Interest rates during and after the crisis: Leaning against the wind, or not?

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Workshop on “Interest rates after the financial crisis,”
Örebro University and Kommuninvest, Örebro, October 3–4, 2017

Outline

- Workshop: "Interest rates after the financial crisis"

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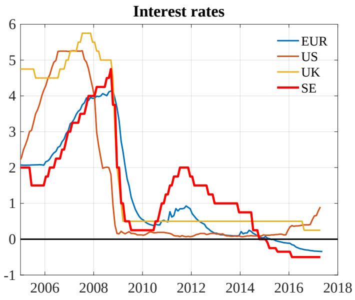
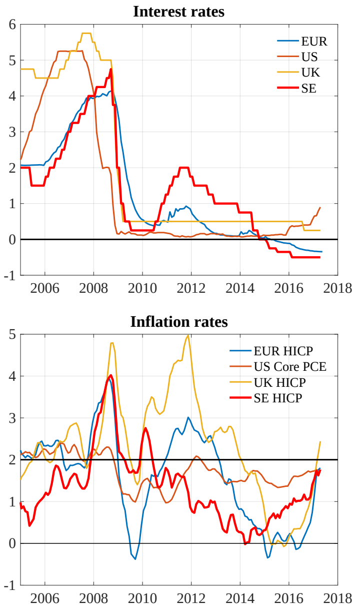
- Was it worth it?
- Cost-benefit analysis of leaning against the wind (JME Oct 2017)

Riksbank LAW 2010–2013 1

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EUR
US
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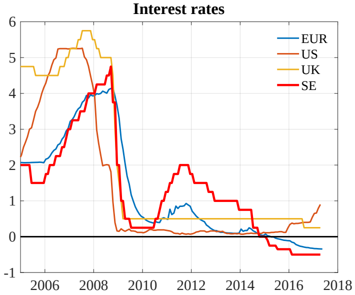

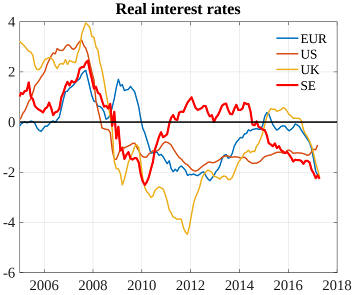

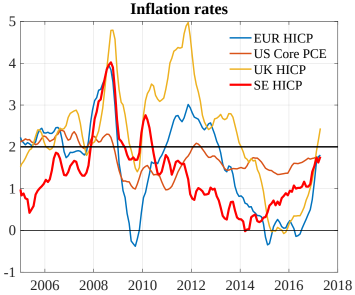

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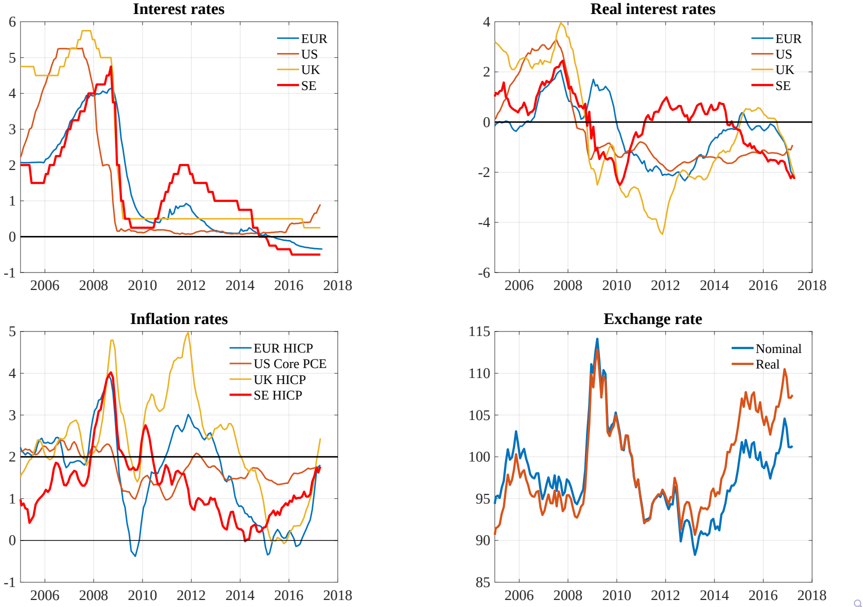
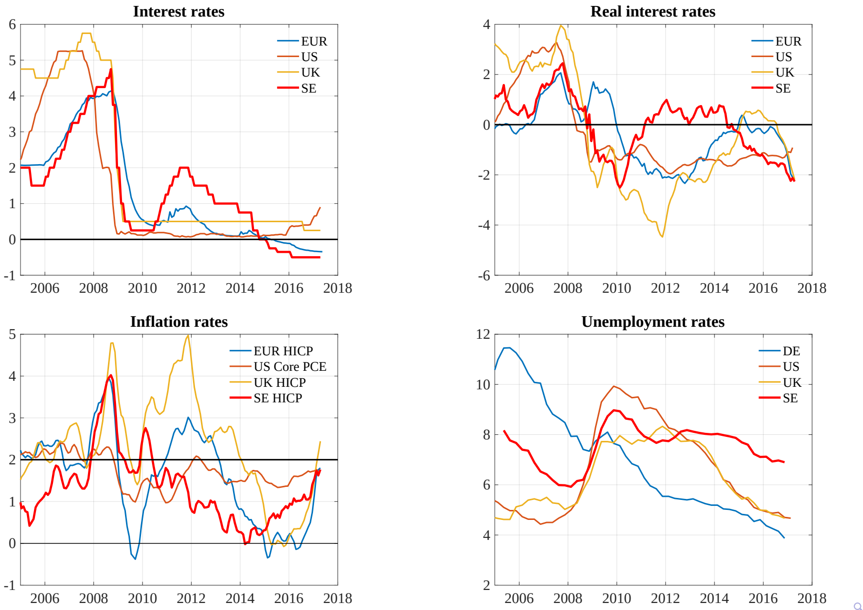


Riksbank LAW 2010–2013 2



Riksbank LAW 2010–2013 3

Ingves, “Stora risker med alltför låg ränta,” SvD, Oct 18, 2012:

> *Dagens höga arbetslöshet är ett problem, men som riksbankschef kan jag inte bara agera kortsiktigt. Jag måste även ta ansvar för de långsiktiga konsekvenserna av dagens penningpolitik. Och det finns risker förknippade med en alltför låg ränta under en lång tid som inte går att bortse från. ... Om Riksbanken inte tar hänsyn till skuldsättningen hos hushåll och företag kan dessa konsekvenser bli mycket allvarliga.*

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Ingves, "Large risks with too low interest rate," SvD, Oct 18, 2012:

> *Today's high unemployment is a problem, but as Governor I cannot only act short-sightedly. I must also take responsibility for the long-run consequences of today's monetary policy. And there are risks associated with too low an interest rate for a long period that cannot be neglected. ... If the Riksbank does not take into account the debt of households and firms, these consequences may become very serious.*

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- Leaning against the wind (LAW): Somewhat tighter policy than justified by standard inflation targeting
- Strongly promoted by BIS, practiced by Norges Bank
- Previously practiced (under strong dissents from Karolina Ekholm and me), but now abandoned by Riksbank
- Scepticism elsewhere (Bernanke, Draghi, Evans, Williams, Yellen, IMF 2015, FOMC 2016, Bank of Canada Review of Inflation Control Target 2016, Independent Review of BIS Research 2017, ...)

