Australian Government
The Treasury

TSY/AU

Treasury Industry Model (TIM)

Sebastian Wende

Macroeconomic Modelling and Policy Division

Macroeconomic Group, Australian Treasury

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Context

- Treasury's purpose is

  "to support and implement informed decisions on policies for the good of the Australian people, consistent with achieving strong sustainable economic growth and fiscal settings"

Context

- The production side of economy is complex
- Treasury’s objectives imply we should be able to provide advice on policy where production complexity needs to be considered.
- Treasury needs to harness approaches consistent with mainstream macroeconomic theory.

TIM project

- We are developing and using a multisector dynamic general equilibrium model, called the Treasury Industry Model (TIM).
- TIM will provide insight into the effects of industry policy on:
  - Economic activity, government budget, welfare
  - Short, medium and long-run effects of policy

Approach

- Part of a fit-for purpose broader model development programme
  - TIM (representative agent model of the Australian economy for industry policy analysis) – January 2018
  - OLGA (overlapping generations model of the Australian economy for fiscal policy analysis) – April 2016
- Ongoing development through modules
  - Today we will present Version 1.0
- Ongoing consultation
- Sustainable staff capability

TIM Overview

- Based on mainstream macroeconomic theory (neoclassical growth model)
- A multi (114) sector dynamic general equilibrium model

TIM Overview (cont.)

- Households
  - One utility-maximising infinitely-lived representative household.
  - Makes forward looking decisions on consumption, leisure/labour and saving to maximise lifetime utility.
- Firms
  - Each industry is a modelled representative firm.
  - Produce using intermediate inputs, labour, variable capital and land/minerals.
  - Make forward looking decision on investment, output and production inputs to maximise their cum dividend value of equity.

TIM Overview (cont.)

- Government
  - Levies taxes
  - Exogenous spending
- Rest of the World
  - Perfect capital mobility
    - Foreign investor is the marginal investor
  - Differentiated exports and imports

TIM Overview (cont.)

- A lot of detail
  - 11 margin goods.
  - Foreign ownership by industry
  - Sales tax, excise, duties, 4 production taxes, CIT and LIT.
  - Industry specific investment goods.
- Calibrated to Australian data
- Captures responses to anticipated policy changes
- Internally consistent welfare measure

Scenarios

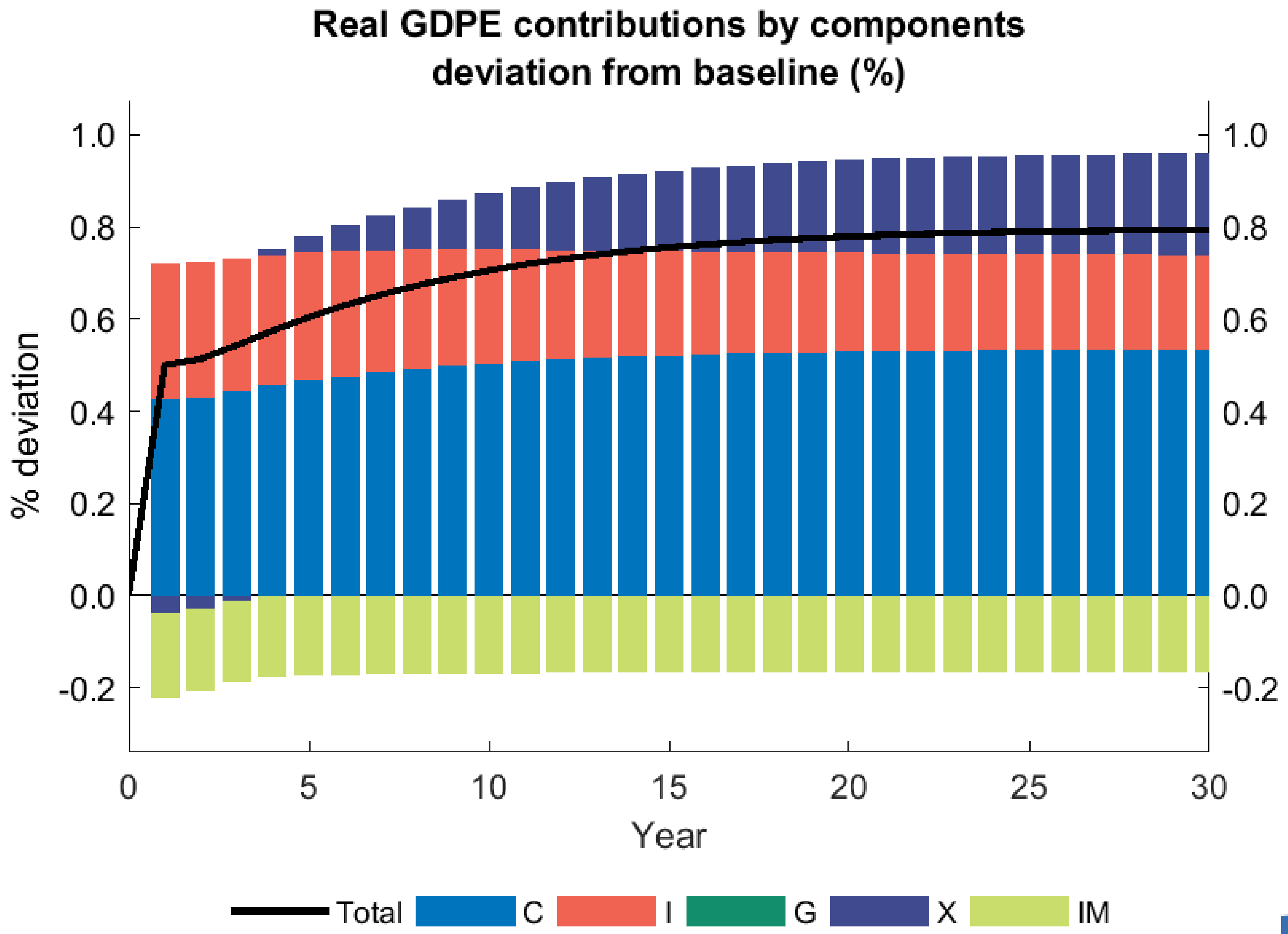
- To illustrate the properties/details of TIM we provide some results from hypothetical scenarios.
- Show industry linkages and forward looking dynamics.
- Indicates models ability to analyse industry specific policy questions.

