)} = T^1 \cdot U_m^{1 \rightarrow 3}$				$F_d^1 = T^1 \cdot Y_d^1$				$F_d^2 = T^1 \cdot Y_m^{1 \rightarrow 2}$...	$F_d^n = T^1 \cdot Y_m^{1 \rightarrow n}$				
	Industry A02									...																		
																		
	Industry U									...																		
Ctry 2	Industry A01	$B_{(2,1)} = T^2 \cdot U_m^{2 \rightarrow 1}$				$B_{(2,2)} = T^2 \cdot U_d^2$...	$B_{(2,3)} = T^2 \cdot U_m^{2 \rightarrow 3}$				$F_m^{2 \rightarrow 1} = T^2 \cdot Y_m^{2 \rightarrow 1}$				$F_d^2 = T^2 \cdot Y_d^2$...	$F_m^{2 \rightarrow n} = T^2 \cdot Y_m^{2 \rightarrow n}$				
	Industry A02									...																		
																		
	Industry U									...																		
...
Ctry n	Industry A01	$B_{(n,1)} = T^n \cdot U_m^{n \rightarrow 1}$				$B_{(n,2)} = T^n \cdot U_m^{n \rightarrow 3}$...	$B_{(3,3)} = T^3 \cdot U_d^3$				$F_m^{n \rightarrow 1} = T^n \cdot Y_m^{n \rightarrow 1}$				$F_m^{n \rightarrow 2} = T^n \cdot Y_m^{n \rightarrow 2}$...	$F_d^n = T^n \cdot Y_d^n$				
	Industry A02									...																		
																		
	Industry U									...																		
CIF-FOB adjustment		C_u^1				C_u^2				...	C_u^n				C_y^1				C_y^2				...	C_y^n				
Direct Purchases Abroad Non-resident purchases in the territory										...					D^1				D^2				...	D^n				
Taxes less subsidies		t_u^1				t_u^2				...	t_u^n				t_y^1				t_y^2				...	t_y^n				
Gross Value Added components	D1	W^1				W^2				...	W^n												...					
	D29X39									...																		
	B2A3G									...																		
GVA B1G																		
Total																		

MCIOT Model D with National pieces inserted

		Ctry 1				Ctry 2				...	Ctry n				Ctry 1				Ctry 2				...	Ctry n				Total			
		Industry A01	Industry A02	...	Industry U	Industry A01	Industry A02	...	Industry U	...	Industry A01	Industry A02	...	Industry U	P3_S14	P3_S15	...	P5M	P3_S14	P3_S15	...	P5M	...	P3_S14	P3_S15	...	P5M	Total			
Ctry 1	Industry A01	$B_{dom}^1(Nat)$												$F_{dom}^1(Nat)$				$F_m^{1 \rightarrow 2}$				$F_m^{1 \rightarrow n}$				g^1	✗				
	Industry A02																														
	...																														
	Industry U																														
Ctry 2	Industry A01	$B_{(2,1)}$				$B_{dom}^2(Nat)$												$F_m^{2 \rightarrow 1}$				$F_{dom}^2(Nat)$				$F_m^{2 \rightarrow n}$				g^2	✗
	Industry A02																														
	...																														
	Industry U																														
Ctry n	Industry A01	$B_{(n,1)}$				$B_{dom}^3(Nat)$												$F_m^{n \rightarrow 1}$				$F_m^{n \rightarrow 2}$				$F_{dom}^n(Nat)$				g^n	✗
	Industry A02																														
	...																														
	Industry U																														
CIF-FOB adjustment		C_u^1				C_u^2				...	C_u^n				C_y^1				C_y^2				...	C_y^n							
Direct Purchases Abroad										...					D^1				D^2				...	D^n							
Non-resident purchases in the territory																	
Taxes less subsidies		t_u^1				t_u^2				...	t_u^n				t_y^1				t_y^2				...	t_y^n							
Gross Value Added components	D1	W^1				W^2				...	W^n												...								
	D29X39																														
	B2A3G																														
GVA		B1G																			
Total		$g^{1'}$				$g^{2'}$...	$g^{n'}$...								

