



Dutch disease in a new era

A tale of renewable resource dependence and tourism in Bhutan

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RENEWABLES IN BHUTAN I



- Carbon negative country
- Almost all electricity comes from renewables (hydropower)
- Major expansion: 11TWh in 2019 → 24TWh from 2025
- Large share exported to India

RENEWABLES IN BHUTAN II

- Primary driver of headline growth in Bhutan
- Period of investment due to end
- Concerns
 - Beyond hydropower investment?
 - Dependence on (renewable) resource revenue



‘DUTCH DISEASE’

- High growth in an enclaved resource-based sector
- Large export revenues → appreciation in the real exchange rate
 - ↓ export focused sectors and ↑ non-tradable service sectors

Resource sector	Lagging export sector	Countries
Oil	Manufacturing	Developed
Oil	Agriculture	Developing
Mining	Tourism	Australia
Hydropower	Tourism	Bhutan?

- Hydropower in Bhutan shares characteristics with the discovery of fossil reserves
- Dutch disease in the age of renewables?

MODEL

Computable General Equilibrium model (GAMS)

- STAGE (McDonald et al. 2022)
- Recursive dynamic mode: 2019-2030
- Endogenous updating of physical capital stocks

Social Accounting Matrix

- 2019 (Feuerbacher, 2022)
- Disaggregated electricity sector
- 38 commodities, 29 activities, 15 factors, 12 households

Closure

- Investment driven
- Mobile labour
- Exchange rate fixed (pegged to Rupee)

SCENARIOS

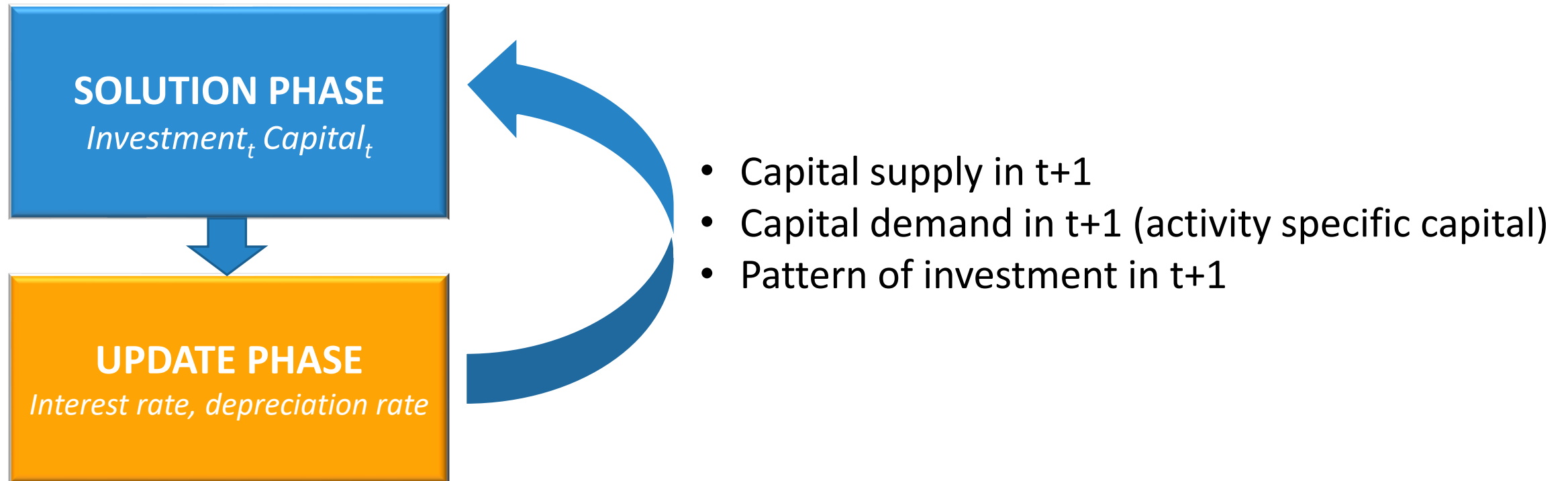
1. No additional hydro

- No further investment in hydropower after 2020
- Export revenues from existing hydropower only

