



C3A Brazil Online model session (1)

Financial Sector Mitigation and Adaptation Tool (FSMAT)

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Financing needs for the low-carbon transition

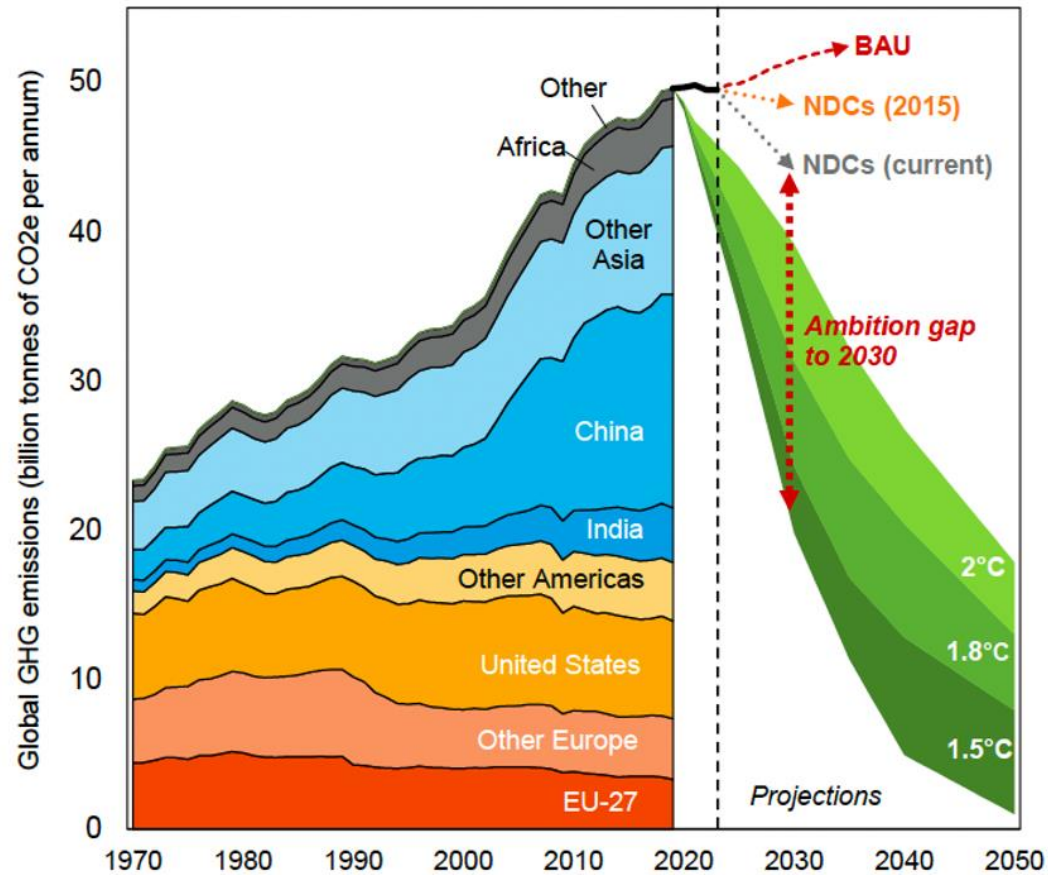
Green Financial Sector Interventions (GFSI)

Modelling pillars of FSMAT

FSMAT Databank

Financing needs for the low-carbon transition

THERE IS STILL A HUGE GAP TO REACH NET ZERO EMISSIONS



Ambition gap: Though countries have increased their mitigation ambition since the signing of the Paris Agreement in 2015, current NDCs would reduce global GHG emissions by just 11%.



Policy gap: In a business-as-usual scenario with no new mitigation policies, global GHG emissions are projected to increase by 4% to 51.5 billion tons in 2030—a rate that would exhaust the carbon budget for 1.5°C by 2035.

