More pluralism, more stability?1

Presentation by Claudio Borio
Head of the BIS Monetary and Economic Department
Seventh high-level SNB-IMF conference on the international monetary system
Zurich, 10 May 2016

I would like to thank the organisers for the kind invitation to speak at this prestigious conference. I am delighted and honoured to be in such distinguished company.

The question I would like to address today is whether a more pluralistic international monetary system – one with more international currencies on a more equal footing – would enhance global monetary, financial and macroeconomic stability.

This is a perennial question. It was, for instance, just as prominent under the Bretton Woods system as under the arrangements that have followed – which some regard as a “non-system” (eg Padoa-Schioppa and Saccomanni (1994)). And it presupposes the answer to another, more fundamental, question: what is the Achilles heel of the international monetary and financial system (IMFS)?

Note that I am choosing my words carefully. For, the “financial” dimension is just as important as the “monetary” one, although the shorthand “international monetary system” is much more common. This tendency perhaps harks back to post-war arrangements in which, for quite some time, finance played a subordinated role owing to constraints on capital flows and foreign exchange transactions. As we all know, that world is long gone.

There are three takeaways from my presentation.

First, there is no doubt that the dominance of one currency creates challenges for the IMFS. Fundamentally, the domestic interests of the country of issue need not coincide with those of the system as a whole.

Second, it is less clear, though, whether a more pluralist system, even if it was achieved, could help address the IMFS’s main weakness. To my mind, that weakness is its inability to prevent the build-up and unwinding of hugely damaging financial imbalances, or outsize financial cycles, thereby amplifying weaknesses in national arrangements (Borio (2014a)). This is what, with a colleague, Piti Disyatat, we have termed its “excess (financial) elasticity” (Borio and Disyatat (2011)). Think of an elastic band that you can stretch out further and further but that, as a result, snaps back more violently.

Third, addressing this weakness would require stronger anchors at national and international level. Some progress has been made, especially at national level. But much more needs to be done.

In what follows, I will first recall some basic facts to illustrate the US dollar’s dominance in the IMFS. Here I will consider the dollar’s three familiar roles, as a means of payment, a store of value and a unit of account. I will then explore the possible problems that this can create and put forward three propositions. I will finally turn to possible solutions and make three observations.

1 I would like to thank Bob McCauley, in particular, for help in the preparation of these remarks.

---

Macroeconomics of Bank Capital and Liquidity Regulations
by Frédéric Boissay (BIS) and Fabrice Collard (University of Bern)

Conference on Financial Stability, Banco de España, 24–25 may 2017

The views expressed in this presentation are our own and do not necessarily reflect those of the BIS
Objectives

- Understand better the transmission channels to the macro–economy of capital and liquidity regulations
  - Trade–offs, interactions, synergies/conflicts, general equilibrium effects, unintended effects

- Emphasize the positive effect of regulation on credit quality and allocative efficiency, versus its negative effect on credit supply

- Provide guidance for the coordination of those regulations (e.g., optimal regulatory mix)

- Develop a quantitative general equilibrium framework, with financial frictions confined to the banking sector and wholesale funding markets
Objectives

- Understand better the transmission channels to the macro–economy of capital and liquidity regulations
  - Trade–offs, interactions, synergies/conflicts, general equilibrium effects, unintended effects

- What is the net welfare gain of stacking regulations on the top of each other?
  - Emphasize the positive effect of regulation on credit quality and allocative efficiency, versus its negative effect on credit supply
  - Provide guidance for the coordination of those regulations (e.g., optimal regulatory mix)
Objectives

- Understand better the transmission channels to the macro–economy of capital and liquidity regulations
  - Trade–offs, interactions, synergies/conflicts, general equilibrium effects, unintended effects

- What is the net welfare gain of stacking regulations on the top of each other?
  - Emphasize the positive effect of regulation on credit quality and allocative efficiency, versus its negative effect on credit supply
  - Provide guidance for the coordination of those regulations (e.g., optimal regulatory mix)