2. Hydro-led

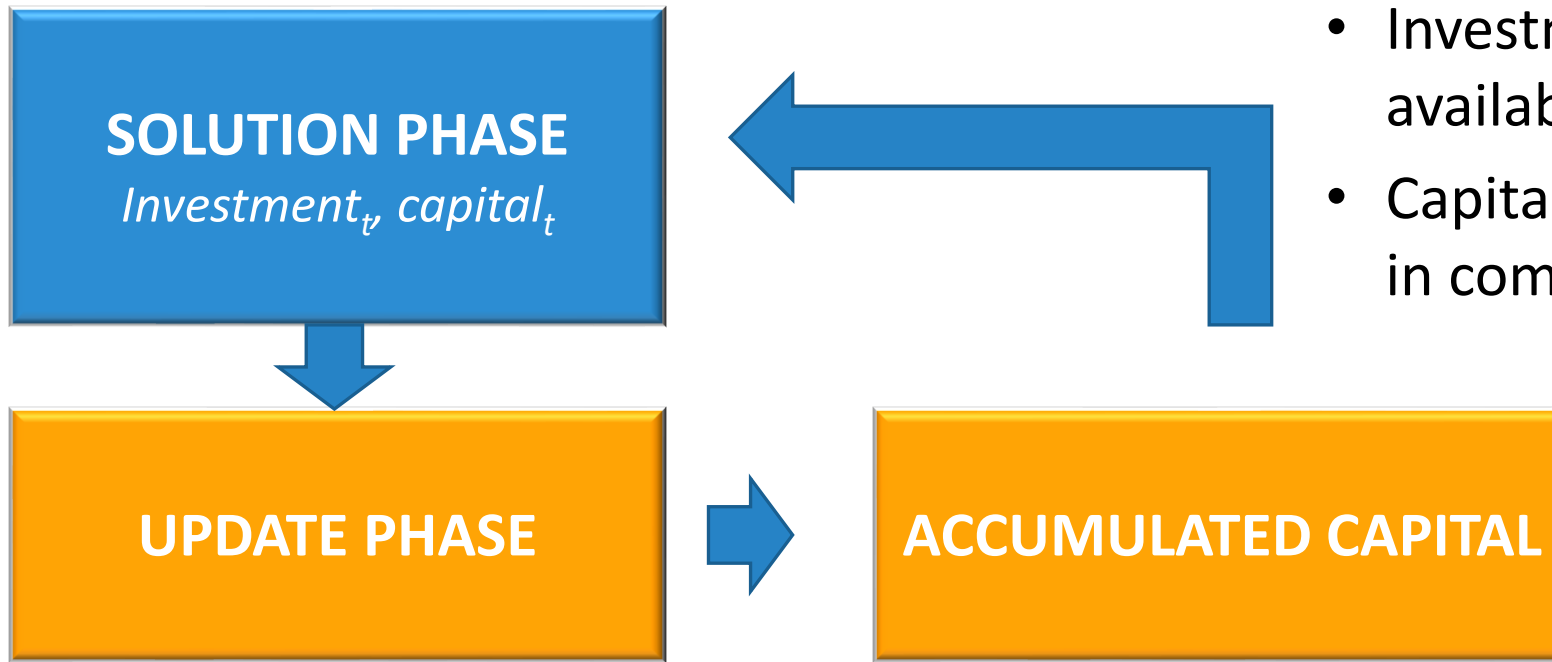
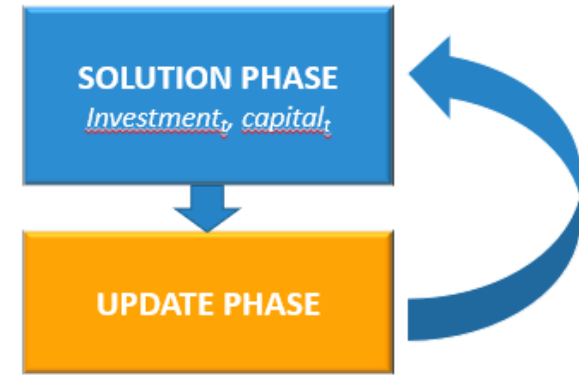
- 4 planned hydropower projects: Punatsangchhu I, Punatsangchhu II, Nikachhu and Kholongchhu
- Construction phase: 2019-2023/2025
- Commissioning: 2023, 2025
- No additional projects after 2025

CAPITAL ACCUMULATION



MODELLING LARGE SCALE INVESTMENT PROJECTS

Challenge: Delayed capital accumulation



- Investment in period t forms capital available in $t+n$ ($n>1$)
- Capital supply and demand only updated in commissioning years (2023, 2025)