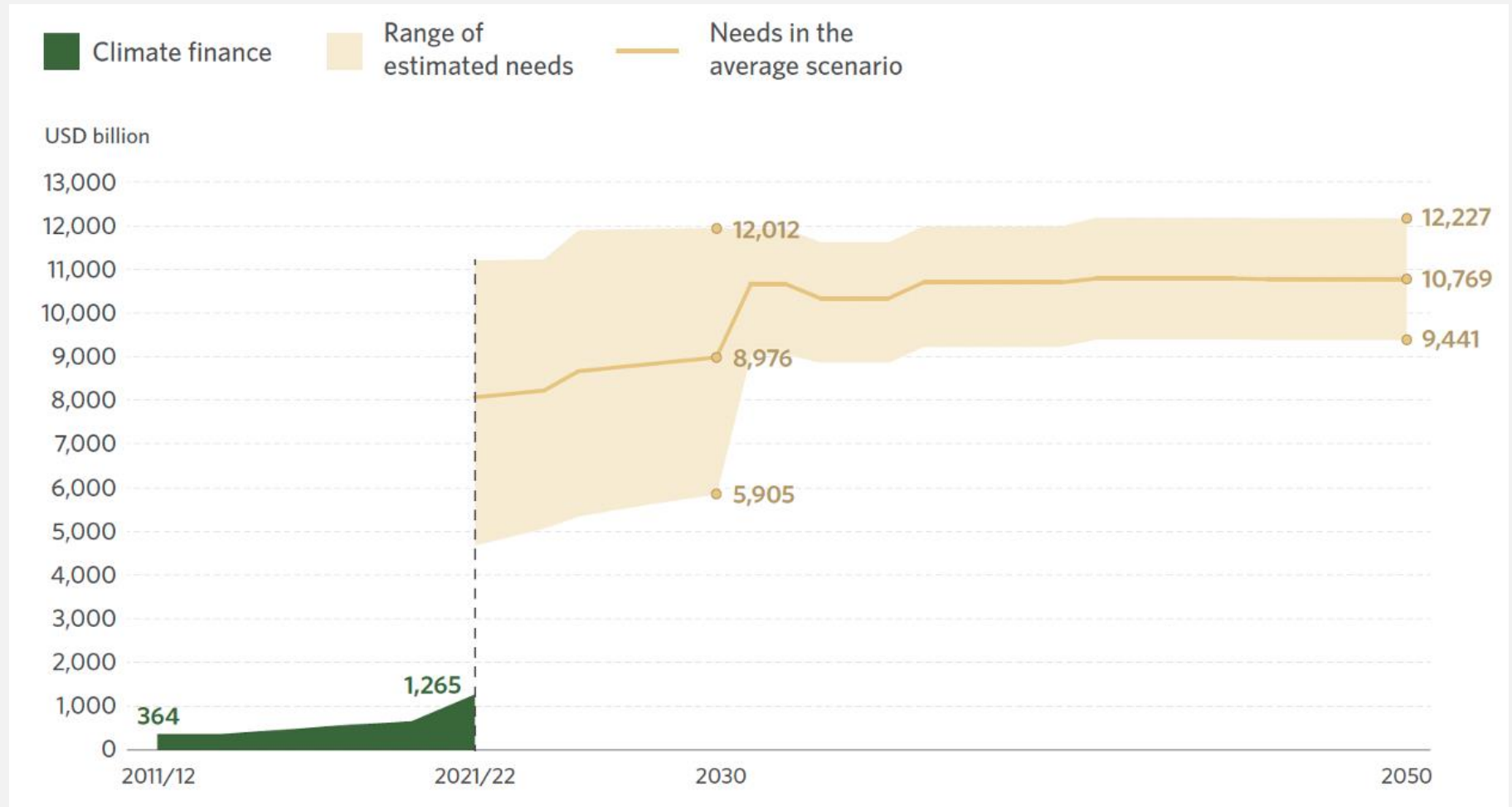
THE URGENT NEED TO RAMP UP CLIMATE FINANCE



Financing gap: despite the recent progress in climate finance, we are still falling short of 6.5 trillion USD yearly to make all the required investments consistent with NZE.



Closing the climate finance gap will involve developing a complete battery of financial sector initiatives.



Source: Climate Policy Initiative (2023). Global Landscape of Climate Finance 2023.

Green Financial Sector Interventions (GFSI)

Some examples of Green Financial Sector Interventions (GFSIs)



Green regulatory policies (GRP)

- Green supporting factor
- Dirty penalizing factor



Green monetary policies (GMP)

- Green collateral framework
- Green QE



Public co-funding of green investments

- Soft loans
- Credit guarantees




Labelling

- Blue and Green Bonds and Loans




Debt for climate/nature swaps

Climate-resilient debt clauses



Ecuador's 'Galapagos Bond' (debt-for-nature swap)

An underwater photograph of a sea turtle swimming in clear blue water. The turtle is the central focus, with its head and front flippers visible. The water is bright and clear, with some ripples on the surface. The background shows the sandy bottom of the ocean.

PBoC's green monetary policies

A photograph of the People's Bank of China (PBoC) building. The building is a large, modern structure with a curved facade and many windows. A flagpole with the Chinese flag is visible in the foreground. The sky is blue and clear.

The low-carbon transition entails challenges for EMDEs



Green investments will bring benefits and costs.

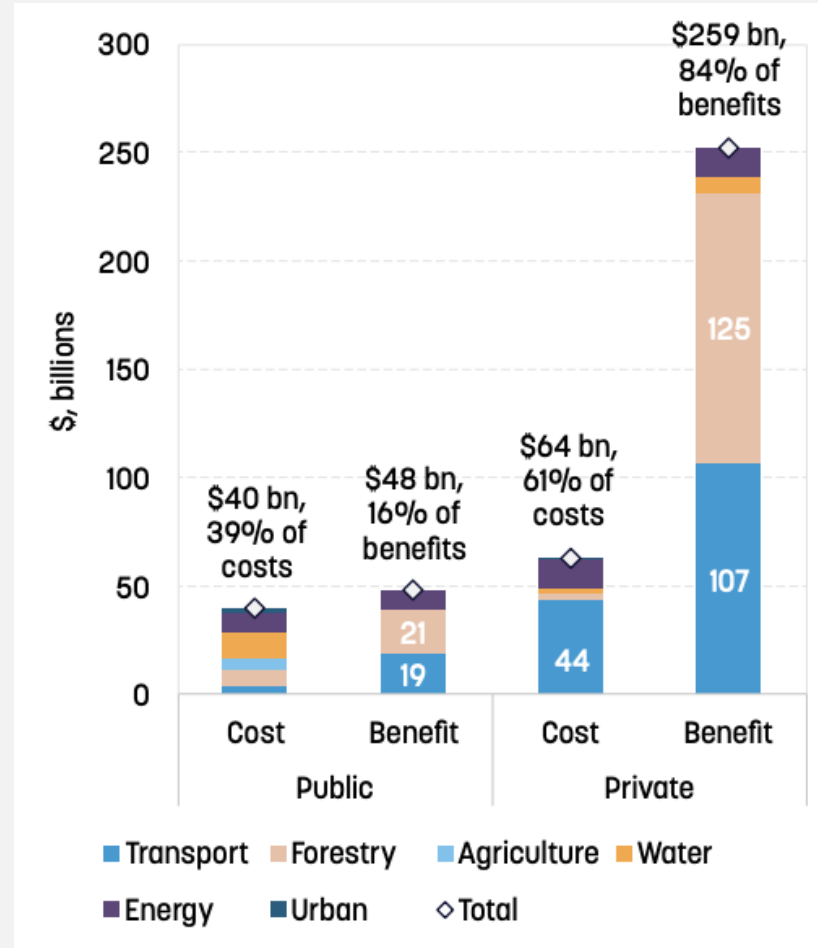


Even when the net benefits are positive, the costs can generate specific vulnerabilities (i.e., an increase in debt).

