Monetary Policy under Climate Change

Bank of Greece

George Economides[1] and Anastasios Xepapadeas[2]

May 13 2019

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- A large body of literature studies:
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  - but also the ways in which to moderate these effects.
- It has been argued that climate change, especially in poor countries, may reduce growth rates and output levels.

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- Climate change policy has therefore been predominantly fiscal policy.
- Very little attention has been paid to the implications of climate change for the conduct of monetary policy and the role of Central Banks.

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- A vital question is whether climate change and the fiscal instruments used to control it could affect the design of monetary policy in a non-trivial way.
- The purpose and the contribution of the present paper is to explore this issue and to demonstrate how and to what extent monetary policy should be adjusted under conditions of climate change.

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- Each of these negative supply shocks will likely lead to a contraction in the economy's productive capacity, thus generating higher prices and diminishing growth rates.
- The more persistent these shocks are, the higher are the chances that they will lead to a permanent reduction of potential output, affecting not only economies' cycles but also their longer-term trends.

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  - On the one hand, energy enters as a separate factor in the firm's production function, thus increasing output.
  - On the other hand, the processing of fossil fuels generates GHG emissions which increase the GHG concentration in the atmosphere, which in turn increases temperature. Higher temperatures negatively affect economic outcomes.

What this paper does-2

Production function

- Output is produced using physical capital, labour and energy:

$$y_t = \widehat{A}_t k_{t-1}^{\alpha_1} h_t^{\alpha_2} E_t^{1-\alpha_1-\alpha_2}$$

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- Dynamics of Global Carbon Emissions:

$$S_t = (1 - \delta^e) S_{t-1} + E_t$$

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- Our framework could be thought of as an integrated assessment model (IAM) in the sense that we incorporate both an economic and a climate sector in a unified setup.
- Monetary policy is assumed to be conducted through the nominal interest rate on government bonds which follows a standard Taylor-type rule (see, e.g., Taylor, 1979, 1993, 1999).

Main results

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- In particular, three main results are established.

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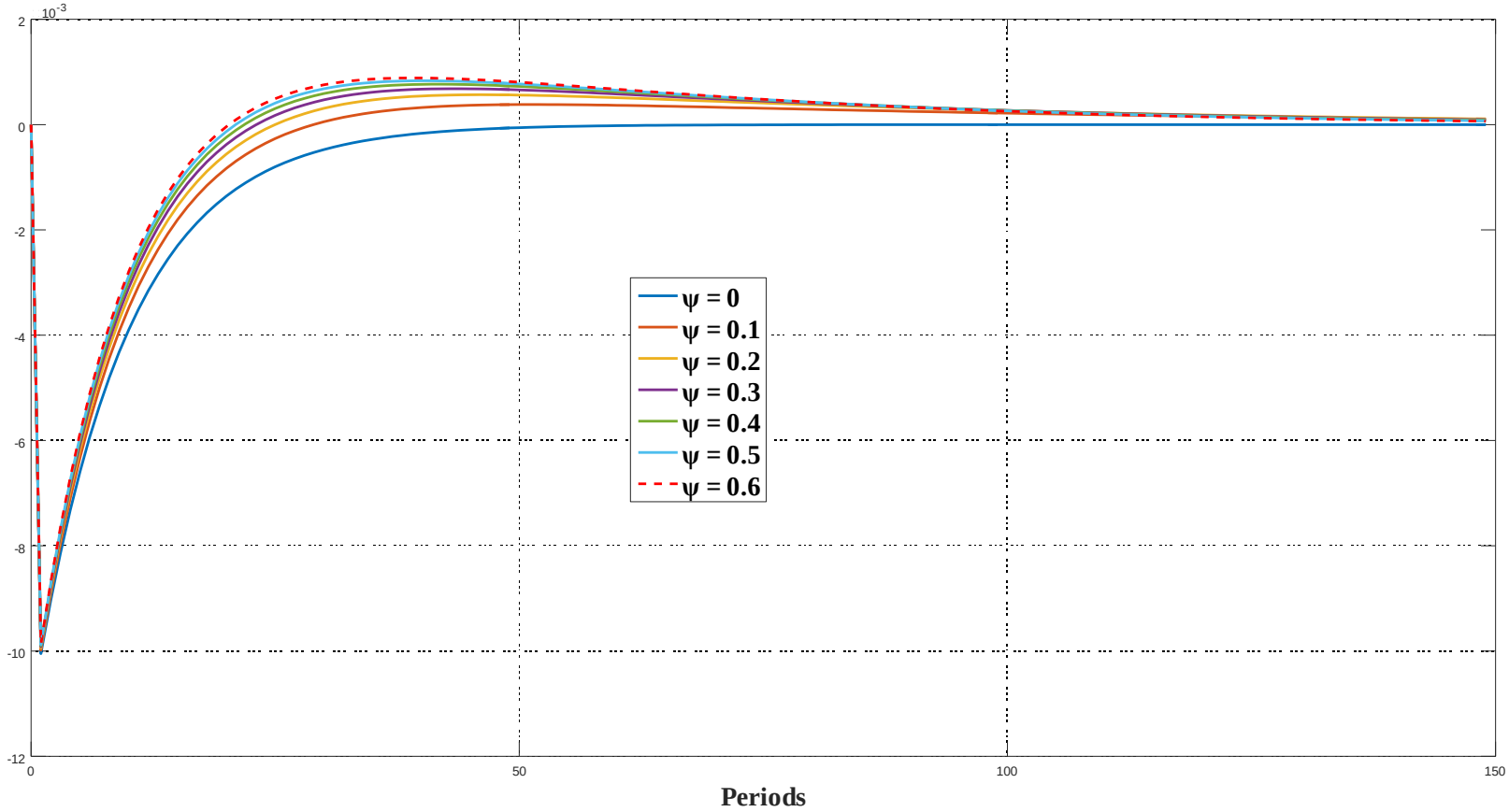
- After a TFP shock, the return of the economy's output to the steady state is slower, and is characterized by oscillations, compared to an economy in which the impact of climate change has not been incorporated.
- Thus, our results seem to confirm the concern that climate change is associated with longer-term turmoil in economic activity.