Introduction 2

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- Williams 2015:
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- FOMC minutes, April 2016:
  "Most participants judged that the benefits of using monetary policy to address threats to financial stability would typically be outweighed by the costs ... ;
  some also noted that the benefits are highly uncertain."

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- Independent Review of BIS Research, January 2017:
  "so far the [BIS] argument for LAW seems to have cut relatively little ice with those actually responsible for setting monetary policy. In part, that is because of the lack of convincing evidence that the expected benefits outweigh the expected costs."

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  "the research effort ... seems excessively focussed on building the case for LAW, rather than also investigating the scope for other policy actions to address financial stability risks."

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- Requires a cost-benefit analysis: Numbers!

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- Lower probability and smaller magnitude of a crisis are possible marginal benefits of LAW
- For empirical estimates and channels, effect of LAW on probability or magnitude of a crisis too small to make marginal benefit exceed marginal cost

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- Last 3: Robust to less effective macroprudential policy!
  Costs actually increase more than benefits!

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- At this stage of knowledge, the burden of proof should be on the proponents of LAW
- To achieve and maintain financial stability, as far as I can see, there is no choice but to use macroprudential policy; monetary policy simply cannot do it

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- Quarterly, quadratic loss function (different from Svensson 2014, 2015)

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The framework 2

Expected quarter-t loss

$$\begin{aligned}
\mathrm{E}_1 L_t &= (1-p_t)\mathrm{E}_1 L_t^{\mathrm{n}} + p_t \mathrm{E}_1 L_t^{\mathrm{c}} \\
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- $\tilde{u}_t^{\mathrm{n}} \uparrow \Rightarrow L_t^{\mathrm{n}} \uparrow$ (1st cost of LAW, 2nd order)
- $\tilde{u}_t^{\mathrm{n}} \uparrow \Rightarrow L_t^{\mathrm{c}} \uparrow$ (2nd cost, 1st order, not in previous literature)
- $p_t \downarrow \Rightarrow p_t \left[\mathrm{E}_1 L_t^{\mathrm{c}} - \mathrm{E}_1 L_t^{\mathrm{n}}\right] \downarrow$ (Benefit from lower probability of crisis)

The framework 2

Expected quarter-t loss

$$\begin{aligned}
\mathrm{E}_1 L_t &= (1-p_t)\mathrm{E}_1 L_t^{\mathrm{n}} + p_t \mathrm{E}_1 L_t^{\mathrm{c}} \\
&= (1-p_t)\mathrm{E}_1(\tilde{u}_t^{\mathrm{n}})^2 + p_t \mathrm{E}_1(\tilde{u}_t^{\mathrm{n}} + \Delta u_t)^2 \\
&= \mathrm{E}_1 L_t^{\mathrm{n}} + p_t \left[\mathrm{E}_1 L_t^{\mathrm{c}} - \mathrm{E}_1 L_t^{\mathrm{n}}\right] \\
&= \mathrm{E}_1(\tilde{u}_t^{\mathrm{n}})^2 + p_t[\mathrm{E}_1(\tilde{u}_t^{\mathrm{n}} + \Delta u_t)^2 - \mathrm{E}_1(\tilde{u}_t^{\mathrm{n}})^2] \\
&= \mathrm{E}_1(\tilde{u}_t^{\mathrm{n}})^2 + p_t[\mathrm{E}_1(\Delta u_t)^2 + 2\mathrm{E}_1 \Delta u_t \, \mathrm{E}_1 \tilde{u}_t^{\mathrm{n}}]
\end{aligned}$$

- LAW: $d\bar{i}_1 \equiv di_t > 0$ for $t = 1, .., 4$
- $\tilde{u}_t^{\mathrm{n}} \uparrow \Rightarrow L_t^{\mathrm{n}} \uparrow$ (1st cost of LAW, 2nd order)
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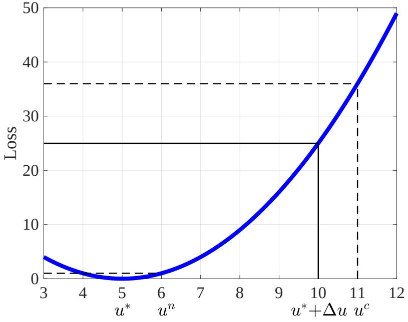
- $p_t \downarrow \Rightarrow p_t \left[\mathrm{E}_1 L_t^{\mathrm{c}} - \mathrm{E}_1 L_t^{\mathrm{n}}\right] \downarrow$ (Benefit from lower probability of crisis)
- $\Delta u_t \downarrow \Rightarrow L_t^{\mathrm{c}} \downarrow$ (Benefit from smaller magnitude of crisis)

The two costs of LAW



$$
\begin{aligned}
L_t &= (u_t - u_t^*)^2 = (\tilde{u}_t)^2 \\
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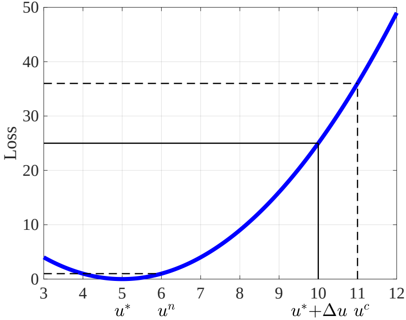
&= (\tilde{u}_t^{\mathrm{c}})^2
\end{aligned}
$$

The two costs of LAW



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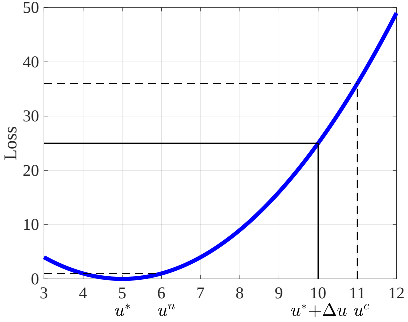
- $u^{\mathrm{n}} : u^* \to u^n$ (1st cost)