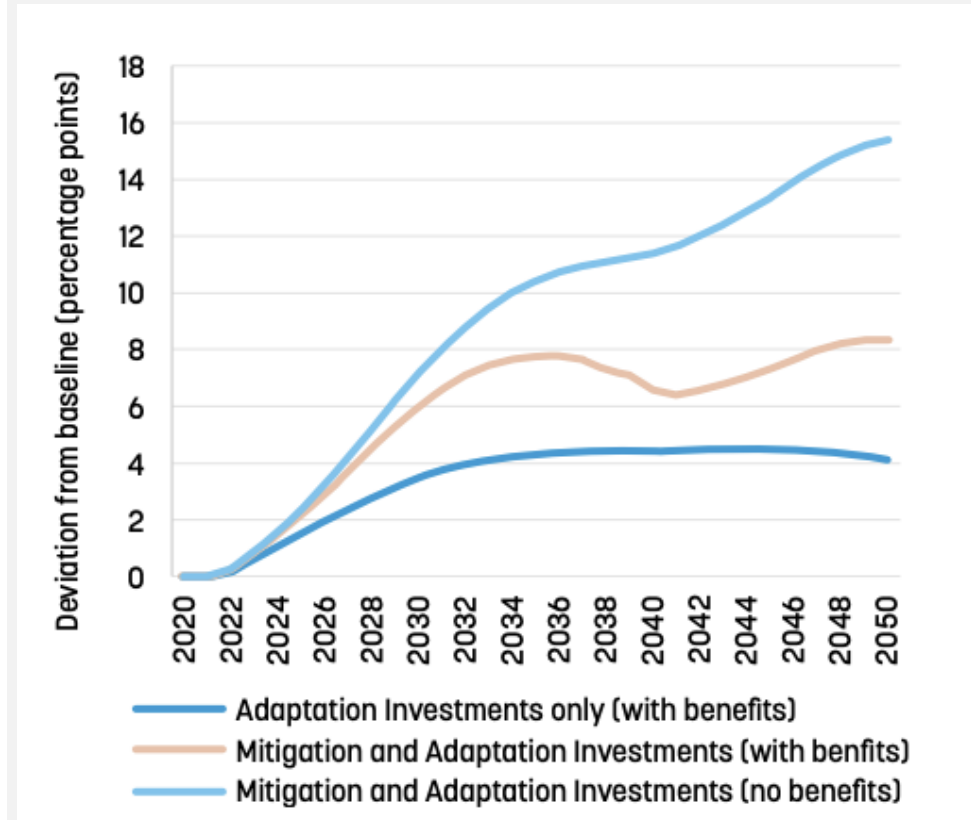


To prevent these vulnerabilities, policy makers could be tempted to delay the transition.

Benefits and costs of the low-carbon transition in Peru



Impact on the Public Debt-to-GDP ratio



Source: "World Bank Group. 2022. Peru Country Climate and Development Report. CCDR Series; World Bank, Washington, DC.

What is FSMAT aiming to?

FSMAT is a tool to evaluate Green Financial Sector Interventions.



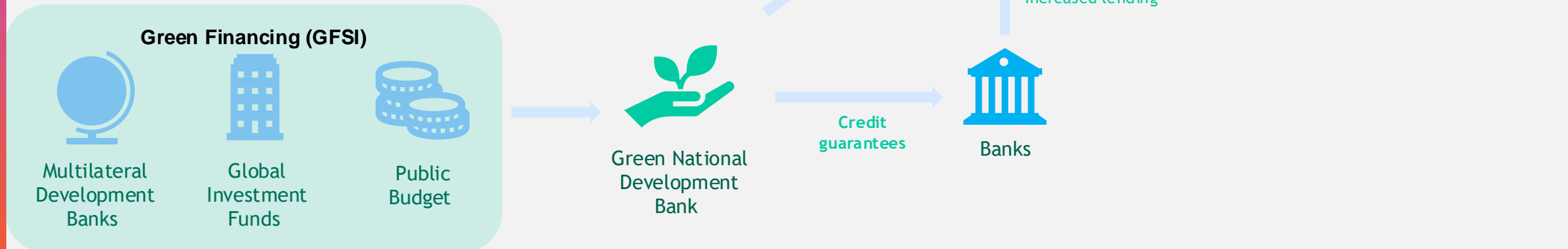
What are the dynamic macro-financial implications of GFSI?



How effective GFSI are to help reduce GHG emissions and cushion the effects of climate-related shocks?

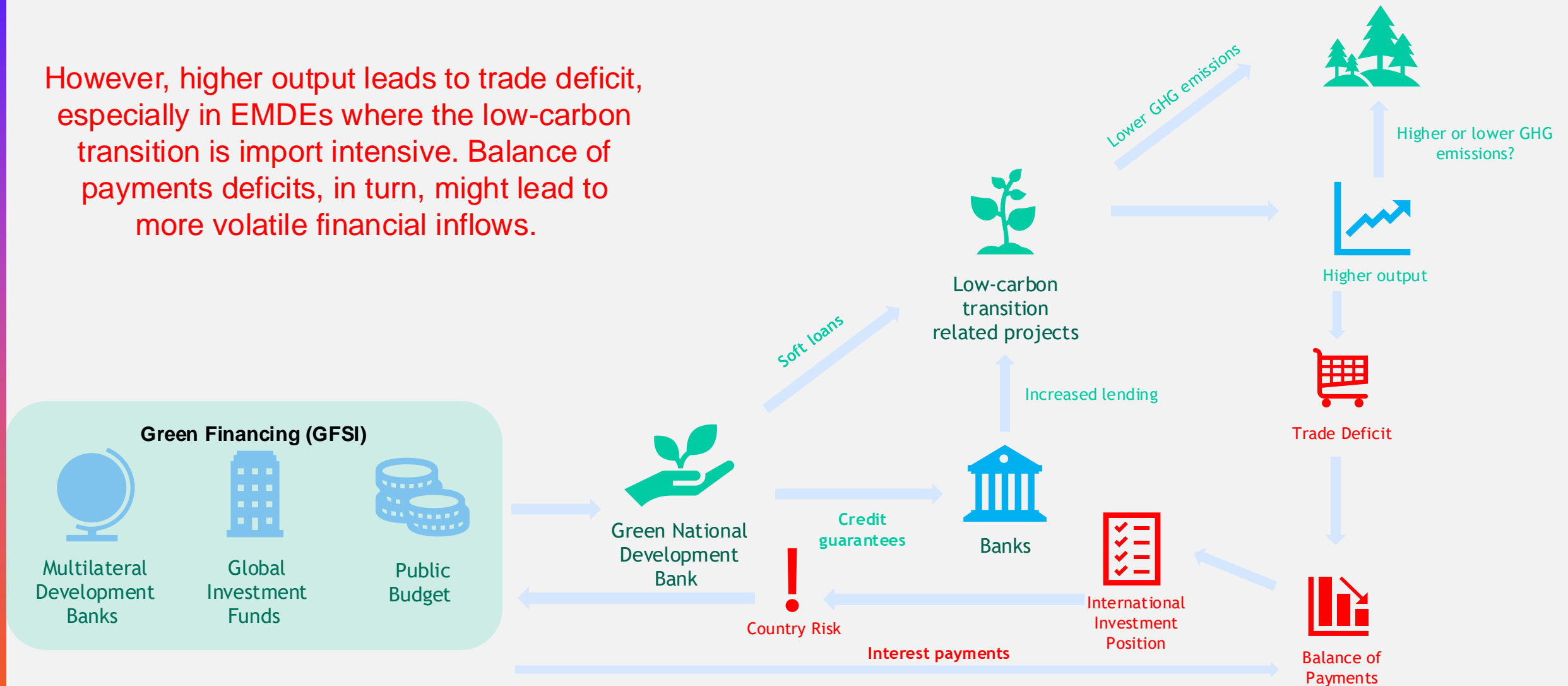
GFSI as enablers of the low-carbon transition