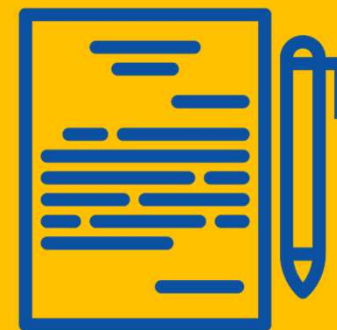
OK OK OK

For each exporting country (Country i)

		Ctry 1				Ctry 2				...	Ctry n				Ctry 1				Ctry 2				...	Ctry n				Target
		Industry A01	Industry A02	...	Industry U	Industry A01	Industry A02	...	Industry U	...	Industry A01	Industry A02	...	Industry U	P3_S14	P3_S15	...	P5M	P3_S14	P3_S15	...	P5M	...	P3_S14	P3_S15	...	P5M	
Ctry i	Industry A01	0				B_(i,2)				...	B_(i,3)				0				F_m^{i-->2}				...	F_m^{i-->n}				g'-B_(i,1)'l-F_dⁱ'l
	Industry A02									...													...
					
	Industry U									...													...
Target		0				l'B_(i,2)				...	l'B_(i,3)				0				l'F_m^{i-->2}				...	l'F_m^{i-->2}				

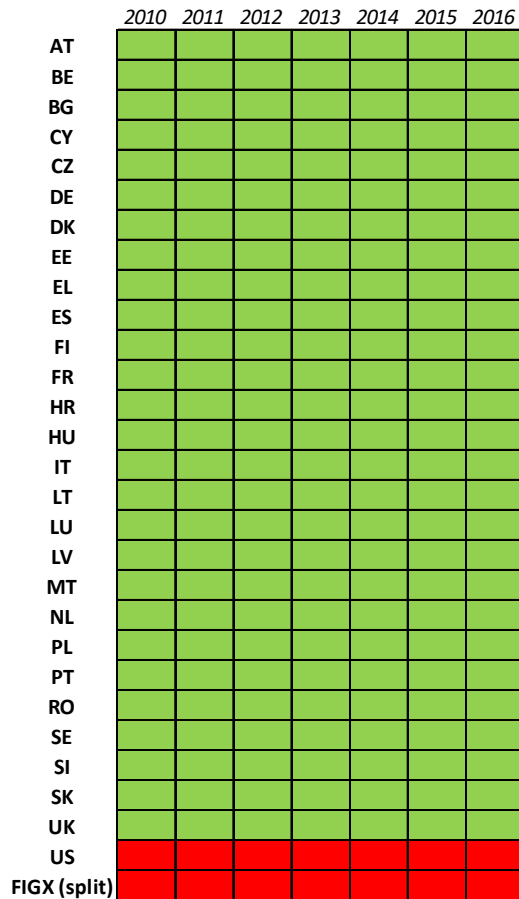
- GRAS balancing by exporting country (horizontal blocks)
- Domestic Intermediate and Final Demand blocks coming from Nat IOTs are kept constant
 - We set these blocks to 0
 - Recalculation of targets
 - Col targets equal to original col sum
- After balancing, reintegration of Nat IOTs blocks
- Fully consistent result with MCIOT targets and preservation of bilateral BVT