The two costs of LAW



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- $u^{\mathrm{n}} : u^* \to u^n$ (1st cost)
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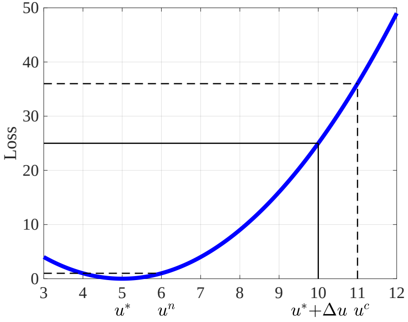
The two costs of LAW



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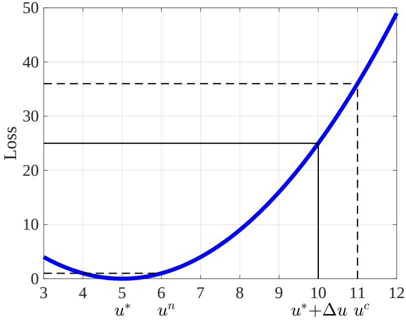
The two costs of LAW



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- $p_t \downarrow$ (1st benefit, lower probability)
- $\Delta u \downarrow$ (2nd benefit, lower magnitude)

Net Marginal Cost, Marginal Cost, Marginal Benefit 1

Expected quarter-t loss

$$\mathrm{E}_1 L_t = \mathrm{E}_1(\tilde{u}_t^{\mathrm{n}})^2 + p_t[\mathrm{E}_1(\Delta u)^2 + 2\mathrm{E}_1 \Delta u \mathrm{E}_1 \tilde{u}_t^{\mathrm{n}}]$$

Net Marginal Cost, Marginal Cost, Marginal Benefit 1

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Net Marginal Cost: $\mathrm{NMC}_t \equiv d\mathrm{E}_1 L_t / d\bar{i}_1$

Net Marginal Cost, Marginal Cost, Marginal Benefit 1

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Net Marginal Cost: $\mathrm{NMC}_t \equiv d\mathrm{E}_1 L_t / d\bar{i}_1$

$$= 2\ \underbrace{[\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}} + p_t \mathrm{E}_1 \Delta u]}_{\text{Exp. unempl. deviation}}\ \frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1}$$

$$- \{\underbrace{[\mathrm{E}_1(\Delta u)^2 + 2\mathrm{E}_1 \Delta u \mathrm{E}_1 \tilde{u}_t^{\mathrm{n}}]}_{\text{Crisis loss increase}}(-\frac{dp_t}{d\bar{i}_1}) + \{2p_t\ \underbrace{\mathrm{E}_1(\tilde{u}_t^{\mathrm{n}} + \Delta u)}_{\text{Crisis unempl. dev'n}}\ (-\frac{d\mathrm{E}_1 \Delta u}{d\bar{i}_1})\}$$

$$\equiv \mathrm{MC}_t - \{\mathrm{MB}_t^p + \mathrm{MB}_t^{\Delta u}\} \equiv \mathrm{MC}_t - \mathrm{MB}_t$$

Exogenous crisis probability and magnitude: LWW!

What if crisis probability and magnitude are exogenous?

$$\frac{dp_t}{d\bar{i}_1} = \frac{d\mathrm{E}_1 \Delta u_t}{d\bar{i}_1} = 0 \text{ for } t \geq 1$$

$$\mathrm{MB}_t^p = \mathrm{MB}_t^{\Delta u} = 0$$

$$\mathrm{NMC}_t = \mathrm{MC}_t = 2\mathrm{E}_1 \tilde{u}_t \frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1} = 2(\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}} + p_t \mathrm{E}_1 \Delta u_t) \frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1} = 0$$

$$\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}} = -p_t \mathrm{E}_1 \Delta u_t \quad [= -0.06 \cdot 5 \text{ pp} = -0.30 \text{ pp}]$$

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LWW, but too small to bother about.

Net Marginal Cost, Marginal Cost, Marginal Benefit 2

$$\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}} \equiv \mathrm{E}_1 (u_t^{\mathrm{n}} - u_t^*) \begin{cases} > 0 & \text{LAW} \\ = 0 & \text{No leaning (NL)} \\ < 0 & \text{LWW} \end{cases}$$

Net Marginal Cost, Marginal Cost, Marginal Benefit 2

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Examine NMC_t for $\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}} = 0$ (NL):

Net Marginal Cost, Marginal Cost, Marginal Benefit 2

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Net Marginal Cost, Marginal Cost, Marginal Benefit 2

$$\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} \equiv \mathrm{E}_1(u_t^{\mathrm{n}} - u_t^*) \begin{cases} > 0 & \text{LAW} \\ = 0 & \text{No leaning (NL)} \\ < 0 & \text{LWW} \end{cases}$$

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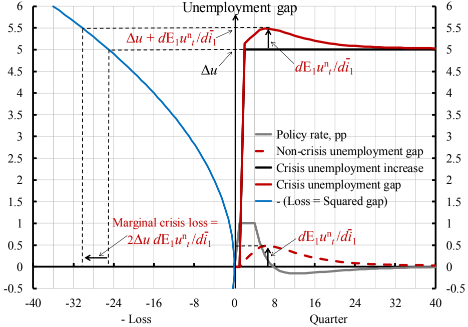
Examine

$$\sum_{t=1}^{\infty}[\delta^{t-1}]\mathrm{NMC}_t \begin{cases} > 0 & \Rightarrow \text{LWW} \\ = 0 & \Rightarrow \text{No leaning} \\ < 0 & \Rightarrow \text{LAW} \end{cases}$$

Understanding the marginal cost of LAW

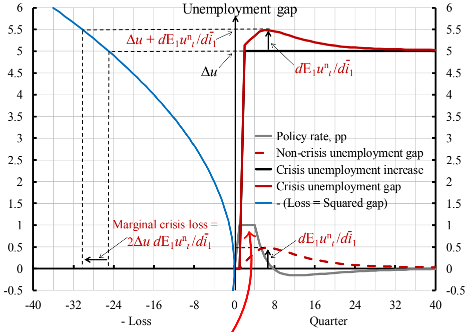
Loss = (Unemployment deviation)^2



- Policy-rate effect on non-crisis unemployment, $dE_1 u_t^n / d\bar{i}_1$

Understanding the marginal cost of LAW

Loss = (Unemployment deviation)^2



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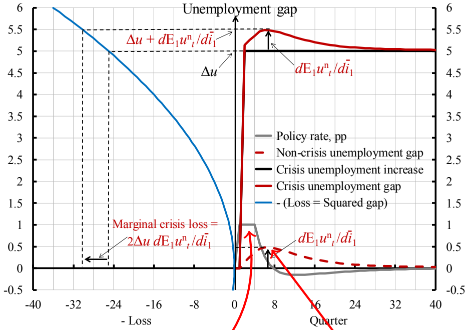
Understanding the marginal cost of LAW