Ex: Promoting green loans through a National Development Bank will foster the low-carbon transition, increase output and create new job opportunities

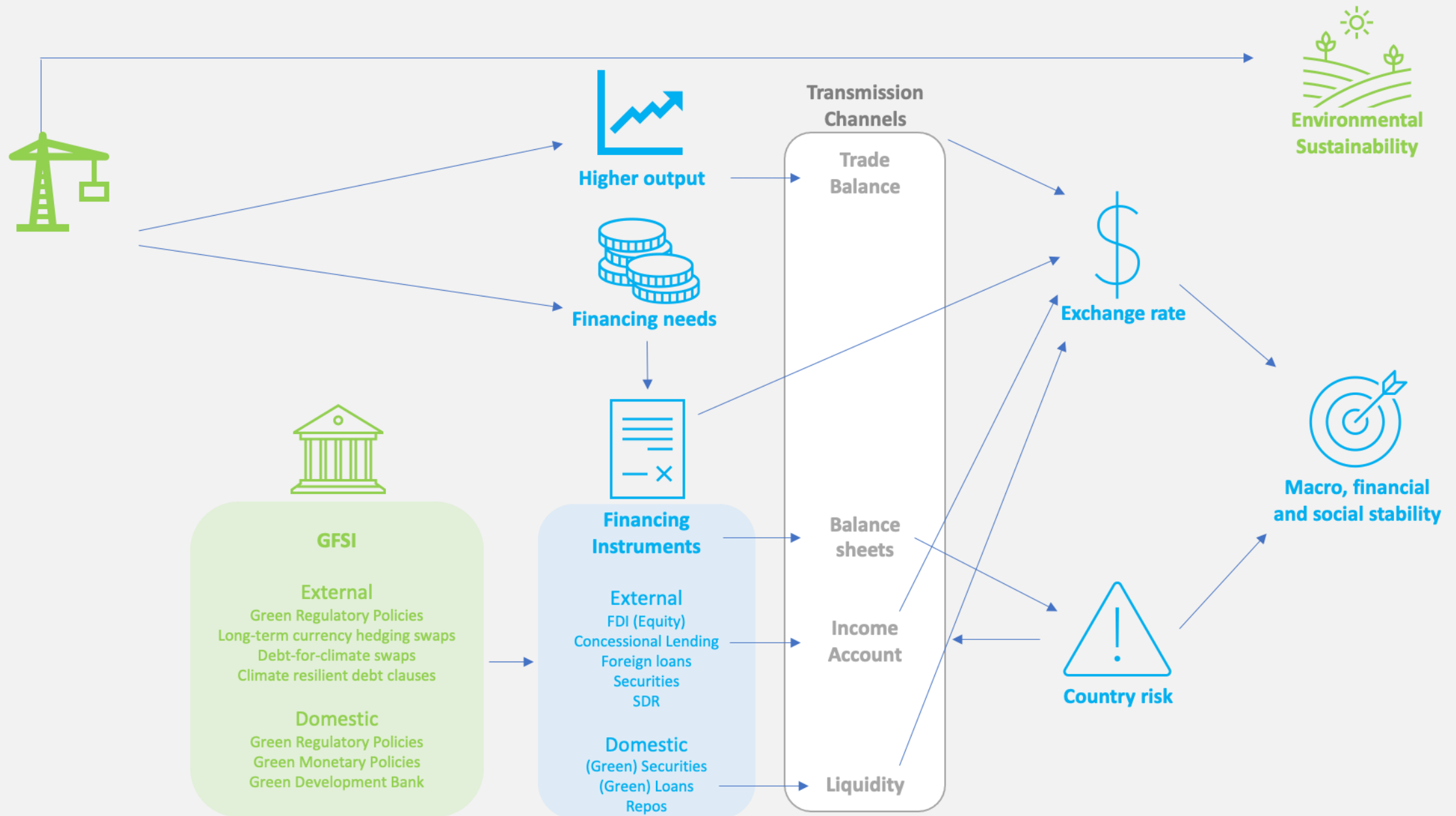


But GFSI can be self-defeating if not adequately designed and implemented

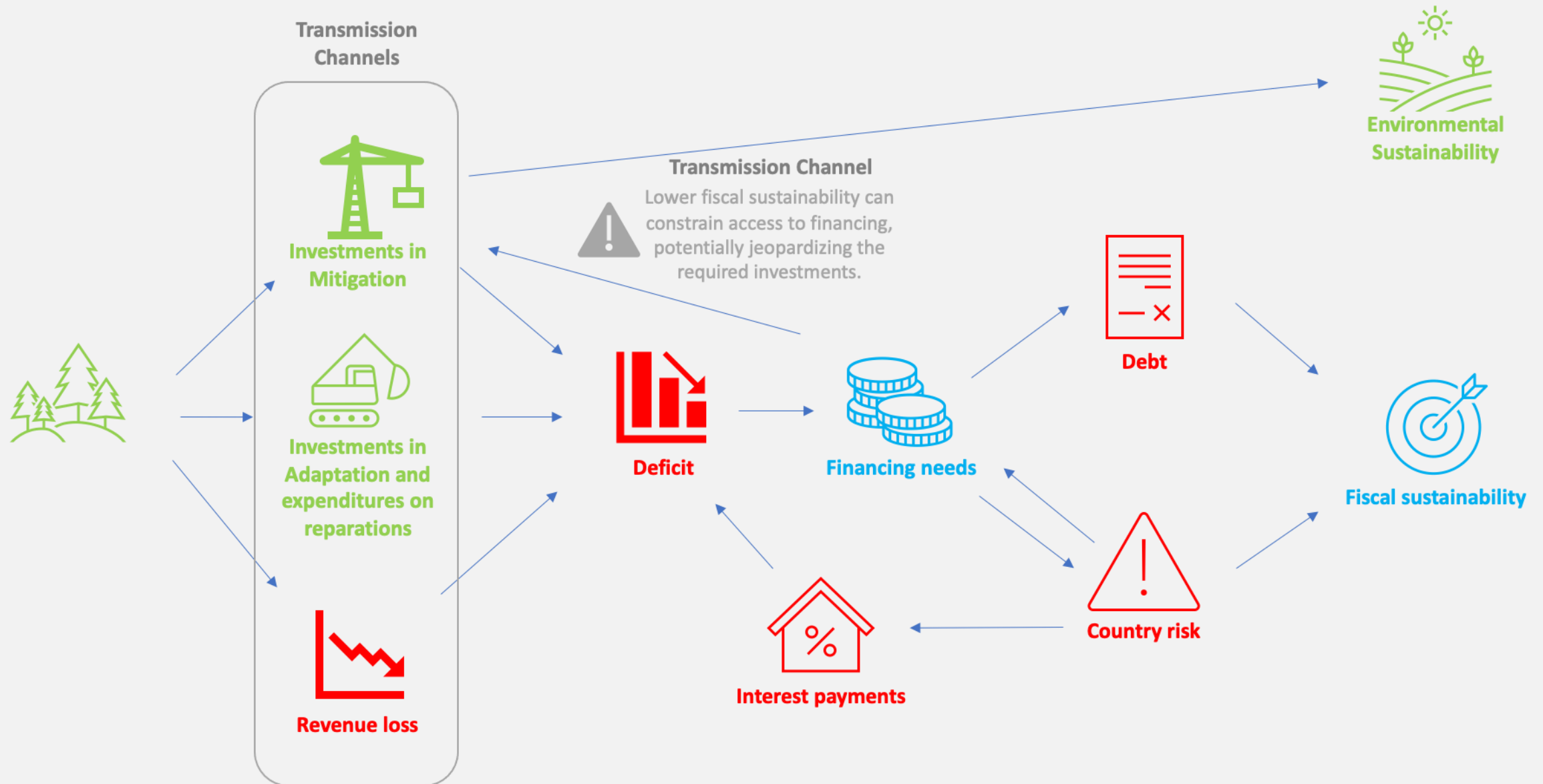
However, higher output leads to trade deficit, especially in EMDEs where the low-carbon transition is import intensive. Balance of payments deficits, in turn, might lead to more volatile financial inflows.



Key vulnerabilities and transmission channels captured by FSMAT



Key vulnerabilities and transmission channels captured by FSMAT (fiscal and debt side)



Modelling Pillars of FSMAT



Modelling pillars of FSMAT

Stock-Flow Consistency

- Flows affect stocks, which dynamically feed back into the flows.
- Quadruple entry bookkeeping
- Fulfilment of budget constraints.

Real and Financial spheres interdependencies

- The monetary and financial spheres are not just a mirror of the real side of the economy.
- The financial sector is autonomous and produces direct effects on the real side.

Disequilibrium approach

- Disequilibria in real and financial markets.
- Simultaneous price and quantity adjustment, but at different speeds.
- Continuous time modeling

Structuralism

- A country's economic structure conditions its macroeconomic performance.
- Need to account for these structural features.
- Alternative closures.

FSMAT builds upon a series of preexisting modeling approaches quickly gaining momentum.

Empirical SFC Models

US, Greece, Denmark, France, Argentina, England, Italy, Vietnam

GEMMES Approach

Tunisia, Morocco, Brazil, Colombia, Vietnam, Mexico, India

FSMT 1

Excel static tool for >100 countries

Model Features



Disequilibrium approach

- Markets, real and financial, simultaneously adjust via price and quantities, but at different speeds.



Full integration of the System of National Accounts

- The whole sequence from generation of income to the financial account are explicitly incorporated in the model's accounting structure.
- This allows for the fulfilment of institutional agents' budget constraints.



Fully empirical models

- Country models are anchored on data, allowing for country-specific structural and institutional parameters, as well as vulnerability measures.
- Dynamic calibration methods (CMA-ES).



Detailed financial sphere

- Broad range of financial instruments (at an aggregate level), representing the complexity of contemporary economies' financial dimension.



