Integrated Economic-Environmental Modeling for Evidence-Based Public Policy and Investment Design

ISIM-IEEM Chile Exercises: Infrastructure Investment with Alternative Financing Mechanisms

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  - shocks, macro closure, and rules
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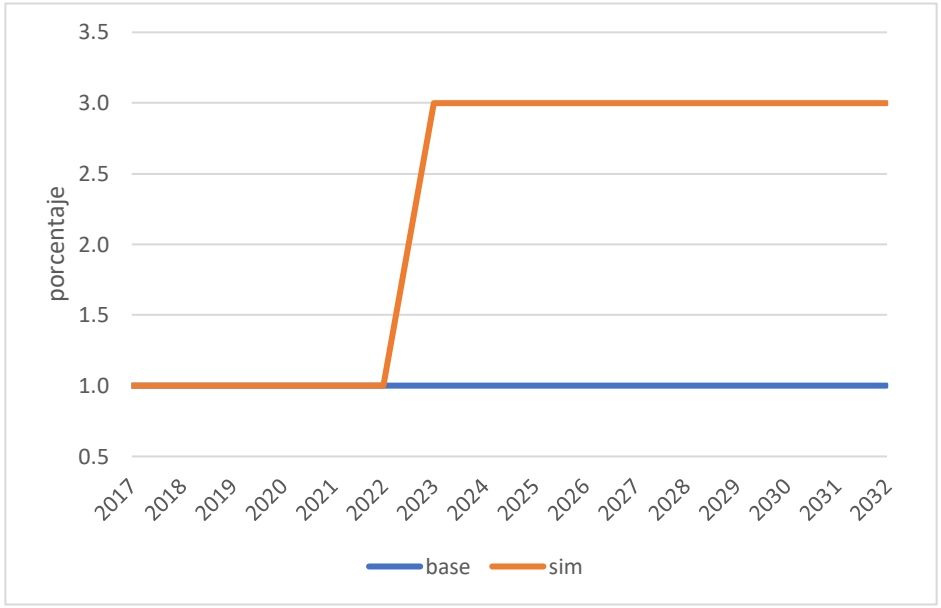
Scenario Definitions: Shocks

- **inf-tdir** = increase government investment; 3 times relative to base during 2023-2030; direct tax financing
- **inf-dbor** = increase government investment; 3 times relative to base during 2023-2030; domestic (borrowing) financing
- **inf-fbor** = increase government investment; 3 times relative to base during 2023-2030; foreign (borrowing) financing

Scenario Definitions: Value for the Marginal Product of Government Infrastructure Capital

- First, assume that marginal product of government infrastructure capital is 0.30 ($100 government investment increase output by $30)
  - go to Sim Parameters | Shocks | Investment | Marginal Product of Capital
  - introduce 0.30 as the value for **mpcapgovsim** for the three scenarios
- Second, assume that all activities benefit equally from government investment
  - go to Sim Parameters | Shocks | Investment | Mapping bt Activities and Capital Stocks
  - introduce 1 for all activities for the three scenarios

Scenario Definitions: Shocks – cont.



Scenario Definitions: Shocks (Sim Parameters | Shocks | Investment | Government Investment)

dkinsbsim(sim,ins2,fcap,t)			real gross fixed capital formation invg and invng for govz and ngovz													
sim	**ins2**	**fcap**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
X inf-tdir	govz	f-capg	1	1	1	1	1	1	1	3	3	3	3	3	3	3	3
X inf-dbor	govz	f-capg	1	1	1	1	1	1	1	3	3	3	3	3	3	3	3
X inf-fbor	govz	f-capg	1	1	1	1	1	1	1	3	3	3	3	3	3	3	3

Scenario Definitions: Factor Markets Closure

- In this case, we keep the assumptions of the base scenario
  - which are they?

Scenario Definitions: Macro Closure
Scenario **inf-tdir**

- Government (**govclossim**) = **direct tax** rate is the clearing variable for the government budget (SURPG = YG – EG – INVVALG).
- Savings-Investment (**siclossim**) = **non-government investment** is the clearing variable (i.e., exog MPS).
- External Sector (BoP) (**rowclossim**) = the real exchange rate adjusts endogenously to balance foreign currency inflows and outflows.