4. Implementation of the process in FIGARO Act I (2010-2019)

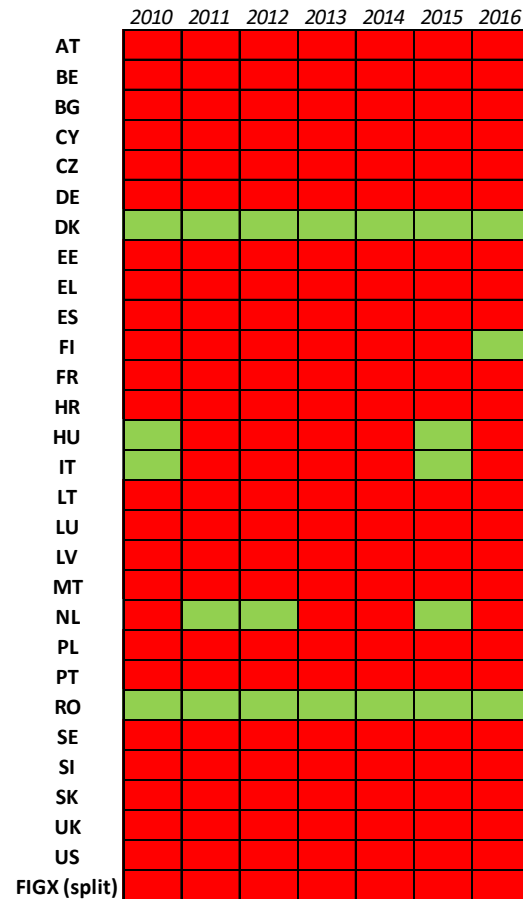


Availability

Product by product IOT Available

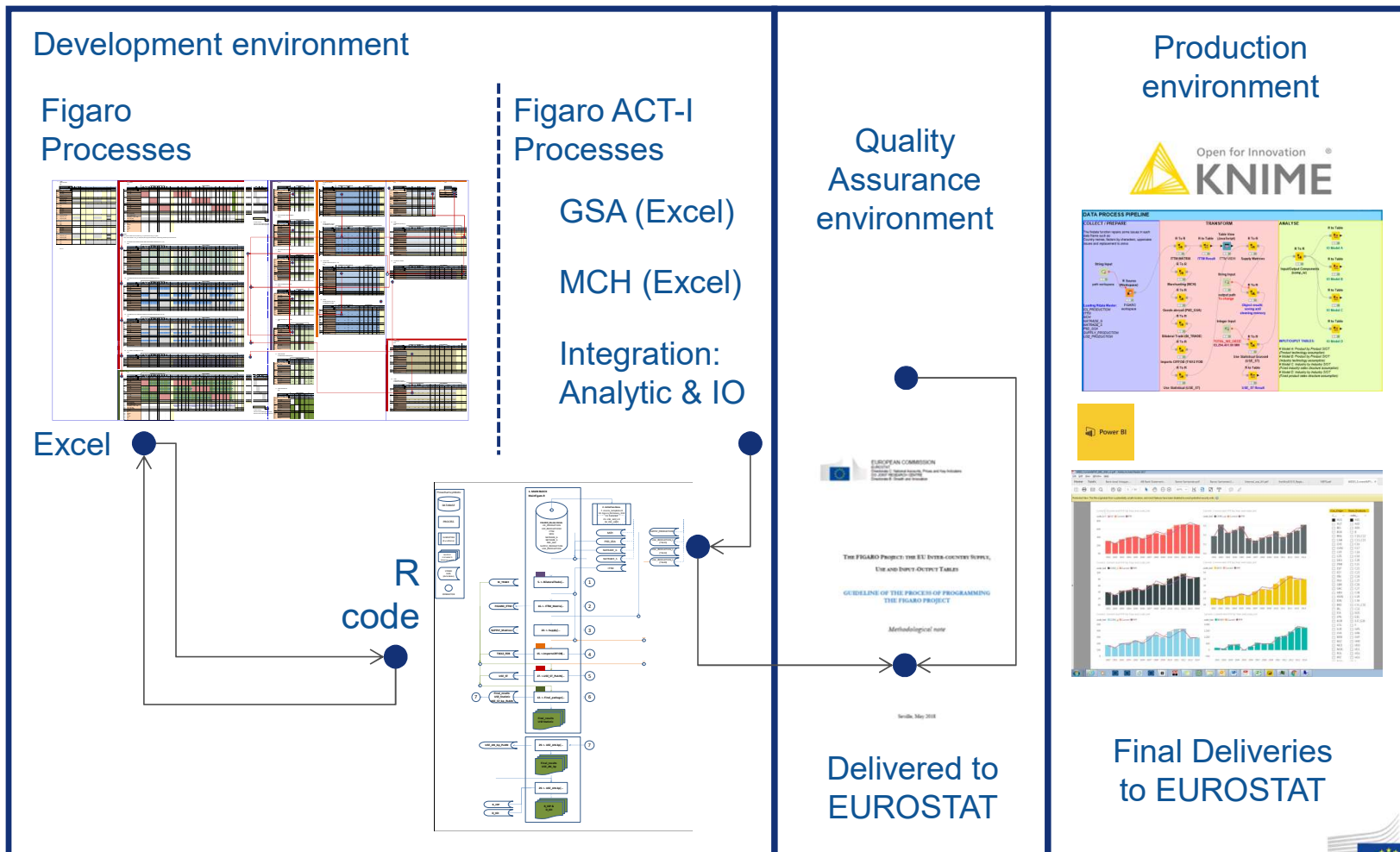


Industry by industry IOT Available

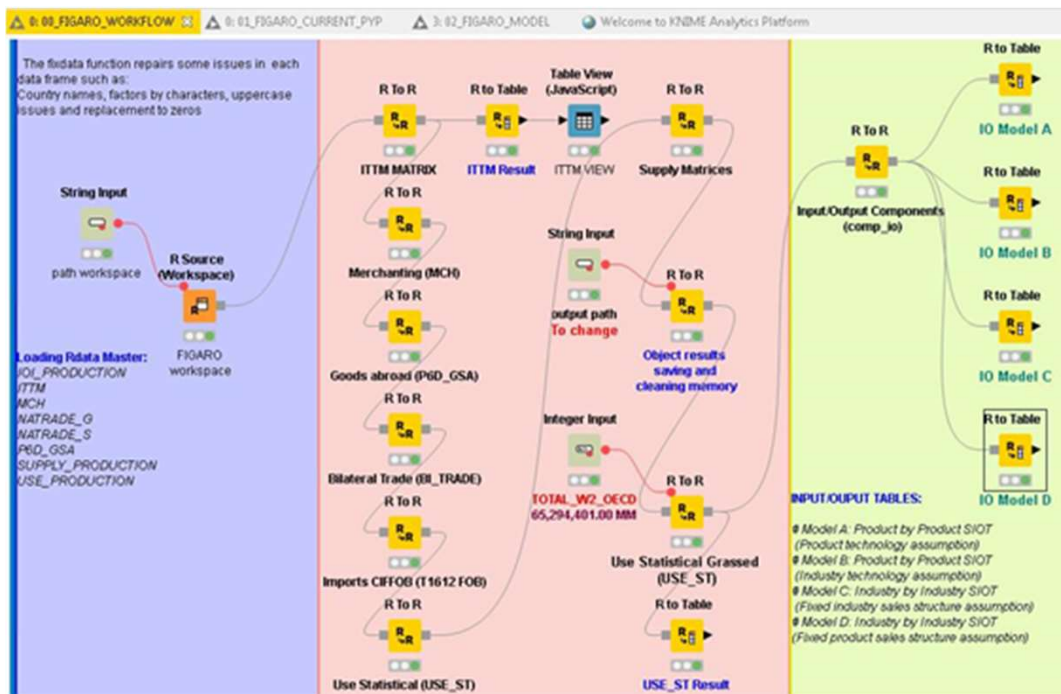


- Yearly process of MCIOT estimation
- Replacement of all suitable National blocks
 - Domestic I.D., TLS for I.D. and GVA in pxx IOT
 - Domestic I.D. and Final demand blocks in ixi IOT
- Exclusion of non-available IOTs of the yearly process
- Non available or confidential, IOT is replaced from MCIOT (model B or D)
- Identity of blocks between National Use table, National IO and MCIOT

IT implementation



IT Implementation



- Fully automatized process
- R language
- Development vs. Production process
- Ensuring continuity and transferability
- Integrated in KNIME platform
- Quality assurance

5. Conclusions

Conclusions

National IOTs very useful

- NSI detailed info.
- More accurate.
- Closer to reality.

Development of a new methodology

- Using properties of methods for construction of IOTs and SUTs.
- Mutual consistency.
- GRAS balancing.
- Result fully consistent and preserving bilateral BVT.

FIGARO 2010

- Model B and Model D MCIOTs.
- Need for further developments.

Implementation in FIGARO

- Insertion of available National IOTs.
- IT implementation.