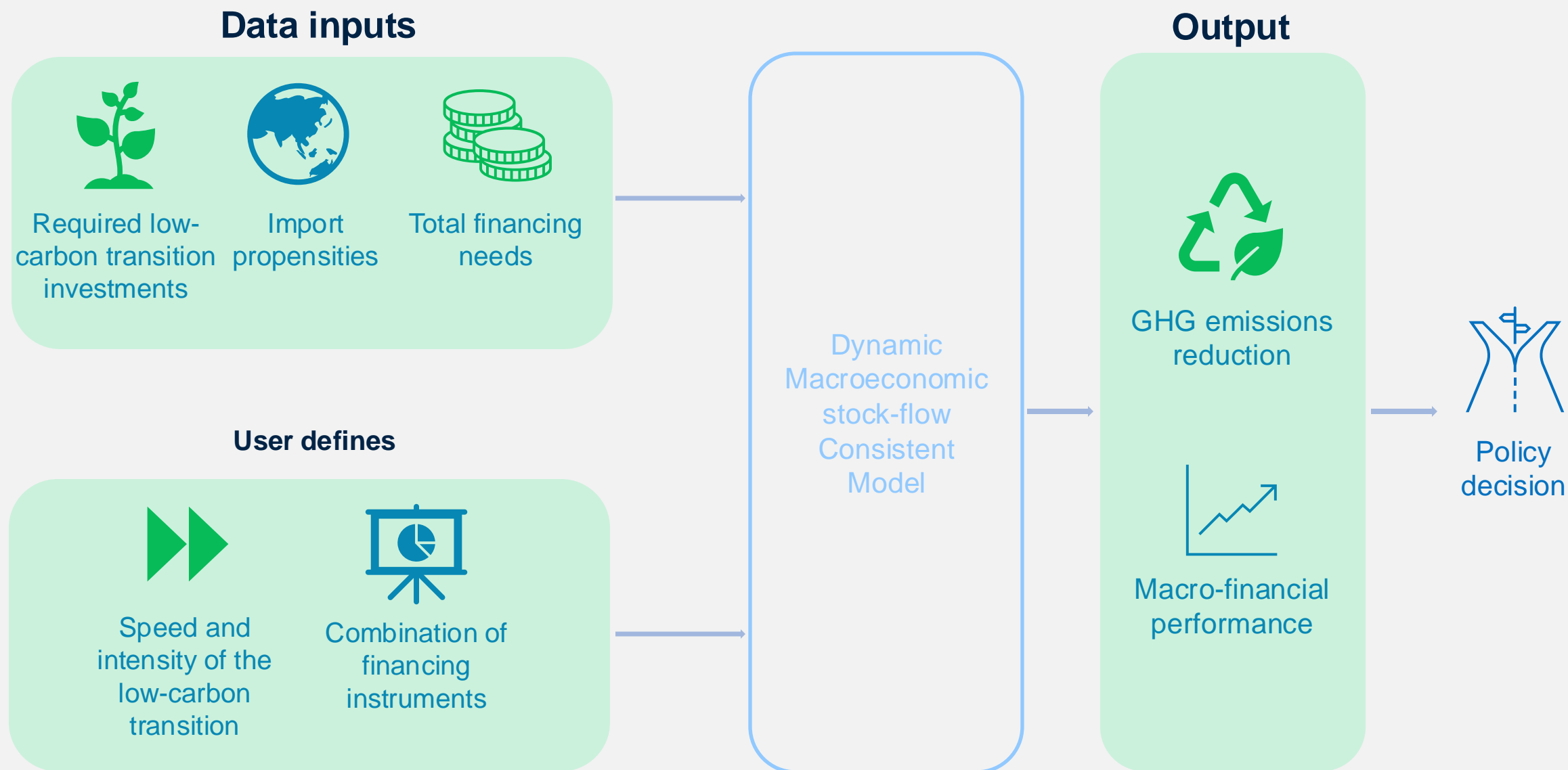
Pragmatic approach to behavioral equation specification

- Prioritize the model's capacity to replicate actual economic dynamics.
- Importance of equations providing accurate descriptions of agents' decision-making processes.



Initially, single-sector economy (with some sectoral flavor in the different blocks)

