When is debt best?

Financial CGE studies of highway expenditure programs in the USA

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Overview

The total economic impact of deficit-financed infrastructure investments is unclear [US CBO (2016) and Stupak (2018)].

- **Finance models**: competition for scarce financial resources;
- **Economic models:** competition for scarce factors of production;
- **Transport models**: fuel and time savings, reduced maintenance costs;
- How do we integrate these approaches?

Our contribution

Turn a real-side CGE model (USAGE-Hwy) into a financial CGE model (USAGE-HwyF).
Interface USAGE-HwyF with a transport model (HERS).

1. **How do financial market considerations impact outcomes?** Two scenarios:
- Debt **financing** *versus* pay-as-you-go (**PAYGO**) revenue forecasting.

2. **How does the economic environment impact outcomes?** Two basecase forecasts:
- **Normal** economic conditions *versus* **Recession** conditions.

Background

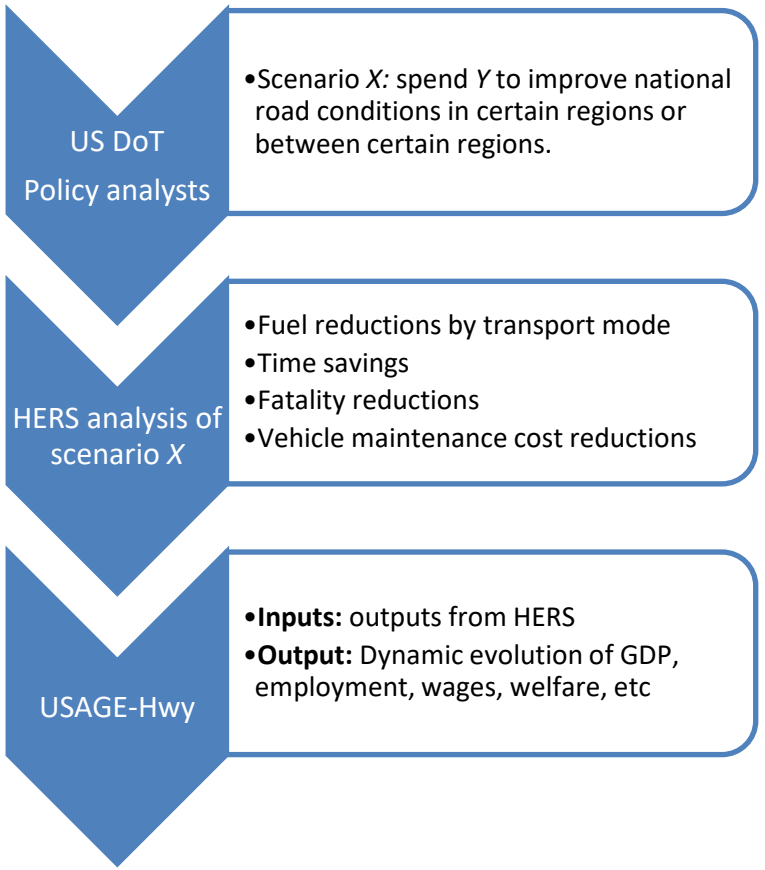
How do we study highway investment in a CGE model?

Technical specialists build detailed models to answer questions in their field of specialization.

- **Economists:** CGE models of the real economy, econometric models, financial market models, etc.
- **Scientists:** Climate models, transport models, etc.

We try to link these models to expand enrich the analysis of particular projects.

Dixon, Rimmer and Waschik (2017, Economic Modelling 66): Describe how specialist transport models, e.g., HERS at the US DoT, can be integrated with real-side CGE models like USAGE-Hwy.



Scenario analysis with USAGE-Hwy

HERS and other transport models can provide an array of outputs for a given scenario. These can be linked to agent expenditure, preferences or welfare in a CGE model.

1. **Expenditure shocks:** Increase in government demand for highway and bridge construction services. **Competition for labour crowds out other investment, and impacts export competitiveness.**

2. **Driving time savings:** Feed into labour supply. **Offset direct effects of expenditure shocks on labour and export competitiveness.**

3. **Vehicle operating costs:** Reduction in household and industry propensity to consume car and truck repair services on PRT and truck maintenance.

4. **Fuel savings:** Preference twists away from fuel use by trucking and PRT.

5. **Safety costs:** Modelled as changes in consumption of medical services by households.

6. **Fatalities:** Feed in to welfare.

What are we missing?

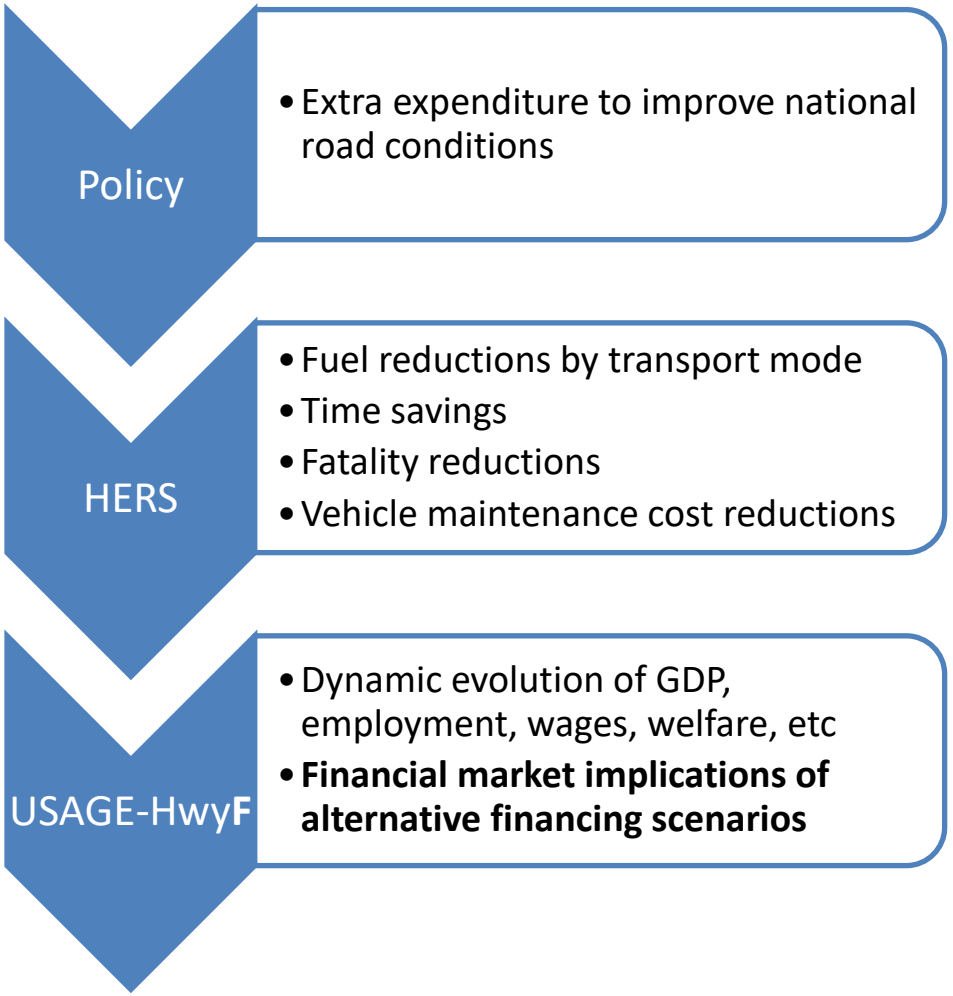
USAGE-Hwy accepts all of the six inputs outlined counterfactual shocks.

