Cost-Benefit Analysis of Leaning Against the Wind: Are Costs Larger Also with Less Effective Macroprudential Policy?

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Introduction

- Leaning against the wind (LAW): Somewhat tighter policy than justified by standard inflation targeting
- Strongly promoted by BIS, scepticism elsewhere (Bernanke, Draghi, Evans, Williams, Yellen, IMF 2015, FOMC 2016, ...)
- Williams 2015: "[M]onetary policy is poorly suited for dealing with financial stability, even as a last resort."
- 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."

Introduction

- LAW has costs in terms of a weaker economy, but possibly benefits in terms of a lower probability or smaller magnitude of a crisis
- Is LAW justified?
- Requires a cost-benefit analysis: Numbers!

This paper

- Multiperiod quarterly model (as in Diaz Kalan et al.)
- New:
  - Additional cost: Cost of crisis (*loss increase* in crisis) higher if economy initially weaker (main cost of LAW)
    (Disregarded in previous papers [IMF, DK et al., Ajello et al., Svensson]: *Fixed loss* in crisis)
  - Role of monetary neutrality: Implies no cumulative effect on probability of crisis
  - Role of less effective macroprudential policy: LAW more or less justified?

Conclusions 1

- For existing empirical estimates, marginal cost of LAW much higher than marginal benefit
- Thus, LAW not justified. If anything, small leaning *with* the wind justified.
- LAW increases not only *non-crisis* unemployment gap but also *crisis* unemployment gap; the latter is main component of marginal cost
- Lower probability of a crisis is main component of possible marginal benefit of LAW
- For empirical estimates and channels, effect of LAW on probability of a crisis too small to make marginal benefit exceed marginal cost
- Effect on magnitude even smaller, can be disregarded

Conclusions 2

- Empirically, probability of a crisis seems to depend on real debt growth
- If monetary policy neutral in long run, no long-run effect on real debt and cumulative real debt growth
- Then, if real debt growth and probability of a crisis lower for a few years, they must be *higher* in later years; probability of crisis postponed; no effect on long-run average probability of a crisis
- Even if monetary policy non-neutral and lowers real debt in the long run, empirically marginal benefit still much smaller than marginal cost
- Less effective macroprudential policy might increase the probability, magnitude, or duration of a crisis
- However, each of these increases marginal cost more than marginal benefit and strengthens the case *against* LAW

Conclusions 3

- 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
- As far as I can see, to achieve and maintain financial stability, there is no choice but to use macroprudential policy; monetary policy simply cannot do it

Recent response by BIS (2016), *86th Annual Report*

- BIS Annual Report, criticism of my paper (Box IV.B, pp 76-77):
  (1) Uses credit growth instead of "financial cycle"
  (2) Assumes exogenous magnitude of crisis
  (3) Examines one-off policy-rate increase instead of systematic optimal leaning against the wind
- On (1): No principle difference between credit growth and "financial cycle." Crucial issue is empirical: Best predictor of financial crisis? Policy-rate impact on that predictor? Debt/GDP component of financial cycle. Impact on debt/GDP smaller than impact on debt and of uncertain sign
- On (2): Appendix D deals with endogenous magnitude of crisis: Empirically policy-rate impact on magnitude too small to matter
- On (3): Sections 3.3 and 3.4 deal with optimal policy: Optimal policy is small leaning *with* the wind

Unemployment rates, crises, and probabilities

- u_t unemployment rate in quarter t
- In each quarter $t \geq 1$, two possible states:
  - $u_t = u_t^{\mathrm{n}}$, *non-crisis* unemployment rate
  - $u_t = u_t^{\mathrm{c}} \equiv u_t^{\mathrm{n}} + \Delta u$, *crisis* unemployment rate
- $\Delta u > 0$ fixed crisis *increase* of the unemployment rate ($\Delta u = 5$ pp (Riksbank assumption) (6 pp))
- More realistic than fixed crisis *level* of the unemployment rate
- q_t probability of a crisis *start* in quarter t
- n crisis duration ($n = 8$ quarters (12 quarters))
- p_t probability of (*being* in) a crisis in quarter t: $p_t = \sum_{\tau=0}^{n-1} q_t$
- Appendix: Acceptable linear approximation to Markov process for relevant range of parameters

If *exogenous* probability: Lean *with* the wind (!)

- Temporarily, assume *exogenous* crisis probabilities $\bar{p}_t$, $t \geq 1$
- Optimal policy: Set expected unemployment gap equal to zero

$$\begin{aligned} \mathrm{E}_1 \tilde{u}_t &= (1 - \bar{p}_t)\mathrm{E}_1 \tilde{u}_t^n + \bar{p}_t \mathrm{E}_1 \tilde{u}_t^c \\ &= (1 - \bar{p}_t)\mathrm{E}_1 \tilde{u}_t^n + \bar{p}_t(\mathrm{E}_1 \tilde{u}_t^n + \Delta u) \\ &= \mathrm{E}_1 \tilde{u}_t^n + \bar{p}_t \Delta u \\ &= 0 \end{aligned}$$

$$\mathrm{E}_1 \tilde{u}_t^n = -\bar{p}_t \Delta u \; (= -0.064 \cdot 5 \text{ pp} = -0.32 \text{ pp}) < 0$$

- Optimal policy is negative non-crisis unemployment gap: Small leaning *with* the wind
- Can a higher policy rate reduce the probability or magnitude of a crisis so much so as to counter this tendency toward leaning with the wind?

The expected future unemployment rate and LAW

- Expected future unemployment rate:

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

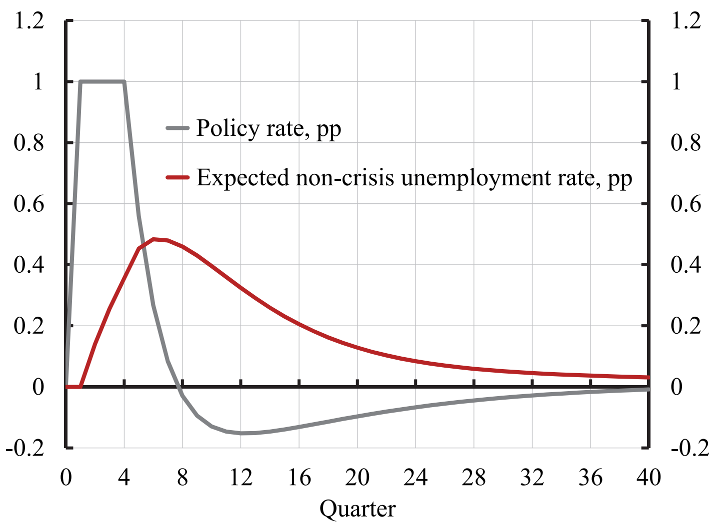
- i_t, policy rate, constant during qtrs 1–4: $i_t = \bar{i}_1, 1 \leq t \leq 4$
- Leaning against the wind (LAW): $d\bar{i}_1 > 0$
- Effect on expected future unemployment rate:

$$\frac{d\mathrm{E}_1 u_t}{d\bar{i}_1} = \frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1} + \frac{dp_t}{d\bar{i}_1}\Delta u \quad (+ p_t \frac{d\Delta u}{d\bar{i}_1})$$

- Need to determine $\frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1}$ and $\frac{dp_t}{d\bar{i}_1}$, $t \geq 1$
- Disregard $\frac{d\Delta u}{d\bar{i}_1}$ (appendix D: negligible, uncertain sign; Flodén 2014; Jorda, Schularick, Taylor 2013; Krishnamurthy, Muir 2016)

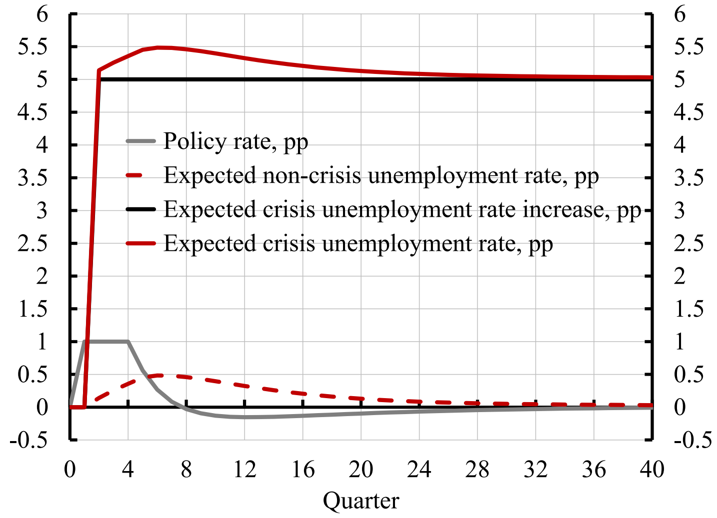
Effect on the expected non-crisis unemployment rate

$\frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1}$, $t \geq 1$, example and benchmark: Riksbank estimate



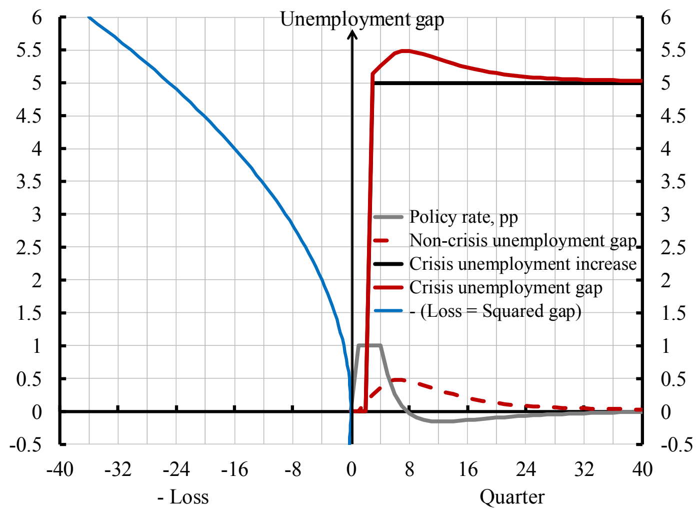
Effect on the expected *crisis* unemployment rate

If a crisis happens: $\Delta\bar{i}_1 = 1$, $\mathrm{E}_1 u_t^{\mathrm{c}} = \mathrm{E}_1 u_t^{\mathrm{n}} + \Delta u$



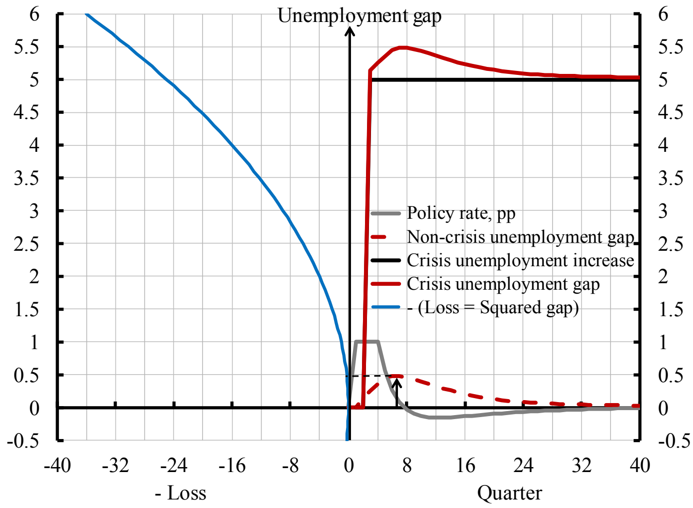
Crisis and non-crisis unemployment gaps and losses 1

Loss = (Unemployment gap)^2



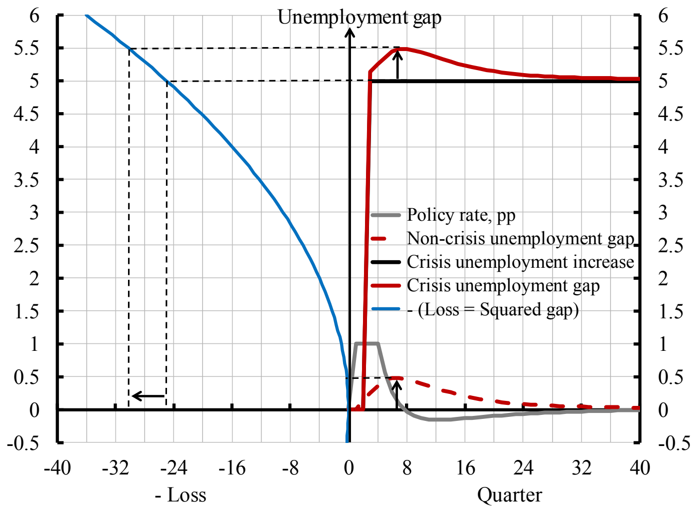
Crisis and non-crisis unemployment gaps and losses 2