- Develop a quantitative general equilibrium framework, with financial frictions confined to the banking sector and wholesale funding markets
Main Takeaways

1. Liquidity and capital regulations mutually reinforce each other (i.e. tightening one regulation makes the other more effective)

2. There may be tensions between the two regulations due to general equilibrium effects; but those tensions are meaningful only when liquid assets are scarce (this is not the case in the version of our model calibrated for the US)

3. The optimal regulatory mix in our model consists of a leverage ratio requirement at around 17% and a liquidity ratio requirement at around 12%
Model

$S_t^h$ to $s_t$

$e_t, d_t$ to $m_t$

$b_t$ to $m_t$

$m_t$ to $n_t$

$s_t^b$ to $s_t$

Households $a_t$

Governments $\bar{s}$

Firms $x_t$
Transaction Costs: $\chi_t$

Productivity Gains: $\Omega_t$

**Model**

**Households** $a_t$

**Banks** $m_t$

**Firms** $\chi_t$

**Government** $\bar{s}$

Transaction Costs: $\chi_t$

Productivity Gains: $\Omega_t$

**Households** $a_t$

**Banks** $m_t$

**Firms** $\chi_t$

**Government** $\bar{s}$

Transaction Costs: $\chi_t$

Productivity Gains: $\Omega_t$
Model

Transaction Costs: $\chi_t$

Productivity Gains: $\Omega_t$

Households $a_t$

Banks $b_t$

Firms $x_t$

Government $\bar{s}$

$e_t, d_t$

$s_t^h$

$s_t^b$
Household Sector – “Cost Channel” of Regulation

- The representative household works $h_t$, consumes $c_t$, invests in physical assets $i_t$ and financial assets $d_{t+1}$, $e_{t+1}$, $b_{t+1}$, and $s_h^{t+1}$, with convex transaction costs $\chi^d_t$, $\chi^e_t$, $\chi^b_t$, and $\chi^s_t$.

$$\max \left\{ \sum_{s=0}^{\infty} \beta^s \mathbb{E}_q \left[ \max \left\{ u(c_{t+s}) - v(h_{t+s}) \right\} \right] \right\}$$

- subject to the constraint:

$$c_t + i_t + d_{t+1} + e_{t+1} + s_h^{t+1} + b_{t+1} + \chi^d_t + \chi^e_t + \chi^s_t + \chi^b_t = r^d_t d_t + r^e_t e_t + r^s_h s_h^{t+1} + r^b_t b_t$$

$$+ \rho_t k_t + w_t h_t + \pi^f_t + \pi^x_t + \pi^b_t - T_t$$
Firms – “Credit Quality” Channel of Regulation

\[
\max_{k_t, h_t, x_t, b_t, l_t} \pi^f_t \equiv \Omega_t \left( z \min \left[ f(k_t, h_t); \varsigma x_t \right] - \tilde{\rho}_t k_t - \tilde{w}_t h_t - \tilde{r}_t^b b_t - \tilde{r}_t^\ell l_t \right)
\]

with \( l_t + b_t = x_t \)

- Continuum of \textit{ex ante} identical firms, each of which borrowing \( l_t \) from one bank and \( b_t \) from the household to purchase intermediate goods \( x_t \)

- Aggregate productivity \( \Omega_t \equiv \int_{r_t}^{1} q^\ell \frac{d\mu_\ell(q^\ell)}{1-\mu_\ell(r_t^m)} \) is determined by the average financial intermediation skill of the banks that lend to the firms, i.e. on how savings are re–allocated inside the banking sector
Banking Sector

- **1\textsuperscript{st} Stage:** Representative bank issues $d_t + e_t$ and purchases government bonds $s_t^b$