First result-2

% Deviation of Adjusted TFP from the Steady State



Second result-1

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- This happens because:
  - the negative TFP shock decreases both output and the demand for energy, and
  - the latter effect causes a decrease in the use of fossil fuels, which positively affects the productivity of the economy (through the slowdown in temperature rise).

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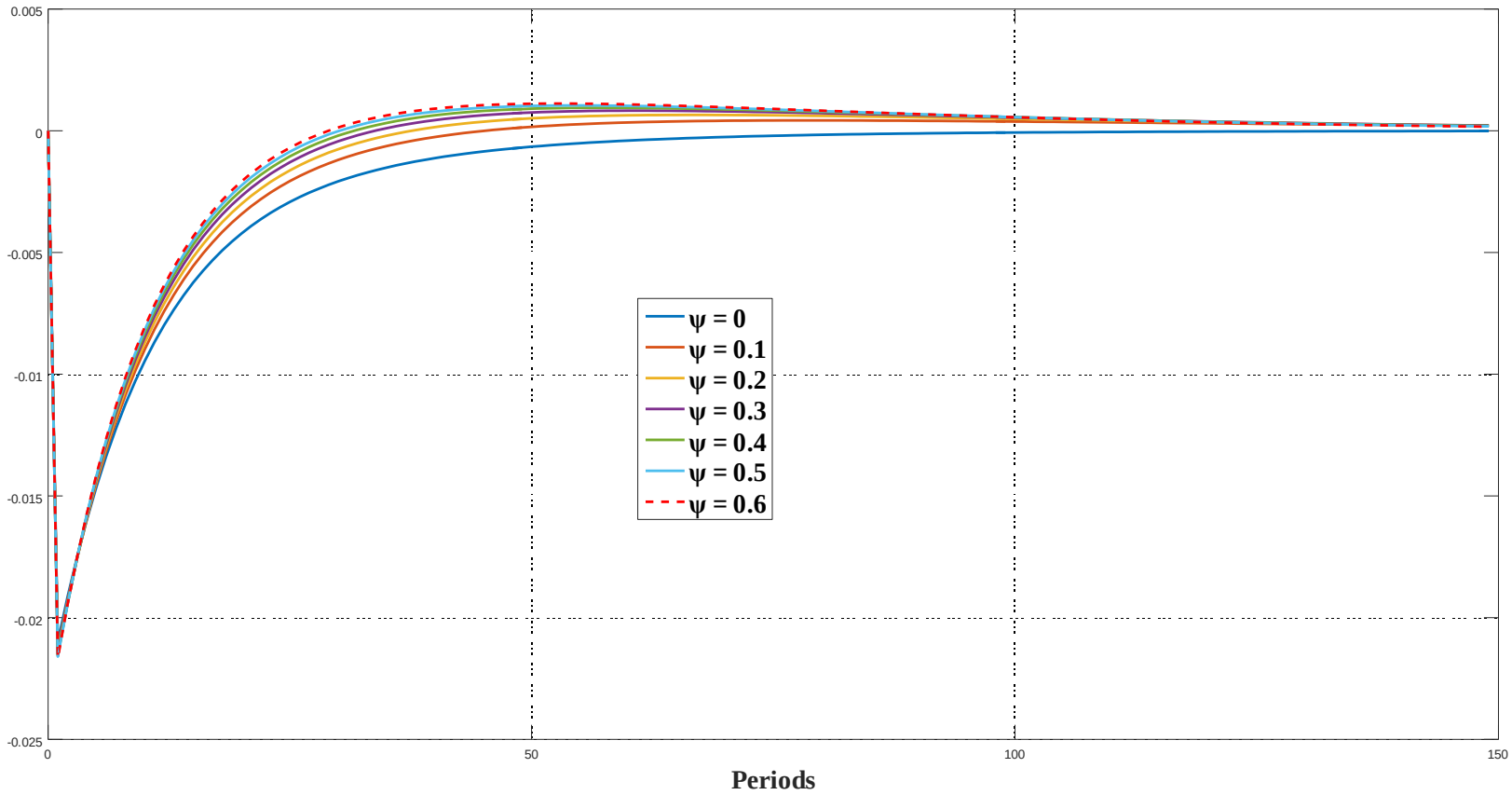
- The strength of this positive effect depends on the magnitude of the damage elasticity of output which captures the detrimental effects of climate change on the economy's productivity.
- Thus, although output initially falls below the steady-state level due to the negative TFP shock, it rises above it afterwards, before eventually converging again to the steady state.
- Therefore, incorporating climate change into a standard new Keynesian framework requires revisiting the design of the appropriate monetary policies when the aim is short-term stabilization.