Scenario Definitions: Rules for Government Receipts (**govrecrulesim**)

- trgovrow = real values setup scenario
- trgovngov = real values setup scenario
- netforfingov = real values setup scenario
- netdomfin = real values setup scenario
- ‘tax-act’ = tax rates setup scenario
- ‘tax-imp’ = tax rates setup scenario
- ‘tax-com’ = tax rates setup scenario
- ‘tax-dir’ = endogenous – see govclossim (!)
- Question: do we need to introduce any change?

Scenario Definitions: Rules for Government Spending (**govspndrulesim**)

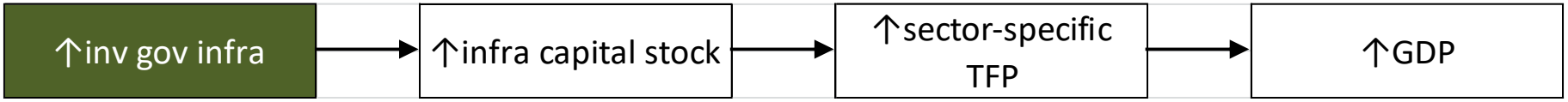
- trngovgov = real values setup scenario
- trrowgov = real values setup scenario
- congov = real values setup scenario
- ‘f-capg’ = real values setup scenario
- Question: do we need to introduce any change?

Scenario Definitions: Rules for Non-Government Payments (**ngovpayrulesim**)

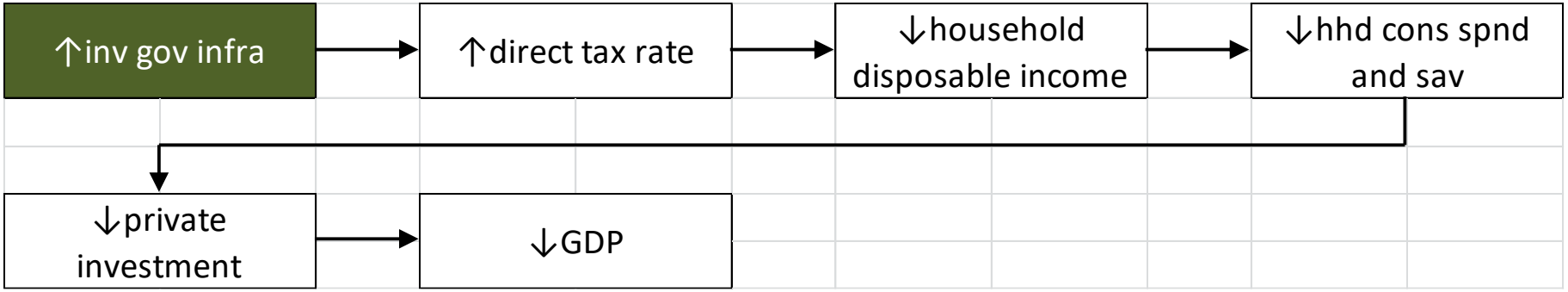
- trngovrow = real values setup scenario
- trrowngov = real values setup scenario
- savngov = real values setup scenario
- trfacrow = real values setup scenario
- trrowfac = real values setup scenario
- netforfinngov = real values setup scenario
- fdi = real values setup scenario
- ‘f-cap’ = endogenous – see siclossim (!)
- Question: do we need to introduce any change?