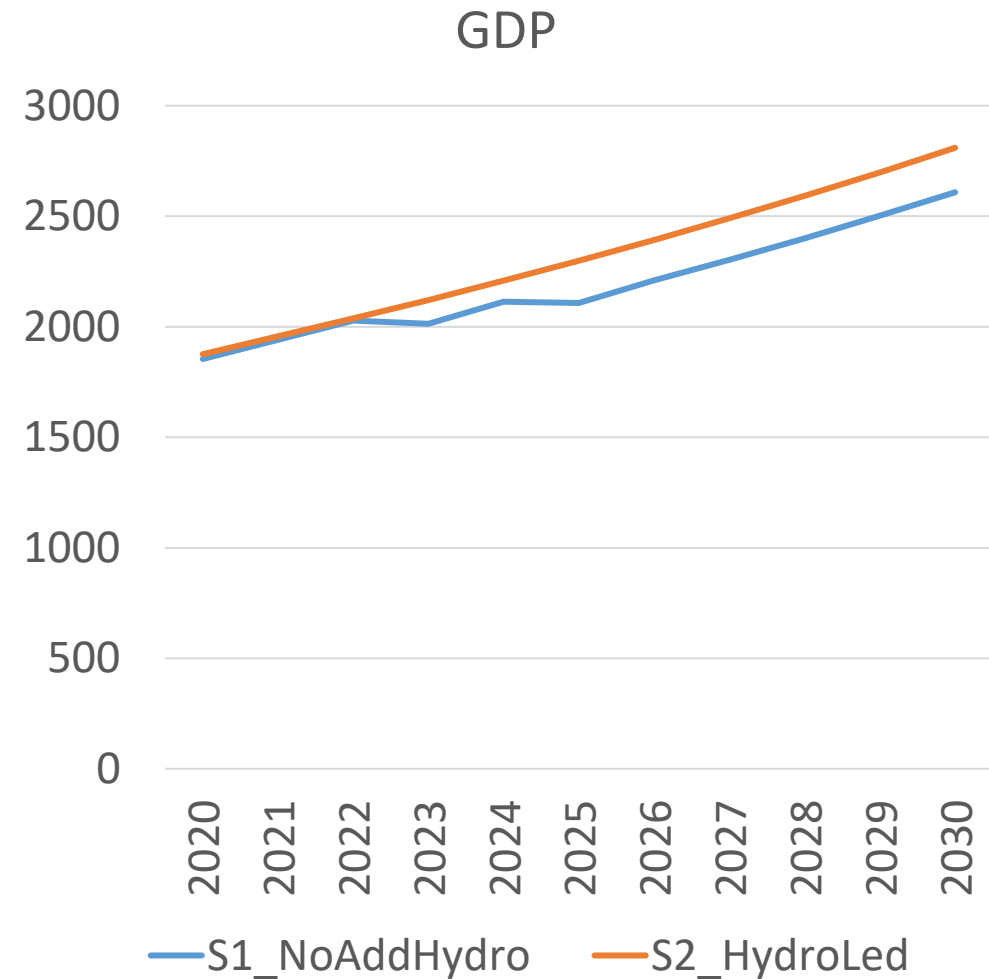
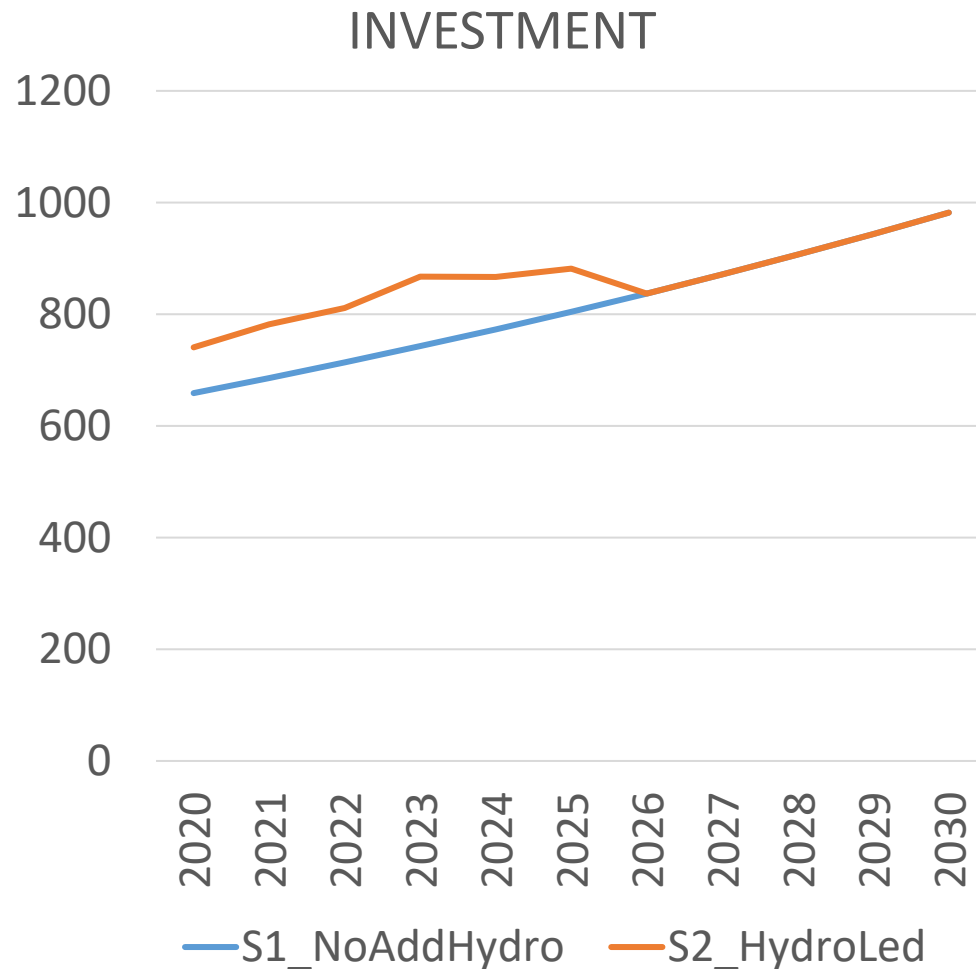
SCENARIO QUANTIFICATION

	S1 No additional hydro	S2 Hydro-led
Non-hydro investment (real)	35% of S2 real GDP projections	
Hydro investment after 2020 (real)	0	57401 (Nu, millions)
Hydroelectricity production	10.7TWh	10.7TWh (2019), 15.5TWh (2023), 23.6TWh (2025)
Hydro interest payments	Calibrated to yield hydro revenue projections (World Bank macro model).	