BUT…
Funding deficits are **implicitly foreign financed**.

SO…
There are no impacts on financial markets as a result.

WHAT TO DO?
Integrate financial markets and agents and the real economy ala Nassios *et al.* (2020).

Integrate this model with HERS ala Dixon *et al.* (2017).



What is a financial CGE model?

What is a financial CGE model?

Consists of two integrated parts:

1. A traditional real-side CGE model like USAGE-Hwy.
    - Many industries, many commodities, multiple final demanders.

2. **A financial module**, spanning multiple financial agents.

The financial agents use multiple financial instruments in their dual roles as:

- Liability agents:
    - Capital structure is set to facilitate purchases of physical capital/financial assets;

- Asset agents:
    - **Super funds:** purchase financial assets on behalf of members in line with contributions;
    - **Banks:** financial intermediaries who issue loan finance subject to regulator-imposed capital requirements.
    - **Households:** Financial asset acquisition is tied to savings.

Financial agents & instruments

Agents (*L*, *A*):

1. **Government**
2. **Households**
3. **Industries**
4. **Foreigners**
5. Commercial banks
6. Central bank
7. Non-bank financial intermediaries
8. Superannuation funds
9. Life insurance funds
10. **Reproducible housing (RH)**
11. Non-reproducible housing (NRH)

We require behavioural assumptions relating to (*L*,*A*) over (*F*)

Housing sector split in two –

- Reproducible housing: outer suburbs & units
- Non-reproducible housing: established inner city

Financial instruments (*F*)

1. Bonds
2. Cash
3. Deposits and loans
4. Equity
5. Gold & special drawing rights

STOCK(*L*, *F*, *A*)

Value of financial instrument (*F*); issued as a liability by agent (*L*); and, held as an asset by agent (*A*).

Also: **ROR (*L*, *F*, *A*)** **FLOW (*L*, *F*, *A*)**

Financial stocks in USAGE-HwyF (US$bn, 2016)
STOCK(I,a)

Asset Ag. / Liab. Ag.	(1A)	(2A)	(3A)	(4A)	(5A)	(6A)	(7A)	(8A)	(9A)	(10A)	(11A)	*Tot. liab.*
(1L) Banks	0	130	1283	441	9438	2073	2076	135	81	0	0	15657
(2L) US fed	2673	0	540	982	269	270	295	5	19	0	0	5053
(3L) Foreigners	820	23	0	349	2847	5365	3891	1251	1283	0	0	15828
(4L) Gov	906	2602	7527	0	2708	1299	2570	6113	758	0	0	24482
(5L) HouseH	0	0	0	0	0	0	0	0	0	0	0	0
(6L) Industry	2536	0	9720	657	22012	0	8274	4143	2597	0	0	49939
(7L) Non-banks	3186	1557	4838	791	11597	1344	0	5176	2211	0	0	30699
(8L) Super fnds	0	0	0	0	17627	0	0	0	0	0	0	17627
(9L) Life ins.	153	0	343	12	5101	546	344	796	0	0	0	7295
(10L) NR house	1317	0	0	693	5371	3275	3116	4	27	0	0	13805
(11L) R house	1500	0	0	315	2894	1347	3419	5	29	0	0	9509
Tot. assets	13092	4312	24251	4240	79864	15519	23985	17627	7004	0	0	189895

1. **Net government debt** = 24 482 – 4240 = US$20 242 bn
2. **Net household assets** = US$79 864 bn
3. **Aggregate non-res. capital** = 49 939 – 15 519 = US$34 420 bn
4. **Aggregate housing capital** = 13 805 + 9 509 = US$23 314 bn
5. **Net foreign debt** = 24 251 – 15 828 = US$8 423 bn

Linking the financial and real economies

Four key linkages exist between the financial module and the real-side CGE model:

- CAD financing requirement;
- PSBR financing requirement;
- Household savings;
- Financing of gross fixed capital formation by industry and housing sectors.

Multiple optimising agents with many financial sector / real economy links establishes a series of policy transmission channels:

- ***Interest rate channel*:** Interest-sensitive real expenditure can be affected by a rise in the cost of bank finance;
- ***Exchange rate channel*:** Offshore funding propensities can induce exchange rate movement;
- *Asset price channel*;
- *Bank lending channel*.

Linking the real-side and financial models via *FLOW(L, A)*
Creating USAGE-HwyF

Asset Ag. / Liab. Ag.	(1A)	(2A)	(3A)	(4A)	(5A)	(6A)	(7A)	(8A)	(9A)	(10A)	(11A)	*Liability flows*
(1L) Banks	0	32	11	-6	-6	53	30	7	3	0	0	125
(2L) US fed	-7	0	-72	9	-36	-23	-46	-1	-2	0	0	-179
(3L) Foreigners	-33	3	0	-3	32	322	-31	25	16	0	0	330
(4L) Gov	-5	-196	62	0	14	64	-40	45	5	0	0	-51
(5L) HouseH	0	0	0	0	0	0	0	0	0	0	0	0
(6L) Industry	-36	0	583	18	1660	0	253	317	111	0	0	2907
(7L) Non-banks	-85	-18	43	-13	424	127	0	211	5	0	0	694
(8L) Super fnds	0	0	0	0	626	0	0	0	0	0	0	626
(9L) Life ins.	-1	0	5	0	84	39	-5	21	0	0	0	143
(10L) NR house	46	0	0	-32	-173	83	75	0	1	0	0	0
(11L) R house	245	0	0	18	145	154	457	1	4	0	0	1024
Asset flows	125	-179	631	-9	2770	818	694	626	143	0	0	5618

Government savings = (4A) – (4L) = US$42 bn

***plus* Household savings = (5A) = US$2 770 bn**

***less* Non-res. investment = - [(6L) – (6A)] = - US$2 089 bn**

***less* Housing investment = - (11L) = - US$1 024 bn**

***plus* Current account deficit = (3A) – (3L) = US$301 bn**

= 0

Assumptions

1. **Liability agents:** Minimise cost of capital;

2. **Asset agents:** Maximise portfolio rates of return;

3. **Nominal rigidity:** Nominal wage is sticky in the short-run, flexible over the medium-term to ensure the unemployment rate is returned to the NAIRU (4.4 percent);