Economy-wide LATP increase

- Permanent level increase in labour-augmenting technical progress (LATP) of 1 per cent
  - 100 workers now equivalent to 101 workers before increase (working same time)
- To all industries
- Do not capture cost of productivity increase

What we expect

- Households:
  - Wage ↑ -> Labour supply ↑
  - Income ↑ -> Labour supply ↓, consumption ↑,
  - Labour supply ?, welfare ↑
- Firms:
  - Effective labour ↑ -> output, profits ↑ -> investment ↑ -> long run capital ↑ -> long run output ↑
- In a simple model (Swan-Solow)
  - In short run 1 % ↑ LATP -> 0.6 % ↑output (labour ~60% value add)
  - In long run 1 % ↑ LATP -> 1 % ↑output



Real GDPE contributions by components
deviation from baseline (%)
% deviation
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
0
5
10
15
20
25
30
Year
Total
C
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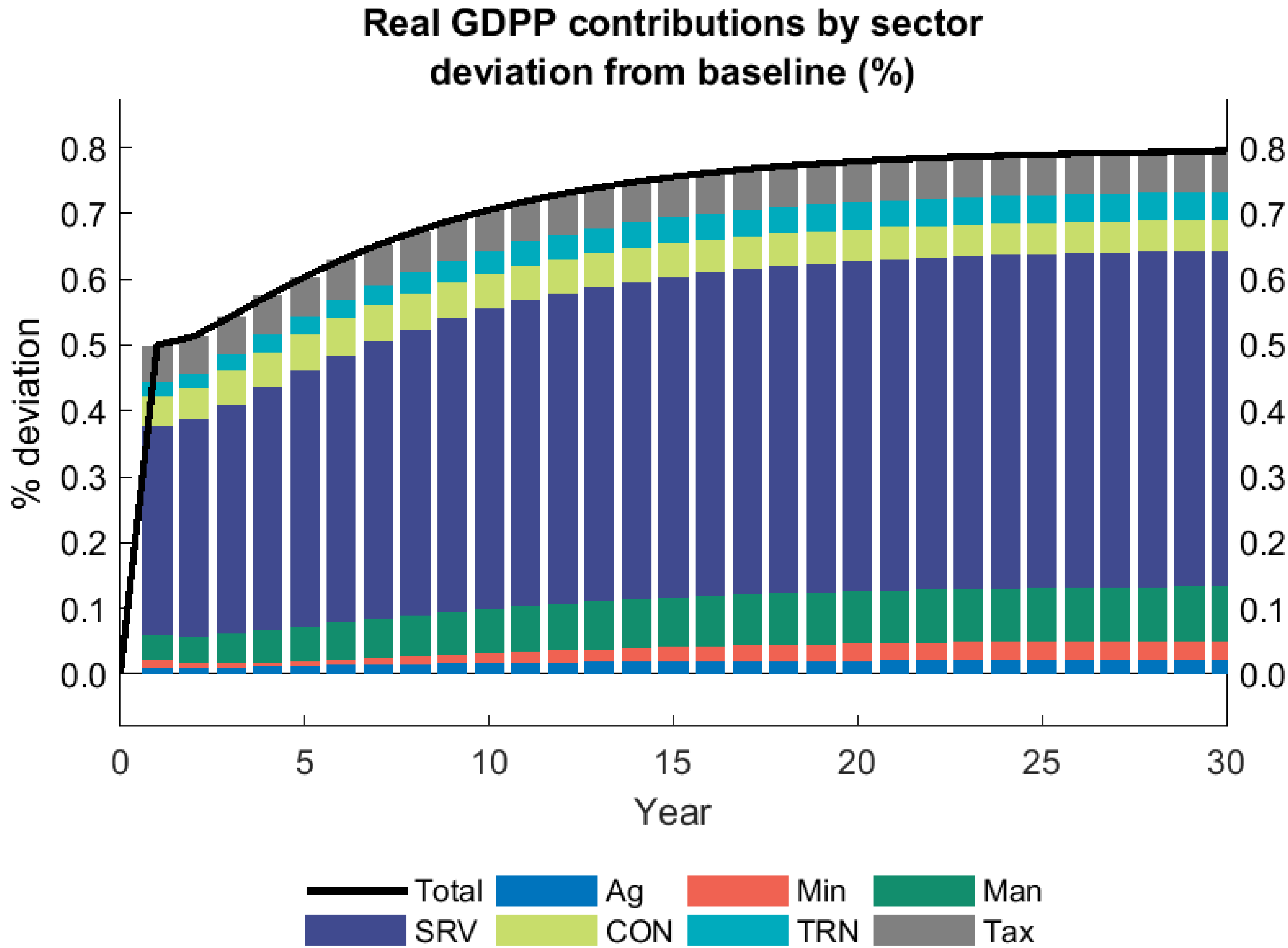

Real GDPP contributions by sector
deviation from baseline (%)
% deviation
Year
0.0
0.1
0.2
0.3
0.4
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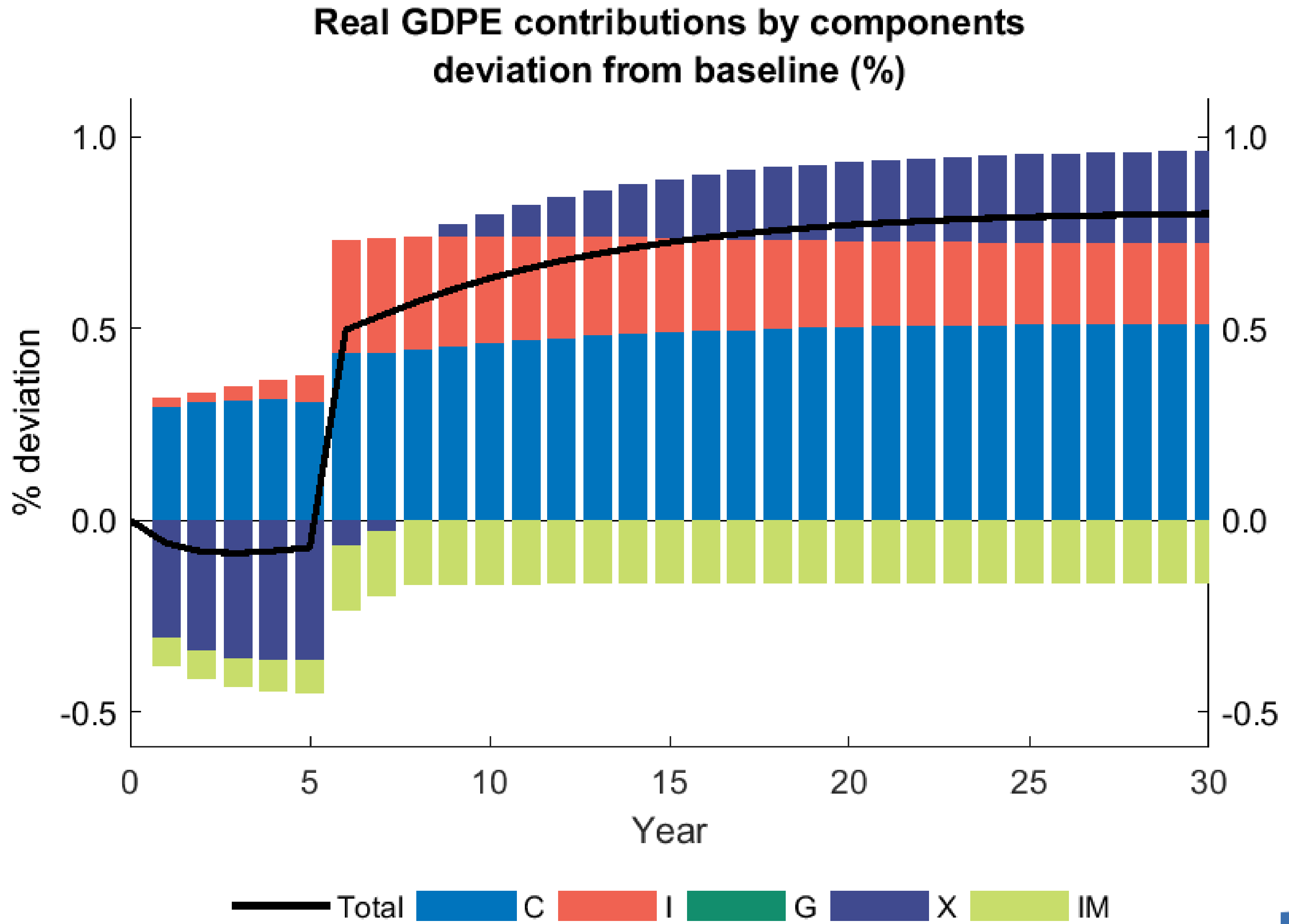
0.7
0.8
0
5
10
15
20
25
30
Total
Ag
Min
Man
SRV
CON
TRN
Tax