Loss = (Unemployment gap)^2



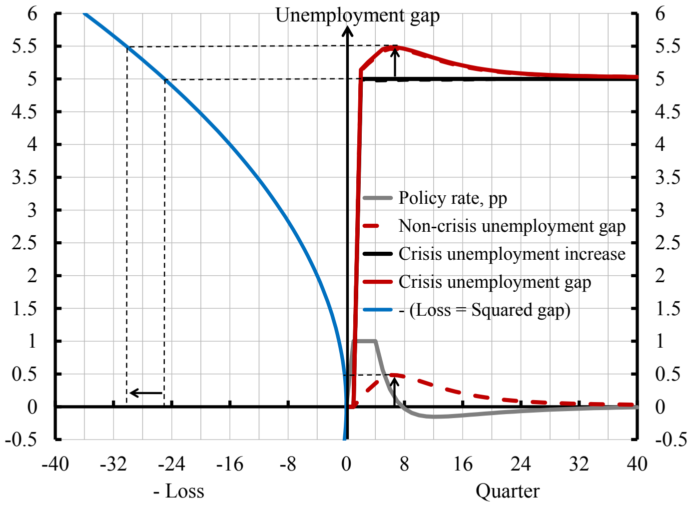
Crisis and non-crisis unemployment gaps and losses 3

Loss = (Unemployment gap)^2



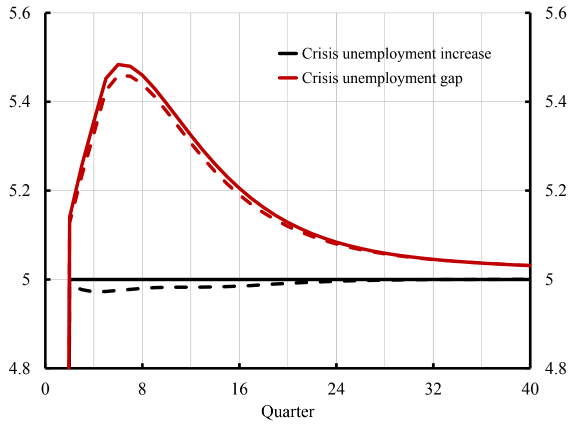
Crisis and non-crisis unemployment gaps and losses 4

Appendix: With Flodén (2014) OECD effect on crisis increase of unemployment gap (magnitude), $d\Delta u / d\bar{i}_1$. Maximum fall in Δu: 0.03 pp in quarter 4 (dashed, barely visible)



Crisis and non-crisis unemployment gaps and losses 5

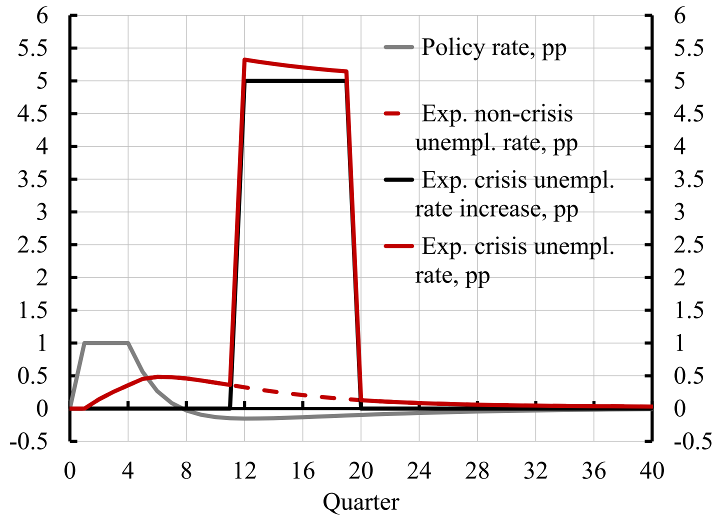
Appendix: With Flodén (2014) OECD effect on crisis increase of unemployment gap (magnitude), $d\Delta u / d\bar{i}_1$. Maximum fall in Δu: 0.03 pp in quarter 4 (dashed, enlarged and visible)



Krishnamurthy, Muir 2016, similar
Jorda, Schularick, Taylor 2013, double, still negligable

Effect on the expected *crisis* unemployment rate

If a crisis happens in quarter 12: $\Delta \bar{i}_1 = 1$, $\mathrm{E}_1 u_t^{\mathrm{c}} = \mathrm{E}_1 u_t^{\mathrm{n}} + \Delta u$



Effect on the probability of a crisis 1

- Schularick and Taylor (2012):
  The probability of a crisis start in quarter t (q_t) depends on real debt growth (annual data, 14 countries, 1870–2008)
- Main logit equation, adapted to quarterly data

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

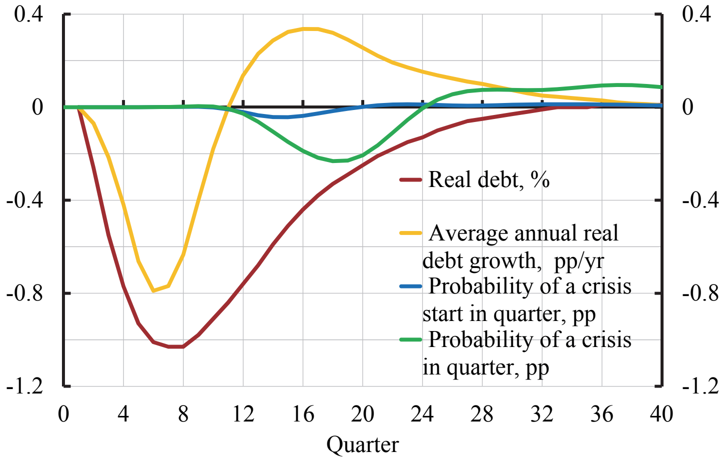
$$X_t = [-3.89] - \underset{(2.110)}{0.398}\, g_{t-4} + \underset{(2.631)}{7.138^{***}}\, g_{t-8} + \underset{(2.948)}{0.888}\, g_{t-12} + \underset{(1.378)}{0.203}\, g_{t-16} + \underset{(1.640)}{1.867}\, g_{t-20}$$

$$g_t \equiv \left(\sum_{\tau=0}^{3} d_{t-\tau}/4\right)/\left(\sum_{\tau=0}^{3} d_{t-4-\tau}/4\right) - 1$$

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

Effect on probability of a crisis 2

- $\frac{d(d_t)}{d\bar{i}_1}$, $t \geq 1$, example and benchmark: Riksbank estimate (not significant)



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

An intertemporal quadratic (indirect) loss function

- u_t^* *benchmark* unemployment rate: (Appendix: Optimal for flexible inflation targeting when $p_t \equiv 0$, $t \geq 1$)
- $\tilde{u}_t \equiv u_t - u_t^*$ unemployment gap (non-crisis: $\tilde{u}_t^{\rm n} \equiv u_t^{\rm n} - u_t^*$, crisis: $\tilde{u}_t^{\rm c} \equiv u_t^{\rm c} - u_t^*$); $\tilde{u}_t^{\rm n} > 0$: LAW; $\tilde{u}_t^{\rm n} < 0$: LWW;
- Intertemporal (indirect) loss function (relevant loss for $p_t \geq 0$, $t \geq 1$):

$$\sum_{t=1}^{\infty} \delta^{t-1} \mathrm{E}_1 L_t$$

$$L_t = (\tilde{u}_t)^2$$

- Expected quarter-t loss:

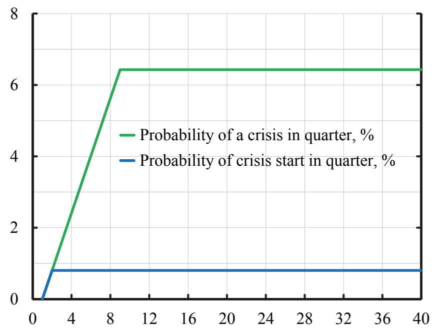
$$\mathrm{E}_1 L_t = (1 - p_t)\mathrm{E}_1(\tilde{u}_t^{\rm n})^2 + p_t \mathrm{E}_1(\tilde{u}_t^{\rm c})^2$$
$$= (1 - p_t)\mathrm{E}_1(\tilde{u}_t^{\rm n})^2 + p_t \mathrm{E}_1(\tilde{u}_t^{\rm n} + \Delta u)^2$$

- Need to know the probability of a crisis, p_t, $t \geq 1$

The probability of a crisis

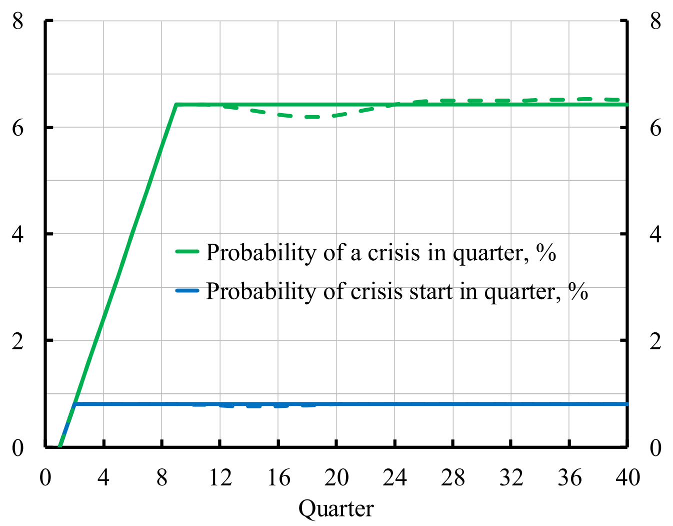
- Annual benchmark steady state probability of crisis start $4q = 3.2\%$:
  A crisis start on average every 31 years
  Quarterly probability of crisis start $q = 0.8\%$
- Conditional on no crisis in qtr 1, benchmark probability of crisis in qtr t ($n = 8$):

$$p_t = \begin{cases} 0 & \text{for } t = 1, \\ (t-1)q = (t-1)\,0.8\% > 0 & \text{for } 1 \leq t \leq 8, \\ nq = 6.4\% > 0 & \text{for } t \geq 9. \end{cases}$$



The probability of a crisis w/o and w/ LAW

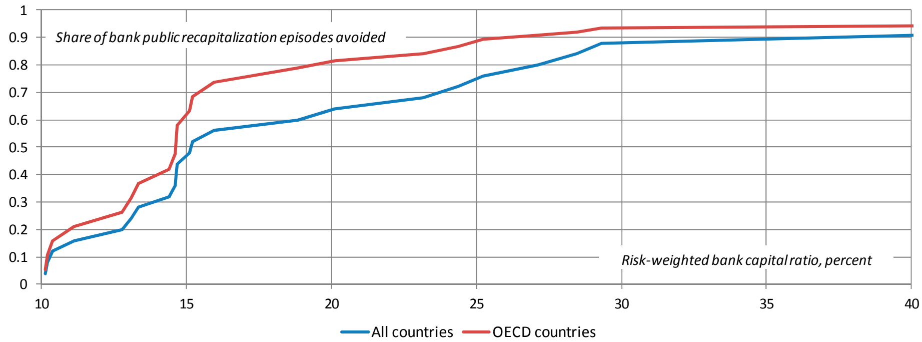
- The effect on the probability of crisis from LAW
- Solid lines: Without LAW
- Dashed lines: With LAW (1 pp higher policy rate for 4 quarters)



The probability of a crisis with enough bank capital 1

- 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)

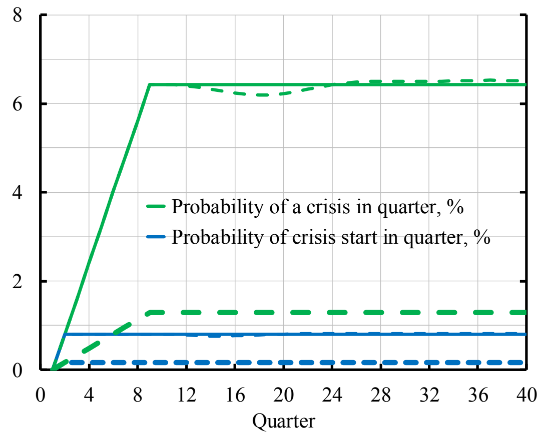
Figure 7. Share of Public Recapitalizations Avoided, Depending on Hypothetical Precrisis Bank Capital Ratios