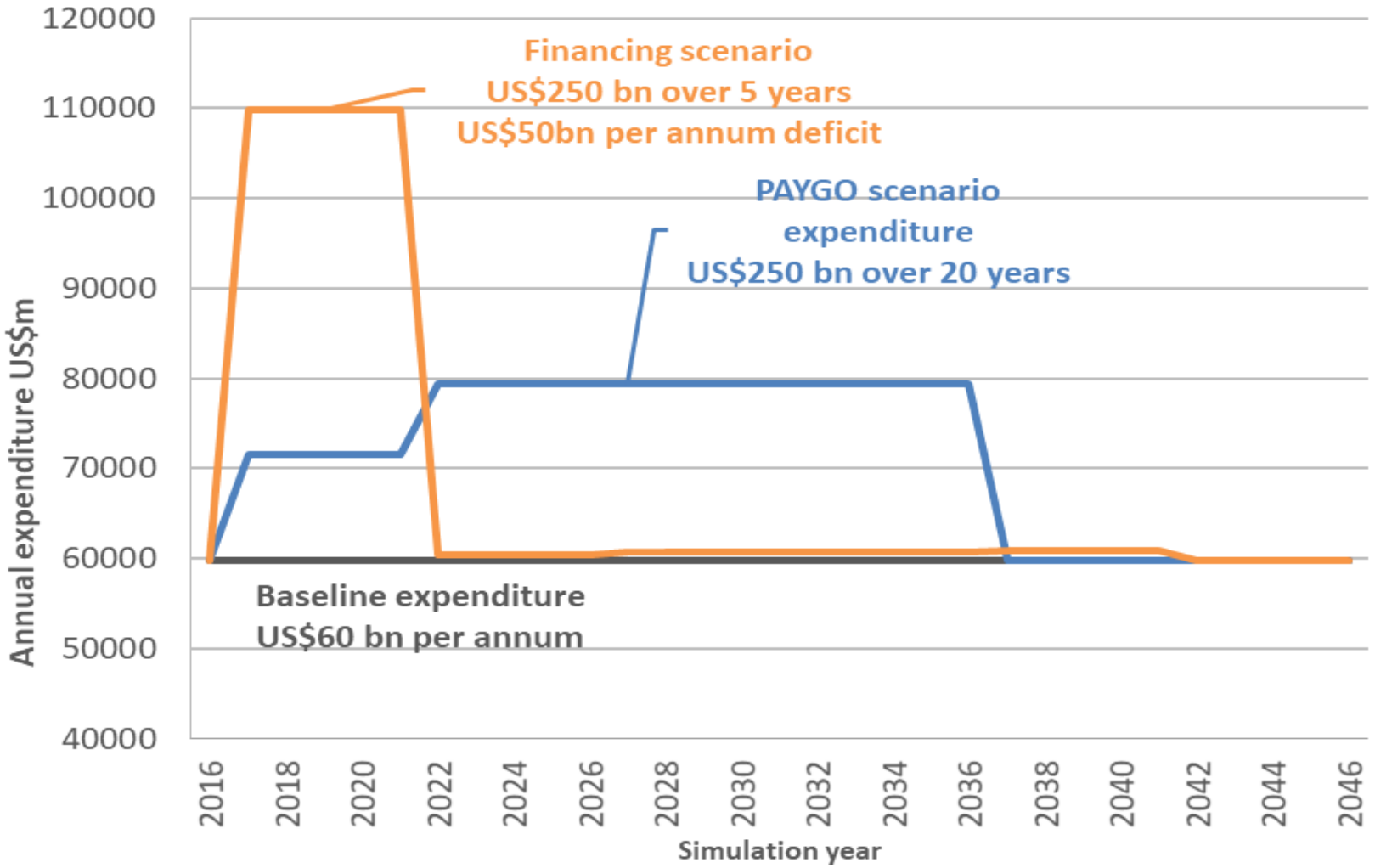
4. **Commercial banks:** Constrained to maintain a fixed ratio of tier-1 equity liabilities to risk weighted assets (Basel III).

5. **Monetary Policy:** Endogenous cash rate, set according to a policy rule linked to the deviation in the price level and employment from target.
    - **NAIRU**: 4.4 per cent p.a.
    - **CPI** (non-volatile items): 2 per cent p.a.