Loss = (Unemployment deviation)[2]



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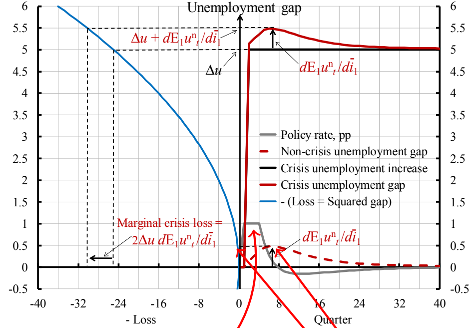
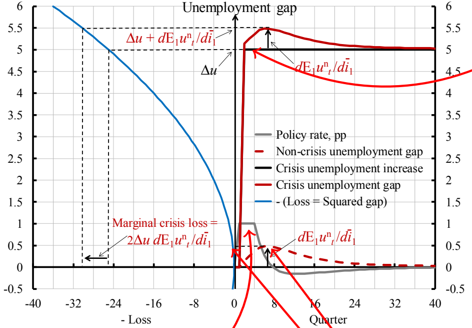


- Policy-rate effect on non-crisis unemployment, $dE_1 u^n_t / d\bar{i}_1$
- Marginal *non-crisis* loss = 0, a 2nd-order loss (at zero u deviation)

Understanding the marginal cost of LAW

Loss = (Unemployment deviation)^2



- Crisis unemployment increase (net of policy response), Δu
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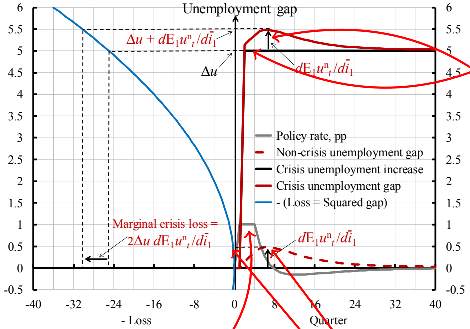

- Crisis unemployment increase (net of policy response), Δu
- Effect on *crisis* unemployment, $dE_1 u_t^n / d\bar{i}_1$
- Policy-rate effect on non-crisis unemployment, $dE_1 u_t^n / d\bar{i}_1$
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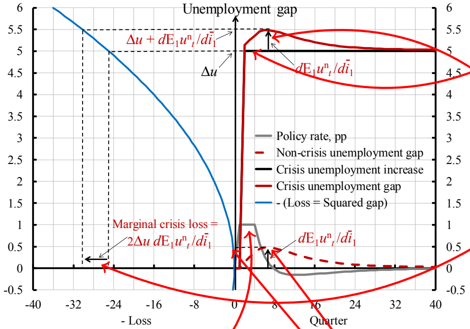
Understanding the marginal cost of LAW

Loss = (Unemployment deviation)[2]



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- Marginal crisis loss = $2\Delta u \frac{dE_1 u^n_t}{d\bar{i}_1}$, a 1st-order loss

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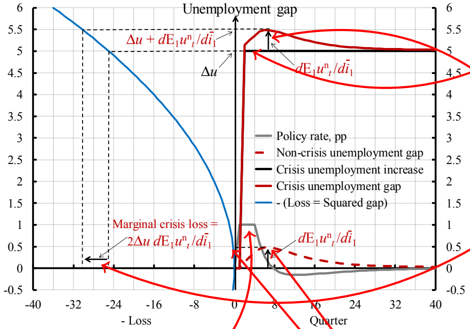

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Understanding the marginal cost of LAW

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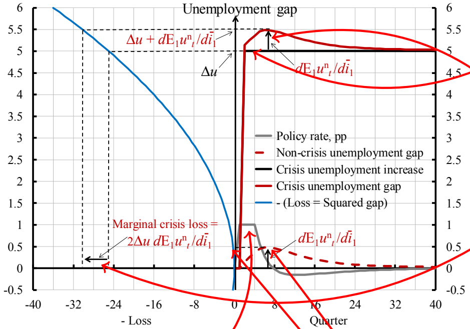

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Understanding the marginal cost of LAW

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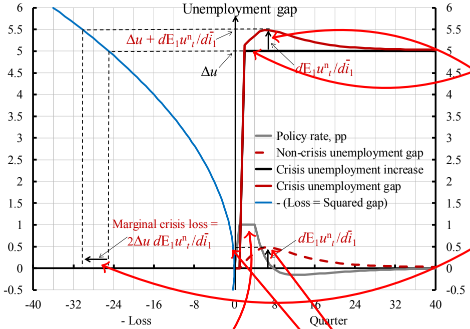

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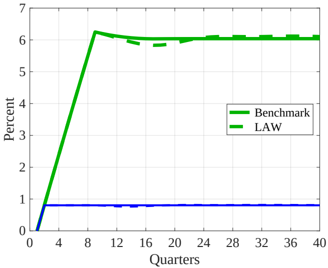
- Crisis loss is higher with a higher non-crisis unemployment deviation due to LAW

The probability of a crisis, p_t



- Benchmark probability of crisis start in qtr t: $q_t = 0.8\%,$ solid line (probability 3.2%/yr, 1 crisis on average every 33 years)

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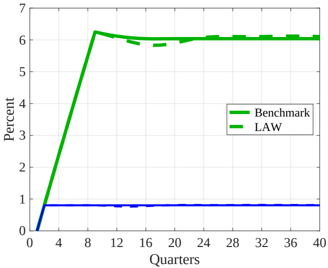

- Benchmark probability of crisis start in qtr t: $q_t = 0.8\%$, solid line (probability 3.2%/yr, 1 crisis on average every 33 years)
- Benchmark crisis duration: $n = 8$ quarters

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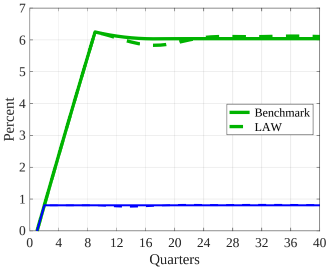