Anticipated LATP increase

- In year 1 everyone realises mining productivity will permanently increase in year 6
- Productivity increase same size as previously
- In anticipation we expect:
  - Higher future profits: investment ↑
  - Cheaper future investment goods : investment ↓
  - Increased lifetime income: Consumption ↑, N ↓


Real GDPE contributions by components
deviation from baseline (%)
% deviation
1.0
0.5
0.0
-0.5
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Year
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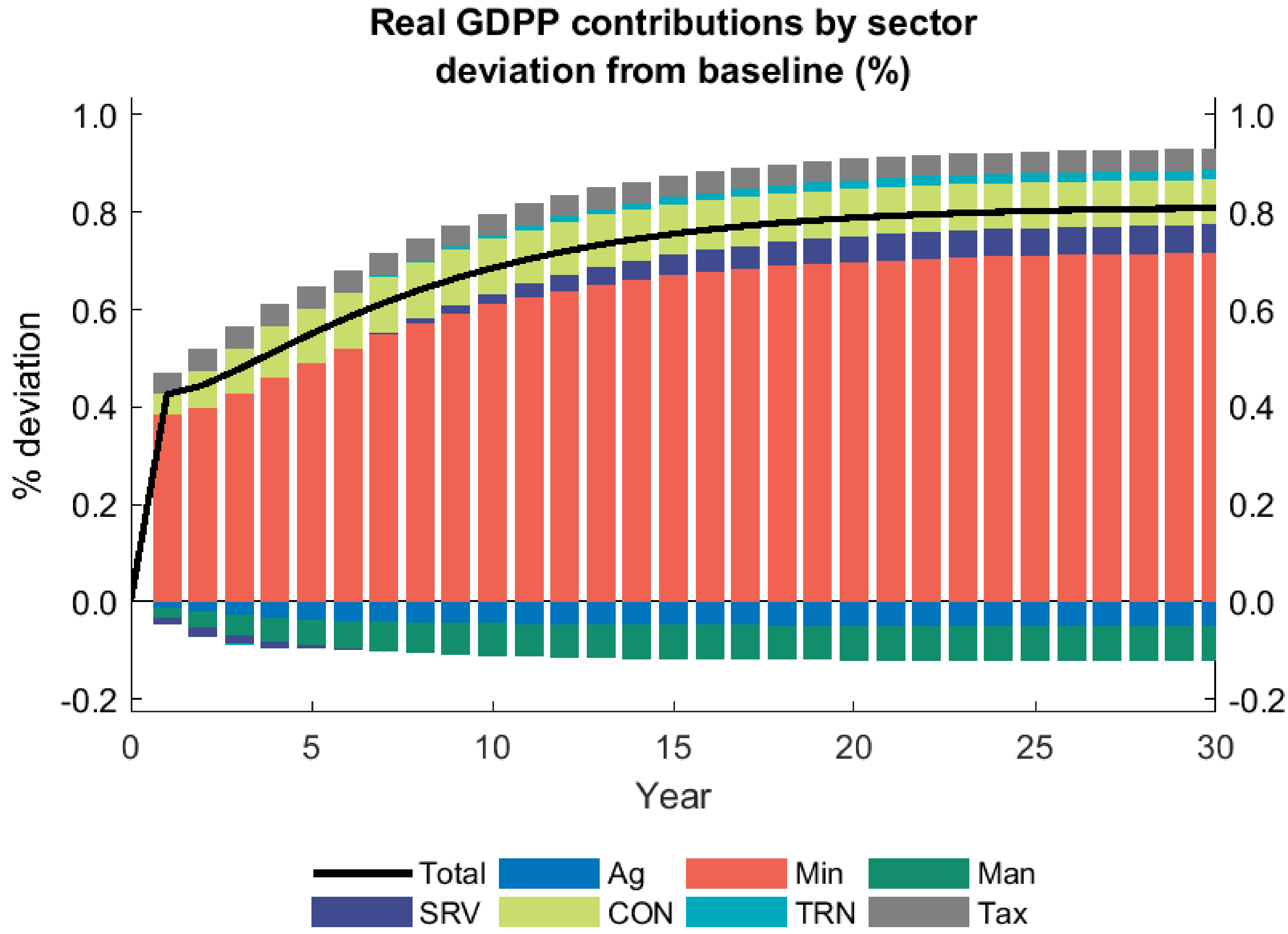
Mining sector LATP increase

- LATP increase only impacts the mining sector
- To make results comparable productivity increase is 27% (mining 4% of labour use)