Transmission Channels inf-tdir

impact due to increase TFP

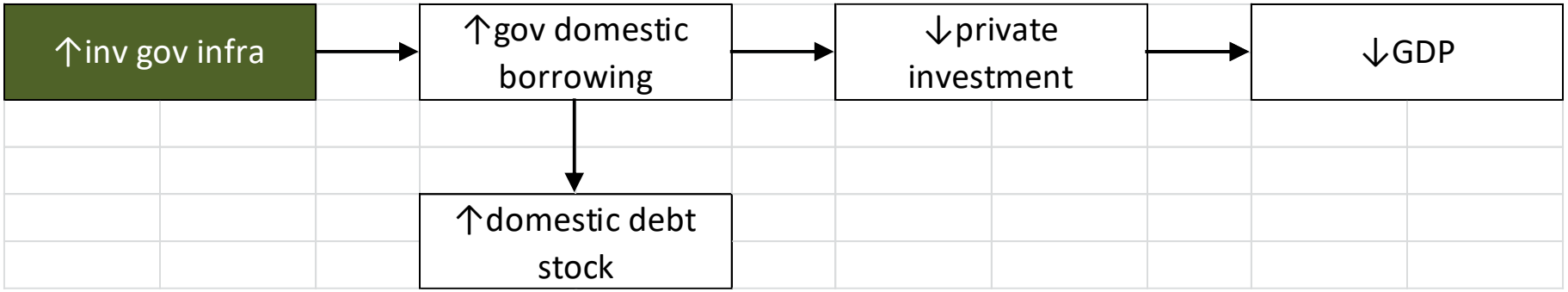


impact due to source of financing; direct tax

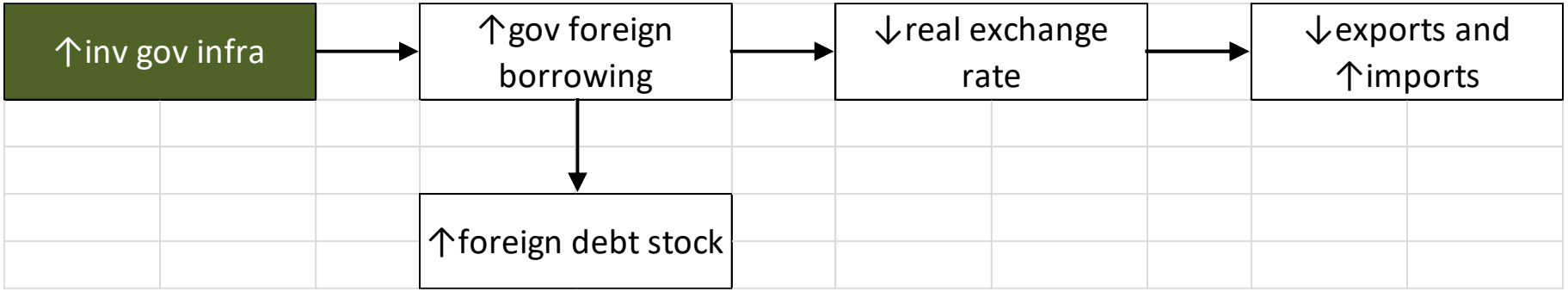


Transmission Channels inf-dbor and inf-fbor

impact due to source of financing; domestic borrowing



impact due to source of financing; foreign borrowing



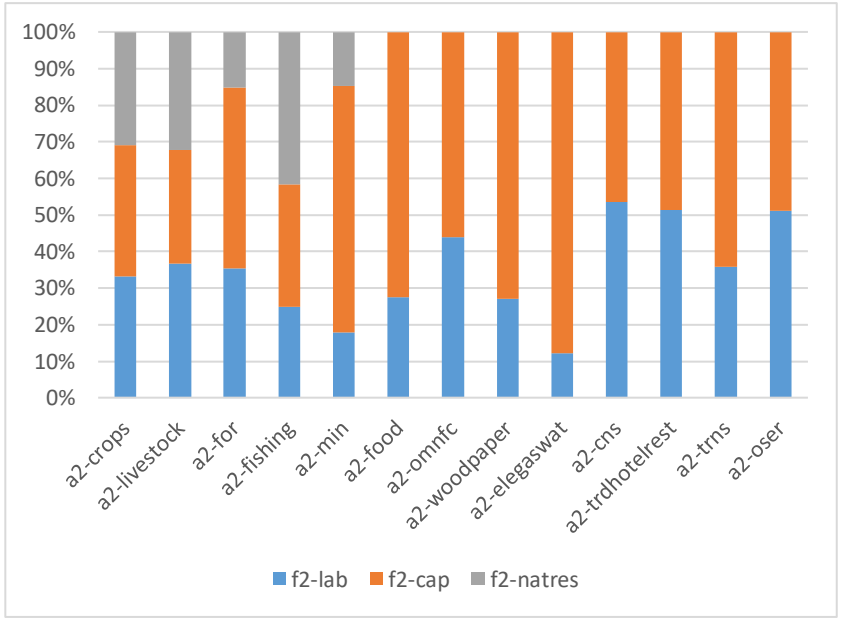
Key Base-Year Data: Government Budget

Item	Nominal miles mill $	GDPshr %
IncCur-DirTax	10487.0	6.19
IncCur-ActTax	1788.2	1.06
IncCur-ComTax	15937.6	9.40
IncCur-ImpTax	695.5	0.41
IncCur-TrnsfrDom	3168.7	1.87
IncCur-FacInc	1984.4	1.17
IncCur-Total	34061.4	20.10
SpndCur-Con	23361.9	13.79
SpndCur-TrnsfrDom	8596.0	5.07
SpndCur-TrnsfrFor	73.8	0.04
SpndCur-Total	32031.7	18.90
GovSav	2029.8	1.20
SpndCap-FixInv	3989.1	2.35
SpndCap-StockChange	-8.3	0.00
GovSurp	-1951.1	-1.15
IncCap-NetDomFin	1455.7	0.86
IncCap-NetForFin	495.3	0.29
Inc-Total	36012.5	21.25
Spnd-Total	36012.5	21.25

Key Base-Year Data: Commodity Composition of Capital Goods

	f-cap	f-capg
c-crops	0.36%	0.36%
c-livestock	0.13%	0.13%
c-for	0.19%	0.19%
c-otrmin	0.94%	0.94%
c-tex	0.03%	0.03%
c-wood	0.03%	0.03%
c-cauchoplast	0.60%	0.60%
c-met	2.10%	2.10%
c-maq	20.04%	20.04%
c-vehic	8.12%	8.12%
c-othmnfc	0.41%	0.41%
c-cns	50.37%	50.37%
c-othsvc	16.67%	16.67%
total	100.00%	100.00%

Key Base-Year Data: Factor Intensity (%) (see c-cns)



Key Equations and Variables: Increased TFP

$$dkins_{gov,f,t} \cdot PK_{f,t} = INVG_t \qquad f \in FCAPG,\ t \in T$$