- **2\textsuperscript{nd} Stage:** The bank consists of a continuum of bankers; each banker draws financial intermediation skill $q^\ell$:
  - $q^\ell = \text{success probability of the firms that borrow from banker } q^\ell$
  - Banker $q^\ell$'s effective return on corporate loans is $q^\ell \tilde{r}_t^\ell$, with $q^\ell \in [0, 1]$
  - Banker $q^\ell$ invests wealth $n_t \equiv d_t + e_t - s_t^b$
• **Interbank transactions** help to migrate savings from low–\(q^\ell\) to high–\(q^\ell\) bankers

• Banker \(q^\ell\) chooses whether she lends or borrows on the interbank market

• Frictions on the interbank market:
  - Bankers can divert cash for private benefit \(\gamma\) (cash is “risky”)
  - Skills \(q^\ell\) are private information

• A borrowing limit is needed to restore bankers’ incentives
Banking Sector

- The bank maximizes its expected profit:

\[
\max_{s^b_t, d_t, e_t} \Psi_{t-1, t} \int_0^1 \max_{\phi_t, \Pi_t} \left( r_s^b s_t^b - r_d^d d_t - r_e^e e_t + \Pi_t r_m^m n_t + (1 - \Pi_t) (q^f r_t^\ell (1 + \phi_t) - r_m^m \phi_t) n_t \right) \, d\mu(\ell(q^f))
\]

- subject to the incentive compatibility constraint:

\[
(IC) \quad \gamma (1 + \phi_t) n_t - r_e^e e_t \leq r_m^m n_t + r_s^s s_t^b - r_d^d d_t - r_e^e e_t
\]

→ Deposits are subject to moral hazard
The bank maximizes its expected profit:

$$\max \limits_{s_{t}^{b}, d_{t}, e_{t}} \Psi_{t-1,t} \int_{0}^{1} \max \limits_{\phi_{t}, \Pi_{t}} \left( r_{t}^{s} s_{t}^{b} - r_{t}^{d} d_{t} - r_{t}^{e} e_{t} + \Pi_{t} r_{t}^{m} n_{t} + (1 - \Pi_{t}) \left( q_{\ell} \tilde{r}_{t}^{\ell} (1 + \phi_{t}) - r_{t}^{m} \phi_{t} \right) n_{t} \right) d\mu_{\ell}(q_{\ell})$$

subject to the incentive compatibility constraint:

$$\gamma (1 + \phi_{t}) n_{t} - r_{t}^{e} e_{t} \leq r_{t}^{m} n_{t} + r_{t}^{s} s_{t}^{b} - r_{t}^{d} d_{t} - r_{t}^{e} e_{t}$$

→ No banker absconds
The bank maximizes its expected profit:

$$\max_{s^b_t, d_t, e_t} \Psi_{t-1,t} \int_0^1 \max_{\phi_t, \mathbb{1}_t} \left( r^s_t s^b_t - r^d_t d_t - r^e_t e_t + \mathbb{1}_t r^m_t n_t + (1 - \mathbb{1}_t) \left( q^\ell r^\ell_t (1 + \phi_t) - r^m_t \phi_t \right) n_t \right) d\mu(\ell(q))$$

subject to the incentive compatibility constraint:

$$(IC) \quad \gamma(1 + \phi_t) n_t - r^e_t e_t \leq r^m_t n_t + r^s_t s^b_t - r^d_t d_t - r^e_t e_t$$

→ Deposits are subject to moral hazard
The bank maximizes its expected profit:

\[
\max_{s^b_t, d_t, e_t, \phi_t} \int_0^1 \max_{\psi_{t-1}, \mu_\ell} \left( \psi_{t,1} + \int_0^1 \max_{\phi_t, \nu_t} \left( r^s_t s^b_t - r^d_t d_t - r^e_t e_t + \mathbb{I}(1 - q^\phi_t) \right) \right) \text{d}\mu_\ell(q^\ell)
\]

subject to the incentive compatibility constraint:

\[
(\text{IC}) \quad \gamma(1 + \phi_t)n_t - r^e_t e_t \leq r^m_t n_t + r^s_t s^b_t - r^d_t d_t - r^e_t e_t
\]