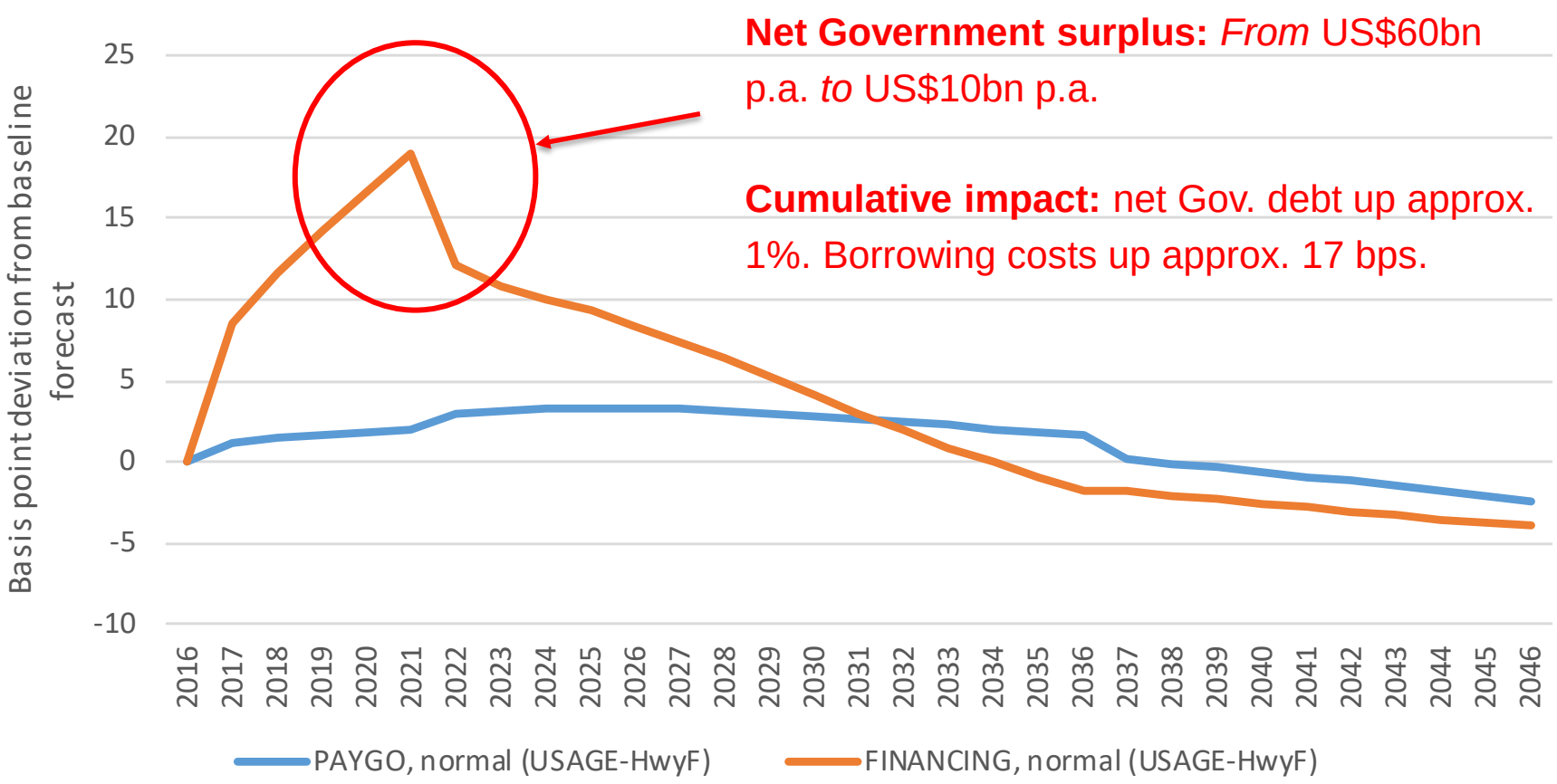
QUESTION ONE

Debt *versus* pay-as-you-go (PAYGO/revenue) financing

Two scenarios
Expenditure profiles from HERS

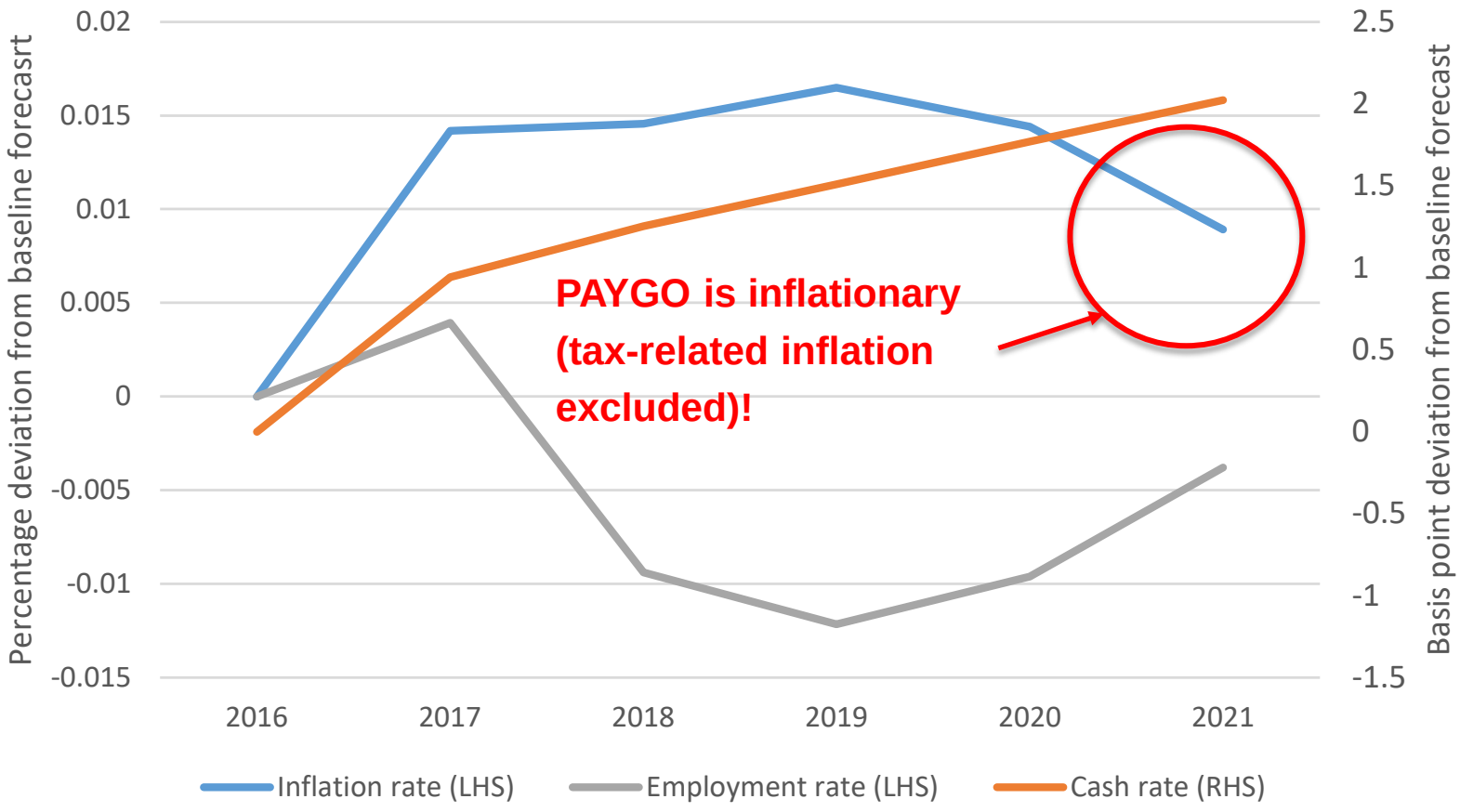


Leading-order financial effect
Government yield, Financing *vs* PAYGO (USAGE-HwyF)