Second result-3

The CB cares only about the inflation gap - % Deviation of Output from the Steady State



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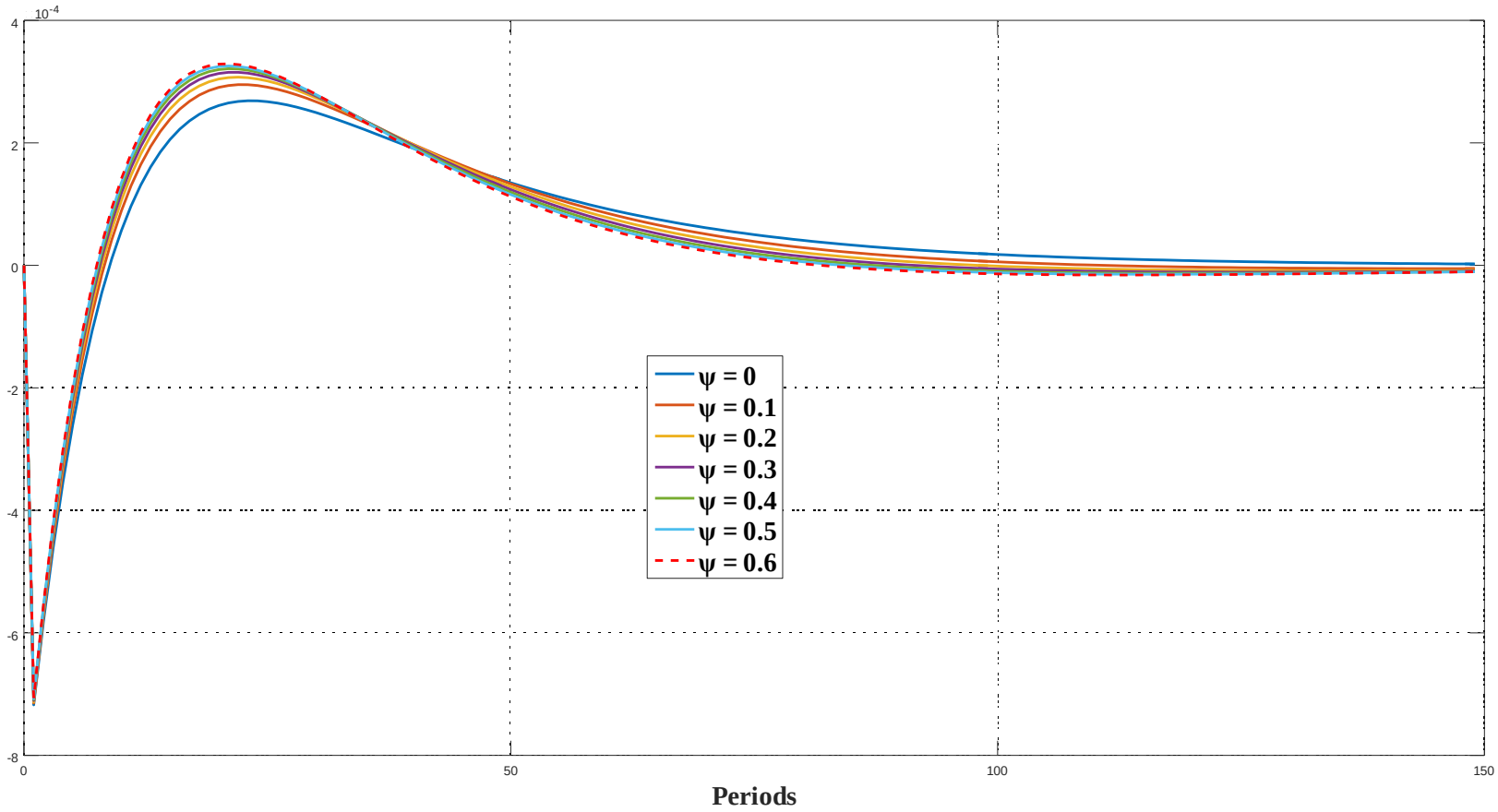
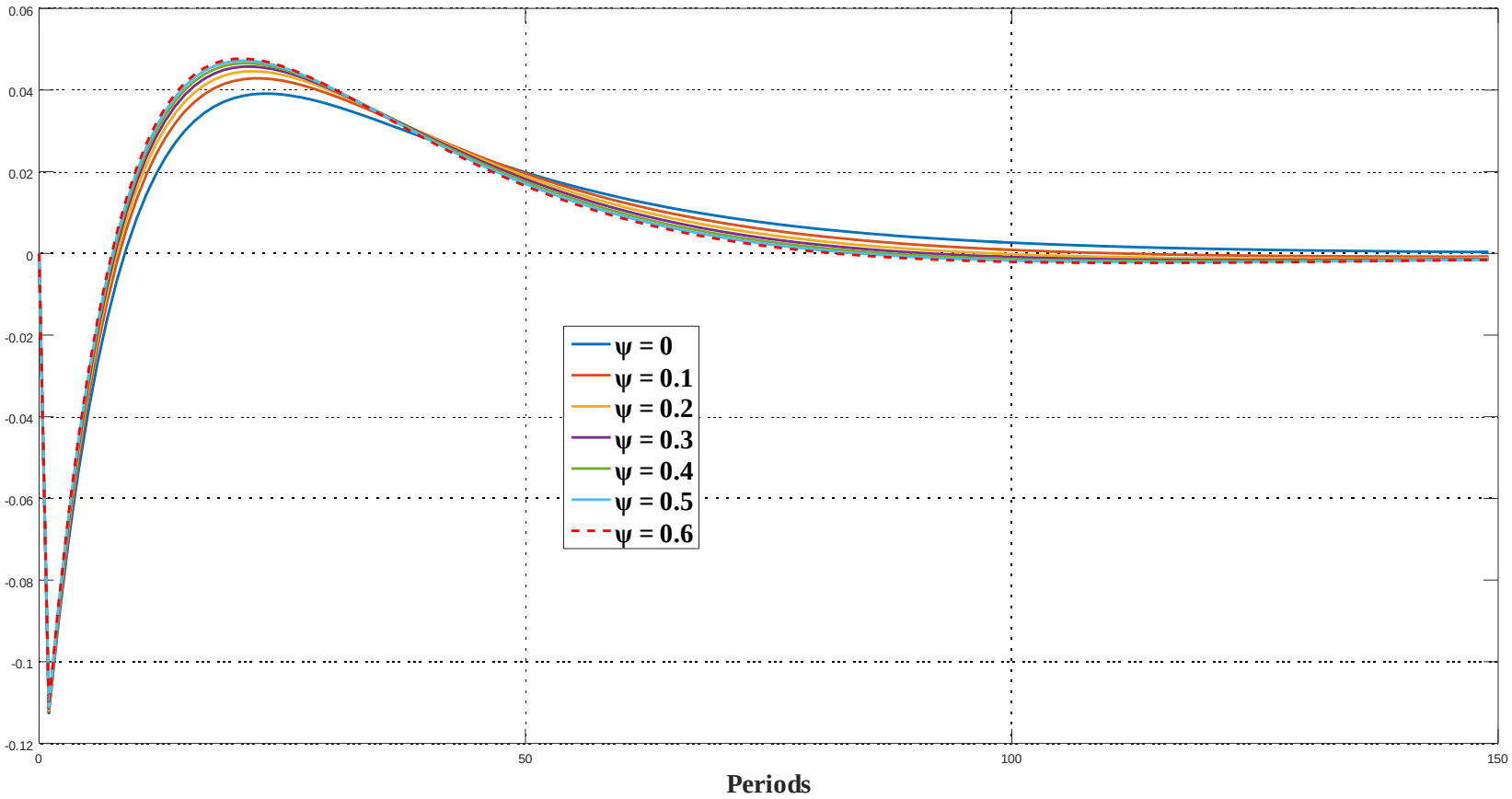