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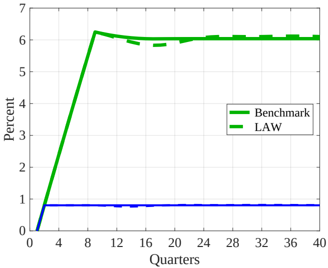

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- Benchmark probability of crisis in qtr t (Markov process): Approximation $p_t \approx \sum_{\tau=0}^{n-1} q_t,$ solid line
- Dashed lines: Effect of LAW, $dq_t/d\bar{i}_1$, $dp_t/d\bar{i}_1$ (small)

Policy-rate effect on the probability of a crisis 1

- Schularick and Taylor (2012): Probability of crisis start in qtr t, q_t, related to real debt growth (14 countries, 1870–2008)

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- Main logit equation, adapted to quarterly data

$$q_t = \frac{1}{4}\frac{\exp(X_t)}{1+\exp(X_t)}$$

$$X_t = [-3.89] - \underset{(2.110)}{0.398}\, g_{t-4} + \underset{(2.631)}{7.138^{***}}\, g_{t-8}$$

$$+ \underset{(2.948)}{0.888}\, g_{t-12} + \underset{(1.378)}{0.203}\, g_{t-16} + \underset{(1.640)}{1.867}\, g_{t-20}$$

$$g_t \equiv \log(\textstyle\sum_{\tau=0}^{3} d_{t-\tau}/4) - \log(\textstyle\sum_{\tau=0}^{3} d_{t-4-\tau}/4)$$

d_t real debt, g_t annual growth rate of average annual debt

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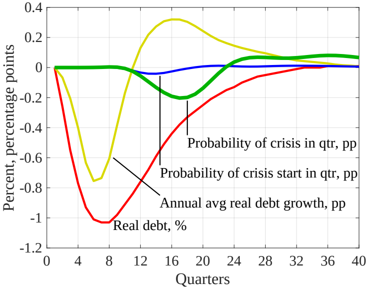
d_t real debt, g_t annual growth rate of average annual debt

- Main determinant is 2-year lag of annual credit growth, *not* cumulative 5-year growth as in some papers (coefficients different)

Policy-rate effect on probability of a crisis 2

- Policy-rate effect on real debt, $\frac{d(d_t)}{d\bar{i}_1}$, $t \geq 1$, example and benchmark: Riksbank estimate (not statistically significant)



- Determines effects on
  average annual real debt growth, $\frac{dg_t}{d\bar{i}_1}$,
  probability of a crisis start, $\frac{dq_t}{d\bar{i}_1}$, and
  probability of a crisis, $\frac{dp_t}{d\bar{i}_1} = \sum_{\tau=0}^{n-1} \frac{dq_t}{d\bar{i}_1}$

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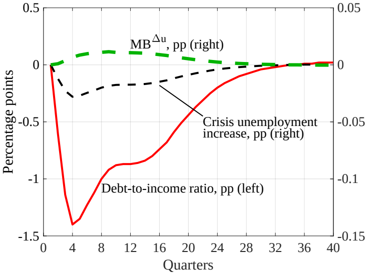

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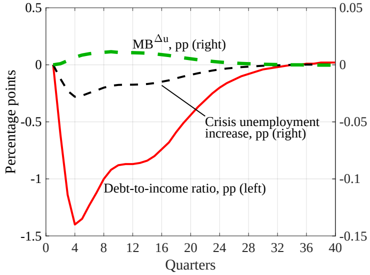

- Jorda, Schularick, Taylor (2013) implies 1 pp higher credit/GDP implies 0.04 pp higher unemployment increase (double Flodén's)

Benchmark MC, MB and NMC

- $\mathrm{MC}_t = 2p_t \Delta u \frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1}$; $\mathrm{MB}_t = \mathrm{MB}_t^p + \mathrm{MB}_t^{\Delta u}$
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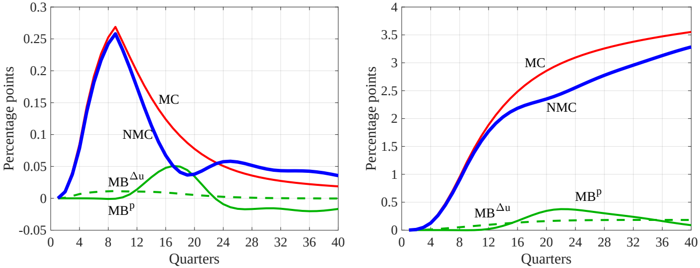

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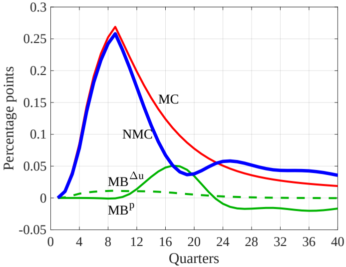

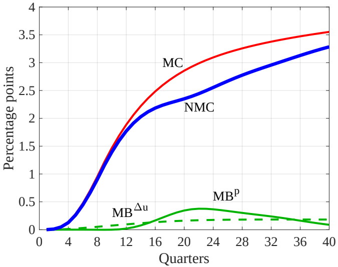

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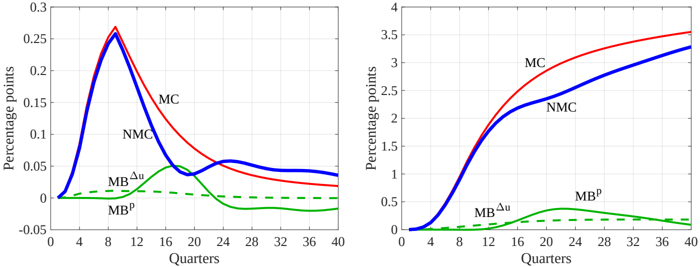

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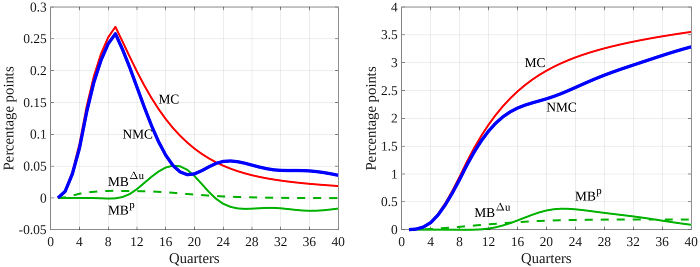