\[
\Rightarrow \quad \text{Equity is not subject to moral hazard}
\]
The bank maximizes its expected profit:

\[
\max_{s^b_t, d_t, e_t} \psi_{t-1,t} \int_0^1 \max_{\phi_t, \Pi_t} \left( r^s_t s^b_t - r^d_t d_t - r^e_t e_t + \Pi_t r^m_t n_t + (1 - \Pi_t) (q^\ell r^\ell_t (1 + \phi_t) - r^m_t \phi_t) n_t \right) d\mu(\ell) (q^\ell)
\]

subject to the incentive compatibility constraint:

\[(IC) \quad \gamma (1 + \phi_t) n_t - r^e_t e_t \leq r^m_t n_t + r^s_t s^b_t - r^d_t d_t - r^e_t e_t \]

→ Government bonds are seizable/pledgeable
Banker $q^\ell$ borrows funds if $q^\ell > \frac{r^m_t}{r^\ell_t}$, and lends otherwise.

The borrowing limit is

$$\phi_t = \frac{r^d_t e_t}{d_t + e_t} + \left( r^s_t - r^m_t \right) \frac{s^b_t}{d_t + e_t} + \frac{r^m_t - r^d_t}{\gamma \left( 1 - \frac{s^b_t}{d_t + e_t} \right)} - 1$$
Externalities and Capital Regulation

\[
\phi_t \equiv \frac{r^d}{d_t + e_t} \left( r^s - r^m \right) \frac{s^b}{d_t + e_t} + r^m - r^d
\gamma \left( 1 - \frac{s^b}{d_t + e_t} \right) - 1
\]
Externalities and Capital Regulation

\[ \varphi_t \equiv \frac{r^d_t e_t}{d_t + e_t} + \left( r^{s}_t - r^{m}_t \right) \frac{s^b_t}{d_t + e_t} + r^{m*}_t - r^d_t \]

\[ \gamma \left( 1 - \frac{s^b_t}{d_t + e_t} \right) - 1 \]

- Pecuniary externalities:

\[ \frac{d\varphi_t}{d \left( \frac{e_t}{d_t + e_t} \right)} = \frac{\partial \varphi_t}{\partial \left( \frac{e_t}{d_t + e_t} \right)} + \frac{\partial \varphi_t}{\partial r^{m*}_t} \times \frac{\partial r^{m*}_t}{\partial \Phi_t} \times \frac{\partial \Phi_t}{\partial \left( \frac{E_t}{D_t + E_t} \right)} \]
Externalities and Capital Regulation

\[ \bar{\phi}_t \equiv \frac{e_t}{d_t + e_t} \left( r^d_t - r^m_t \right) \frac{s^b_t}{d_t + e_t} + r^m_t - r^d_t \gamma \left( 1 - \frac{s^b_t}{d_t + e_t} \right) - 1 \]

- Pecuniary externalities:

\[ \frac{d\bar{\phi}_t}{d\left( \frac{e_t}{d_t + e_t} \right)} = \frac{\partial \bar{\phi}_t}{\partial \left( \frac{e_t}{d_t + e_t} \right)} + \frac{\partial \bar{\phi}_t}{\partial r^m_t} \times \frac{\partial r^m_t}{\partial \Phi_t} \times \frac{\partial \Phi_t}{\partial \left( \frac{E_t}{D_t + E_t} \right)} \]

\[ \Rightarrow \text{Regulatory capital constraint:} \quad \frac{e_t}{d_t + e_t} \geq \tau C \]
Externalities and Liquidity Regulation

\[
\phi_t \equiv \frac{r_t^d e_t}{d_t + e_t} + \frac{(r_t^s - r_t^m) s_t^b}{d_t + e_t} + r_t^{m*} - r_t^d \times \frac{s_t^b}{d_t + e_t} + \gamma \left(1 - \frac{s_t^b}{d_t + e_t}\right) - 1
\]