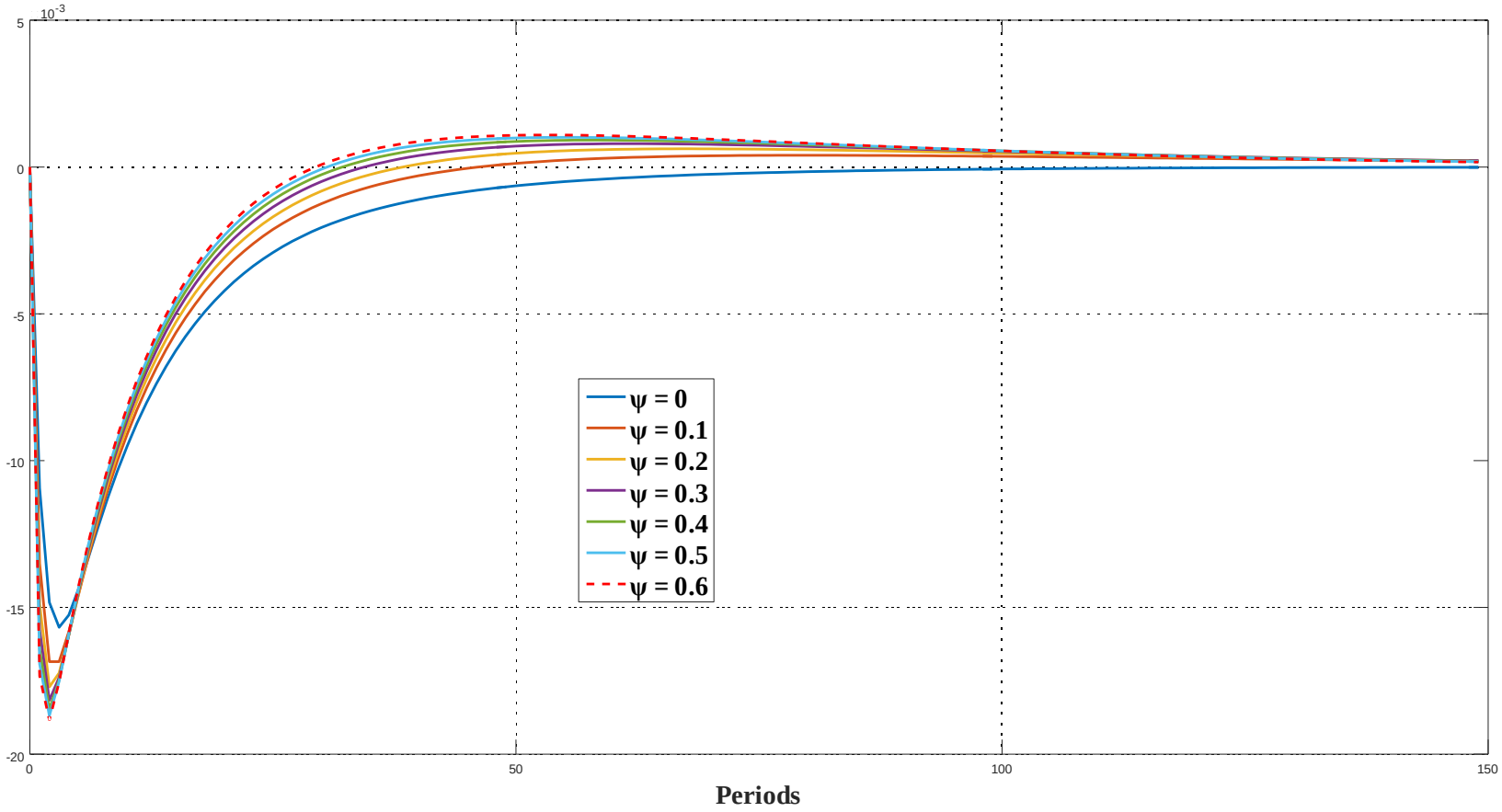
Second result-5

The CB cares only about the inflation gap - % Deviation of Nominal Interest Rate from the Steady State