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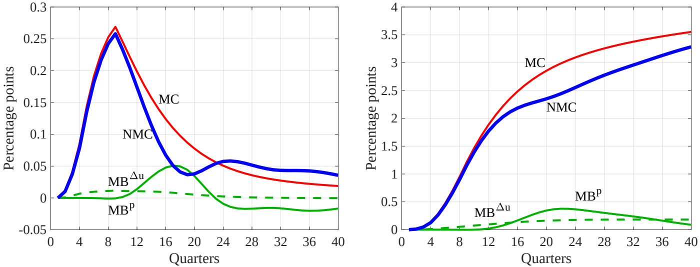

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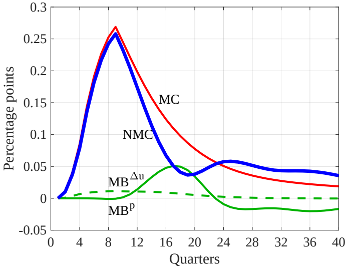

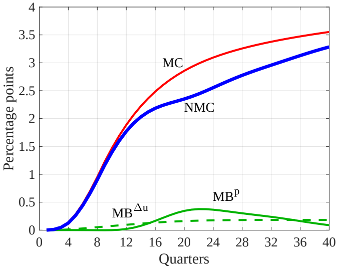

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- Debt to GDP instead of real debt; 5-year moving averages
- Break-even ($\sum MC = \sum MB$) requires effects that are 5–40 standard errors larger than empirical benchmark estimates

Monetary non-neutrality: Permanent effect on real debt

- Assume that real debt stays at its lowest deviation from baseline
- Negative cumulative effect on crisis probabilities
- $\mathrm{MC}_t = 2p_t \Delta u \frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1}$,
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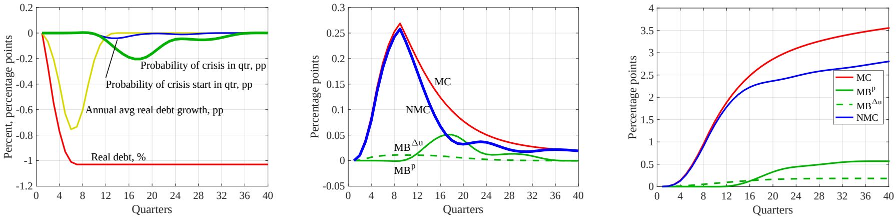
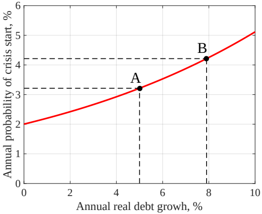
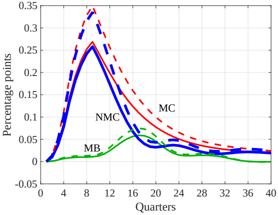


- Marginal cost still exceeds marginal benefit

Credit boom and higher probability of crisis start

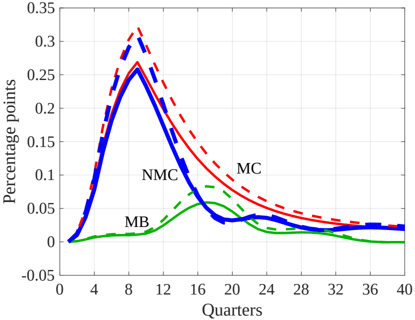
- Credit boom: Increase in annual real debt growth from 5% to 7.9%
- Increase in annual probability $4q$ from 3.21% to 4.21%
- dq/dg increases $\Rightarrow \left|dq_t/d\bar{i}_1\right|, \left|dp_t/d\bar{i}_1\right|$ increase
- $\mathrm{MC}_t = 2p_t \Delta u \frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1}$; $\mathrm{MB}_t^p = (\Delta u)^2 (-\frac{dp_t}{d\bar{i}_1})$; $\mathrm{MB}_t^{\Delta u} = 2p_t \Delta u (-\frac{d\Delta u_t}{d\bar{i}_1})$
- Increase in annual probability $4q$ from 3.21% to 4.21% (dashed)





A larger crisis increase in the unemployment rate

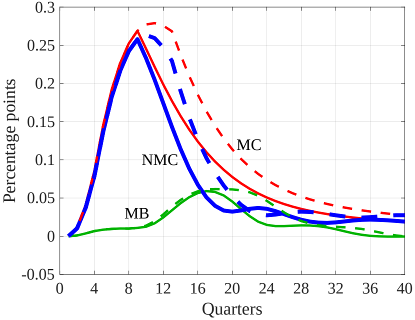
- Larger Δu, from 5 to 6 percentage points (dashed)
- $\mathrm{MC}_t = 2p_t \Delta u \frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1}$; $\mathrm{MB}_t^p = (\Delta u)^2 (-\frac{dp_t}{d\bar{i}_1})$; $\mathrm{MB}_t^{\Delta u} = 2p_t \Delta u (-\frac{d\Delta u_t}{d\bar{i}_1})$



- Break-even requires $\Delta u = 32$ pp

A longer crisis duration

- Increase in n from 8 to 12 quarters; $p_t \approx \sum_{\tau}^{n-1} q_{t-\tau}$ (dashed)
- $\mathrm{MC}_t = 2p_t \Delta u \frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{di_1}$; $\mathrm{MB}_t^p = (\Delta u)^2 (-\frac{dp_t}{di_1})$; $\mathrm{MB}_t^{\Delta u} = 2p_t \Delta u (-\frac{d\Delta u_t}{di_1})$



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- Do not do any LAW without support from a thorough cost-benefit analysis
- At this stage of knowledge, the burden of proof should be on the advocates of LAW
- To achieve and maintain financial stability, as far as I can see, there is no choice but to use macroprudential policy; monetary policy simply cannot do it

Bank-capital effect on probability of crises

- Dagher, Dell'Ariccia, Laeven, Ratnovski, Tong (2016, "Benefits and Costs of Bank Capital," IMF SDN/16/04)

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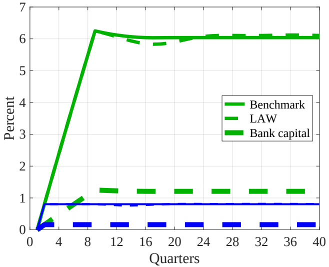
- Dramatic effect on probability of crises with enough bank capital: Shift from solid lines to thick dashed lines



Additional slides

Recent criticism of my approach 1

- BIS Annual Report 2016:
  - (1) Uses credit growth instead of "financial cycle",
    (2) assumes exogenous magnitude of crisis,
    (3) only examines one-off policy-rate increase instead of systematic optimal LAW, and
    (4) implies responding too late and ignoring cumulative impact (Juselius, Borio, Disyatat, and Drehmann 2016)
  - But
    (1) empirical issue: best predictors of crises, policy-rate impact on predictors;
    (2) examined in Svensson (2016, appendix D);
    (3) optimal policy examined in Svensson (2016, section 3);
    (4) all empirical lags and cumulative effects taken into account.