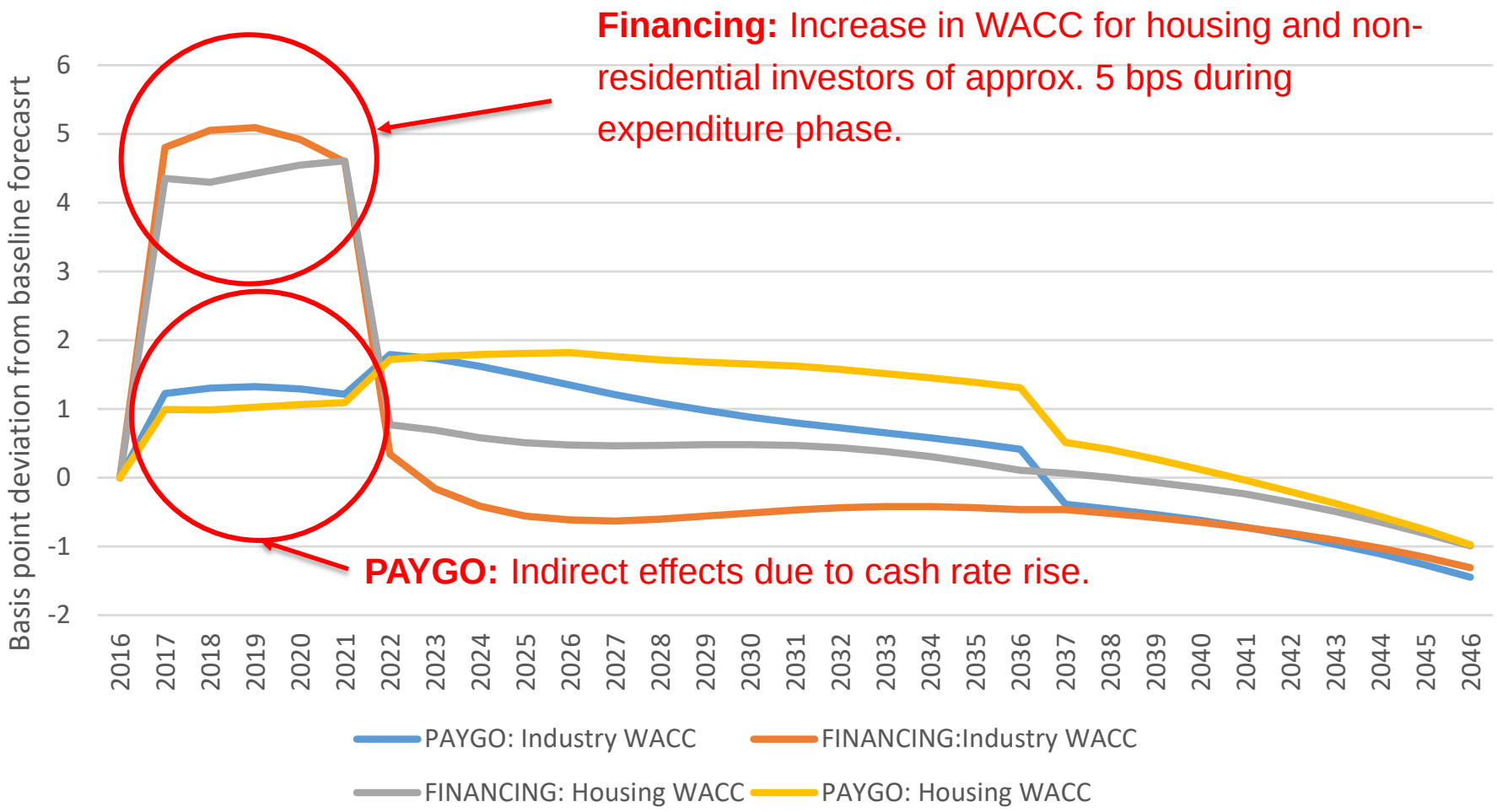


Why do PAYGO borrowing costs rise?
Inflation and the cash rate (PAYGO scenario, USAGE-HwyF)

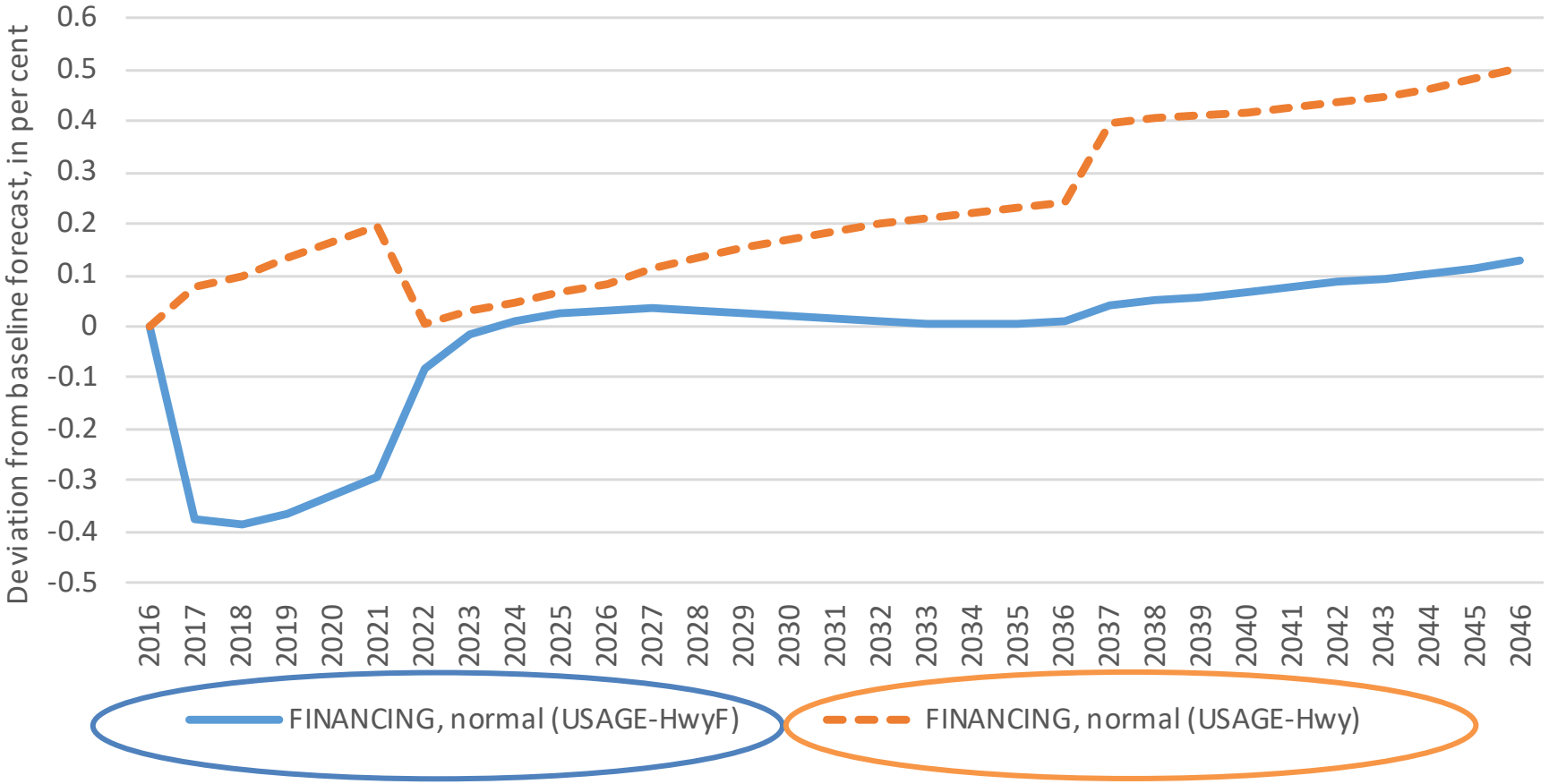
QUESTION: Why do Government borrowing costs rise under PAYGO with no direct effect on Government indebtedness?



Indirect effects on other agents financial effect
Weighted cost of capital (WACC, USAGE-HwyF)



Interest rate channel in effect
Real investment, Financing scenario (USAGE-Hwy and USAGE-HwyF)



As WACC rises, real investment response is damped.

Implicit financing by foreign investors. No indirect WACC rises for investors!