Second result-6

The CB cares also about the output gap - % Deviation of Output from the Steady State



Second result-7

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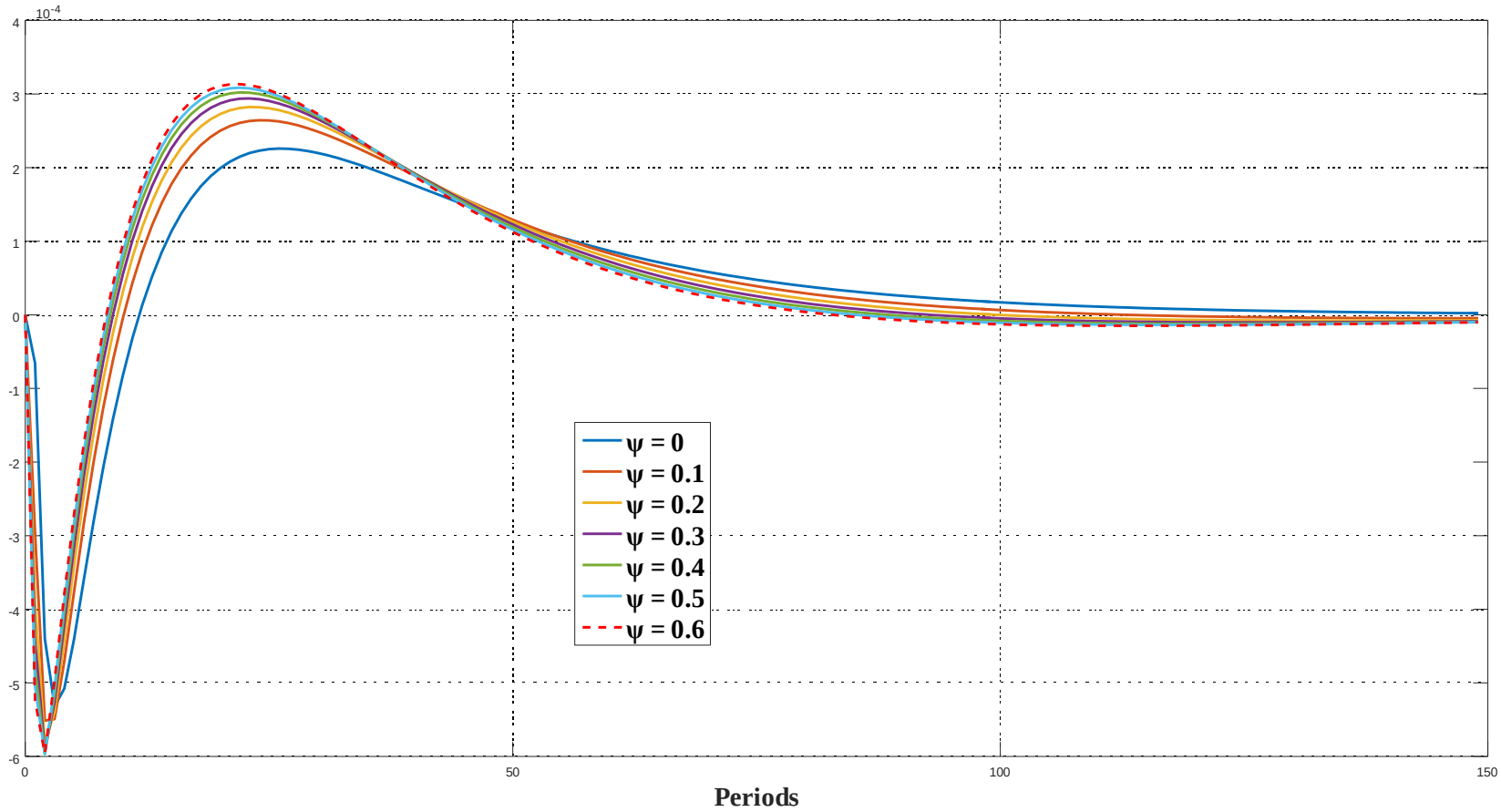
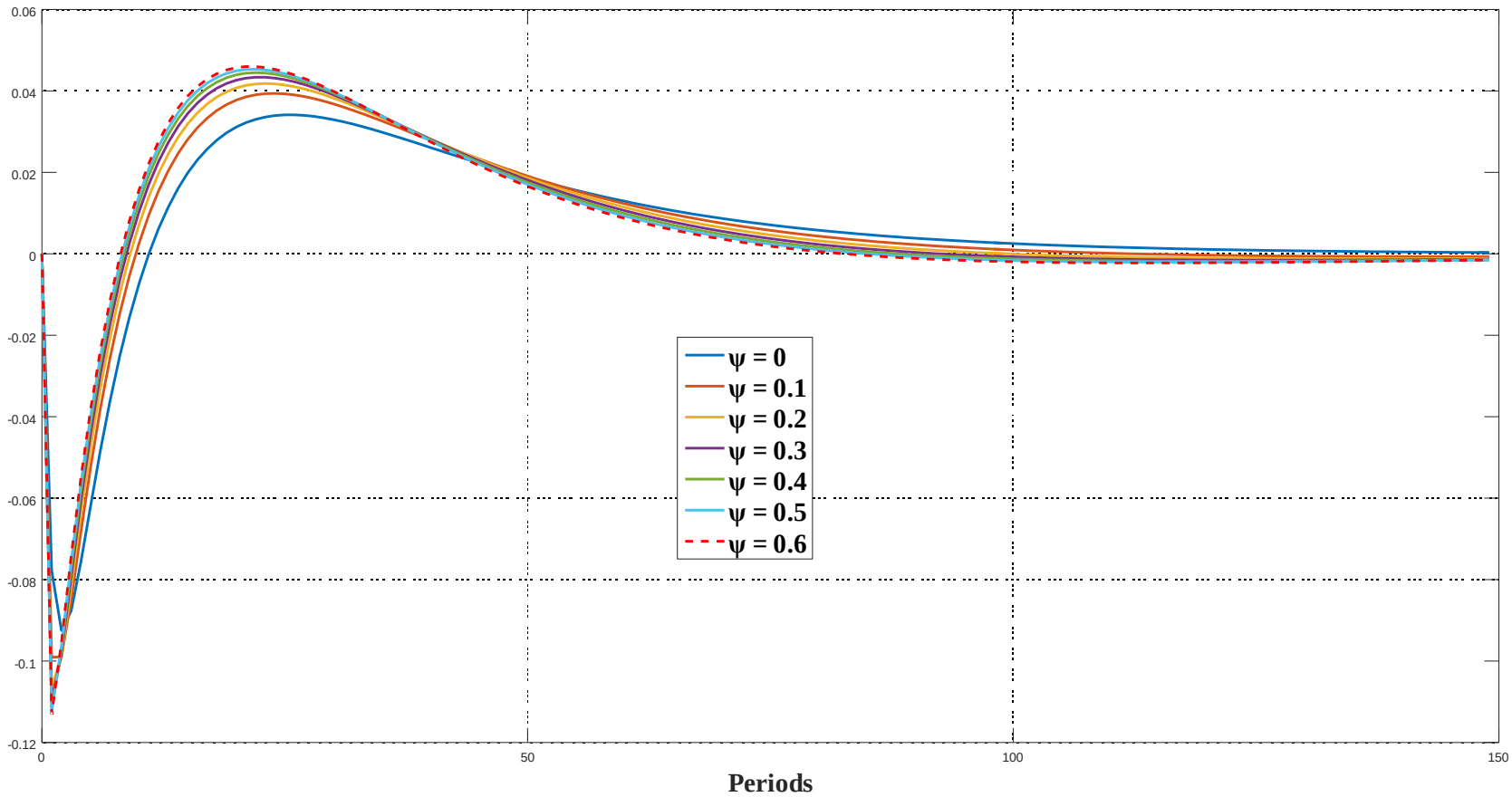