Recent criticism of my approach 2

- Adrian and Liang (2016)
  - Suggest "reasonable alternative assumptions" about effect on probability and magnitude of crisis will overturn my result
  - But their "reasonable" assumptions imply effects that are 13 standard errors larger than ST's estimate, and 40 (11) standard errors larger than Flodén's (JST's) estimates

Svensson (2017), "The Robustness of the Result that the Cost of 'Leaning Against the Wind' Exceeds the Benefit: Response to Adrian and Liang," www.larseosvensson.se

Svensson (2017), "Re-evaluating the result that the costs of leaning against the wind exceed the benefits," Vox column, January 24, 2017, www.voxeu.org

Recent criticism of my approach 3

Filardo and Rungcharoenkitkul (2016), and Gourio, Kashyap, and Sim (2017): LAW optimal

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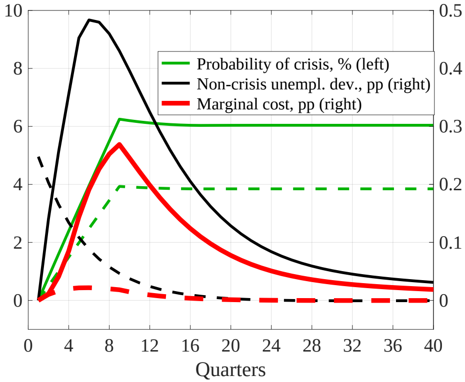
- Complex models, numerous assumptions, not robust results

Recent criticism of my approach 4 GKS

Benchmark (solid lines)
Gourio, Kashyap, and Sim (dashed lines)
Realistic shape and magnitude of policy-rate effect on unemployment important for marginal cost



My approach to cost-benefit analysis of LAW

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  - If policy is optimal, for any deviation from policy $\Delta\text{Loss} \geq 0$
  - For any marginal deviation, $\Delta\text{Loss} = \text{MC} - \text{MB} = 0$
  - Indeed, MC = MB is a first-order condition for optimal policy

My approach to cost-benefit analysis of LAW

- Compare MC and MB of raising the policy rate when policy is optimal according to standard flexible inflation targeting (probability of financial crisis set to zero)
- Is "one-off" LAW (policy-rate increase) different from "systematic" LAW? (argued by BIS)
- Not really, just test of first-order conditions for optimal policy
- Recall "calculus of variations"
  - If policy is optimal, for any deviation from policy $\Delta \text{Loss} \geq 0$
  - For any marginal deviation, $\Delta \text{Loss} = \text{MC} - \text{MB} = 0$
  - Indeed, MC = MB is a first-order condition for optimal policy
- Testing policy by comparing MC and MB of policy change therefore OK

Effect on probability of crisis: 3 limitations

1. Neutrality of monetary policy: No long-run effect on real debt implies no effect on long-run average probability
2. Policy-rate effect on real debt and debt-to-GDP small and of any sign (Svensson)
   - Higher policy rate slows down both numerator and denominator. Numerator (nominal stock of debt) sticky
   - Several papers confirm effect on debt-to-GDP positive or ambiguous (Alpanda & Zubairy, Gelain et al., Robstad)
3. Empirical relation real debt growth-financial crisis reduced form
   - Underlying factors: Resilience of financial system and economy; nature, magnitude of shocks
   - Balance sheets, asset quality, capital, lending standards, liquidity, maturity transformation, risk-taking, speculation,...
   - "Good" and "bad" credit growth
   - Less data on underlying factors
   - Policy-rate effect on underlying factors weak
   - Micro/macroprudential policy stronger effect (IMF staff paper)

Previous closely related literature

- 2-period model (Ajello et al. 2015, Svensson 2014, 2015)
  - Period 1: LAW and higher unemployment, but *no crisis* (*understates cost* of LAW, because crisis can come any time, and cost of crisis higher if initial unemployment higher)
  - Period 2: Lower probability of crisis with *fixed loss* (*understates cost* of LAW; *overstates benefit* of LAW, because monetary neutrality disregarded, as we shall see)
- Multiperiod quarterly model (Diaz Kalan et al. 2015)
  - Fixed loss in crisis (*understates cost* of LAW, because cost higher in weaker economy)
- Still, in these papers either cost higher than benefit, or net benefit and optimal LAW tiny (With fixed loss in crisis, optimal LAW tiny; probability reduction and net gain completely insignificant)

The FSA, no “inaction bias” 2

- Annual mortgage market report (from February 2010), with stress tests on individual data on new household borrowers, according to which
  - lending standards are high
  - households loss-absorbing and debt-service capacity is good and increasing over time
  - households resilience to disturbances in the form of mortgage rate increases, housing price falls, and income falls due to unemployment is good and increasing over time
- Mortgage LTV cap of 85% (October 2010)

The FSA, no "inaction bias" 1

- Risk-weight floor for mortgages 15% (May 2013)
- LCR-regulation (Basle 3, USD, EUR, total) (Jan 2014)
- Pillar II capital add-on 2% for 4 largest banks (Sep 2014)
- Risk-weight floor for mortgages 25% (Sep 2014)
- Systemic buffer 3% for 4 largest banks (Jan 2015)
- CCyB activated at level 1% (Sep 2015)
- Amortization requirements (Jun 2016)
- CCyB raised to 1.5% (June 2016)
- CCyB raised to 2.0% (March 2017)
- Current capital requirements for 4 largest banks 22% of RWA (17% CET1)
- Proposed stricter amortization requirement for households with high debt-to-income ratios (June 2017)

Alternative loss functions

Constant crisis loss level (Ajello et al., Diaz Kalan et al.) :

$$\mathrm{E}_1 L_t = (1-p_t)\mathrm{E}_1 L_t^{\mathrm{n}} + p_t \mathrm{E}_1 L_t^{\mathrm{c}} = (1-p_t)\mathrm{E}_1(\tilde{u}_t^{\mathrm{n}})^2 + p_t \mathrm{E}_1(\Delta u_t)^2$$

$$\mathrm{MC}_t = 2(1-p_t)\mathrm{E}_1\tilde{u}_t^{\mathrm{n}}\frac{d\mathrm{E}_1\tilde{u}_t^{\mathrm{n}}}{d\bar{i}_1};\ \mathrm{MC}_t = 0 \ \text{ for } \ \mathrm{E}_1\tilde{u}_t^{\mathrm{n}} = 0$$

$$\mathrm{MB}_t^p = \mathrm{E}_1(\Delta u_t)^2(-\frac{dp_t}{d\bar{i}_1});\ \mathrm{MB}_t^{\Delta u} = 2\mathrm{E}_1\Delta u_t(-\frac{d\Delta u_t}{d\bar{i}_1})$$