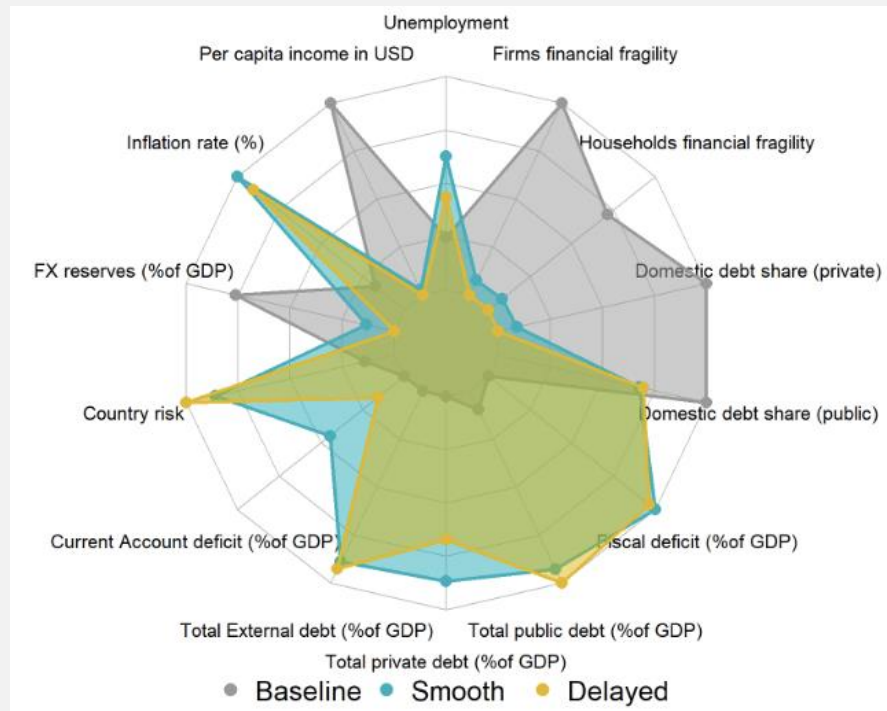
FSMAT – End-user experience



FSMAT - Output

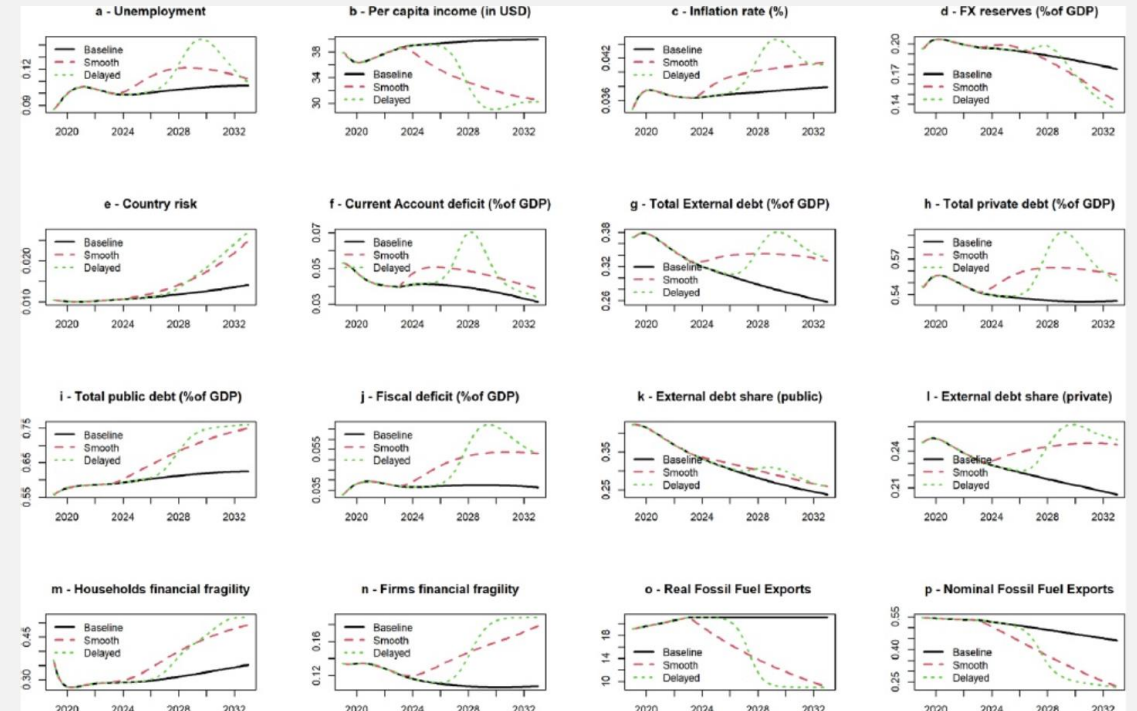
Radar charts

Summarize the impact on all variables for a specific point in time



Line plots

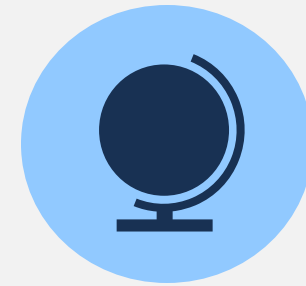
Describe the dynamic trajectory of each variable



Source: Moreno, A., Guevara, D., Andrade, J., Pierros, C., Valdecantos, S., Godin, A. & Yilmaz, D. (2023). Low-carbon Transition and Macroeconomic Vulnerabilities: A Multidimensional Approach in Tracing Vulnerabilities and its Application in the Case of Colombia. *AFD Research Papers*.

Global coverage and stock-flow consistent

(Quasi) global coverage: FSMAT 1.0 will cover around 100 EMDEs



Integrated assessment approach with stock-flow consistency

User friendly: easily usable interface to design, analyze and compare different GFSIs





FSMAT Databank



FSMAT Data Sources

The multidimensional nature of FSMAT requires compiling macroeconomic data from several international databases.