$$QFINS_{gov,f,t} = QFINS_{gov,f,t-1}\left(1 - depr_{f,t-1}\right) + dkins_{gov,f,t-1} \qquad f \in FCAP,\ t \in T,\ t \notin TMIN$$

$$QA_{a,t} = \varphi_a^{va}\left(\sum_{f \in F} \delta_{f,a}^{va} \cdot QF_{f,a,t}^{-\rho_a^{va}}\right)^{\frac{-1}{\rho_a^{va}}} + \sum_{f \in FCAP} mpk_{a,f,t}\left(\sum_{i \in INS} QFINS_{i,f,t} - \sum_{i \in INS} QFINS_{i,f,t}^{0}\right) \qquad a \in A,\ t \in T$$

$$INVG_t = (YG_t - EG_t) + ndfg_t \cdot \overline{CPI_t} + nff_{gov,t} \cdot EXR_t \qquad t \in T$$

Key Equations and Variables: Increased Final Demand

$$QINV_{c,t} = \sum_{i \in INS} \sum_{f \in FCAP} capcomp_{c,f} \cdot DKINS_{i,f,t} \qquad \begin{matrix} c \in C \\ t \in T \end{matrix}$$

$$QQ_{c,t} = \sum_{h \in H} QH_{c,h,t} + \sum_{a \in A} QINT_{c,a,t} + QINV_{c,t} + QG_{c,t} + QT_{c,t} + \sum_{i \in INSD} qdstk_{c,i,t} \qquad \begin{matrix} c \in C \\ t \in T \end{matrix}$$

Key Equations and Variables: Financing through Direct Taxes (inf-tdir)

$$YG_t \qquad t \in T$$

$$= \sum_{i \in INSDNG} TY_{i,t} \cdot YI_{a,t} + \sum_{f \in F} tf_{f,t} \cdot YF_t + \sum_{a \in A} ta_{a,t} \cdot PA_{a,t} \cdot QA_{a,t}$$

$$+ \sum_{c \in C} tq_{c,t} \cdot PQS_{c,t} \cdot QQ_{c,t} + \sum_{c \in C} tm_{c,t} \cdot EXR_t \cdot pwm_{c,t} \cdot QM_{c,t}$$

$$+ \sum_{c \in C} te_{c,t} \cdot EXR_t \cdot pwe_{c,t} \cdot QE_{c,t} + trnsfr_{gov,row,t} \cdot EXR_t$$

$$+ \sum_{i \in INSDNG} TRII_{gov,i,t} \sum_{f \in F} YIF_{gov,f,t}$$

$$TY_{i,t} = tyb_{i,t} \cdot TYSCAL_t \qquad i \in INSDNG,\ t \in T$$

Key Equations and Variables: Financing through Direct Taxes (inf-tdir) – cont.