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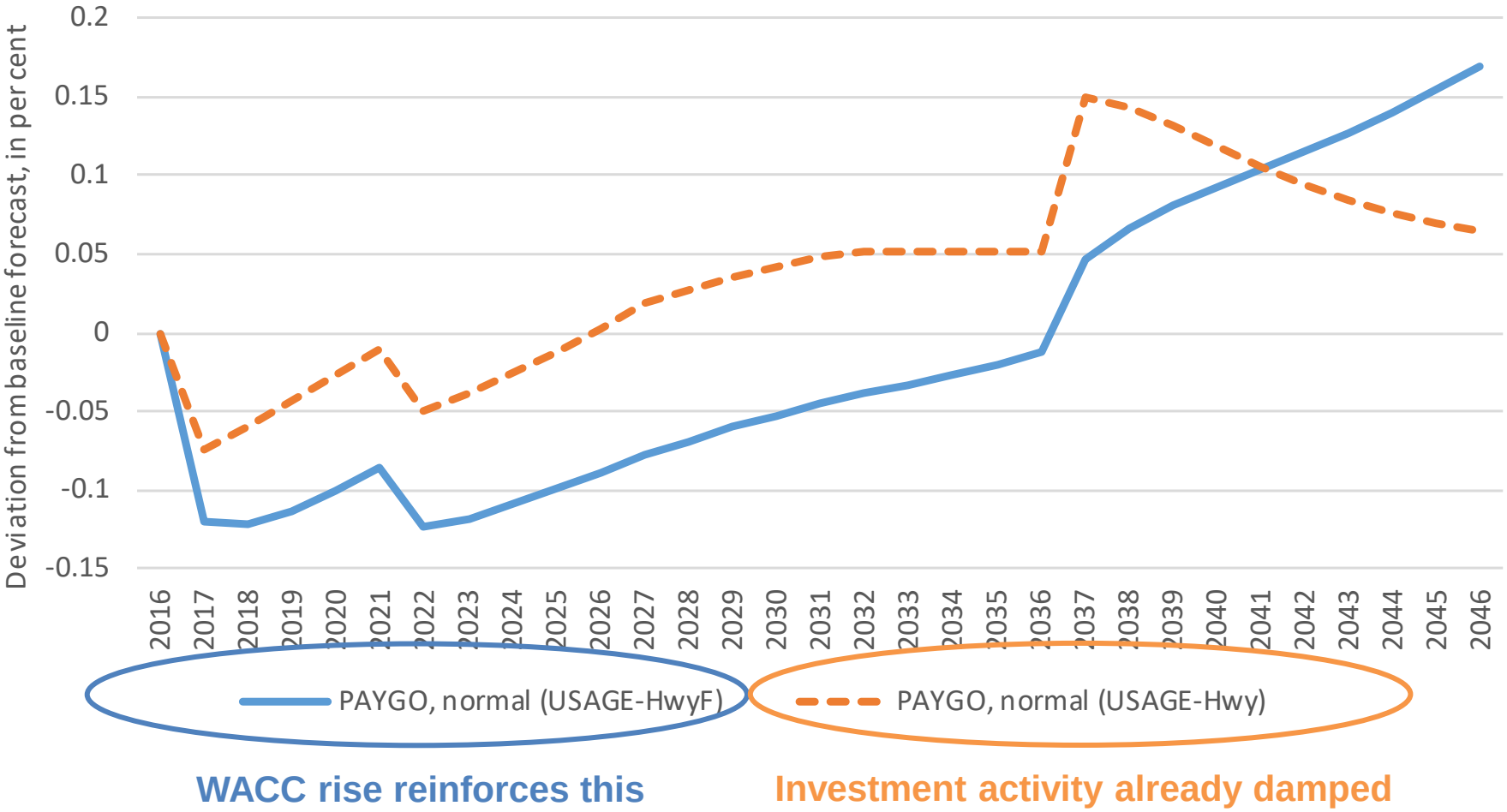
Interest rate channel in effect
Real investment, PAYGO scenario (USAGE-Hwy and USAGE-HwyF)



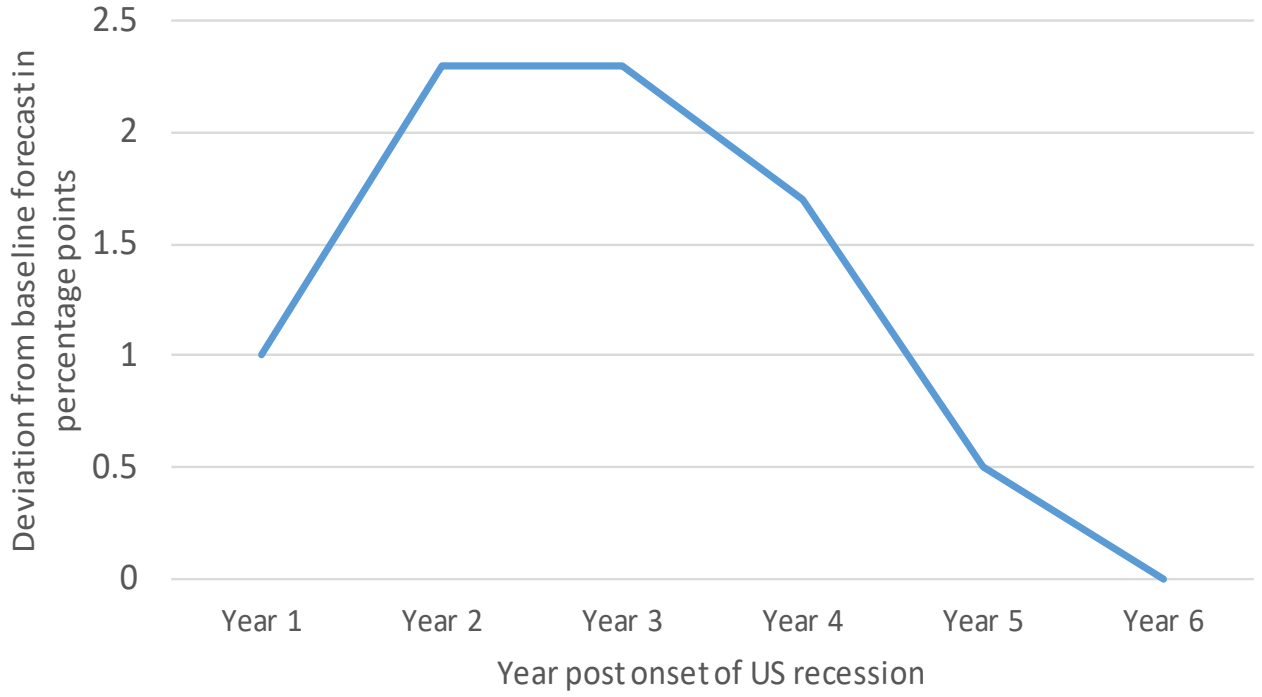
QUESTION TWO

Debt financing under normal *vs* recessionary conditions

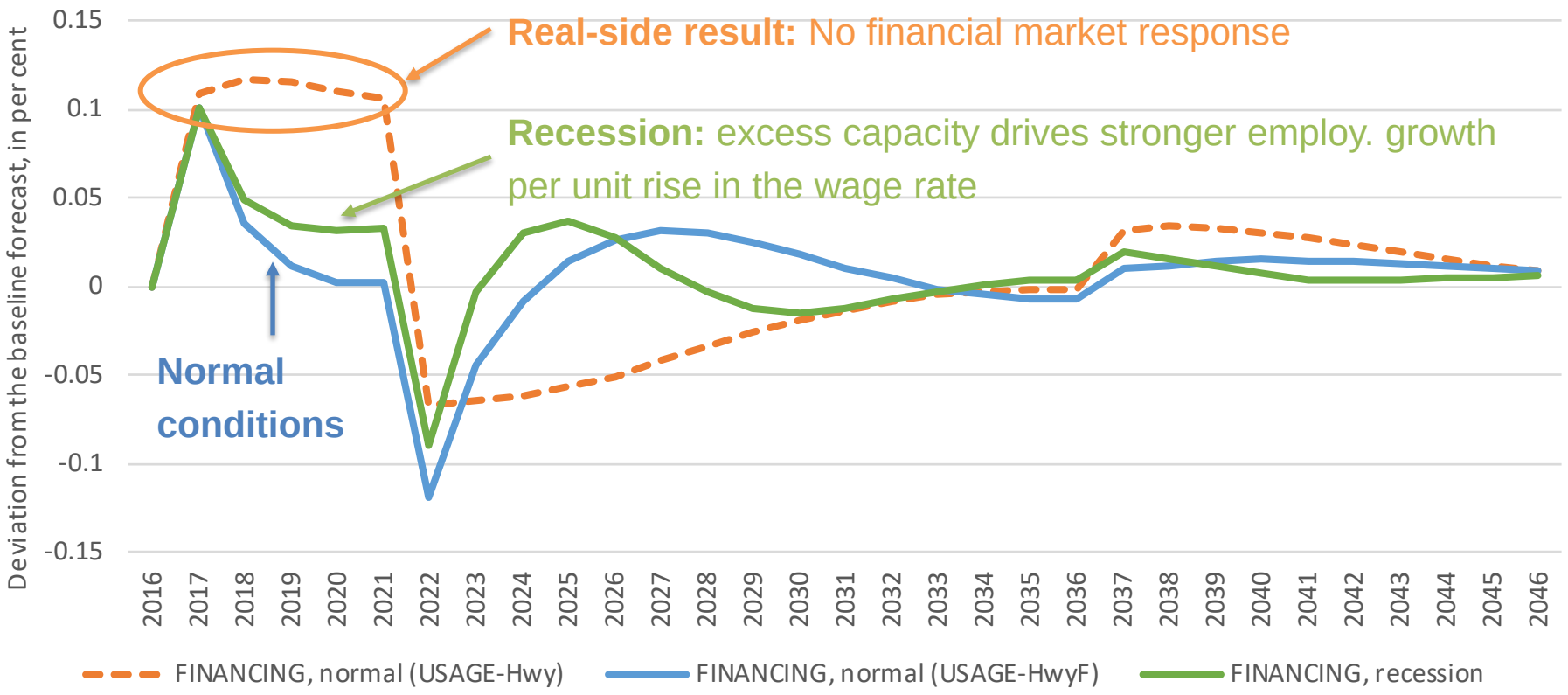
When to spend?
Simulating a typical US recession