- Pecuniary externalities:

\[
\frac{d\phi_t}{d\left(\frac{s_t^b}{d_t + e_t}\right)} = \frac{\partial\phi_t}{\partial\left(\frac{s_t^b}{d_t + e_t}\right)} + \frac{\partial\phi_t}{\partial r_t^{m*}} \times \frac{\partial r_t^{m*}}{\partial \Phi_t} \times \frac{\partial \Phi_t}{\partial \left(\frac{S_t^b}{D_t + E_t}\right)}
\]

\[\Rightarrow\text{ Regulatory liquidity constraint: } \frac{s_t^b}{d_t + e_t} \geq \tau_L\]
Synergies: Partial Equilibrium Effects

- By “mechanically” reducing the volume of risky cash per unit of equity capital, liquidity regulation makes capital regulation more effective

\[
\frac{\partial^2 \phi_t}{\partial \left( \frac{e_t}{d_t+e_t} \right) \partial \left( \frac{s^b_t}{d_t+e_t} \right)} > 0
\]

\[\Rightarrow \text{In this sense, liquidity and capital requirements mutually reinforce each other}\]
Tensions: General Equilibrium Effects and Portfolio Re-balancing

Bank balance sheet

<table>
<thead>
<tr>
<th>Ass.</th>
<th>Lia.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n_t$</td>
<td>$e_t$</td>
</tr>
<tr>
<td>$m_t$</td>
<td>$m_t$</td>
</tr>
</tbody>
</table>

$\uparrow s^b_t$ $\uparrow d_t$ $s^b_t + s^h_t = s$

Household balance sheet

<table>
<thead>
<tr>
<th>Ass.</th>
<th>Lia.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$e_t$</td>
<td>$e_t$</td>
</tr>
<tr>
<td>$b_t$</td>
<td>$s^h_t$</td>
</tr>
</tbody>
</table>

$\uparrow d_t$ $\downarrow s^h_t$
Bank balance sheet

\[ n_t \]
\[ e_t \]
\[ m_t \]

\[ \uparrow s^b_t \]
\[ \uparrow d_t \]
\[ s^b_t + s^h_t = \bar{s} \]

Household balance sheet

\[ e_t \]
\[ m_t \]

\[ \uparrow d_t \]
\[ \downarrow s^h_t \]
\[ \uparrow b_t \]
### Steady State Welfare Gains

<table>
<thead>
<tr>
<th>Perm. cons. gain (%)</th>
<th>Regulation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. St. Incl. Transition</td>
<td>$\tau_C$ $\tau_L$</td>
</tr>
<tr>
<td>NR $\rightarrow$ ORM</td>
<td>0.6591 0.5888</td>
</tr>
</tbody>
</table>

**Note:** NR $\rightarrow$ ORM: Permanent Consumption gain (in percent) from the non-regulated (NR) economy to the economy with the optimal regulatory mix (ORM).
Other Points of Discussion in the Paper

- Regulation reduces banks’ overall cost of funding
- A risk-weighted capital requirement is almost as effective as both leverage and liquidity requirements
- The leverage ratio is useful as a backstop if banks misreport their risk weights
- Financial dis-intermediation acts as a “safety valve”
- The “sterilization” of liquidity regulation through government bond issuance can reduce the cost of regulation
Conclusion

- Macro-framework to understand better the transmission of multiple banking regulations
- In a regulated economy, banks supply less credit, but their credit is more productive
- In the case of the US, capital and liquidity regulations reinforce each other, despite GE feedback effects; those GE effects are not model-specific and may be more relevant for countries where liquid assets are scarce
- The optimal regulatory mix features relatively high capital and liquidity requirements
- More results on risk-weighted capital, financial dis-intermediation, leverage ratio as a backstop, sterilization
THANK YOU
- Unregulated economy
- Standard for the real sector
- Nine financial parameters and nine financial variables to match:
  - Two interest rates (interbank, corporate loan)
  - Five balance sheet ratios (households and banks)
  - Proportion on non-performing loans
1. \( r^m = r^d = r^s = 1.0167 \). The real returns on interbank loans, deposits, and government bonds match the Federal Fund Rate, and are equal to 1.67%;