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

The probability of a crisis with enough bank capital 2

- 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)
- Possible probability of crises with enough bank capital (thick dashed lines)



The expected quarter-t loss 1

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

$$\mathrm{E}_1(\tilde{u}_t^{\mathrm{n}})^2 = (\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + \mathrm{Var}_1\tilde{u}_t^{\mathrm{n}}$$
$$\mathrm{E}_1(\tilde{u}_t^{\mathrm{n}} + \Delta u)^2 = (\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} + \Delta u)^2 + \mathrm{Var}_1\tilde{u}_t^{\mathrm{n}}$$

$$\mathrm{E}_1 L_t - \mathrm{Var}_1\tilde{u}_t^{\mathrm{n}} = (1-p_t)(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + p_t(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} + \Delta u)^2$$
$$= (1-\bar{p}_t)(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} + \Delta u)^2$$
$$- (\bar{p}_t - p_t)[(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} + \Delta u)^2 - (\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2]$$

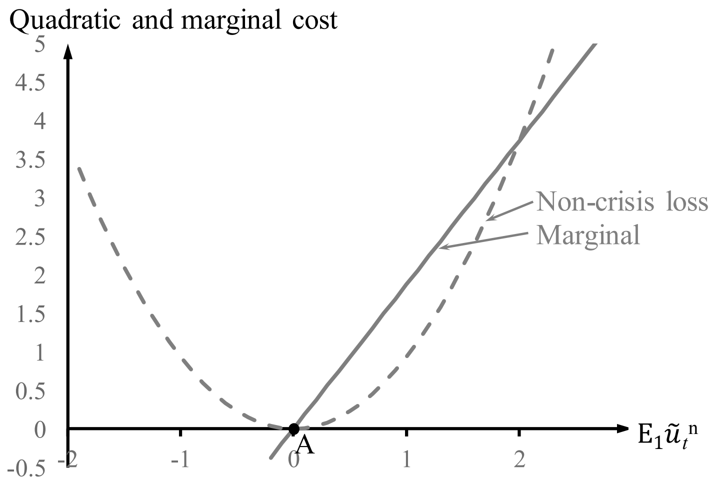
$$= \{(1-\bar{p}_t)(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} + \Delta u)^2\}$$
$$- (\bar{p}_t - p_t)[(\Delta u)^2 + 2\Delta u \mathrm{E}_1\tilde{u}_t^{\mathrm{n}}]$$

$$\equiv \{C_t^{\mathrm{n}} + C_t^{\mathrm{c}}\} - B_t \equiv C_t - B_t$$

The expected quarter-t loss 2

$$\mathrm{E}_1 L_t - \mathrm{Var}_1\tilde{u}_t^{\mathrm{n}} = \{(1-\bar{p}_t)(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} + \Delta u)^2\}$$
$$- (\bar{p}_t - p_t)[(\Delta u)^2 + 2\Delta u \mathrm{E}_1\tilde{u}_t^{\mathrm{n}}]$$

$$\bar{p}_t - p_t = (-dp_t/d\mathrm{E}_1 u_t^{\mathrm{n}})\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} = 0.0085\,\mathrm{E}_1\tilde{u}_t^{\mathrm{n}},\ \bar{p}_t = 0.064,\ \Delta u = 5$$



The expected quarter-t loss 3

$$\mathrm{E}_1 L_t - \mathrm{Var}_1 \tilde{u}_t^{\mathrm{n}} = \{(1-\bar{p}_t)(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} + \Delta u)^2\}$$
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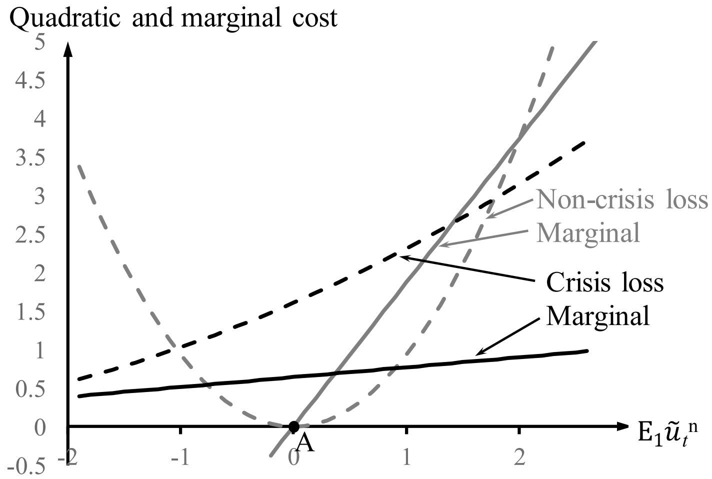

The expected quarter-t loss 4

$$\mathrm{E}_1 L_t - \mathrm{Var}_1 \tilde{u}_t^{\mathrm{n}} = \{(1-\bar{p}_t)(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} + \Delta u)^2\}$$
$$- (\bar{p}_t - p_t)[(\Delta u)^2 + 2\Delta u \mathrm{E}_1 \tilde{u}_t^{\mathrm{n}}]$$
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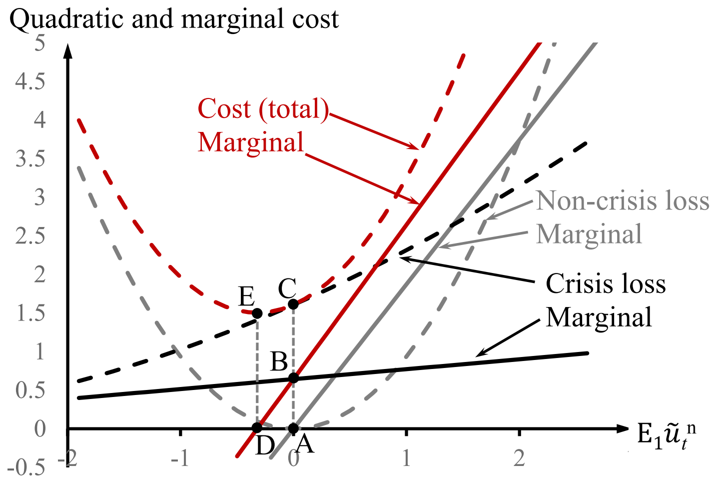

The expected quarter-t loss 5

$$\mathrm{E}_1 L_t - \mathrm{Var}_1 \tilde{u}_t^{\mathrm{n}} = \{(1-\bar{p}_t)(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} + \Delta u)^2\}$$
$$- (\bar{p}_t - p_t)[(\Delta u)^2 + 2\Delta u \mathrm{E}_1\tilde{u}_t^{\mathrm{n}}]$$

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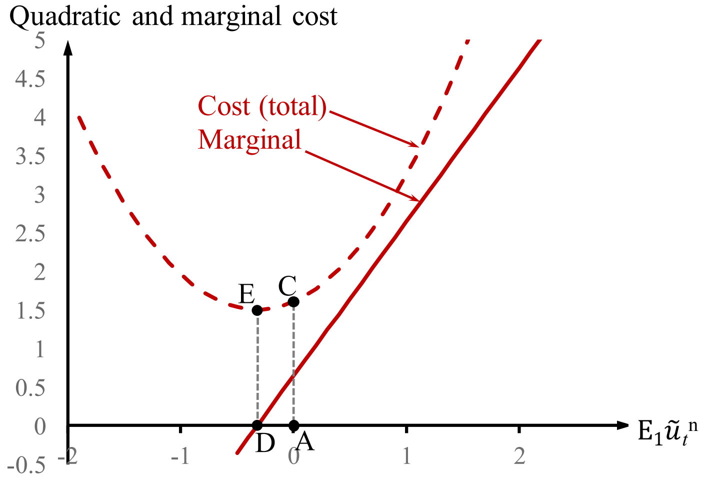

The expected quarter-t loss 6

$$\mathrm{E}_1 L_t - \mathrm{Var}_1 \tilde{u}_t^{\mathrm{n}} = \{(1-\bar{p}_t)(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} + \Delta u)^2\}$$
$$- (\bar{p}_t - p_t)[(\Delta u)^2 + 2\Delta u \mathrm{E}_1\tilde{u}_t^{\mathrm{n}}]$$

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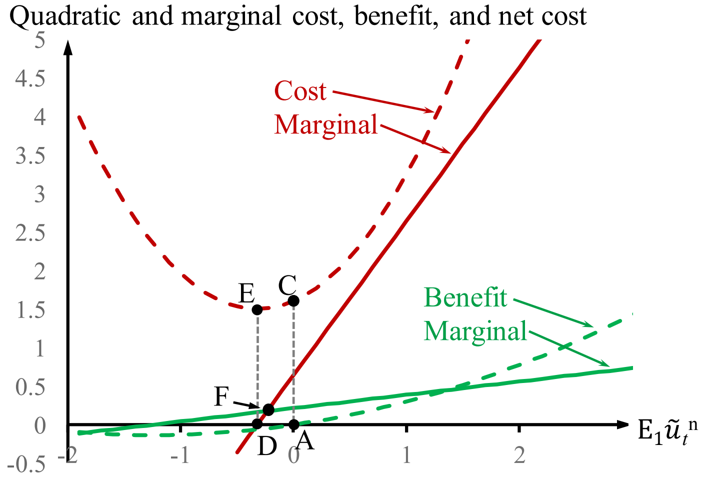

The expected quarter-t loss 7

$$\mathrm{E}_1 L_t - \mathrm{Var}_1 \tilde{u}_t^{\mathrm{n}} = \{(1-\bar{p}_t)(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} + \Delta u)^2\}$$
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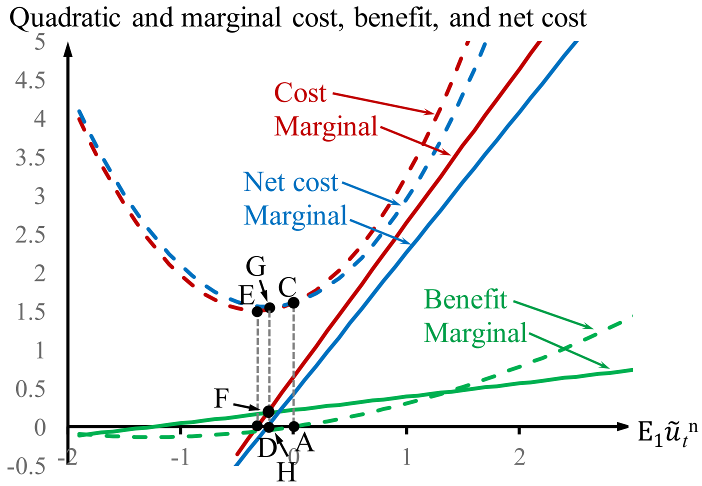
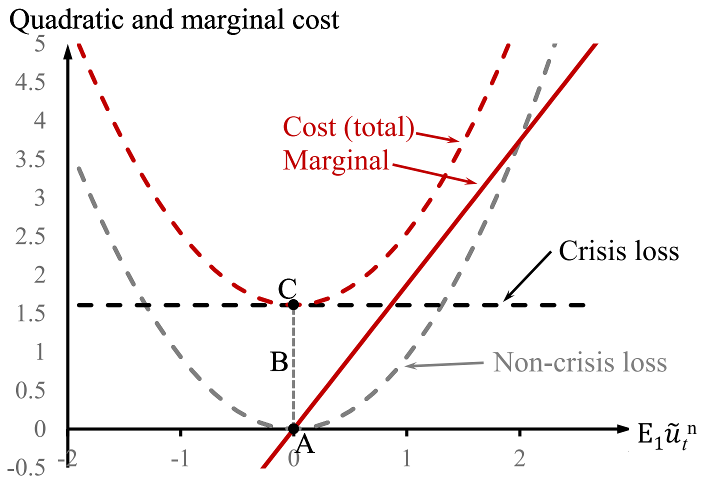