Constant cost of a crisis (crisis loss less non-crisis loss) (GKS, FR):

$$\mathrm{E}_1 L_t = \mathrm{E}_1 L_t^{\mathrm{n}} + p_t \mathrm{E}_1(L_t^{\mathrm{c}} - L_t^{\mathrm{n}}) = \mathrm{E}_1(\tilde{u}_t^{\mathrm{n}})^2 + p_t\mathrm{E}_1(\Delta u_t)^2$$

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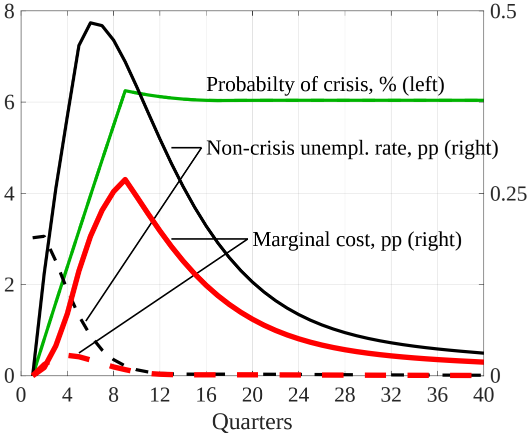
Svensson (2017), "Leaning Against the Wind: The Role of Different Assumptions about the Costs," www.larseosvensson.se.

Gerdrup, Hansen, Krogh, and Maih



Svensson (2017), "Leaning Against the Wind: Costs and Benefits, Effects on Debt, Leaning in DSGE Models, and a Framework for Comparison of Results," *International Journal of Central Banking* (September 2017) 385–408

The effect on the magnitude of a crisis 2

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- Jorda, Schularick, and Taylor (2013), 14 countries, 1870-2008:
  1 pp higher credit/GDP: GDP lower by 0.08% (avg over 5 yrs)
  - For Okun coefficient of 2, 0.04 pp higher unemployment; twice as large as Flodén's estimate
- Krishnamurthy and Muir (2016), 14 countries, 1869–2014:
  1 pp higher 3-year growth in the credit-to-GDP ratio: (statistically insignificant) 0.05 pp larger GDP decline from peak to trough in a financial crisis
  - For Okun coefficient of 2, 0.025 pp larger unemployment increase
- Similar small magnitudes

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- For an Okun coefficient of 2, unemployment increases by 0.04 pp
- For credit/GDP $\approx$ 100%, 1% is 1 pp, so 1 pp higher credit/GDP increases unemployment by 0.04 pp

A general problem with Taylor rule

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- A simple instrument rule, such as the Taylor rule, is not optimal, also when coefficients optimized; it has too few arguments
- Optimal policy responds to all state variables or shocks
- Adding an argument means that the arguments better span the space of relevant state variables or shocks
- Not surprising if adding an argument leads to better outcome, but arguably need not prove anything
- To avoid such problems, do optimal policy, with and without positive probability of a crisis

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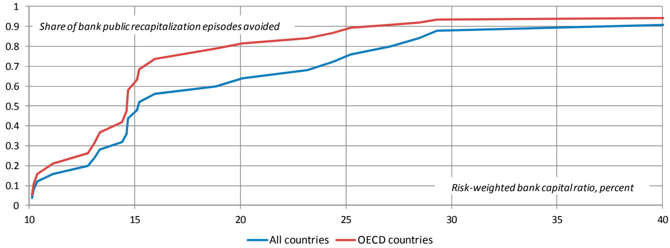
- Thus, any such result does not necessarily prove anything
- Chris Sims has said: “DSGE models are story-telling devices, not science” (I agree with at least the first part)
- For credible conclusions, empirical support, simplicity, transparency, and robust relations are desirable, even necessary

Monetary policy and financial stability (financial crises)

- Monetary policy (MoP) effect on financial stability
  - Best predictors of financial crises (probability and magnitude)
  - MP effect on these predictors
  - Are real credit growth, debt/GDP (growth), ... the best predictors? (Reduced form, single equations, HP filtering, spurious correlations, correlations w/ "true" predictors/determinants?)
- "True" predictors of probability and magnitude of crises
  - Resilience to disturbances: Loss-absorbing capacity, capital/assets (stock/stock); debt-service capacity, debt service/income (flow/flow); lending standards, exuberance, ... ; *not* debt/GDP (also stock/flow)
  - Monetary policy effects on resilience small and unsystematic
- Monetary policy cannot achieve and maintain resilience of the financial system and borrowers and lenders
- Macroprudential policy (MaP) can achieve and maintain such resilience

- The effect on the probability of a crisis of more bank capital
- 20% bank capital relative to RWA might have avoided 80% of historical banking crises in OECD since 1970
  (Dagher, Dell'Ariccia, Laeven, Ratnovski, Tong (2016, fig. 7), "Benefits and Costs of Bank Capital," IMF SDN/16/04)

Figure 7. Share of Public Recapitalizations Avoided, Depending on Hypothetical Precrisis Bank Capital Ratios



Sources: Bankscope; Laeven and Valencia 2013; and authors' calculations.

Policy-rate effect on credit and credit/GDP

- ST and JST predictors of crisis: *Growth* of real credit or credit/GDP
  - Neutrality of monetary policy: No long-run effect on real credit or credit/GDP implies lower growth and probability followed by higher growth and probability
  - No effect on long-run average probability
- Policy-rate effect on real credit and credit/GDP small and of any sign (Svensson 2013)
  - Higher policy rate slows down both numerator (nominal credit) and denominator (price level or nominal GDP)
  - Numerator quite sticky
  - "Stock" effect may be larger than "flow" effect
  - Several papers confirm effect on debt-to-GDP positive or ambiguous (Alpanda & Zubairy 2014, Bauer & Granziera 2016, Gelain et al. 2015, Robstad 2014)
  - Credit/GDP main component of "financial cycle": Policy-rate effect on "financial cycle" small and ambigious?

Reduced-form and structural relations

- Single-equation estimates of crisis probabilities (ST, JST) are reduced-form
- Results from single-equation models, such as credit growth predicting future lower GDP growth or financial stress, may involve spurious correlations and be misleading
- Understanding correlations and predictive power regarding GDP growth, “bad” excess credit, “good” credit deepening, spreads, financial stress, and monetary policy requires structural multi-equation models (Brunnermeier, Palia, Sastry, Sims 2016, 10-variable monthly model)