2. \( \tilde{r}^b = 1.0465 \). The contractual real corporate bond yield matches Moody’s 3–month Seasoned Baa Corporate Bond Yield and is equal to 4.65%;

3. \( e/d = 0.1190 \). Banks’ equity to deposit ratio is equal to 11.90%;

4. \( b/a = 0.0658 \). The share of corporate bond holding in households’ financial wealth is equal to 6.58%;

5. \( s^h/a = 0.0910 \). The share of sovereign bonds in households’ financial wealth is equal to 9.10%;

6. \( d/\ell = 1.0310 \). The bank deposit to loan ratio is equal to 103.10%.

7. \( \phi n/d = 1.7086 \). The ratio of no–core liabilities to core liabilities is equal to 170.86%;

8. \( \Omega = 0.9841 \). The proportion of non–performing loans is 1.58%. 

Table 1: Calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply of sovereign bonds</td>
<td>$\bar{s}$</td>
</tr>
<tr>
<td>Private benefits</td>
<td>$\gamma$</td>
</tr>
<tr>
<td>Distribution – $\mu_d (q^d)$</td>
<td>$\lambda^d$</td>
</tr>
<tr>
<td>Distribution – $\mu_e (q^e)$</td>
<td>$\lambda^e$</td>
</tr>
<tr>
<td>Distribution – $\mu_b (q^b)$</td>
<td>$\lambda^b$</td>
</tr>
<tr>
<td>Distribution – $\mu_s (q^s)$</td>
<td>$\lambda^s$</td>
</tr>
<tr>
<td>Distribution – $\mu_\ell (q^\ell)$</td>
<td>$\lambda^\ell$</td>
</tr>
</tbody>
</table>

*Slope*  $\lambda^\ell$ | 0.387 |

*Lower bound*  $\theta$ | 0.959 |
Calibration

\[ \mu_j(q) = (q)^{\lambda} \]

\[ \mu_e(q), \quad \mu_b(q), \quad \mu_{sh}(q), \quad \mu_d(q). \]
Timeline

1. The government issues debt $s$. Firms produce, pay the wages, pay the rent of physical capital, pay their debts; and die. Banks pay their debts, distribute dividends; and die.

2. The household consumes $c_t$, invests into $i_t$ units of physical capital goods, and saves $\tilde{a}_{t+1}$.

3. The goods market clears and closes.

4. Household members draw their financial skills ($q^{sh}, q^b, q^d, q^e$) and invest $\tilde{a}_{t+1}$ into sovereign bonds $s_{t+1}^h$, corporate bonds $b_{t+1}$, bank deposits $d_{t+1}$, and bank equity $e_{t+1}$.

5. New banks are born and demand sovereign bonds, $s_{t+1}^b$, deposits, $d_{t+1}$, and equity $e_t$.

6. The sovereign bond, deposit, and equity markets clear and close.

7. Period $t + 1$ starts. New firms are born and issue corporate bonds $b_{t+1}$. Household members purchase corporate bonds. Bankers draw intermediation skills $q^\ell$, and invest $d_{t+1} + e_{t+1} − s_{t+1}^b$ into corporate loans, $\ell_{t+1}$, and interbank loans, $m_{t+1}$.

8. Firms hire labour $h_{t+1}$, rent physical capital $k_{t+1}$, demand loans $l_{t+1}$, and purchase material goods, $x_{t+1}$.