The expected quarter-t loss, *fixed loss* in a crisis 1

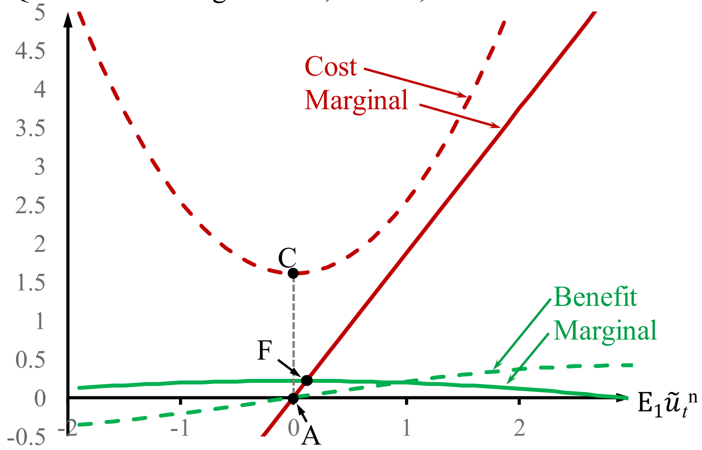
$$\mathrm{E}_1 L_t - \mathrm{Var}_1 \tilde{u}_t^{\mathrm{n}} = \{(1-\bar{p}_t)(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t(\Delta u)^2\}$$
$$- (\bar{p}_t - p_t)[(\Delta u)^2 - (\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2]$$
$$\bar{p}_t - p_t = (-dp_t/d\mathrm{E}_1 u_t^{\mathrm{n}})\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} = 0.0085\,\mathrm{E}_1\tilde{u}_t^{\mathrm{n}},\ \bar{p}_t = 0.064,\ \Delta u = 5$$



The expected quarter-t loss, *fixed loss* in a crisis 2

$$\mathrm{E}_1 L_t - \mathrm{Var}_1 \tilde{u}_t^{\mathrm{n}} = \{(1-\bar{p}_t)(\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t(\Delta u)^2\}$$
$$- (\bar{p}_t - p_t)[(\Delta u)^2 - (\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}})^2]$$

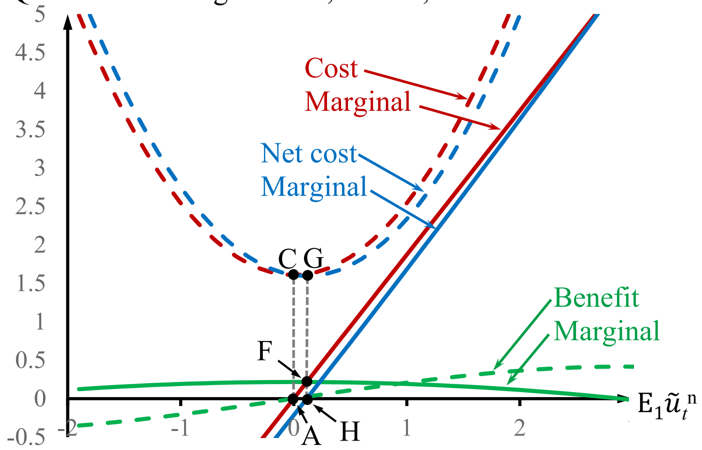
$$\bar{p}_t - p_t = (-dp_t/d\mathrm{E}_1 u_t^{\mathrm{n}})\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}} = 0.0085\,\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}},\ \bar{p}_t = 0.064,\ \Delta u = 5$$



The expected quarter-t loss, *fixed loss* in a crisis 3

$$\mathrm{E}_1 L_t - \mathrm{Var}_1 \tilde{u}_t^{\mathrm{n}} = \{(1-\bar{p}_t)(\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t(\Delta u)^2\}$$
$$- (\bar{p}_t - p_t)[(\Delta u)^2 - (\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}})^2]$$

$$\bar{p}_t - p_t = (-dp_t/d\mathrm{E}_1 u_t^{\mathrm{n}})\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}} = 0.0085\,\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}},\ \bar{p}_t = 0.064,\ \Delta u = 5$$



Marginal effect on expected quadratic loss, Net Marginal Cost

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

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

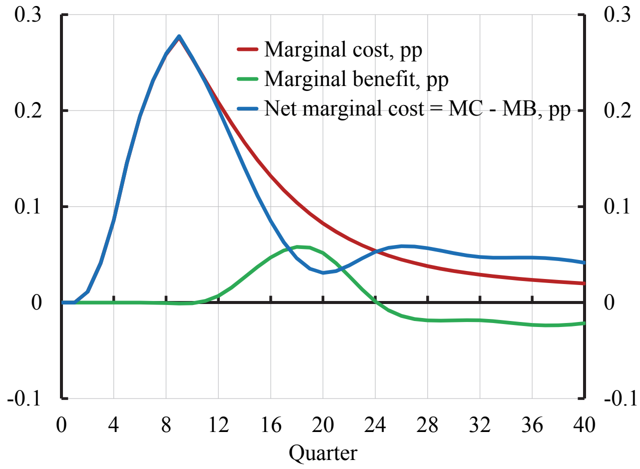
$$= \underbrace{2[\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} + p_t \Delta u]}_{\mathrm{E}_1 \tilde{u}_t} \frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1} - \underbrace{[(\Delta u)^2 + 2\Delta u \mathrm{E}_1 \tilde{u}_t^{\mathrm{n}}]}_{\text{Loss increase in crisis}}\left(-\frac{dp_t}{d\bar{i}_1}\right)$$
$$\equiv \mathrm{MC}_t - \mathrm{MB}_t$$

- Examine MC_t, MB_t, NMC_t for $\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} = 0$: If $\mathrm{NMC}_t > 0$, no LAW!

$$\mathrm{NMC}_t = \mathrm{MC}_t - \mathrm{MB}_t$$
$$= 2p_t \Delta u \frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1} - (\Delta u)^2\left(-\frac{dp_t}{d\bar{i}_1}\right)$$

Marginal cost, marginal benefit, and net marginal cost

- $\mathrm{MC}_t = 2p_t \Delta u \frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1}$, $\mathrm{MB}_t = (\Delta u)^2\left(-\frac{dp_t}{d\bar{i}_1}\right)$
- $\mathrm{NMC}_t = \mathrm{MC}_t - \mathrm{MB}_t$



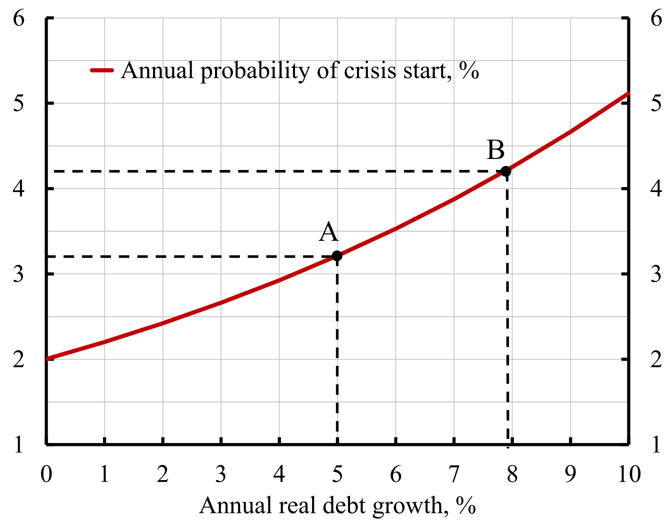
- Marginal cost dominates over marginal benefit
- Cumulative marginal benefits: $\sum_{t=1}^{40} \mathrm{MB}_t \approx 0$

What if less effective macroprudential policy?

- Does less effective macroprudential policy justify leaning against the wind?
- Consequences of less effective macroprudential policy:
  - Less loss-absorbing capital, weaker balance sheets, lower credit standards,...
  - Higher probability of a crisis start, q_t
  - Larger crisis increase in unemployment rate, Δu
  - Longer duration of crisis, n
- Additional sensitivity analysis

A higher probability of crisis start

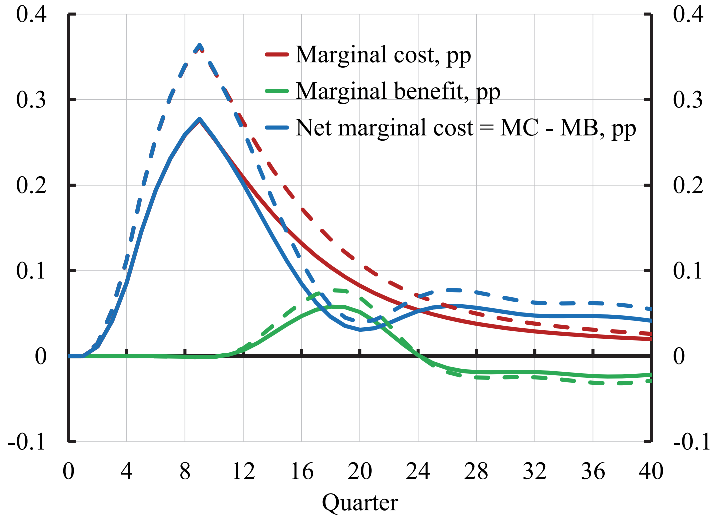
- Increase in annual probability $4q$ from 3.21% to 4.21%



- Credit boom: Increase in annual real debt growth from 5% to 7.9%
- dq/dg increases $\Rightarrow \left|dq_t/d\bar{i}_1\right|, \left|dp_t/d\bar{i}_1\right|$ increase

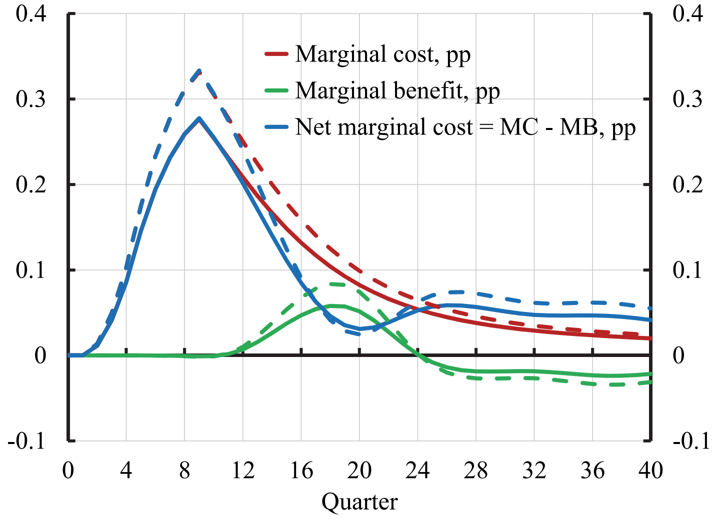
A higher probability of crisis start

- $\text{MC}_t = 2p_t \Delta u \frac{d\text{E}_1 u_t^{\text{n}}}{d\bar{i}_1}$, $\text{MB}_t = (\Delta u)^2(-\frac{dp_t}{d\bar{i}_1})$, $\text{NMC}_t = \text{MC}_t - \text{MB}_t$
- Increase in annual probability $4q$ from 3.21% to 4.21% (dashed)



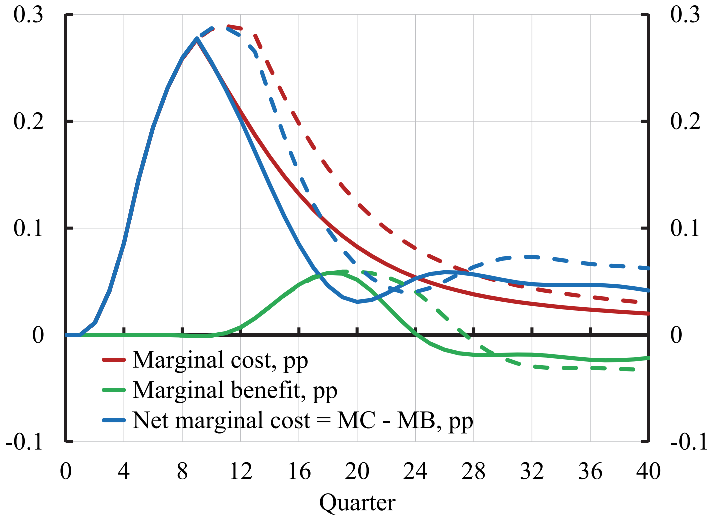
A larger crisis increase in the unemployment rate