Second result-8

The CB cares also about the output gap - % Deviation of Nominal Interest Rate from the Steady State



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- In other words, the adoption of climate policies, in the form of carbon taxes, seems to imply a short-term cost in terms of output but is growth enhancing in the long run.
- This seemingly paradoxical result is not due to the substitution of more distorting taxes by the less distorting carbon taxes, as the literature on the "double dividend hypothesis" would probably suggest.

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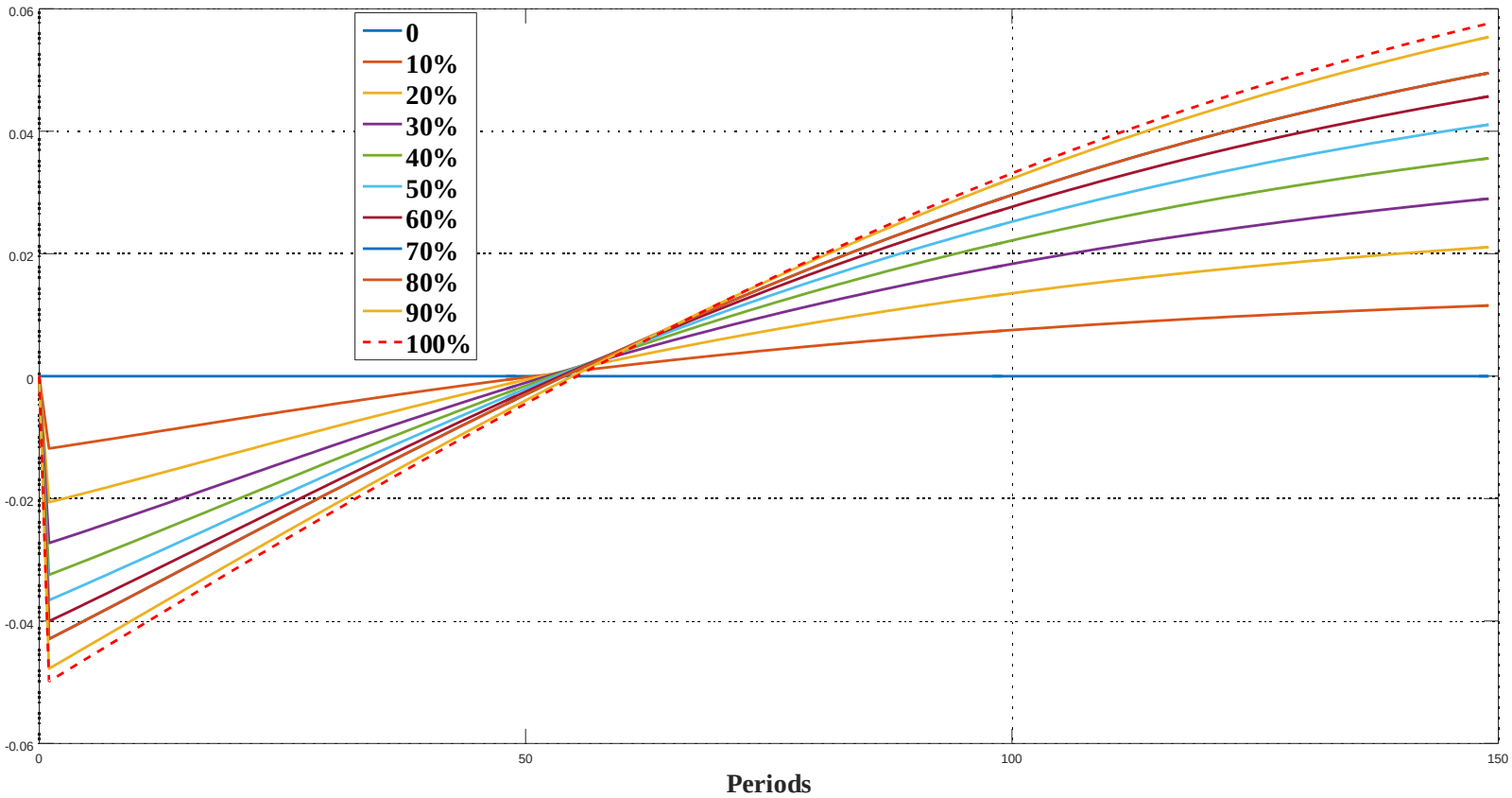
- The decrease in the use of fossil fuels initially reduces output but in the long run it positively affects the productivity of the economy, ultimately leading to a higher output level.
- As a result, during the transition from the initial steady state to the new long-run equilibrium, there will be fluctuations in both output and price level, which should be taken into account when designing the appropriate monetary policy actions.