Real GDPP contributions by sector
deviation from baseline (%)
% deviation
Year
1.0
0.8
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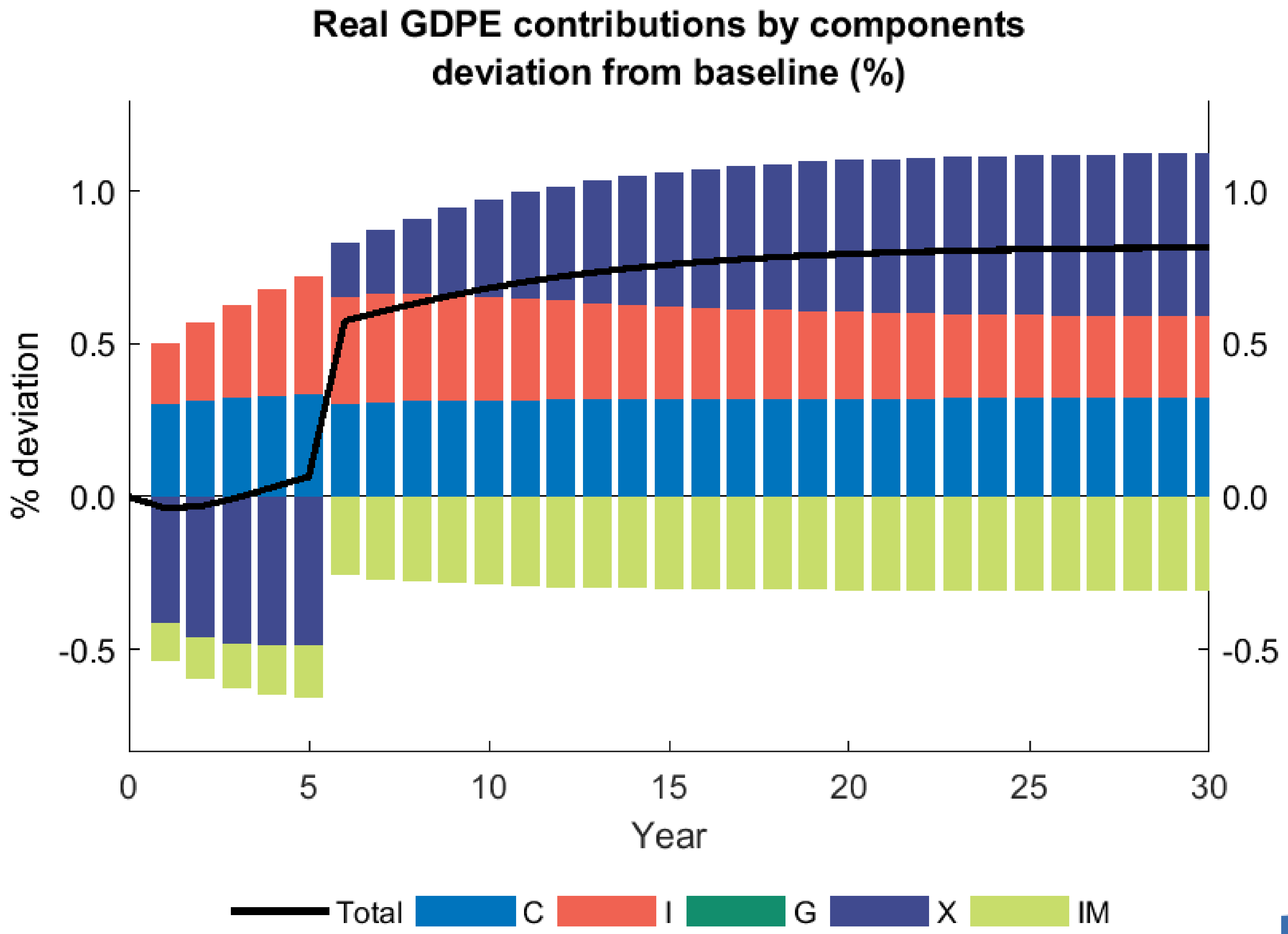
Real GDPE contributions by components
deviation from baseline (%)
% deviation
Year
1.0
0.5
0.0
-0.5
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Total
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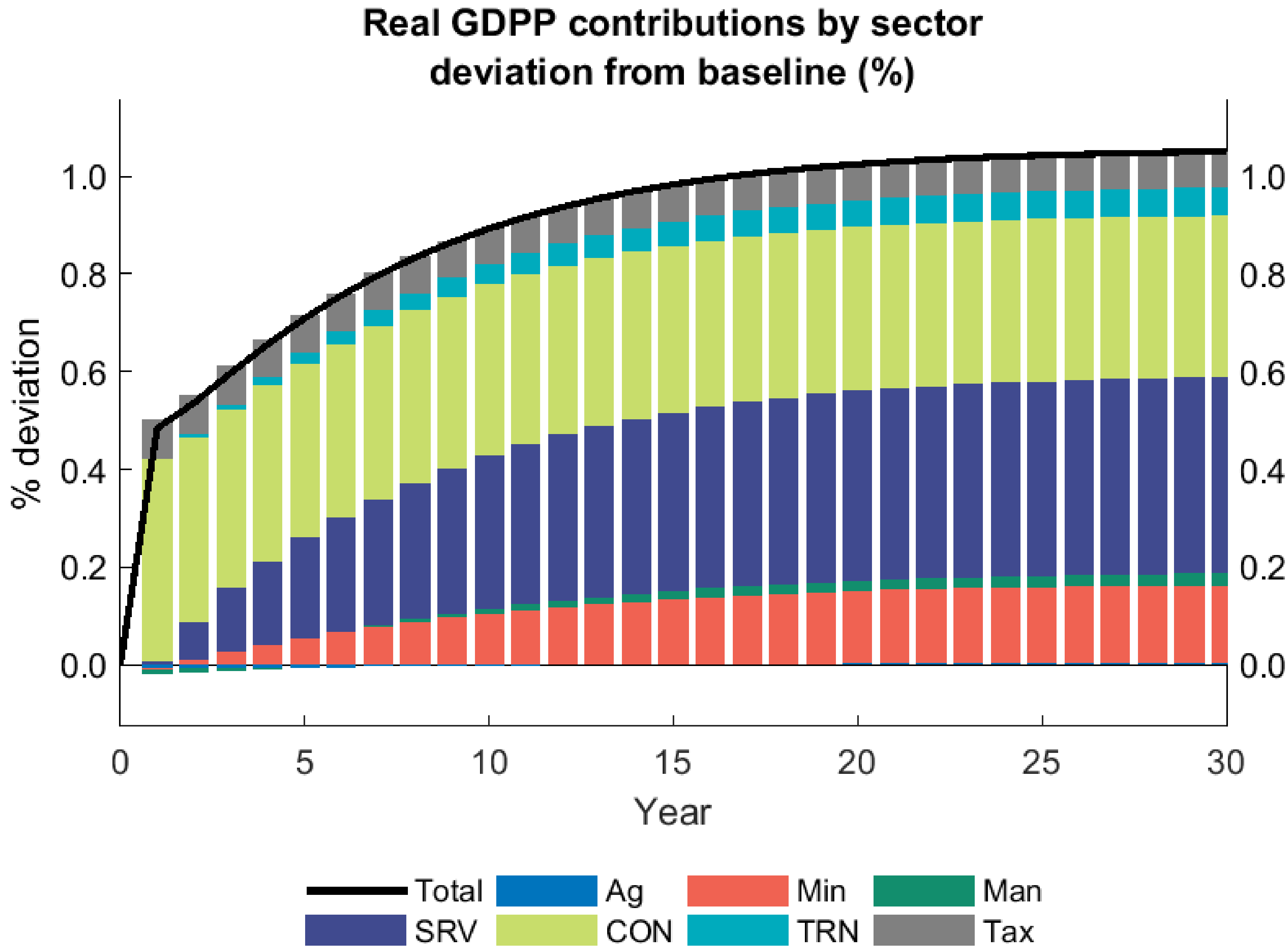
IM

Construction sector LATP increase

- Construction sector LATP increases 12% (8% of labour use)