$$YI_{i,t} = \sum_{f \in FVA} YIF_{i,f,t} + trnsfr_{i,gov,t} \cdot \overline{CPI_t} + trnsfr_{i,row,t} \cdot EXR_t + \sum_{i' \in INSDNG} TRII_{i,i',t} \qquad i \in INSDNG,\ t \in T$$

$$MPS_{i,t} = mpsb_{i,t} \cdot \overline{MPSSCAL_t} \qquad i \in INSDNG,\ t \in T$$

$$SAV_{i,t} = MPS_{i,t}\left(1 - TY_{i,t}\right)YI_{i,t} \qquad i \in INSDNG,\ t \in T$$

Key Equations and Variables: Financing through Direct Taxes (inf-tdir) – cont.

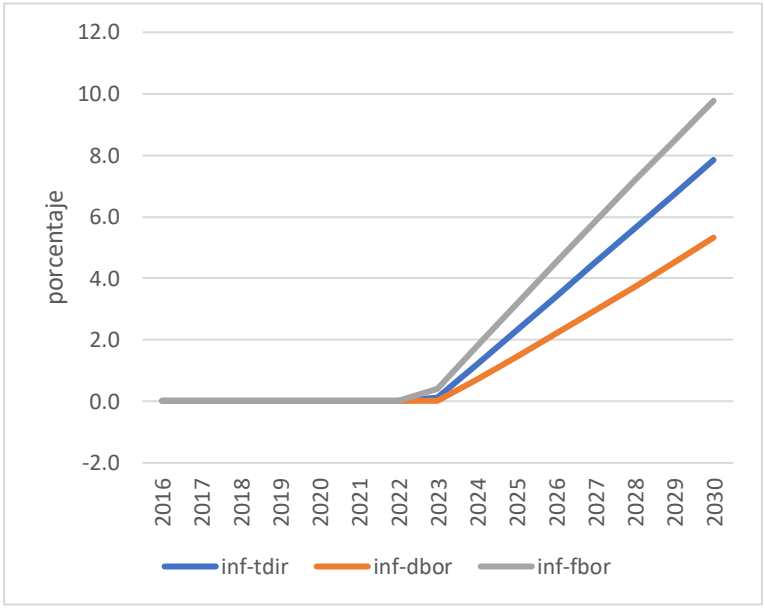
$$EH_{h,t} = \left(1 - TY_{h,t}\right) YI_{h,t} - SAV_{h,t} - \sum_{i \in INS} TRII_{i,h,t} \qquad \begin{matrix} h \in H \\ t \in T \end{matrix}$$

$$QH_{c,h,t} = pop_{h,t} \left[\gamma_{c,h}^{min} + \frac{\beta_{c,h}}{PQ_{c,t}} \left(\frac{EH_{h,t}}{pop_{h,t}} - \sum_{c' \in C} PQ_{c',t} \cdot \gamma_{c',h}^{min} \right) \right] \qquad \begin{matrix} c \in C \\ h \in H \\ t \in T \end{matrix}$$