Third result-3

% Deviation of Output from the Steady State without Carbon Taxes



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- Optimal policies.

The effects of climate change on a small open economy

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- This is important, because although a small open economy cannot seriously affect the dynamics of climate change, through its economic activity and the associated emmited pollution, it can suffer from the impact of climate change.

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- Our framework could be thought of as an integrated assessment model (IAM) in the sense that we incorporate both an economic and a climate sector in a unified setup.

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Production function

- Output is produced using physical capital, labour and energy:

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- Damage elasticity of output for the Greek economy:

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- The temperature anomaly 2018-2100:

PERIOD	PES	OPT
$2018-2030$	15.9	15.7
$2031-2040$	16.4	16.1
$2041-2050$	16.9	16.4
$2051-2060$	17.4	16.4
$2061-2070$	17.9	16.4
$2071-2080$	18.4	16.4
$2081-2090$	18.9	16.4
$2091-2100$	19.4	16.4

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- We first study the case in which there is not monetary policy independence (i.e. this is equivalent to assuming that the small open economy participates in a monetary union), and then we also investigate the case with flexible exchange rates.

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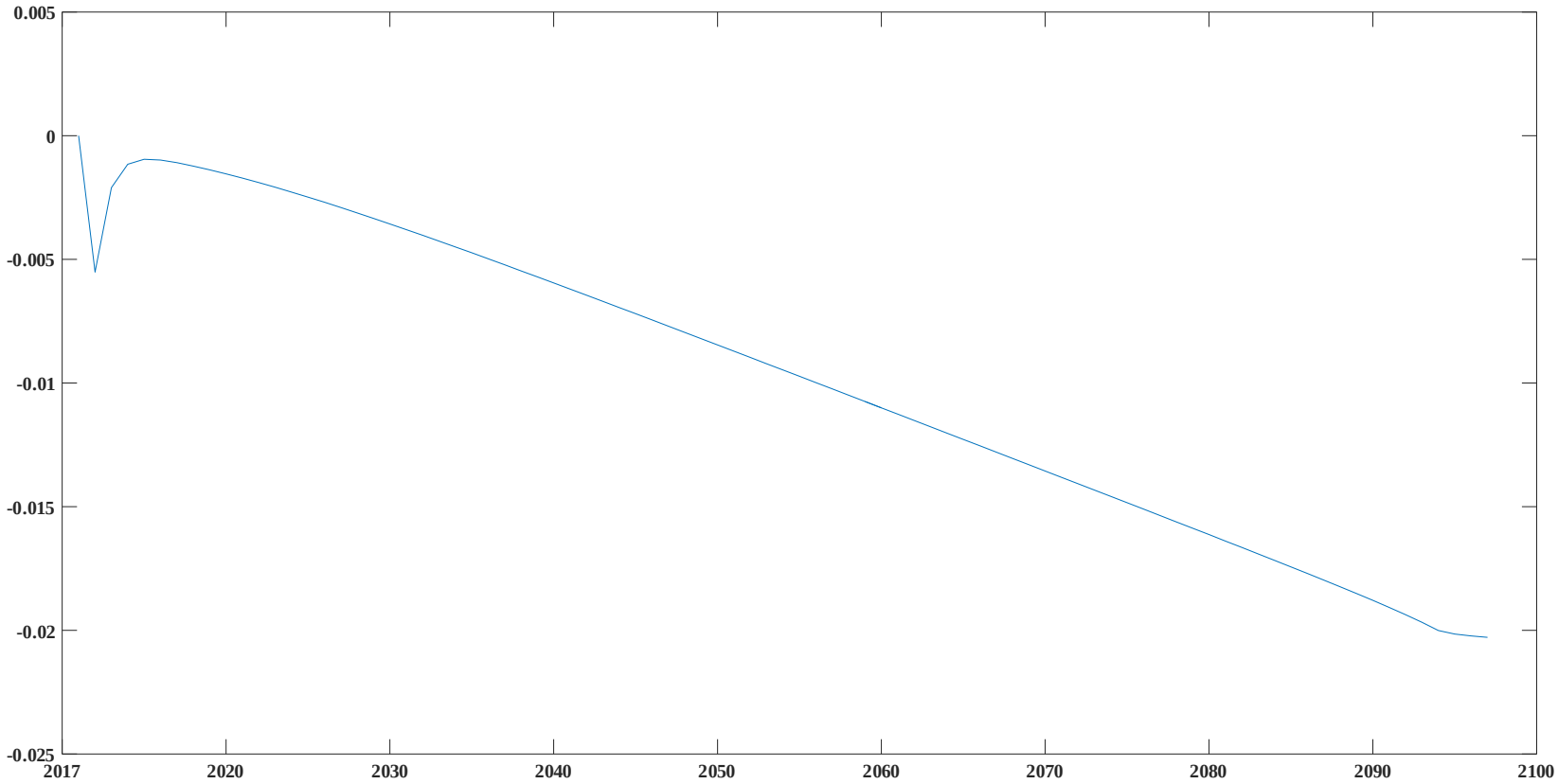
  - First, irrespectively of the type of the exchange rate regime, climate change implies a significant output loss.
  - Second, given the climate change, and in the case without monetary policy independence, the effect of a, negative, temporary TFP shock, is bigger relative to the case without climate change (at least in the impact period).