Real GDPP contributions by sector
deviation from baseline (%)
% deviation
1.0
0.8
0.6
0.4
0.2
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Year
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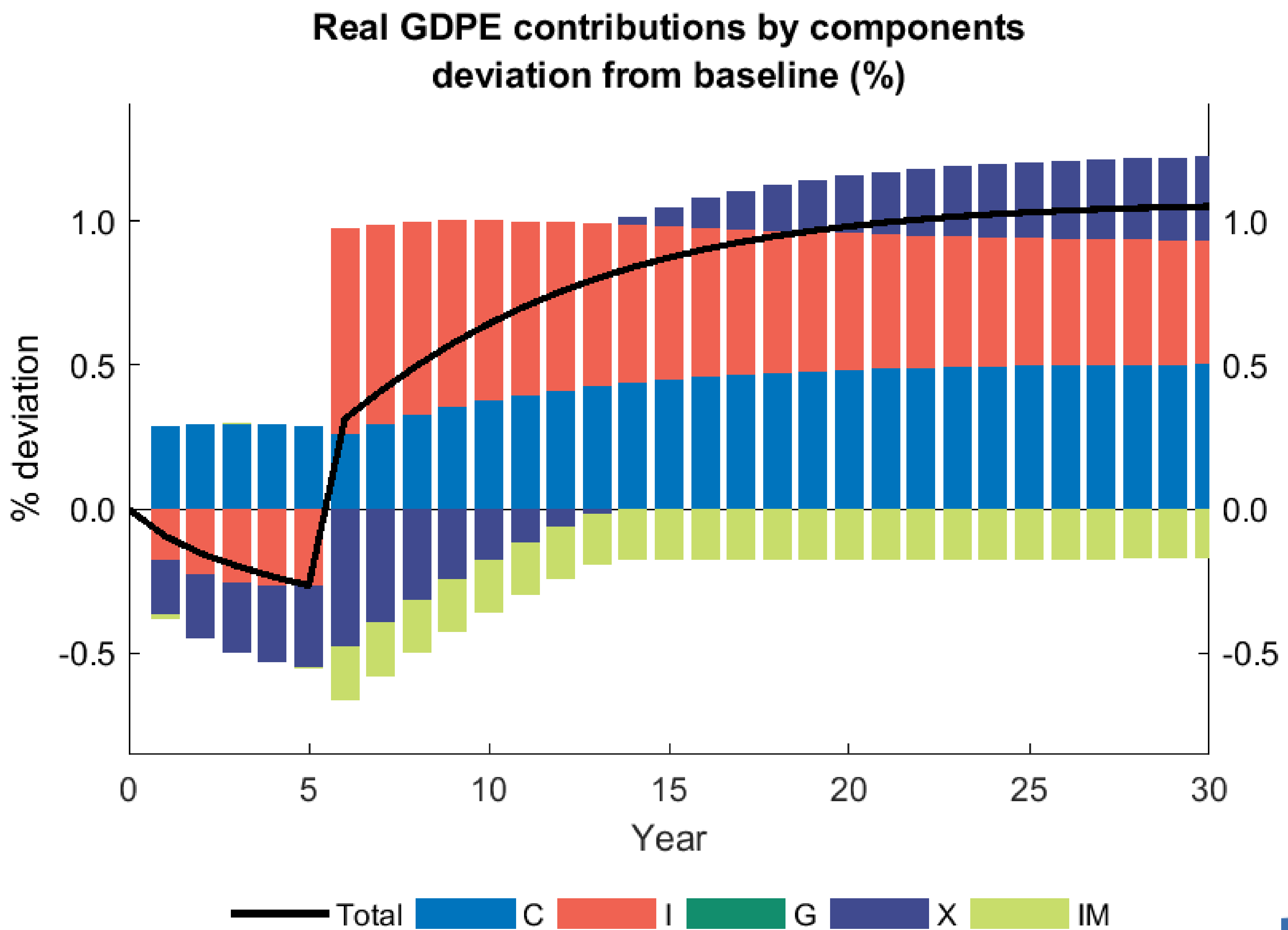

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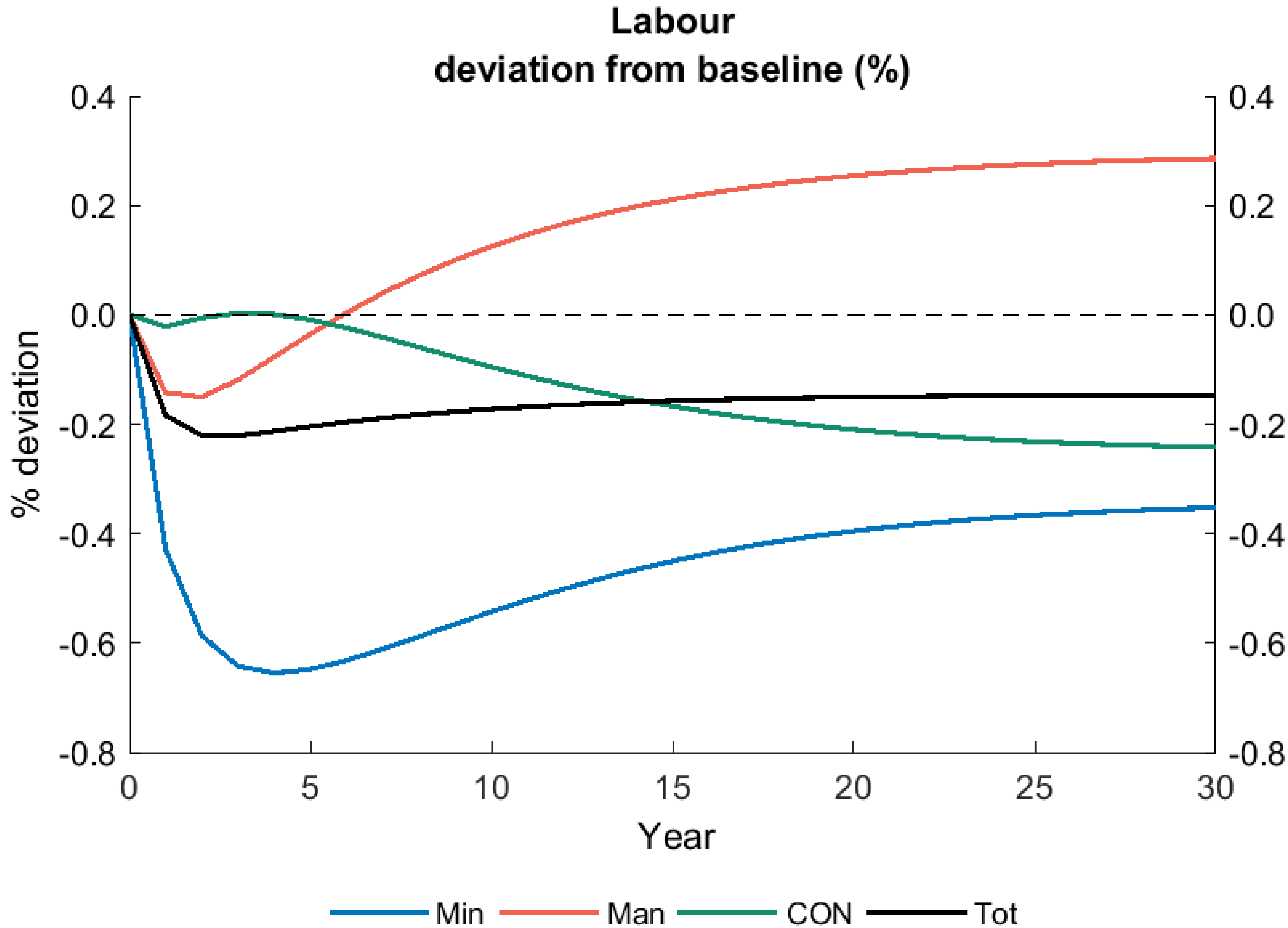
Conclusion

- TIM is a powerful tool for analysis of policy questions with industry detail.
  - Captures much Australian industry detail.
  - Forward looking model useful for considering dynamic aspects of policy.
  - Consistent with mainstream macroeconomic approaches.
  - Part of Treasury’s model development programme.