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



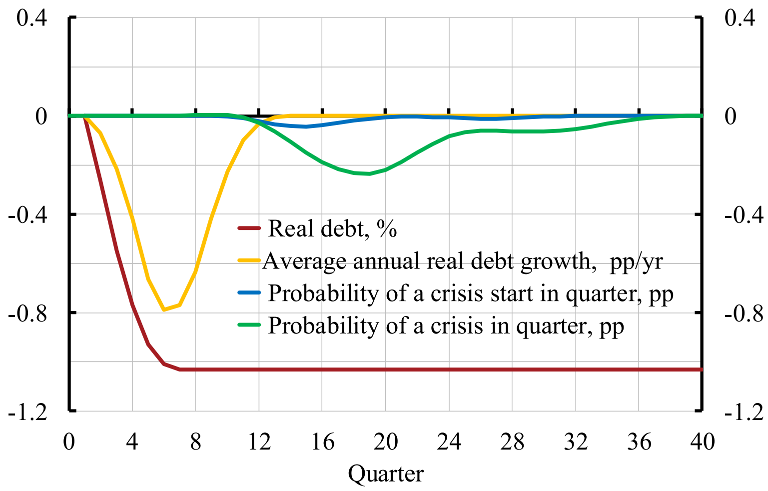
A longer crisis duration

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



Monetary non-neutrality: Permanent effect on real debt

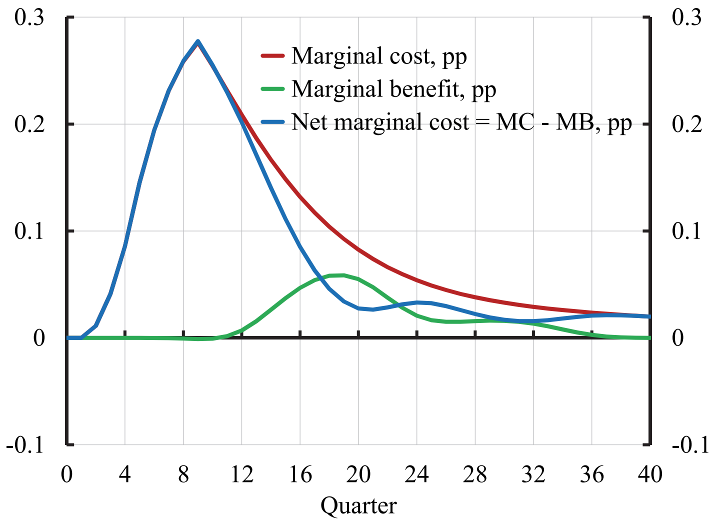
- Real debt stays at its lowest deviation from baseline



- Negative cumulative effect on crisis probabilities

Monetary non-neutrality: Permanent effect on real debt; MC, MB, and NMC

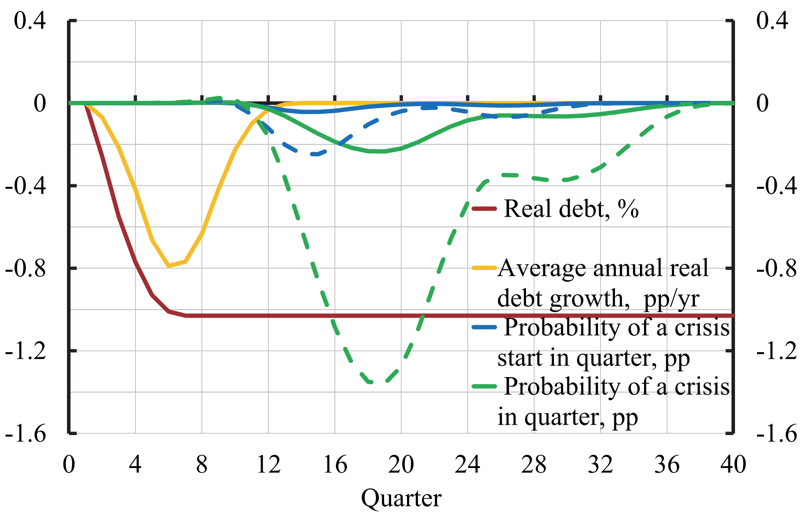
- $MC_t = 2p_t \Delta u \frac{dE_1 u_t^n}{d\bar{i}_1}$, $MB_t = (\Delta u)^2 (-\frac{dp_t}{d\bar{i}_1})$, $NMC_t = MC_t - MB_t$



- Marginal cost still dominates over marginal benefit

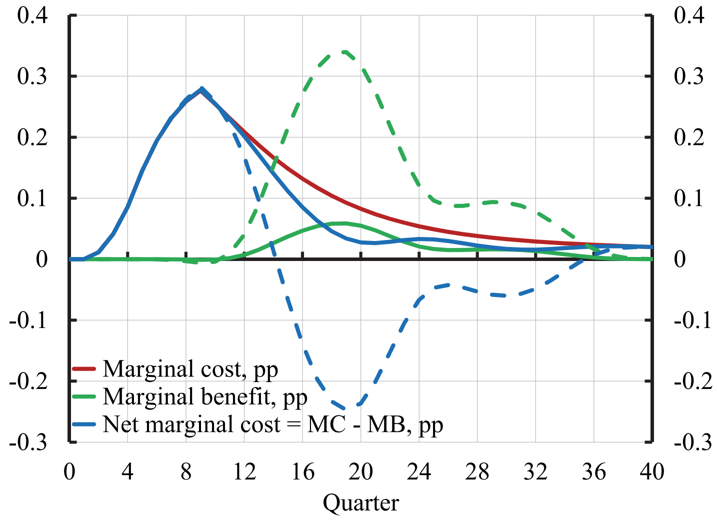
Monetary non-neutrality: Permanent effect on real debt – What is needed for LAW to be justified?

- Just to break even requires 5.8 times larger effect of real debt growth on probability than Schularick & Taylor's estimates (dashed lines)
- Requires adding 13 standard deviations to ST estimates



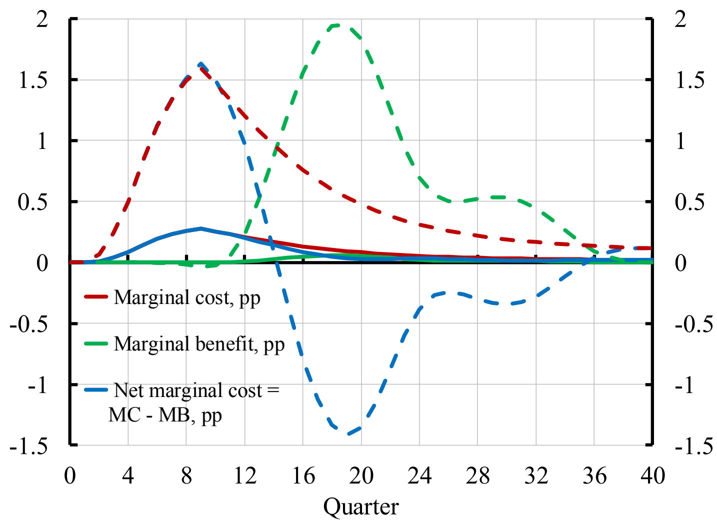
Monetary non-neutrality: Permanent effect on real debt – What is needed for LAW to be justified?

- MB and NMC for 5.8 times larger effect of real debt growth on probability
- Break-even point: $\sum_{t=1}^{40} \text{NMC}_t = \sum_{t=1}^{40} \text{MC}_t - \sum_{t=1}^{40} \text{MB}_t = 0$



Monetary non-neutrality: What crisis unemployment increase is required for break-even?

- Question: What Δu is required to break even, $\sum_{t=1}^{40} \text{NMC}_t = 0$?
- Answer: $\Delta u = 29$ pp (dashed lines) instead of $\Delta u = 5$ pp (solid lines).



Conclusions 1

- For existing empirical estimates, marginal cost of LAW much higher than marginal benefit
- Thus, LAW not justified. If anything, small leaning *with* the wind justified.
- LAW increases not only *non-crisis* unemployment gap but also *crisis* unemployment gap; the latter is main component of marginal cost
- Lower probability of a crisis is main component of possible marginal benefit of LAW
- For empirical estimates and channels, effect of LAW on probability of a crisis too small to make marginal benefit exceed marginal cost
- Effect on magnitude even smaller, can be disregarded

Conclusions 2

- Empirically, probability of a crisis seems to depend on real debt growth
- If monetary policy neutral in long run, no long-run effect on real debt and cumulative real debt growth
- Then, if real debt growth and probability of a crisis lower for a few years, they must be *higher* in later years; probability of crisis postponed; no effect on long-run average probability of a crisis
- Even if monetary policy non-neutral and lowers real debt in the long run, empirically marginal benefit still much smaller than marginal cost
- Less effective macroprudential policy might increase the probability, magnitude, or duration of a crisis
- However, each of these increases marginal cost more than marginal benefit and strengthens the case *against* LAW

Conclusions 3

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

Extra slides

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)
- 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)

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)

Implications of monetary neutrality

- No long-run effect on real debt,

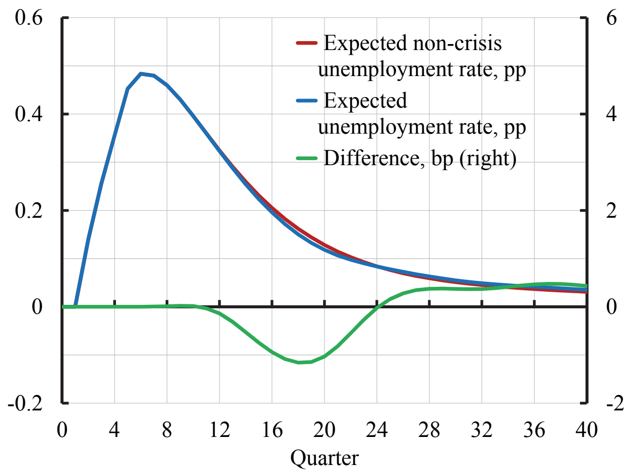
$$\frac{d(d_t)}{d\bar{i}_1} \approx 0 \text{ for } t \geq 40$$

- No cumulative effect on real debt growth, the probability of a crisis start, or the probability of a crisis

$$\sum_{\tau=1}^{40} \frac{dg_t}{d\bar{i}_1} \approx \sum_{\tau=1}^{40} \frac{dq_t}{d\bar{i}_1} \approx \sum_{\tau=1}^{40} \frac{dp_t}{d\bar{i}_1} \approx 0$$

Effect on the expected unemployment rate

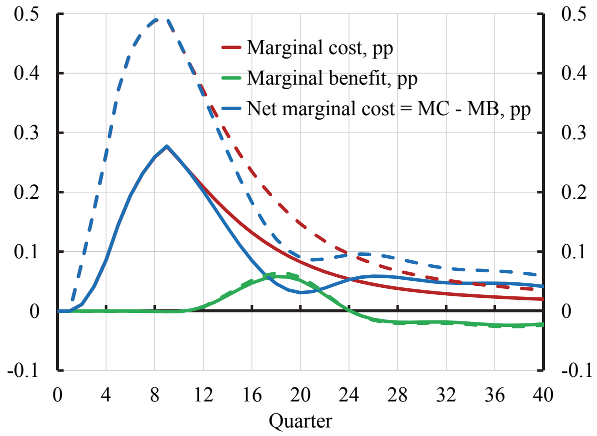
$$\frac{d\mathrm{E}_1 u_t}{d\bar{i}_1} = \frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1} + \frac{dp_t}{d\bar{i}_1} \Delta u$$



- Effect of reduced probability of crisis negligible (Svensson 2014, 2015), and cumulative effect approximately zero, $\sum_{t=1}^{40} \frac{dp_t}{d\bar{i}_1} \Delta u \approx 0$

Sensitivity to initial state of the economy

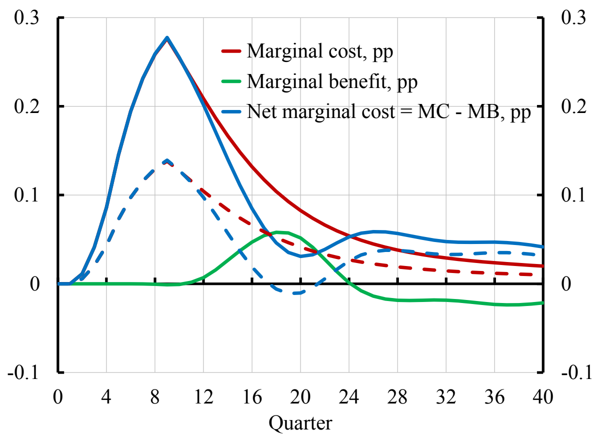
- $\text{MC}_t = 2[\text{E}_1\tilde{u}_t^{\text{n}} + p_t\Delta u]\frac{d\text{E}_1 u_t^{\text{n}}}{d\bar{i}_1}$, $\text{MB}_t = [(\Delta u)^2 + 2\Delta u \text{E}_1\tilde{u}_t^{\text{n}}](-\frac{dp_t}{d\bar{i}_1})$
- Suppose $\text{E}_1\tilde{u}_t^{\text{n}} = 0.25 \text{ pp} > 0$ for all $t \geq 1$ (dashed)