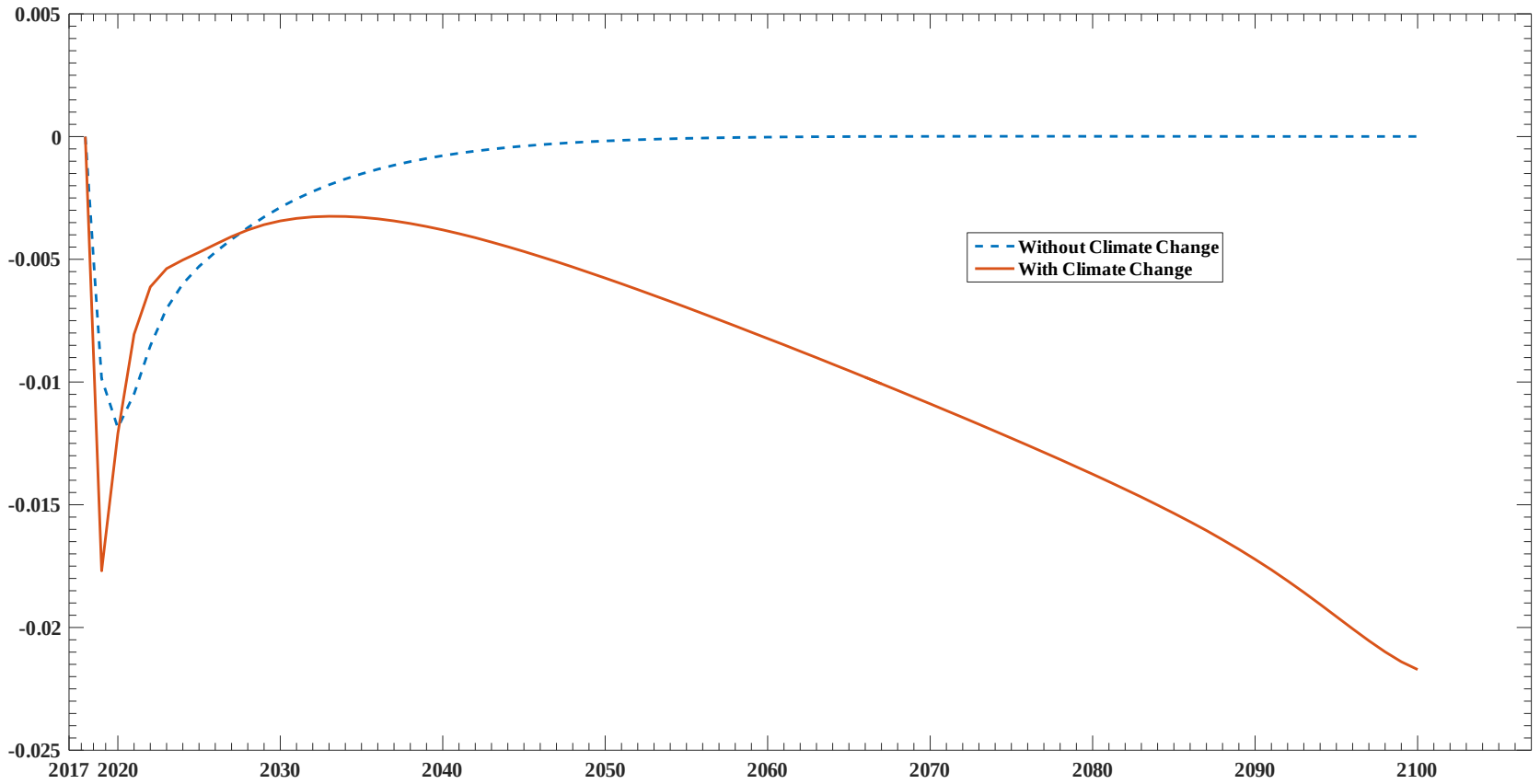
First result

(% deviation of real income from its initial steady state value)



Second result

(% deviation of real income from its steady state value)



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- Additional environmental policy instruments.
- Introduce two types of firms producing "brown" and "green" energy.
- Optimal policies.