Back pocket



Labour
deviation from baseline (%)
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
% deviation
0
5
10
15
20
25
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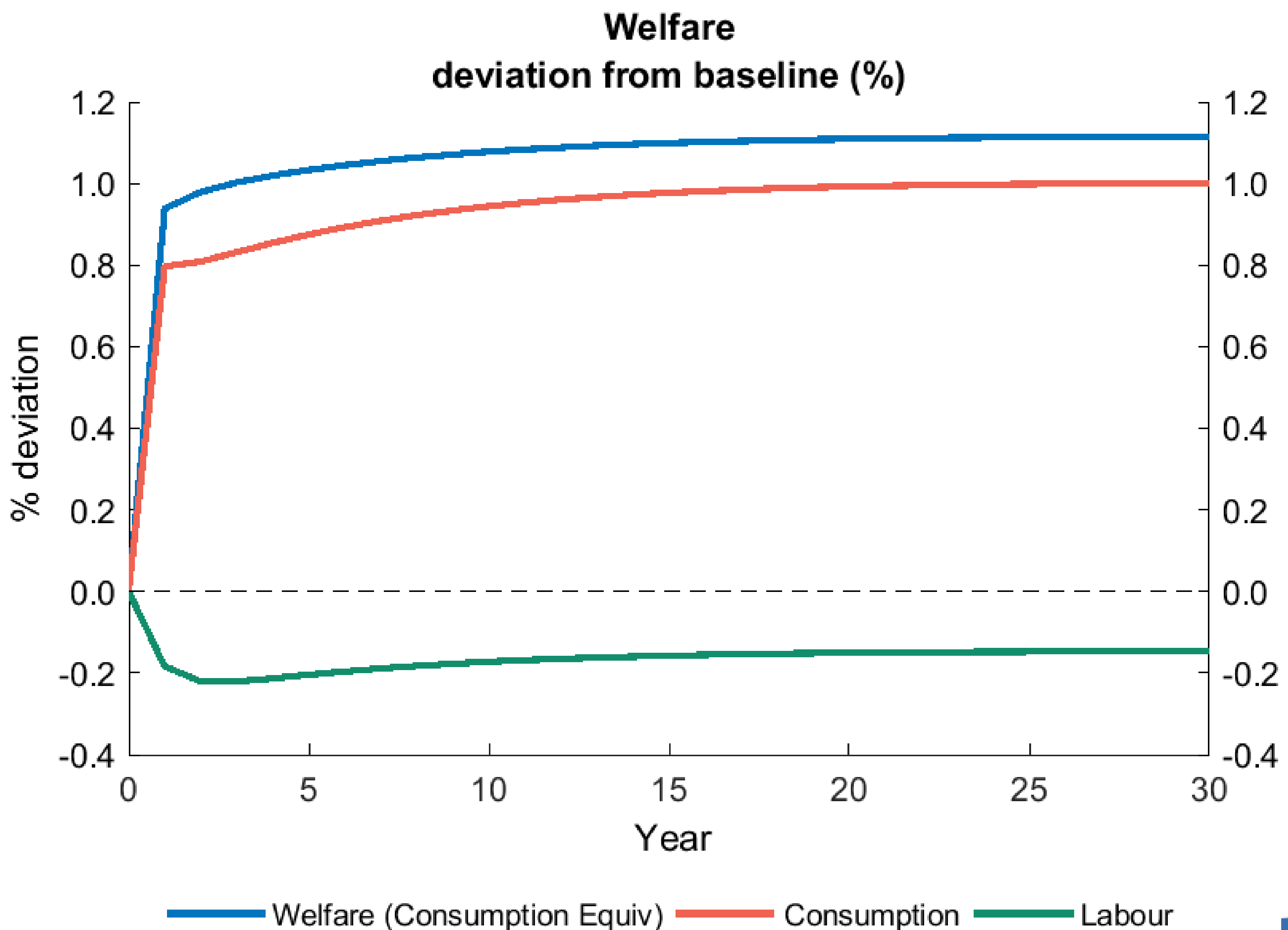
Year
Min
Man
CON
Tot