Common assumptions

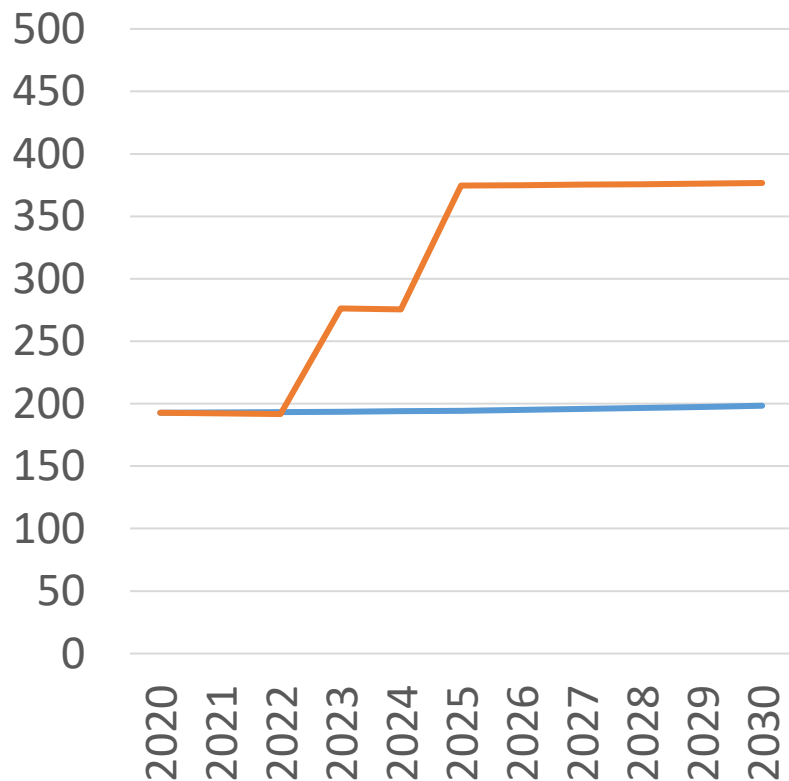
- TFP, employed workers, human capital accumulation, population
- Land area, yields, donor inflows

REAL INVESTMENT & GDP ('00 MILLION NU)

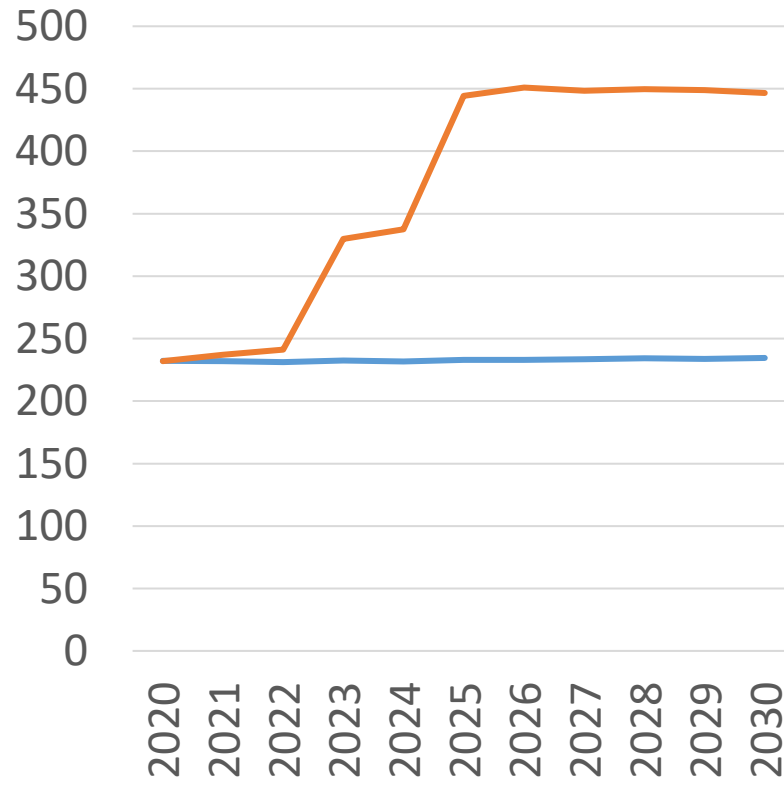


HYDROELECTRICITY ('00 MILLION NU)