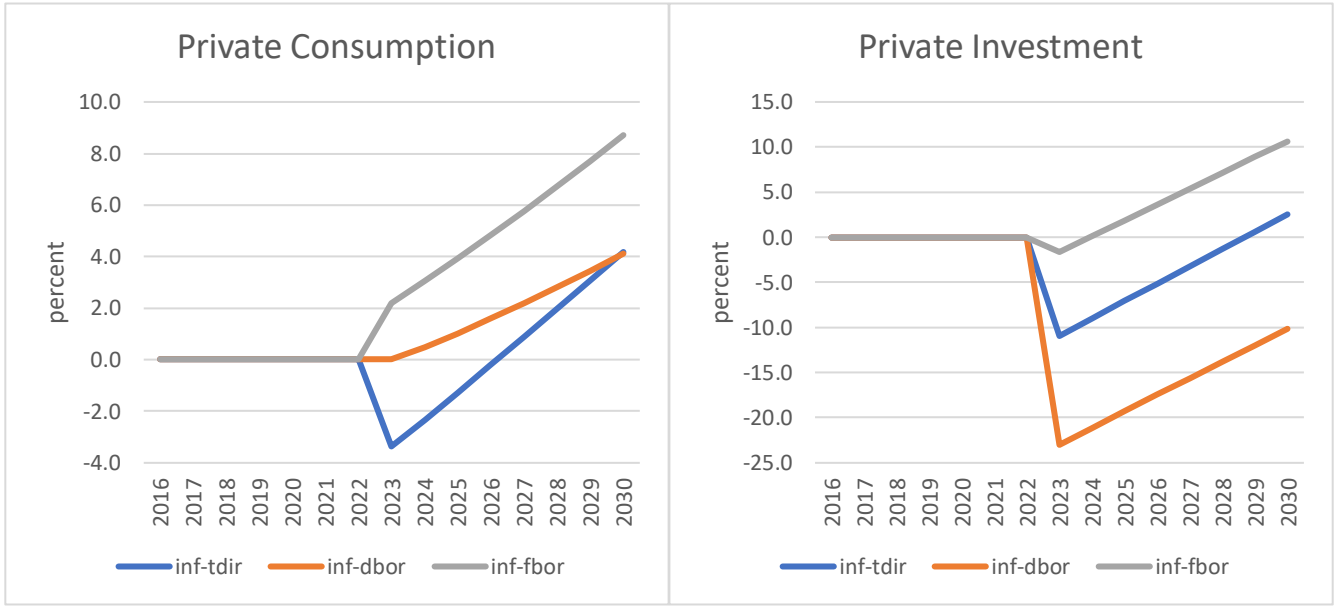
Key Equations and Variables: Financing through domestic borrowing (inf-dbor) and foreign borrowing (inf-fbor)

- Question: What are the relevant equations and variables for these two sources of financing?

GDP at FC (% level deviation from base)



Real Private Consumption and Investment (% level deviation from base)



Macro Results; average growth rate 2023-2030 (%)

	baseyr	base	inf-tdir	inf-dbor	inf-fbor
Absorption	167,937	1.83	2.79	2.48	3.32
PrvCon	107,067	1.84	2.36	2.35	2.91
GovCon	23,362	1.88	1.88	1.88	1.88
FixInv	38,208	1.77	4.43	3.17	5.18
PrvFixInv	34,262	1.77	2.09	0.41	3.06
GovFixInv	3,946	1.77	16.75	16.75	16.75
StockChange	-700	1.88	1.88	1.88	1.88
Exports	46,024	1.74	2.92	2.54	2.58
Imports	45,306	1.60	2.80	2.37	3.49
GDPMP	168,655	1.86	2.82	2.52	3.08
NetIndTax	18,716	1.58	2.57	2.27	2.98
GDPFC	151,048	1.88	2.85	2.55	3.08
REXR	1.00	0.66	0.75	0.77	0.23
Wage	1.00	1.23	2.04	1.62	2.43
CapRet	1.00	1.00	2.36	2.61	2.15
UnempRat	6.51	5.98	5.58	5.77	5.41

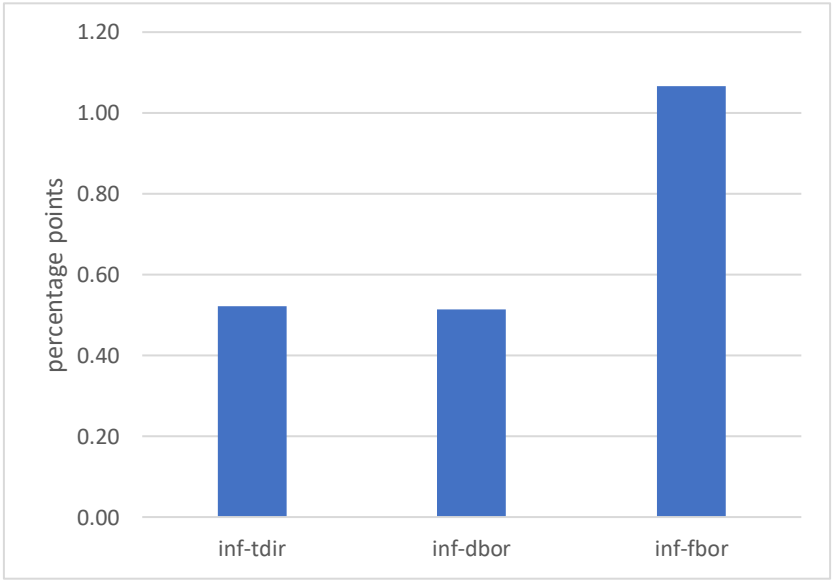
Sectoral VA; average growth rate 2023-2030 (%)

