Main objectives:
- Study lower-for-longer monetary policy strategies under endogenous technology growth
- Evaluate their effectiveness in terms of inflation and output stabilization at the ELB (over both the short- and long-run)
- Analyze their relative performance and potential trade-offs in this context

Research questions:
- What are the true ELB-induced costs when accounting for the long-run output losses through hysteresis effects in TFP?
- What are the benefits and side-effects of targeting the long-run output gap?
- How do lower-for-longer monetary policy strategies perform under endogenous technology growth?

Model
- Medium-scale DSGE model with endogenous total factor productivity dynamics
- Endogenous technology growth mechanism (Comin and Gertler (2006)):
  - Innovation through R&D
  - Technology adoption
- Otherwise standard DSGE model features (Smets and Wouters (2007)):
  - Calvo price and wage rigidities
  - ELB constraint
- Monetary policy strategies:
  - “Bygones” approach: Standard Taylor rules
  - Hysteresis-augmented Taylor rule
  - (Temporary) price level targeting
  - Average inflation targeting

Inflation volatility vs. long-run output losses
<table>
<thead>
<tr>
<th></th>
<th>Long-run output gap</th>
<th>Inflation overshooting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Std. TR</td>
<td>-1.78</td>
<td>0.58</td>
</tr>
<tr>
<td>Hysteresis</td>
<td>-1.14</td>
<td>4.52</td>
</tr>
<tr>
<td>PLT</td>
<td>-1.04</td>
<td>1.04</td>
</tr>
<tr>
<td>AIT (1y)</td>
<td>-2.89</td>
<td>0.14</td>
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<tr>
<td>AIT (2y)</td>
<td>-1.03</td>
<td>0.08</td>
</tr>
<tr>
<td>TPLT</td>
<td>-0.53</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Dynamics under inflationary shocks
- Temporary PLT permits larger permanent TFP gains
- Stronger response to offset inflation under PLT and AIT reduces the technology increases in the upswing
- Novel channel for credibility issues: would monetary policy be ready to counteract not only improvements in the short-run output gap but also in the long-run output path?

Conclusions
- Long-run money non-neutrality: Conduct of monetary policy affects the long-term output path
- Losses owed to the ELB more severe than commonly assessed owed to hysteresis effects in total factor productivity
- Premature tightening under “bygones” strategies
- Lower-for-longer strategies support alignment of inflation with target and alleviate long-term output losses at the ELB
- Relative advantage subject to trade-offs:
  - Inflation volatility vs. long-run output losses
  - Measurement of the technology gap
  - Response to inflationary shocks and related credibility issues

Higher ELB-induced costs due to output hysteresis

Figure 1: Impulse response in the model with and without the ELB (liquidity demand shock)
- Demand-supply spillovers: Weak aggregate demand induces a procyclical drop in investment in R&D and technology adoption
- Hysteresis effects in TFP: the fall in productivity-improving investments generates a drop of TFP relative to trend and thus permanent output losses
- ELB-induced costs more severe than commonly assessed owed to supply-side scarring (effect increasing in depth and length of ELB episode)

Hysteresis-augmented Taylor rule

Figure 2: Impulse response under the rule targeting the technology gap
- Premature tightening under “bygones approach” in the standard Taylor rule
- Lower-for-longer feature supports inflation and closure of short-run output gap
- Targeting the technology gap fully prevents long-run output losses

Figure 3: Impulse response under temporary price level targeting
- Inflation shortfall made up in full in subsequent overshooting episode
- Positive effect on short-run output gap
- Reduction of long-term output losses

Figure 4: Impulse response under average inflation targeting
- Restricts accumulation of inflation shortfall to averaging horizon
- Beneficial effect on inflation and the short-run output gap
- Longer averaging windows associated with reduced long-run output losses

Figure 5: Impulse response to a positive liquidity demand shock

Table 1: Inflation volatility and long-term output losses in the ELB episode (long-run gap: dev. from initial steady state. (in %); inflation: cumul. dev. from target (in %))