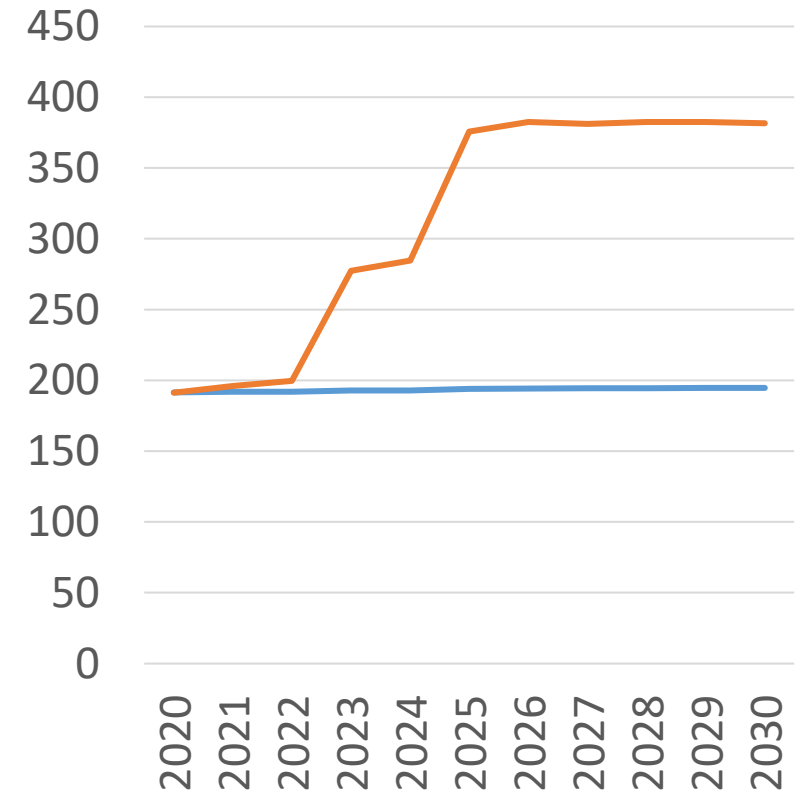
Hydro capital



Hydro production

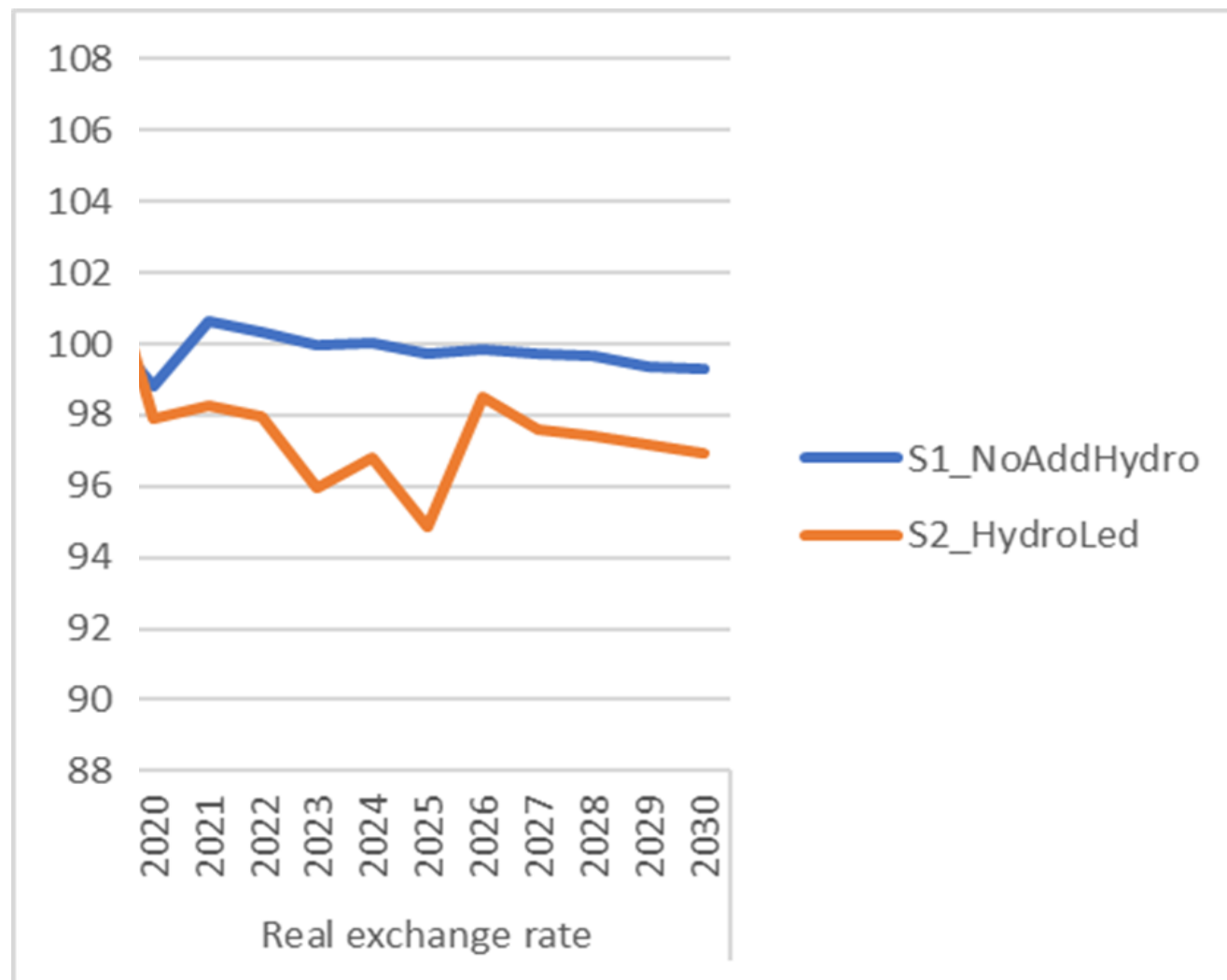


Hydro exports