WBG World Development Indicators

- GDP and components
- Price indexes

IMF Government Finance Statistics

- Taxes on income, profits and capital gains

UN Data

- Inst. sector data

ILOSTAT

- Employment
- Income distribution

IMF International Financial Statistics

- Domestic financial assets and liabilities
- Interest rates

IMF Balance of Payments

- External assets and liabilities
- External transactions

IMF Investment and Capital Stock Statistics

- Capital stock by institutional sector

UNCTAD World of Debt Report

- Public debt interest payments

FSMAT data coverage: an in-depth analysis

Variable	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022		
Repos and advances	7	7	7	7	7	7	7	7	7	7	7	139	140	143	143	141	144	145	146	146	147	147	149	153	155	154	153	152	151	150	146	141	133		
FX deposits and cash (banks)	35	37	38	42	46	54	63	67	72	79	82	90	97	101	106	119	123	128	131	133	137	142	144	155	154	152	151	146	142	142	142	97			
Domestic public securities and loans (banks)	11	11	11	12	12	12	12	12	12	12	12	116	156	158	158	161	162	166	167	168	167	170	170	172	176	178	177	175	174	173	172	168	162	135	
Domestic public securities and loans (CB)	11	11	11	11	11	11	11	11	11	11	11	11	156	158	158	161	163	166	167	167	167	170	170	171	174	174	173	174	174	172	169	161	133		
Domestic public securities and loans (HH)	167	168	162	158	150	141	133	130	126	123	120	38	36	35	34	31	30	28	26	25	166	166	160	156	162	169	155	165	159	152	165	181			
External securities and loans (lab, CB)	30	31	32	37	42	50	60	62	67	75	76	83	90	93	98	130	113	117	119	120	127	131	133	141	141	140	141	140	139	137	136	131	90		
External securities and loans (as ets, gov.)	31	32	33	37	41	47	56	58	62	67	69	72	77	79	84	97	100	104	106	106	110	116	117	128	125	123	125	124	123	122	121	119	80		
External securities and loans (lab, gov.)	36	38	39	43	47	56	66	69	75	80	83	91	98	101	106	119	123	127	131	133	137	142	144	155	154	152	154	153	152	150	145	141	96		
Depreciation	173	168	172	175	179	187	187	187	187	188	192	194	195	195	195	195	195	195	196	196	196	197	199	198	199	199	198	197	196	196	198	187	0		
Gov. Deposits	6	6	6	6	6	6	6	6	6	6	6	6	150	152	152	155	156	160	161	162	162	164	166	170	172	171	169	170	170	169	165	159	113		
Government deposits at CB	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	156	158	158	161	163	166	167	167	170	171	174	173	173	174	173	171	168	160	112	
HH Deposits	10	10	10	11	11	11	11	11	11	11	11	11	11	11	11	155	157	157	160	161	165	166	167	166	169	170	171	174	173	172	172	168	162	135	
Investment	136	137	139	140	144	151	152	152	153	153	159	160	160	161	162	163	165	166	167	168	169	169	169	169	169	171	172	171	168	168	166	155	123		
Changes in inventories	134	135	136	138	141	148	154	151	152	153	161	163	164	163	165	167	168	172	171	172	169	166	167	160	162	161	161	162	156	154	150	142	109		
FDI	28	30	31	34	40	47	59	63	70	77	82	90	97	103	108	121	125	131	135	139	143	148	151	162	161	159	161	160	159	155	149	145	92		
FinanciaVA	51	57	72	75	82	100	106	109	114	124	120	121	123	124	125	128	129	130	131	131	131	131	131	131	129	127	127	126	125	114	108	80	0		
Foreign reserves	135	139	143	154	158	164	166	168	167	170	169	169	170	169	169	170	171	172	173	172	171	171	172	173	173	173	172	170	167	164	155	132			
Government spending	137	139	141	145	148	156	155	155	157	157	162	163	163	165	166	167	169	171	171	172	173	172	173	172	174	176	178	177	177	173	172	168	157	124	
FX deposits and cash (gov.)	3	3	5	7	6	9	16	16	17	22	30	32	37	41	46	55	57	58	63	66	72	76	82	96	99	102	105	113	113	110	112	109	80		
GDP	176	177	178	179	181	189	189	190	191	191	197	198	199	199	200	200	200	200	200	201	202	202	202	201	202	202	201	200	200	199	199	196	188		
Gross operating surplus	27	32	39	45	50	72	79	83	90	94	99	103	106	106	109	108	107	110	110	109	106	104	103	102	98	97	92	88	81	65	21	0			
Consumption	136	137	138	143	147	154	153	154	156	156	161	163	163	165	166	167	169	171	171	171	172	173	172	173	175	177	176	176	173	172	168	157	123		
FX deposits and cash (HH)	0	0	0	0	1	3	3	3	4	9	13	15	18	23	26	35	40	41	47	52	63	76	87	104	111	112	112	121	123	123	121	118	80		
Cash	12	12	12	12	12	12	12	12	12	12	12	12	143	145	145	146	146	149	150	150	149	149	149	151	155	155	154	154	152	149	141	108			
Interest rate deposits	76	79	86	89	95	101	105	108	110	111	112	116	119	121	126	136	137	137	138	136	138	136	138	141	139	138	137	130	118	113	109	86			
Interest on deposits (Gov.)	5	4	6	6	6	6	6	6	5	6	6	6	6	6	102	104	105	110	120	123	124	125	123	125	123	128	136	134	132	117	114	110	105	76	
Interest on deposits (HH)	6	5	7	8	8	8	8	7	8	7	7	7	7	7	103	105	107	112	122	125	126	128	126	126	131	138	139	137	135	133	117	115	111	106	77
Interest rate external	22	19	22	28	33	40	48	54	60	65	67	74	81	83	89	100	101	103	106	108	112	117	117	117	125	124	126	128	127	125	119	85			
Interest rate external assets	20	19	24	27	32	36	43	47	52	54	56	61	68	70	75	85	84	85	84	85	89	90	94	99	95	110	105	109	107	104	101	100	97	73	
Interest rate lending	69	73	79	82	86	93	96	101	105	110	114	115	116	121	131	134	133	134	133	134	133	134	133	136	141	138	134	133	132	120	117	112	108	84	
Interest rate monetary policy	44	47	51	51	66	72	73	76	78	81	88	93	106	108	109	110	115	120	124	124	124	125	126	128	128	127	127	122	106	105	101	85	61		
Interest paid on external securities and loans	22	19	21	27	33	40	48	54	59	64	65	72	79	81	86	96	97	100	103	106	110	114	115	123	122	124	126	126	125	125	119	85			
Interest received on external securities and loans	20	19	24	27	32	36	43	47	52	54	56	61	68	70	75	85	84	85	84	85	89	90	94	99	95	110	105	109	107	104	101	100	97	73	
Interest on domestic private securities and loans	8	9	9	9	9	9	9	8	8	9	9	10	10	10	10	10	11	12	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	
Interest on domestic public securities and loans (Banks)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Interest on domestic public securities and loans (CB)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Interest on domestic public securities and loans (HH)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Interest on repos and advances	4	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	
Interest on domestic reserves	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
Interest rate US	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204
Employment private	1	2	1	2	2	3	5	6	6	10	13	19	17	24	23	30	38	38	39	49	53	57	59	61	68	55	61	75	70	82	63	64	37		
Employment private banks	0	1	0	1	1	2	3	5	3	6	11	14	14	20	20	25	33	32	35	43	49	51	54	55	61	55	55	72	68	77	55	59	34		
Employment private firms	0	1	0	1	1	2	3	5	3	6	11	14	14	20	20	25	33	32	35	43	49	51	54	55	61	55	55	72	68	77	55	59	34		
Employment public	1	2	1	2	2	3	5	6	6	10	13	19	17	24	23	30	38	38	39	49	53	57	59	61	68	55	61	75	70	82	63	64	37		
Employment total	1	2	1	2	2	3	5	6	6	10	13	19	17	24	23	30	38	38	39	49	53	57	59	61	68	55	61	75	70	82	63	64	37		
Domestic private securities and loans	12	12	12	12	12	12	12	12	12	12	12	12	156	158	158	161	162	166	167	168	167	170	170	172	176	178	177	175	174	172	168	162	135		
Imports	143	146	148	152	157	166	166	166	167	167	170	171																							



Thank you!

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