- LAW even less justified, also if $\text{E}_1\tilde{u}_t^{\text{n}} = 0$ for $t \geq 12$

Sensitivity to policy-rate effect on the expected non-crisis unemployment rate

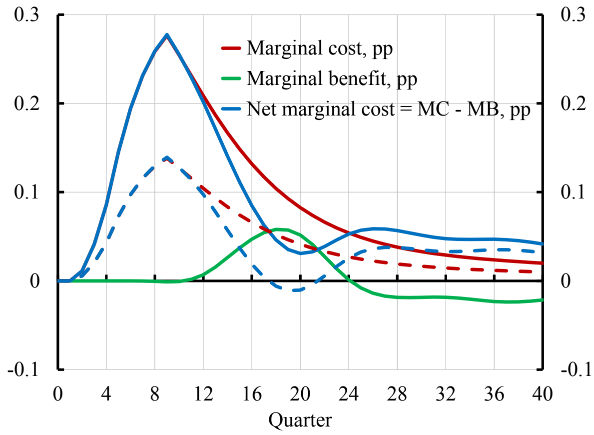
- $\text{MC}_t = 2p_t\Delta u\frac{d\text{E}_1 u_t^{\text{n}}}{d\bar{i}_1}$, $\text{MB}_t = (\Delta u)^2(-\frac{dp_t}{d\bar{i}_1})$.
- Suppose $\frac{d\text{E}_1 u_t^{\text{n}}}{d\bar{i}_1}$ is only a half of the benchmark (dashed)



- LAW still not justified

Sensitivity to probability of crisis

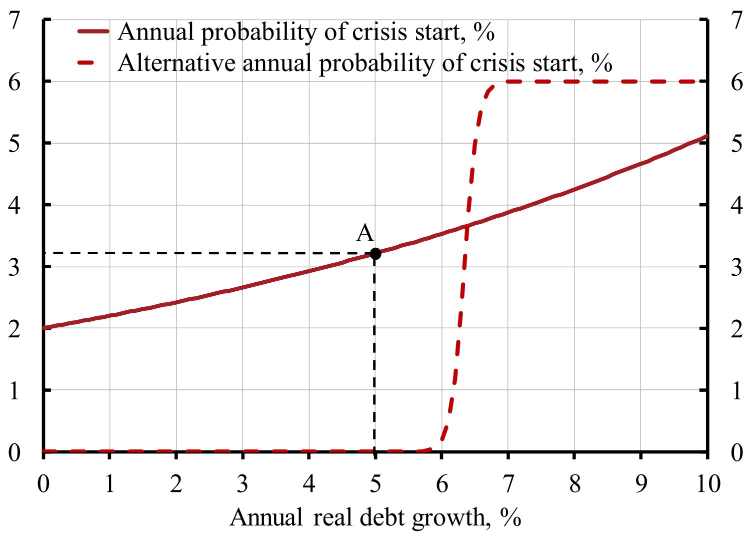
- $\text{MC}_t = 2p_t \Delta u \frac{d\text{E}_1 u_t^{\text{n}}}{d\bar{i}_1}$, $\quad \text{MB}_t = (\Delta u)^2 (-\frac{dp_t}{d\bar{i}_1})$.
- Suppose p_t is only a half of the benchmark (dashed)



- LAW still not justified

More complex dynamics/determinantion of prob. of crisis start?

- ST (and Leuven and Valencia) data support relation like solid line
- In principle, data could (but doesn't seem to) support relation like dashed line for debt growth, debt to GDP, or "financial cycle"
- Simply empirical issue!



More recent data: Probability of a crisis

- IMF staff estimates on Laeven and Valencia (2012), quarterly data, banking crises in 35 advanced countries, 1970-2011,

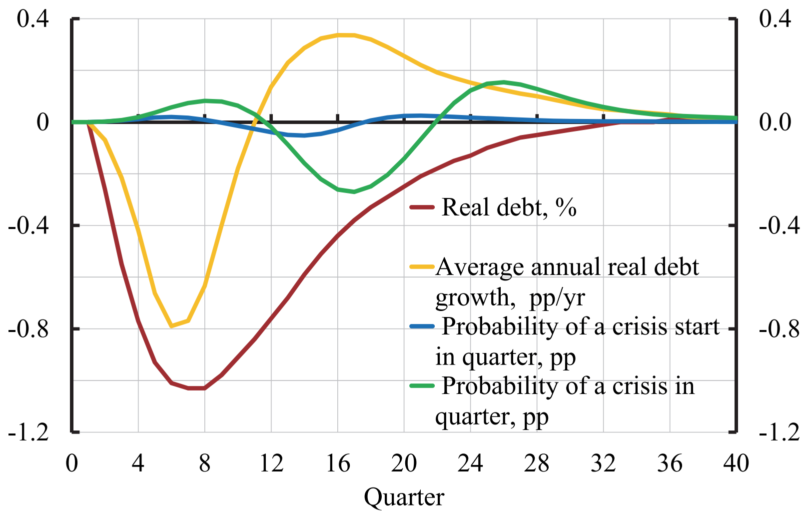
$$q_t = \frac{\exp(X_t)}{1+\exp(X_t)},$$

$$X_t = \underset{(1.008)}{-5.630^{***}} \underset{(3.171)}{-5.650^{*}} g_t + \underset{(3.580)}{4.210} g_{t-4} + \underset{(5.408)}{12.342^{**}} g_{t-8} - \underset{(3.591)}{5.259} g_{t-12}.$$

- For 5% annual real debt growth, annual probability of crisis start $4q = 1.89\%$, $q = 0.47\%$:
  A crisis start on average every 53 years

More recent data: Effect on probability of a crisis

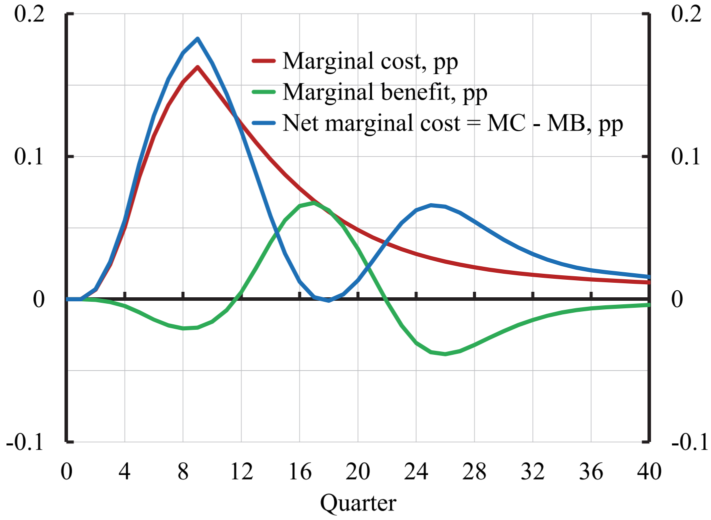
- Riksbank estimate of effect on real household debt, $d(d_t)/d\bar{i}_1$



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

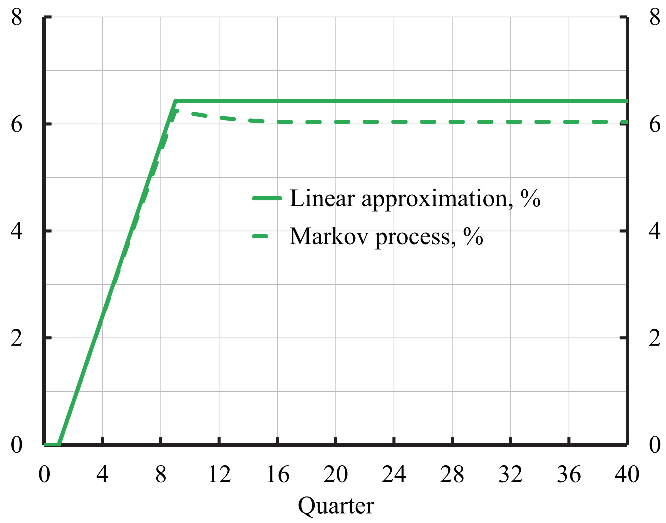
Marginal cost, marginal benefit, and net marginal cost

- More fluctuation in Marginal Benefit, goes to zero at $t = 40$, else similar, no cumulative effect on Marginal Benefits



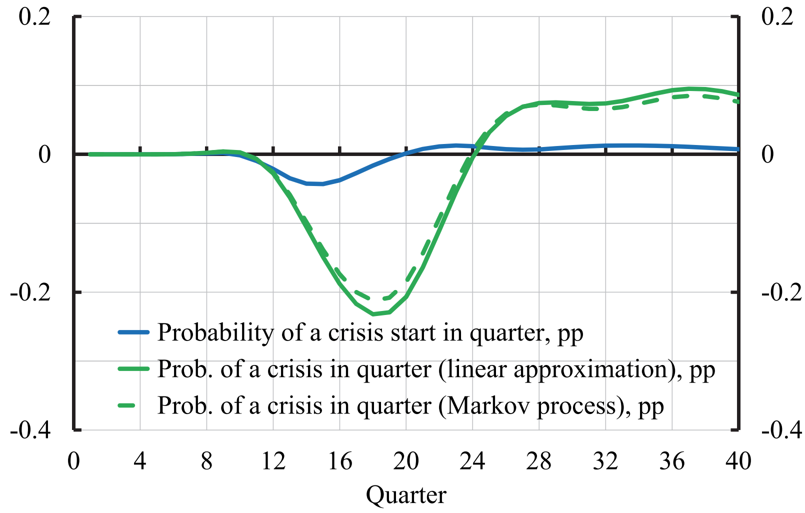
Linear approximation and Markov process

- Probability of a crisis, p_t, $t \geq 1$,
conditional on no crisis in quarter 1, $p_1 = 0$



Linear approximation and Markov process

- Effect of policy rate on probability of crisis, $\frac{dp_t}{d\bar{i}_1}$, $t \geq 1$



Effect on crisis increase in unemployment 1

$$\frac{d\mathrm{E}_1 u_t}{d\bar{i}_1} = \frac{d\mathrm{E}_1 u_t^{\mathrm{n}}}{d\bar{i}_1} + \Delta u \frac{dp_t}{d\bar{i}_1} + \overbrace{p_t \frac{d\Delta u}{d\bar{i}_1}}^{\text{Additional term}}$$

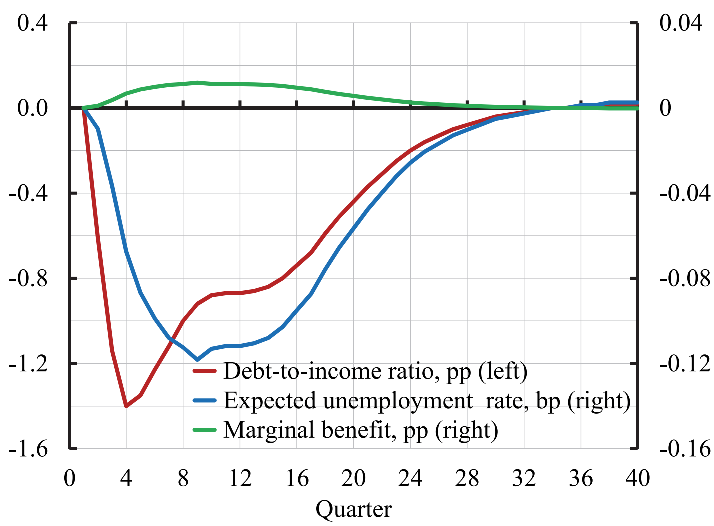
$$\mathrm{MB}_t = (\Delta u)^2 \left(-\frac{dp_t}{d\bar{i}_1}\right) + \underbrace{2 p_t \Delta u \left(-\frac{d\Delta u}{d\bar{i}_1}\right)}_{\text{Additional term}}$$