We re-run the financing and PAYGO scenarios against a baseline recession from 2017 – 2022.

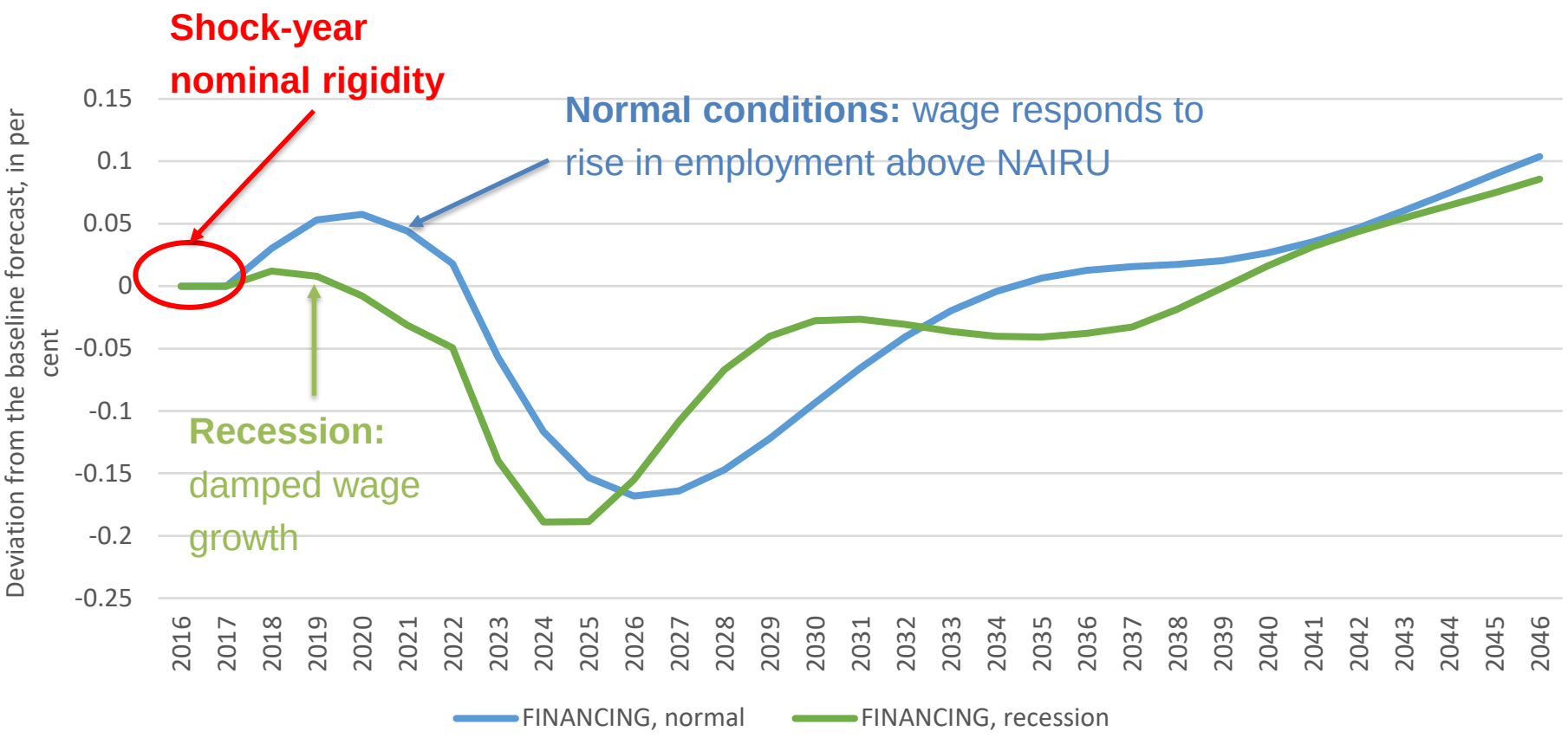
To set the unemployment rate between 2017 and 2022, we rely on Volpe analyses of seven US recessions from 1970 to 2007 (see below).