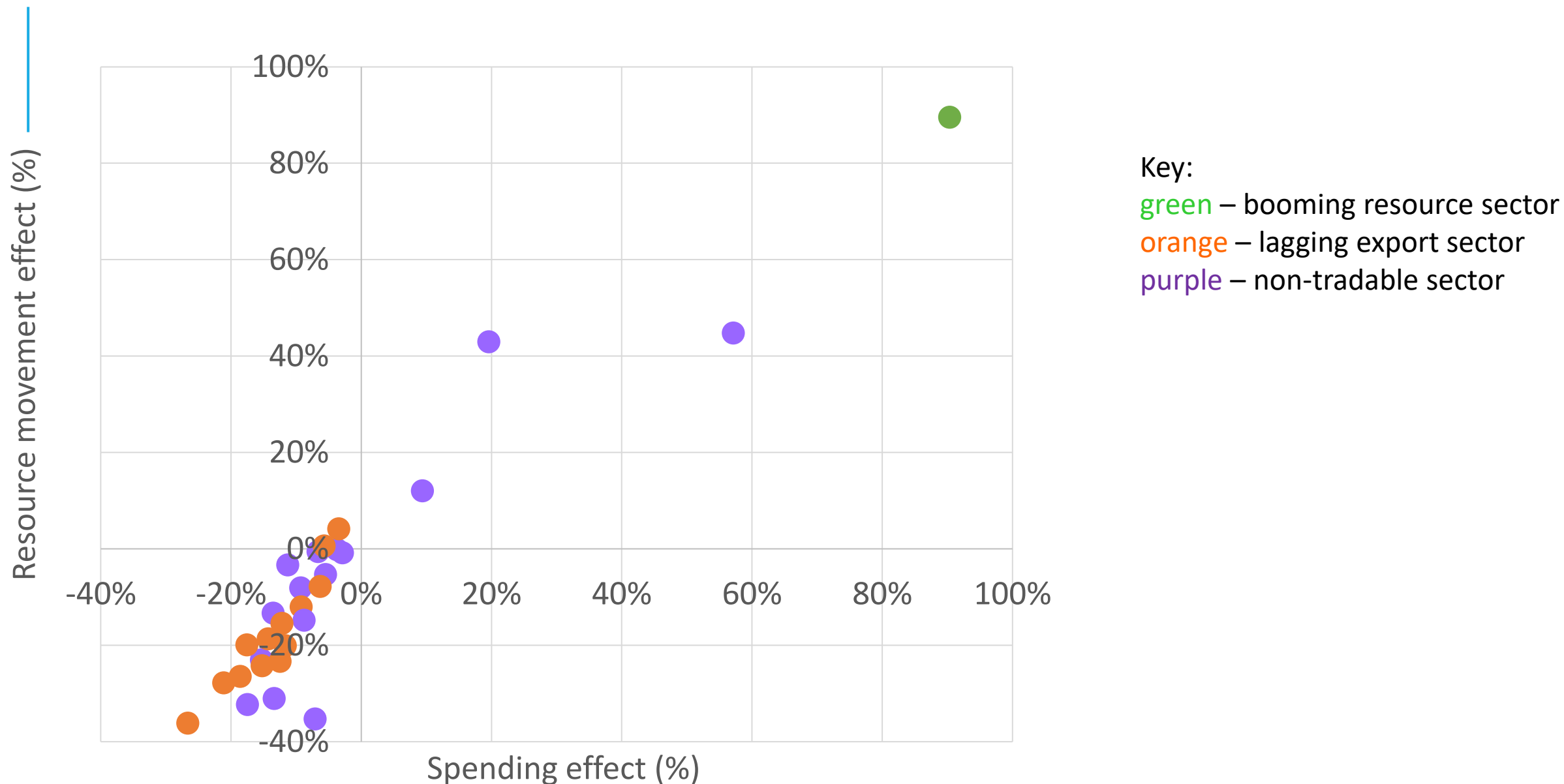


— S1_NoAddHydro — S2_HydroLed

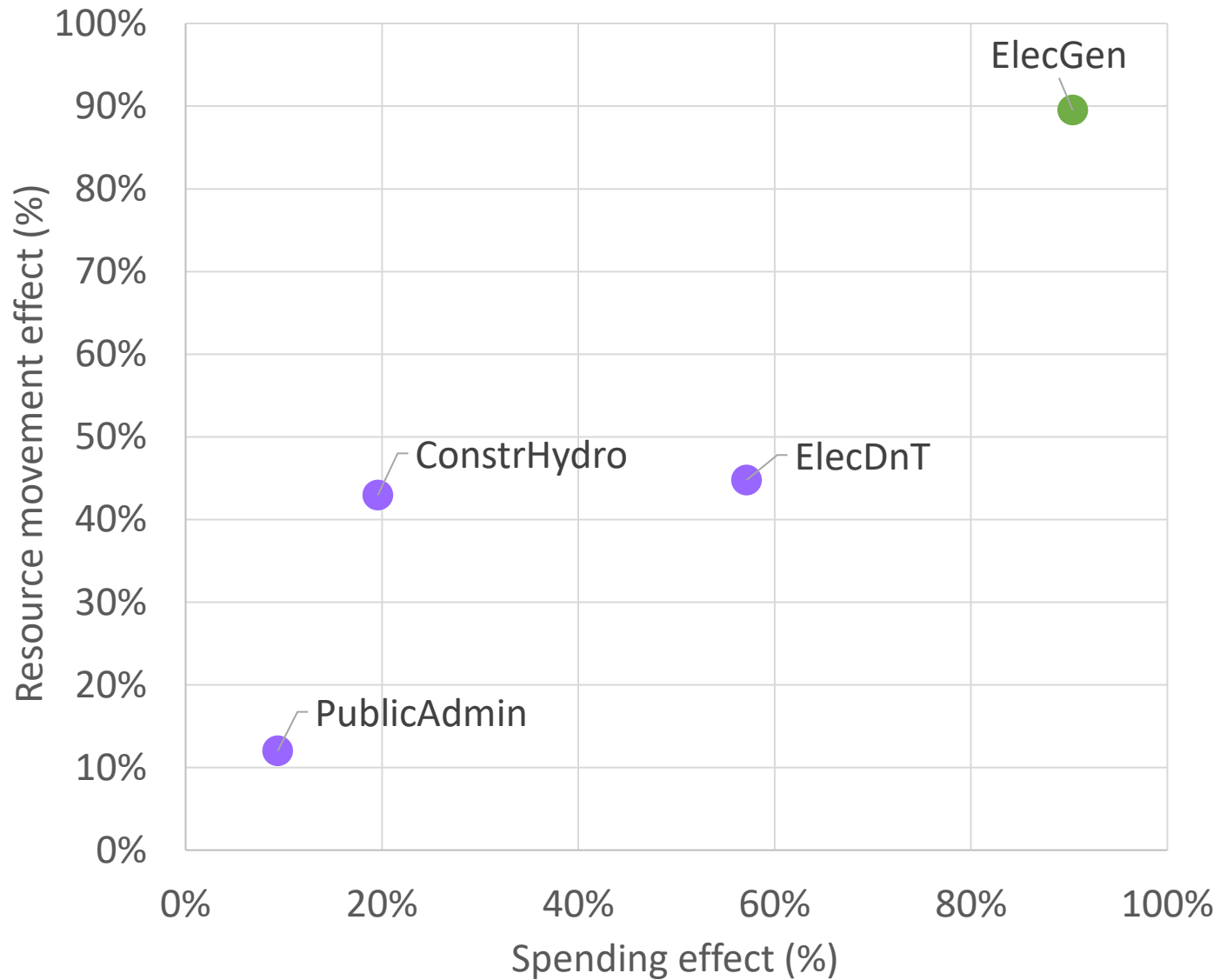
REAL EXCHANGE RATE