Effect on crisis increase in unemployment 2

- Flodén (2014), OECD:
  1 pp higher DTI ratio 2007 is associated with a (barely significant) 0.02 pp larger unemployment increase 2007–2012
- Krishnamurthy and Muir (2016), 14 countries, 1869–2014:
  1 pp higher 3-year growth in the credit-to-GDP ratio is associated with an (insignificant) 0.05 pp larger GDP decline from peak to trough in a financial crisis
- With an Okun coefficient of 2, a 0.05 pp decline in GDP is associated with a 0.025 pp rise in unemployment
- Jorda, Schularick, and Taylor (2013), 14 countries, 1870-2008:
  With an Okun coefficient of 2, effect about twice as large as Flodén's
- Similar small magnitudes

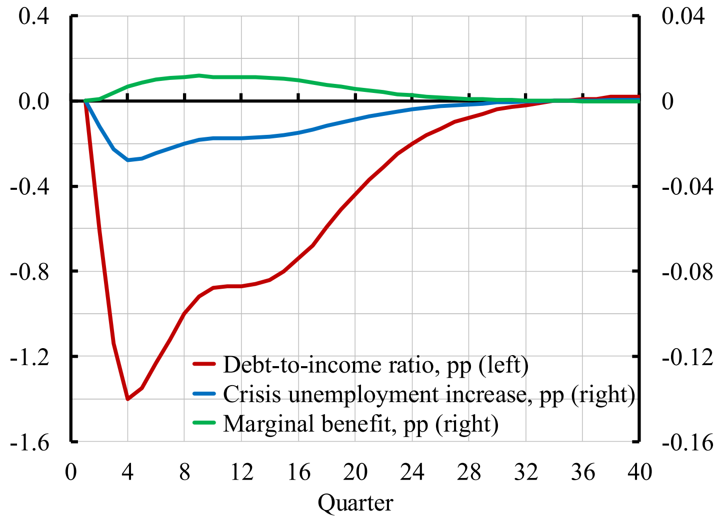
Effect on crisis increase in unemployment 3

- Flodén (2014), OECD: 1 pp higher DTI ratio 2007 is associated with 0.02 pp larger unemployment increase 2007–2012;
  Riksbank estimate of policy-rate effect on DTI ratio
  Effect on $E_1 u_t$: $p_t \frac{d\Delta u}{di_1}$. Effect on MB_t: $2p_t \Delta u (- \frac{d\Delta u}{di_1})$



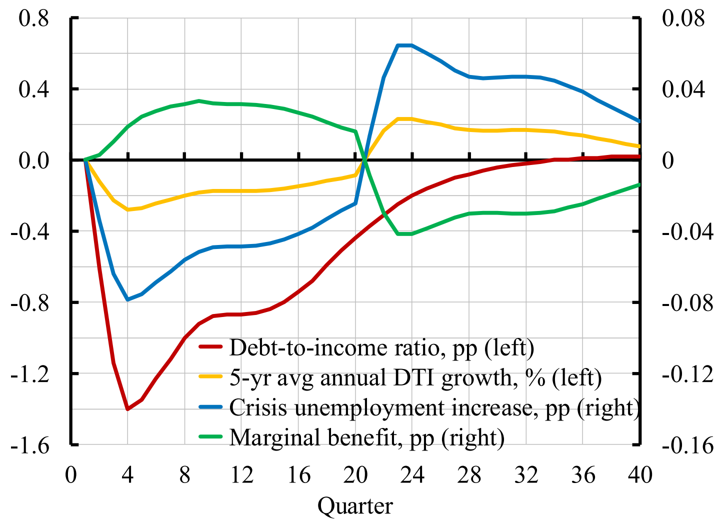
Effect on crisis increase in unemployment 4

- Flodén (2014), OECD: 1 pp higher DTI ratio 2007 is associated with 0.02 pp larger unemployment increase 2007–2012; Riksbank estimate of policy-rate effect on DTI ratio
  Effect on Δu: $\frac{d\Delta u}{d\bar{i}_1}$. Effect on MB_t: $2p_t \Delta u(-\frac{d\Delta u}{d\bar{i}_1})$



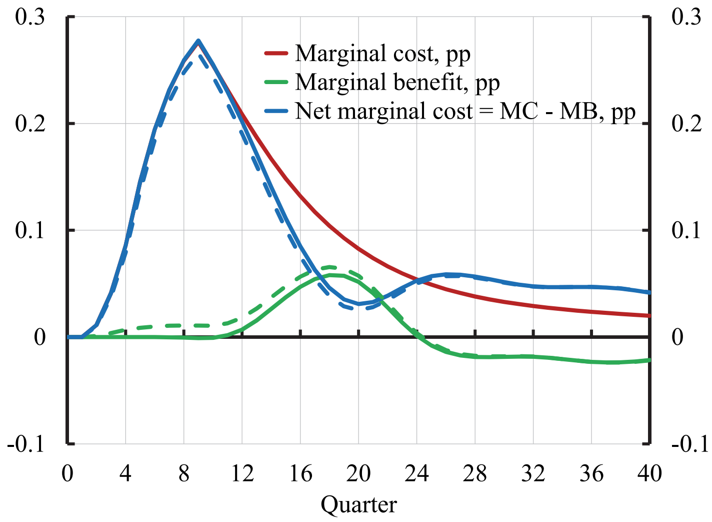
Effect on crisis increase in unemployment 5

- Flodén (2014), OECD: 1 pp higher DTI-ratio average annual growth rate 2003-2007 is associated with (insignificant) 0.28 pp larger unemployment increase 2007–2012; Riksbank estimate of policy-rate effect on DTI ratio
  Effect on Δu: $\frac{d\Delta u}{d\bar{i}_1}$. Effect on MB_t: $2p_t \Delta u(-\frac{d\Delta u}{d\bar{i}_1})$



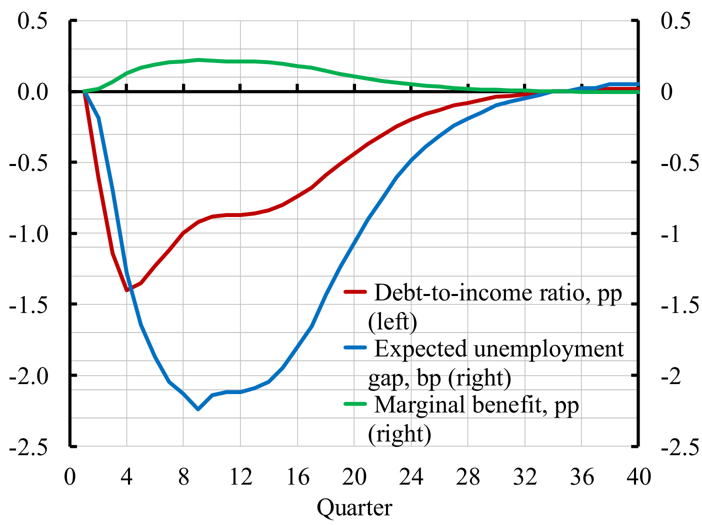
Effect on crisis increase in unemployment 6

- Flodén (2014), OECD: 1 pp higher DTI ratio (level) 2007 is associated with 0.02 pp larger unemployment increase 2007–2012
- Small effect on total marginal benefit and net marginal cost



What policy-rate effect on the crisis increase in unemployment is required for break-even?

- $d\Delta u/d\bar{i}_1$ must be about 19 times larger than Flodén's estimate: $(0.3786/0.02 = 18.93)$



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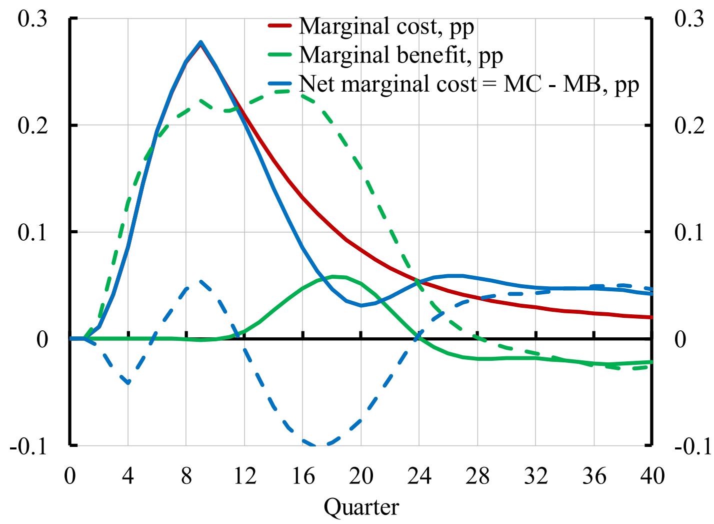
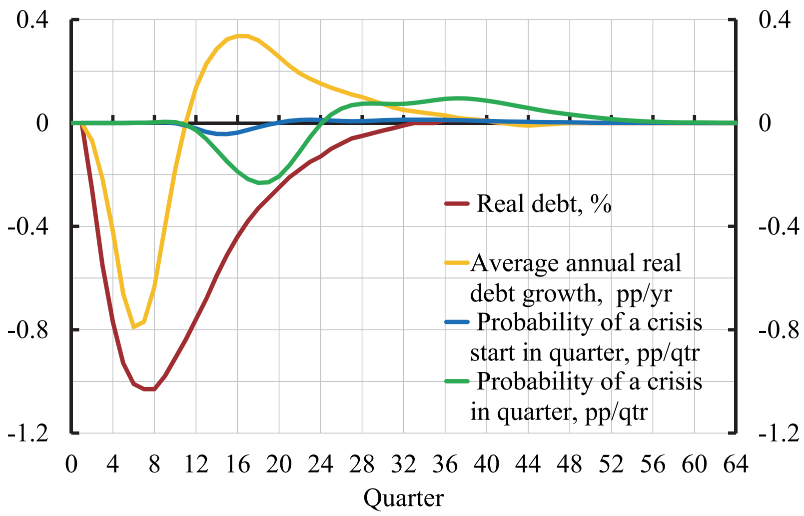


Longer horizon: MC, MB, and NMC

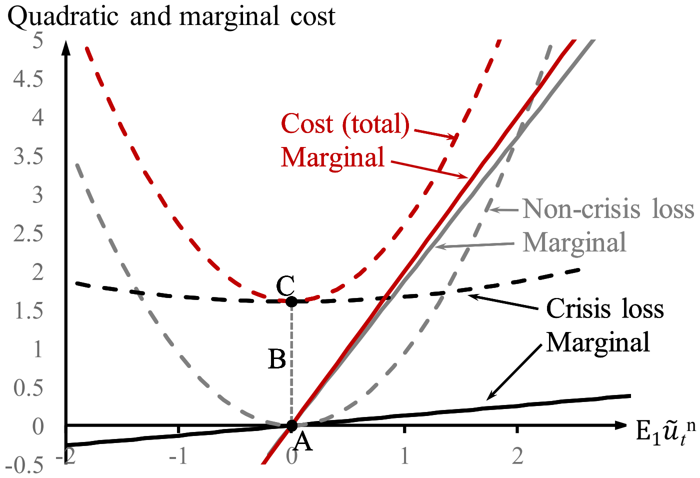


Expected quarter-*t* loss, fixed loss *increase* in crisis 1

Corresponds to Filardo and Rungcharoentkitkul (2016)

$$\mathrm{E}_1 L_t - \mathrm{Var}_1 \tilde{u}_t^{\mathrm{n}} = \{(1-\bar{p}_t)(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t[(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + (\Delta u)^2]\}$$
$$- (\bar{p}_t - p_t)(\Delta u)^2$$

$$\bar{p}_t - p_t = (-dp_t/d\mathrm{E}_1 u_t^{\mathrm{n}})\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} = 0.0085\,\mathrm{E}_1\tilde{u}_t^{\mathrm{n}},\ \bar{p}_t = 0.064,\ \Delta u = 5$$