Welfare
deviation from baseline (%)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
% deviation
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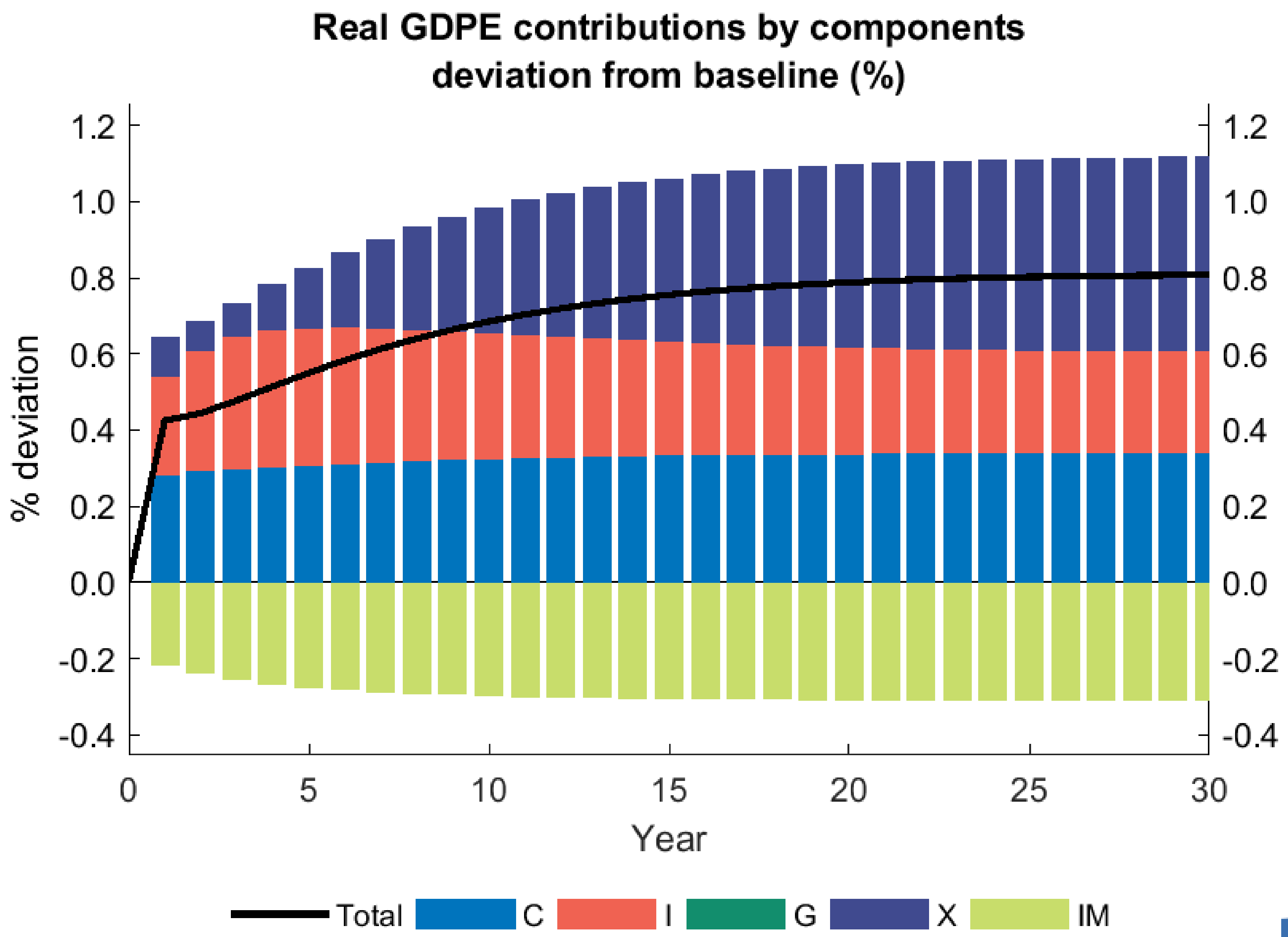
Year
Welfare (Consumption Equiv)
Consumption
Labour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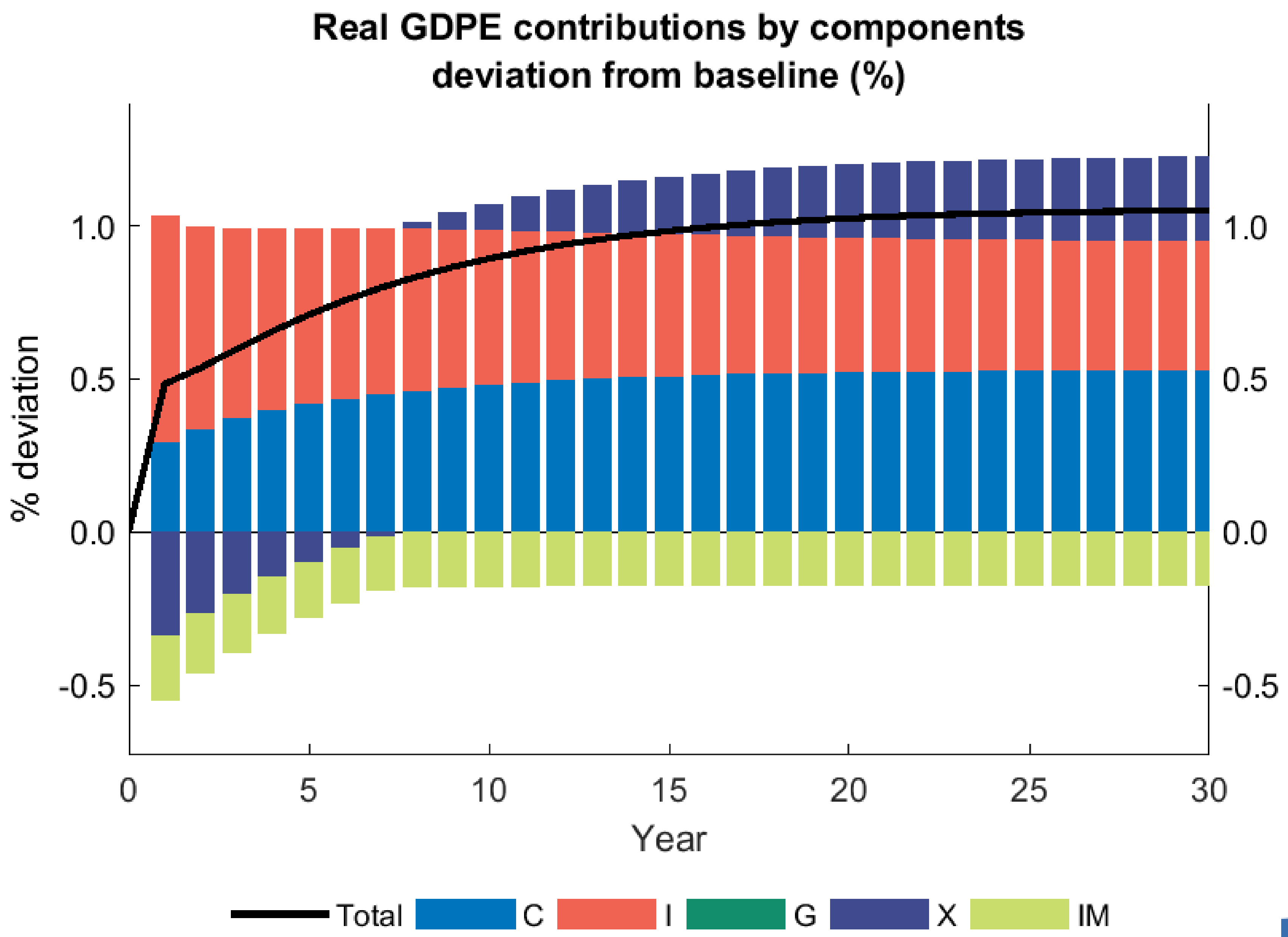