DUTCH DISEASE EFFECTS OF HYDROPOWER EXPANSION



DUTCH DISEASE: WINNERS



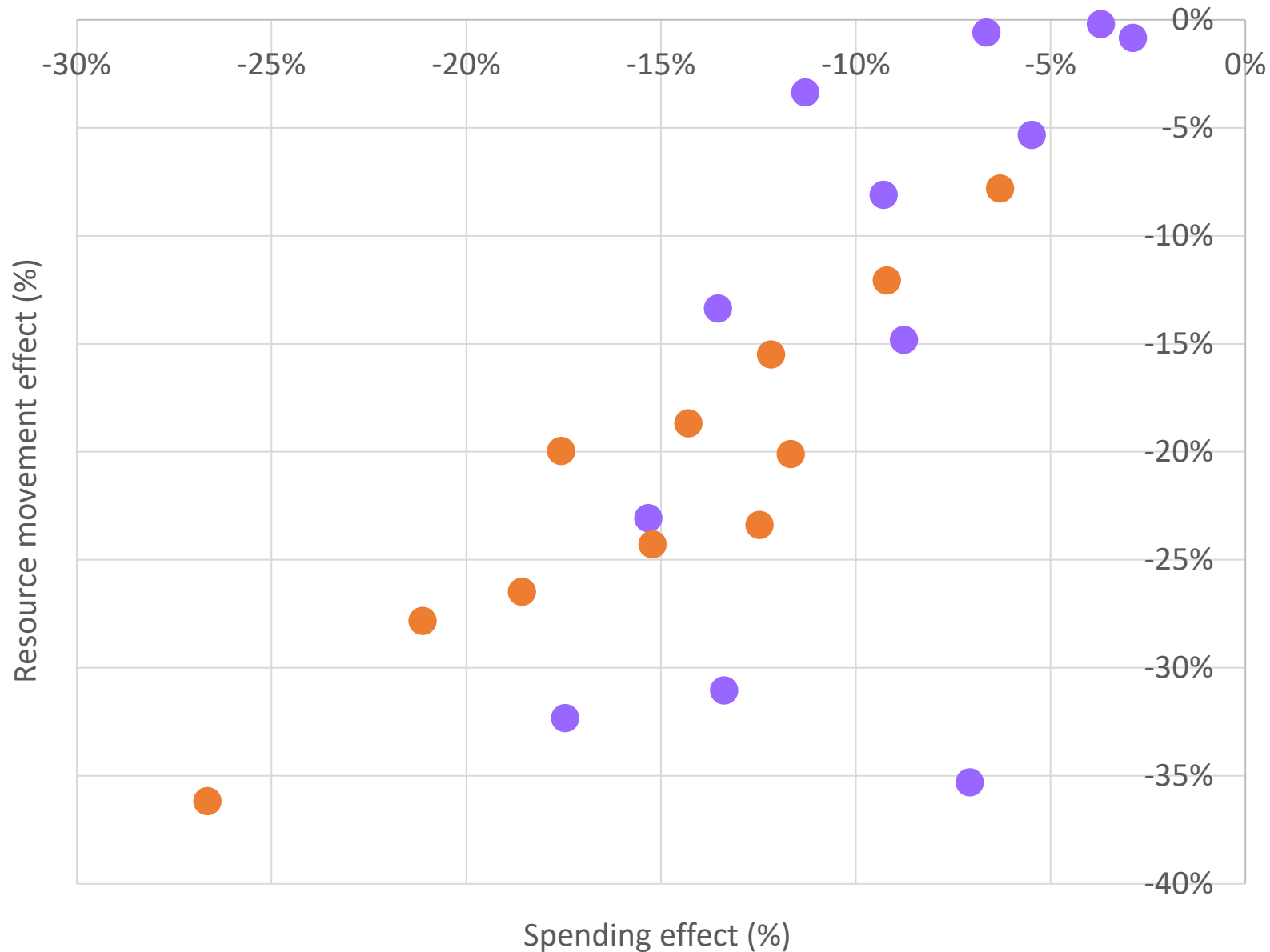
Key:

green – booming resource sector

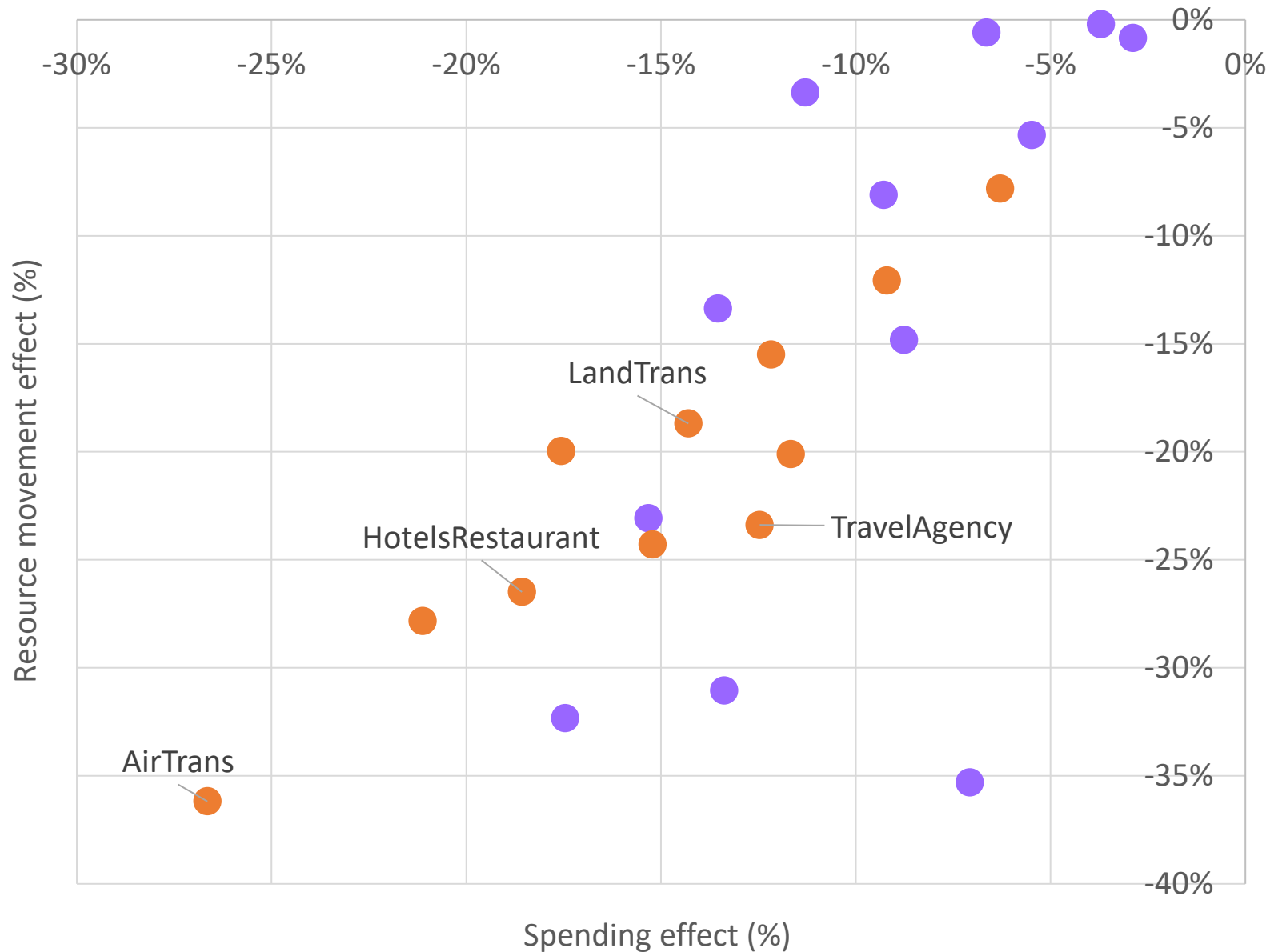
orange – lagging export sector

purple – non-tradable sector

DUTCH DISEASE: LOSERS



DUTCH DISEASE: LOSERS



SUMMARY

- Dutch Disease
 - Mechanism holds for renewable resource dependent economies
 - ↑ in real exchange rate
 - Suppresses key non-resource export sector - tourism
 - Strong effect: only boost to allied industries and public sector

RESPONSES

- Bhutan
 - Low volume, high value tourism strategy
 - Use revenues to offset loss of competitiveness
 - Invest in human and physical capital accumulation
 - Sovereign wealth fund
- For other countries
 - Large scale export of renewables