	baseyr	base	inf-tdir	inf-dbor	inf-fbor
c-crops	4868.5	2.05	3.14	2.85	2.99
c-livestock	8297	1.03	2.45	2.04	2.24
c-for	564.1	1.99	3.06	2.61	3.05
c-fishing	820.5	1.11	2.27	2.05	2.19
c-copper	11131.1	0.96	2.08	1.63	2.06
c-otrmin	1846.5	1.17	2.28	1.81	2.23
c-food	6166.3	1.26	2.41	2.18	2.36
c-tex	286.6	3.36	4.28	4.28	3.81
c-wood	879.9	2.13	3.44	2.85	3.25
c-paper	1351.2	2.05	2.98	2.65	2.84
c-prodpet	567.8	1.72	2.55	2.25	2.85
c-chem	1761.1	2.19	3.13	2.84	2.99
c-cauchoplast	534.2	2.52	3.73	3.38	3.61
c-prodminnmet	553.0	1.93	3.77	2.97	4.18
c-met	1227.4	2.48	3.96	3.39	3.97
c-maq	731.4	2.69	3.93	3.50	3.86
c-vehic	171.0	3.83	4.90	4.69	4.38
c-othmnfc	859.2	2.32	3.04	2.89	3.20
c-ele	3703.5	1.43	2.35	2.01	2.63
c-gas	284.7	1.53	2.41	2.10	2.74
c-wat	712.0	1.44	2.25	2.00	2.63
c-cns	11154.0	1.80	4.16	3.06	4.84
c-trd	14363.1	1.91	2.96	2.67	3.24
c-hotelrest	3817.9	2.11	2.70	2.64	3.08
c-trns	9103.6	1.89	2.75	2.53	2.97
c-admpub	7586.4	1.90	1.92	1.92	1.93
c-eduhealth	15568.5	2.35	2.72	2.79	2.90
c-othsvc	50405.1	1.96	2.87	2.59	3.18
total	151048.2	1.88	2.85	2.55	3.08

Real Wages (rents) by Factor (% level deviation from base in 2030)

	inf-tdir	inf-dbor	inf-fbor
f-lab	6.53	3.13	9.86
f-cap	11.25	13.43	9.48
f-land-crops	8.41	-0.53	-2.67
f-land-livestock	-0.15	-9.57	-1.35
f-land-for	9.01	-2.36	9.29
f-fish	4.30	-3.13	2.02
f-nrcopper	6.99	-5.98	4.76
f-nrothmin	7.00	-5.72	4.42

Consumption Per Capita (average growth rate 2023-2030 pp deviation from base)



Government Budget (GDP % in 2030)

	baseyr	base	inf-tdir	inf-dbor	inf-fbor
IncCur-DirTax	6.40	4.53	7.45	4.54	4.50
IncCur-ActTax	1.06	1.06	1.08	1.07	1.08
IncCur-ComTax	9.40	9.40	9.37	9.44	9.45
IncCur-ImpTax	0.41	0.41	0.41	0.42	0.41
IncCur-TrnsfrDom	1.86	1.90	1.83	1.88	1.87
IncCur-FacInc	1.16	1.23	1.24	1.24	1.23
IncCur-Total	20.29	18.54	21.38	18.60	18.54
SpndCur-Con	13.97	11.88	10.74	10.93	10.66
SpndCur-TrnsfrDom	5.07	5.07	4.67	4.81	4.57
SpndCur-TrnsfrFor	0.04	0.04	0.04	0.04	0.04
SpndCur-Total	19.09	17.00	15.45	15.79	15.27
GovSav	1.20	1.54	5.94	2.81	3.27
SpndCap-FixInv	2.35	2.35	6.69	6.78	6.55
SpndCap-StockChange	0.00	-0.01	0.00	0.00	0.00
GovSurp	-1.15	-0.81	-0.75	-3.96	-3.27
IncCap-NetDomFin	0.86	0.60	0.55	3.77	0.54
IncCap-NetForFin	0.29	0.21	0.19	0.20	2.73
Inc-Total	21.44	19.34	22.13	22.56	21.81
Spnd-Total	21.44	19.34	22.13	22.56	21.81