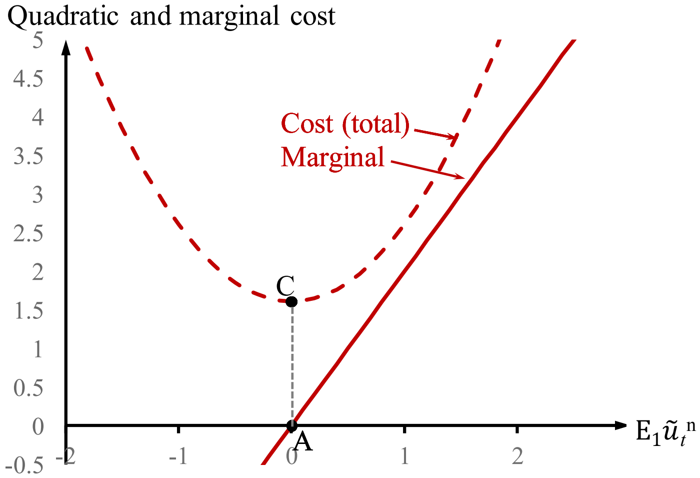


Expected quarter-*t* loss, fixed loss *increase* in crisis 2

Corresponds to Filardo and Rungcharoentkitkul (2016)

$$\mathrm{E}_1 L_t - \mathrm{Var}_1 \tilde{u}_t^{\mathrm{n}} = \{(1-\bar{p}_t)(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t[(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + (\Delta u)^2]\}$$
$$- (\bar{p}_t - p_t)(\Delta u)^2$$

$$\bar{p}_t - p_t = (-dp_t/d\mathrm{E}_1 u_t^{\mathrm{n}})\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} = 0.0085\,\mathrm{E}_1\tilde{u}_t^{\mathrm{n}},\ \bar{p}_t = 0.064,\ \Delta u = 5$$



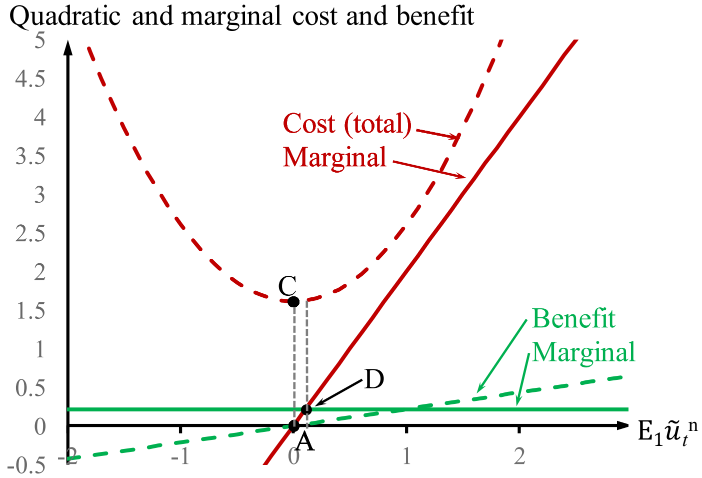
Expected quarter-t loss, fixed loss *increase* in crisis 3

Corresponds to Filardo and Rungcharoentkitkul (2016)

$$\mathrm{E}_1 L_t - \mathrm{Var}_1 \tilde{u}_t^{\mathrm{n}} = \{(1-\bar{p}_t)(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t[(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + (\Delta u)^2]\} - (\bar{p}_t - p_t)(\Delta u)^2$$

$$\bar{p}_t - p_t = (-dp_t/d\mathrm{E}_1 u_t^{\mathrm{n}})\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} = 0.0085\,\mathrm{E}_1\tilde{u}_t^{\mathrm{n}},\ \bar{p}_t = 0.064,\ \Delta u = 5$$

Optimal leaning against the wind: $\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} = 0.11$ pp



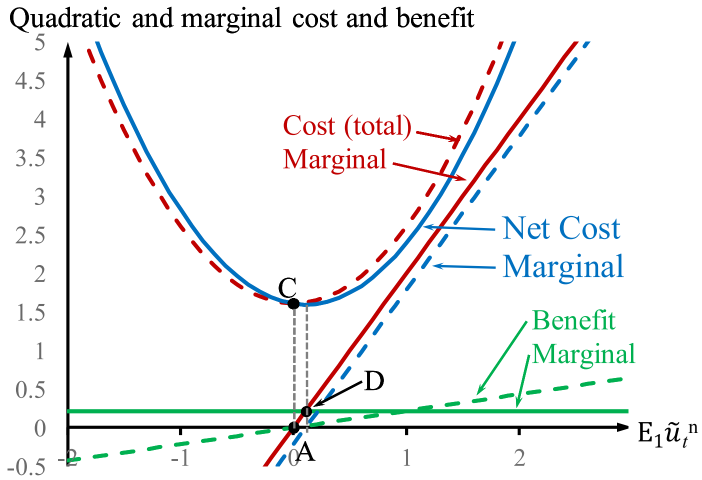
Expected quarter-t loss, fixed loss *increase* in crisis 4

Corresponds to Filardo and Rungcharoentkitkul (2016)

$$\mathrm{E}_1 L_t - \mathrm{Var}_1 \tilde{u}_t^{\mathrm{n}} = \{(1-\bar{p}_t)(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + \bar{p}_t[(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}})^2 + (\Delta u)^2]\} - (\bar{p}_t - p_t)(\Delta u)^2$$

$$\bar{p}_t - p_t = (-dp_t/d\mathrm{E}_1 u_t^{\mathrm{n}})\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} = 0.0085\,\mathrm{E}_1\tilde{u}_t^{\mathrm{n}},\ \bar{p}_t = 0.064,\ \Delta u = 5$$

Optimal leaning against the wind: $\mathrm{E}_1\tilde{u}_t^{\mathrm{n}} = 0.11$ pp



Alternative assumption: Fixed loss in a crisis

- Crisis unemployment rate:
  $u_t^c = \Delta u > 0$ instead of $u_t^c = u_t^n + \Delta u$
- Expected quarter t-loss

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

- Net marginal cost: $\mathrm{NMC}_t \equiv \frac{d\mathrm{E}_1 L_t}{d\bar{i}_1}$

$$= (1 - p_t) 2\mathrm{E}_1 \tilde{u}_t^n \frac{d\mathrm{E}_1 \tilde{u}_t^n}{d\bar{i}_1} - [(\Delta u)^2 - (\mathrm{E}_1 \tilde{u}_t^n)^2](-\frac{dp_t}{d\bar{i}_1})$$

$$\equiv \mathrm{MC}_t - \mathrm{MB}_t$$

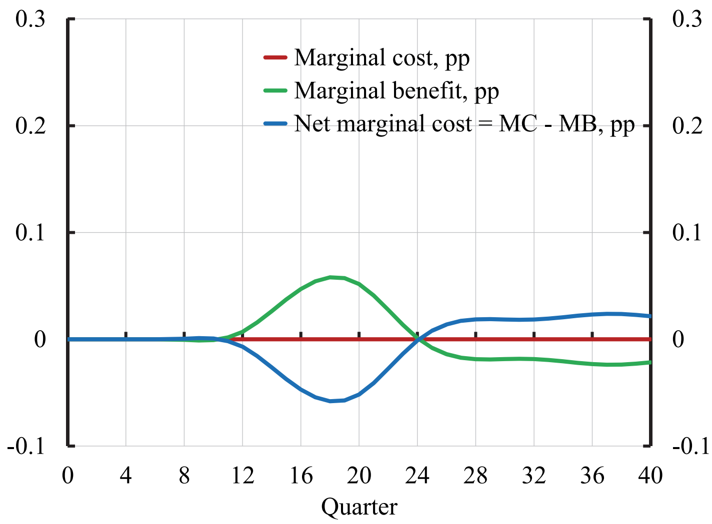
- For $\mathrm{E}_1 \tilde{u}_t^n = 0$,

$$\mathrm{MC}_t = 0$$

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

Fixed loss in a crisis

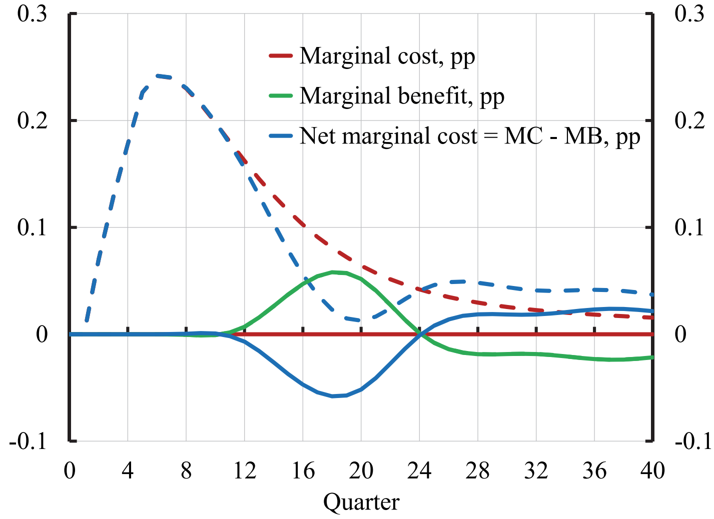
$$\mathrm{MC}_t = 0, \quad \mathrm{MB}_t = (\Delta u)^2(-\frac{dp_t}{d\bar{i}_1})$$



- Some (small) LAW justified (Ajello et al.), *if* horizon not too long (cf. 24 qtrs)

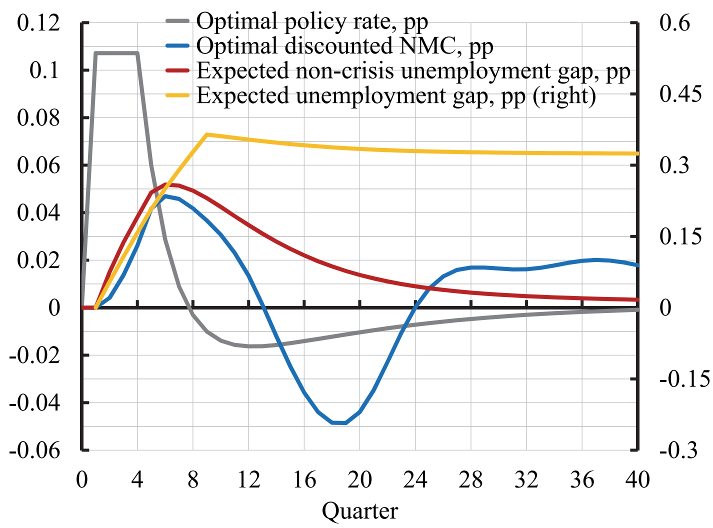
Fixed loss in a crisis: Small initial u gap

- Small initial positive expected non-crisis unemployment gap: $\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}} = 0.25$ pp for $t \geq 1$



Fixed loss in a crisis, short horizon: Optimal LAW 1

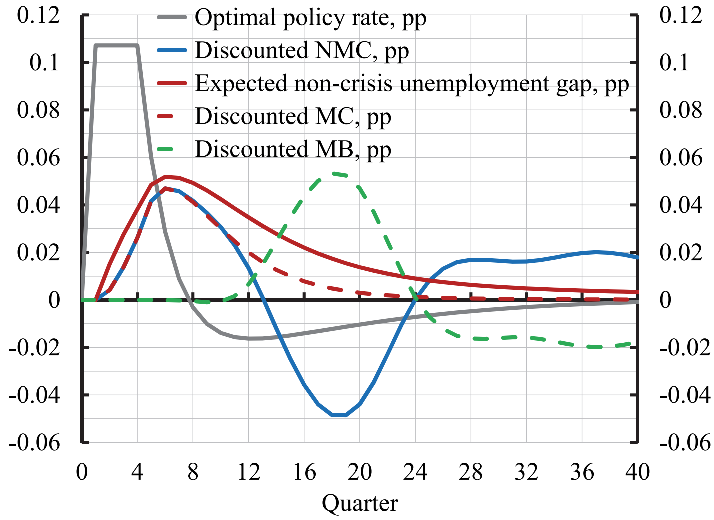
- "Optimal" LAW very small, even if horizon = 24 qtrs (Ajello et al.)



- $\Delta \bar{i}_1 = 0.11$pp: $\max(\mathrm{E}_1 \tilde{u}_t^{\mathrm{n}}) = 0.05$ pp; $\max(-\Delta p_t) = 0.025$ pp (from $p_t = 6.4$ pp); reduction in loss 0.07%

Fixed loss in a crisis, short horizon: Optimal LAW 2

- "Optimal" LAW very small, even if horizon = 24 qtrs (Ajello et al.)



- $\Delta\bar{i}_1 = 0.11$pp: $\max(\mathrm{E}_1\tilde{u}_t^{\mathrm{n}}) = 0.05$ pp; $\max(-\Delta p_t) = 0.025$ pp (from $p_t = 6.4$ pp); reduction in loss 0.07%

A constrained-optimal policy