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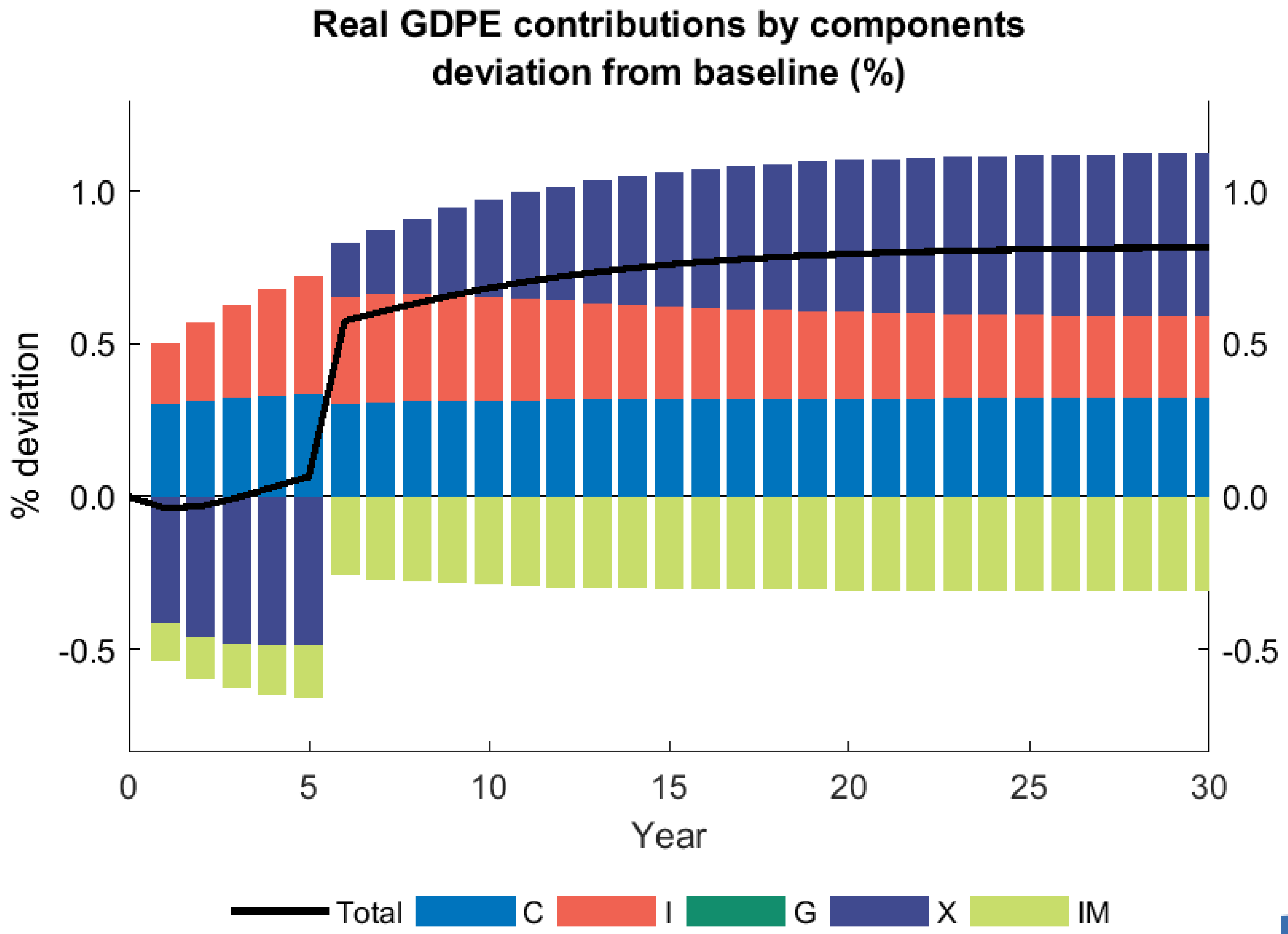
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Scenario comparison

Scenario	GDP	Labour	Consumption	Welfare (Consumption equivalent)
	Long run % change from baseline			Life time % change
Economy wide	0.79	-0.15	1.00	1.10
Mining	0.81	-0.14	0.64	0.74
Construction	1.05	-0.14	0.99	1.07

Household's Problem

- Households maximise expected lifetime utility

$$U_t = \sum_t \beta^t \frac{\left(u_t\right)^{1-\sigma^u}}{\left(1-\sigma^u\right)}$$

- Gives inter-temporal allocation of utility

$$u_t = \left(\frac{P^u_{t+1}}{\beta\left(1+r^d_{t+1}\right)P^u_t} \right)^{\frac{1}{\sigma^u}} u_{t+1}$$

where

$$P^u = \left(\left(P^C\right)^{1-\sigma^{CL}} \alpha^{CL} + \left(P^L\right)^{1-\sigma^{CL}} \left(1-\alpha^{CL}\right) \right)^{\frac{1}{1-\sigma^{CL}}}$$

and

$$P^C = \left(\sum_{i \in \mathrm{I}} \alpha_i^C (P_i^C)^{1-\sigma^C} \right)^{1/(1-\sigma^C)}$$

Firms' Problems

- Firms maximise cum-dividend share price

$$V_{i,t} = DIV_{i,t} + P_{i,t}^{F} = \sum_{t=t_0}^{\infty} \frac{DIV_{i,t}}{\prod_{s=t_0+1}^{t} (1+r\ )(1+\gamma)^{-1}}$$

- Gives the following condition for the marginal product of capital

$$r_{t+1} = \frac{(1-\tau^{k})P_{t+1}^{KS}\omega^{k} + P_{t+1}^{I}\tau^{k}\delta + P_{t+1}^{Y}.5\psi(1-\tau^{k})\left((\frac{I_{t+1}}{K_{t+1}})^{2} - (\gamma+\delta)^{2} \right)}{P_{t}^{I} + P_{t}^{Y}\psi(1-\tau^{k})\left(\frac{I_{t}}{K_{t}} - \delta - \gamma \right)}$$

$$+ \frac{(1-\delta)\left(P_{t+1}^{I} + P_{t+1}^{Y}\psi(1-\tau^{k})\left(\frac{I_{t+1}}{K_{t+1}} - \delta - \gamma \right) \right) - P_{t}^{I} - P_{t}^{Y}\psi(1-\tau^{k})\left(\frac{I_{t}}{K_{t}} - \delta - \gamma \right)}{P_{t}^{I} + P_{t}^{Y}\psi(1-\tau^{k})\left(\frac{I_{t}}{K_{t}} - \delta - \gamma \right)},$$

Firms' Problems

- Firms maximise cum-dividend share price

$$V_{i,t} = DIV_{i,t} + P^F_{i,t} = \sum_{t=t_0}^{\infty} \frac{DIV_{i,t}}{\prod_{s=t_0+1}^{t} (1+r\ \ )(1+\gamma)^{-1}}$$

- Gives the following condition for the marginal product of capital

$$\underbrace{r_{t+1}}_{\text{Required return}} = \frac{\overbrace{(1-\tau^k)P^{KS}_{t+1}\omega^k}^{\text{MPK-tax}} + \overbrace{P^I_{t+1}\tau^k\delta}^{\text{dep-allow}} + \overbrace{P^Y_{t+1}.5\psi(1-\tau^k)\left((\frac{I_{t+1}}{K_{t+1}})^2 - (\gamma+\delta)^2 \right)}^{\text{Benefit of extra capital on adjustment cost}}}{\underbrace{P^I_t + P^Y_t\psi(1-\tau^k)\left(\frac{I_t}{K_t} - \delta - \gamma\right)}_{\text{Investment cost current period}}}$$

$$+ \frac{(1-\delta)\overbrace{\left(P^I_{t+1} + P^Y_{t+1}\psi(1-\tau^k)\left(\frac{I_{t+1}}{K_{t+1}} - \delta - \gamma\right)\right)}^{\text{Investment cost future period}} - \overbrace{P^I_t - P^Y_t\psi(1-\tau^k)\left(\frac{I_t}{K_t} - \delta - \gamma\right)}^{\text{Investment cost current period}}}{\underbrace{P^I_t + P^Y_t\psi(1-\tau^k)\left(\frac{I_t}{K_t} - \delta - \gamma\right)}_{\text{Investment cost current period}}},$$