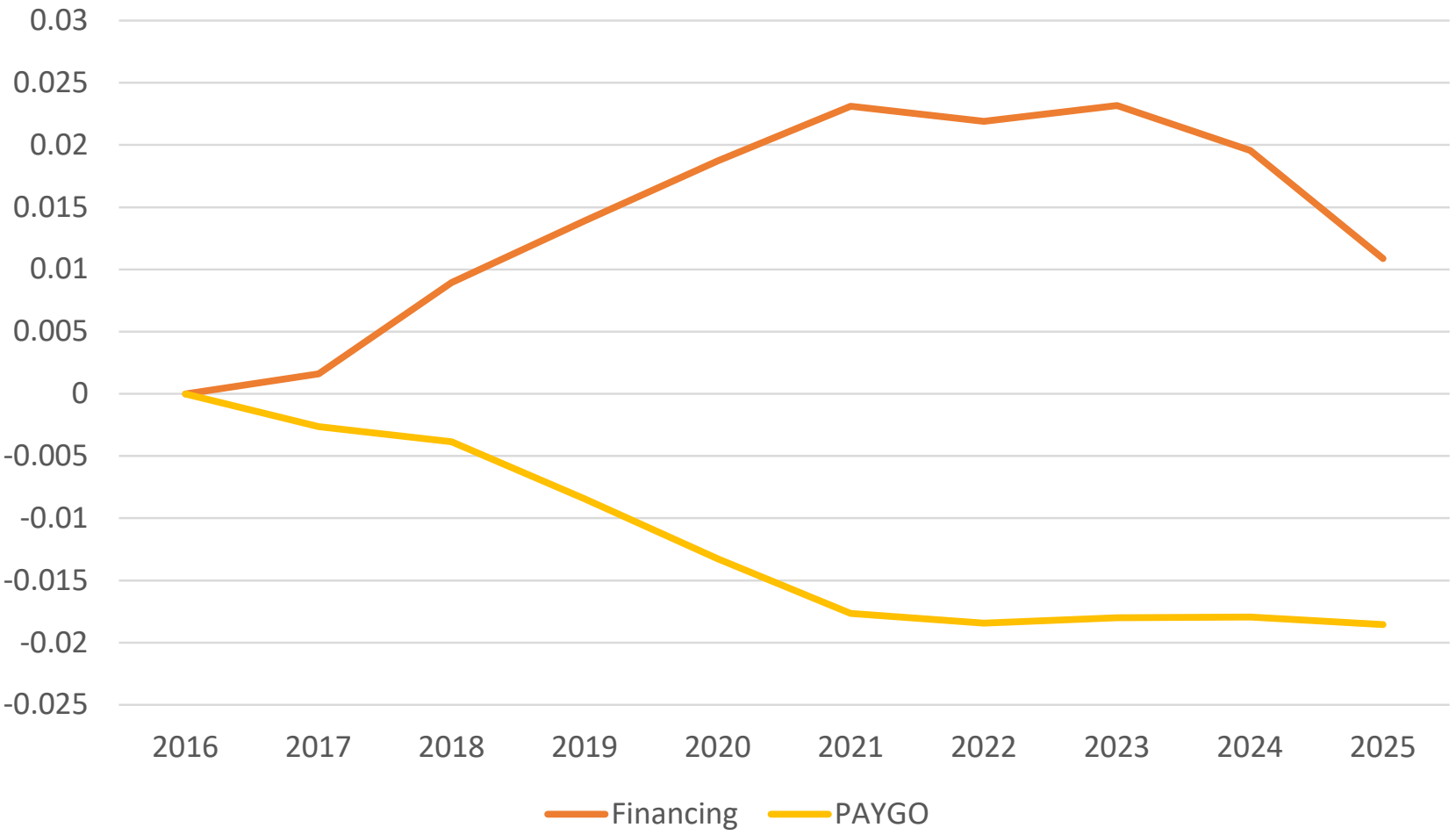
Employment
Financing scenario (normal and recession)



Nominal wages
Financing scenario (normal and recession)



Measuring relative welfare of Financing and PAYGO
Recession – Normal



Concluding remarks

- Specialist models are incredibly useful for understanding linkages in very specific areas.
- They fall short when important feedbacks are assumed away or treated as purely exogenous.
- Our study highlights one such linkage: between financial markets and the real economy.
- Our methodology allows us to quantify:
    - Indirect costs of debt-financed programs
    - Relative impacts on welfare of constituents, by scenario and by economic conditions.
    - **Findings:** taking advantage of excess capacity and damped interest rate pressures during recessions by front-loading expenditures can improve welfare.

Back pocket

Short summary:
Creating USAGE-Hwy from USAGE

USAGE-Hwy differs from other national real-side CGE models of the United States by CoPS, like USAGE2.

1. **Construction:** Split into Highways and Bridges, Street repairs, and other construction;

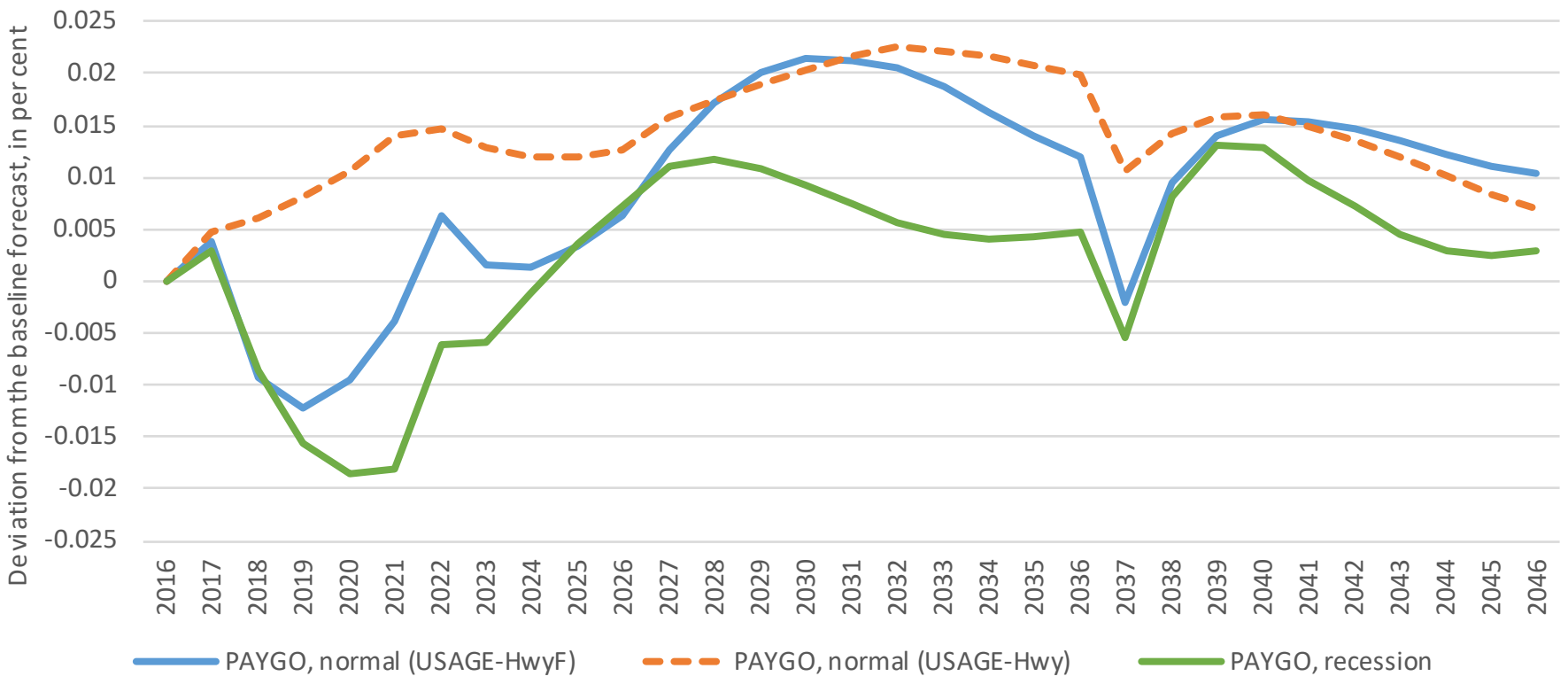
2. **Services NEC:** Split into household car repair and other services;

3. **Demand for transport by households:** Nested decision making via CES preferences across transport mode;

4. **In-house transport:** Four industries introduced to account for in-house air, water, rail and truck transport;

5. **Passenger travel time:** Modelled as cost-neutral phantom taxes that distort economic decision making across transport modes.
    - Travel time savings drive a combination of increased labour and leisure, rather than additional (longer) travel.

Employment
PAYGO scenario, USAGE-Hwy versus USAGE-HwyF (normal and recession)



Nominal wages
PAYGO scenario, USAGE-HwyF (normal and recession)