9. The markets for labour, capital goods, material goods, corporate bonds, corporate loans, and interbank loans clear and close.
Note: Transition path from the unregulated to the regulated equilibrium.
\[ x_t = \frac{1}{\zeta} f(k_t, h_t) \]  
(1)

\[ \tilde{r}_t^\ell = \tilde{r}_t^b \]  
(2)

\[ x_t = l_t + b_t \]  
(3)

\[ \tilde{\rho}_t = \left( z - \frac{\tilde{r}_t^\ell p_t^x}{\zeta} \right) f'_k(k_t, h_t) \]  
(4)

\[ \tilde{\omega}_t = \left( z - \frac{\tilde{r}_t^\ell p_t^x}{\zeta} \right) f'_h(k_t, h_t). \]  
(5)

**Note:**  \( \rho_t \equiv \Omega_t \tilde{\rho}_t \);  \( r_t^b \equiv \Omega_t \tilde{r}_t^b \);  \( w_t \equiv \Omega_t \tilde{\omega}_t \).
Household Sector

- **2nd Stage**: Household member with transaction cost \( 1 - q^d \) (resp. \( q^e, q^s^h, q^b \)) invests \( \tilde{a}_{t+1} \) into \( d \) (resp. \( e, s^h, b \)) iff

  \[
  q^d > q^j \frac{r_{t+1}^j}{r_{t+1}^d} \quad \forall j \neq d
  \]

- **1st Stage**: Representative household supplies \( h_t \), invests \( i_t \), and transfers financial wealth \( \tilde{a}_{t+1} \)

  \[
  \nu'(h_t) = u'(c_t)w_t
  \]

  \[
  \Psi_{t,t+1}r_{t+1} = 1, \quad \text{where} \quad \Psi_{t,t+1} = \beta \frac{u'(c_{t+1})}{u'(c_t)}
  \]

  \[
  r_{t+1} = \rho_{t+1} + 1 - \delta
  \]
## Costs of Funding

<table>
<thead>
<tr>
<th></th>
<th>$r_t^e - r_t^m$</th>
<th>$r_t^d - r_t^m$</th>
<th>$r_t^f - r_t^m$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-Regulated</td>
<td>10.72</td>
<td>0.00</td>
<td>0.73</td>
</tr>
<tr>
<td>Optimal Regulation</td>
<td>14.49</td>
<td>-2.44</td>
<td>0.29</td>
</tr>
</tbody>
</table>

Note: \( r_t^f \equiv \left( r_t^e e_t + r_t^d d_t + r_t^m (1 - \mu(\bar{q}_t^e)) \phi_t n_t \right) / \left( e_t + d_t + (1 - \mu(\bar{q}_t^e)) \phi_t n_t \right) \) denotes the representative bank’s overall cost of funding.
Figure 1: Capital and Liquidity Ratios at Steady State

Left panel: Capital ratio when the regulator imposes a liquidity requirement ($\tau_L$) only. Right panel: Liquidity ratio when the regulator imposes a capital requirement ($\tau_C$) only.
The Credit Quality Channel of Banking Regulation

Unreg. economy

Low quality bankers

High quality bankers

Firms

Household

\( \frac{r_t^m}{r_t^L} \)

\( \phi_t n_t \)

\( n_t \)
The Credit Quality Channel of Banking Regulation
Related Literature

- **Link between finance and aggregate productivity**
  - Finance and growth literature (Greenwood and Jovanovic (1990); Greenwood et al. (2013); Hsieh and Klenow (2009))
  - Venture capital and relationship lending literature: VCs/bankers improve firm productivity with market knowledge, strategic planning, mentoring, etc (Kortum and Lerner (2000); Hellman and Puri (2000), Bolton et al. (2016))
  - Allocative efficiency and the recent crisis (Gopinath et al. (2015); Cuñat and Garicano (2009))

- **Macroeconomic models with financial frictions**
  - Frictions between banks and depositors (Gertler and Karadi (2012), Martinez-Miera and Suarez (2014))
  - Frictions on wholesale funding markets (Boissay, Collard, Smets (2016))

- **Banking regulation in macroeconomic models**
  - Capital requirements only (Clerc et al. (2015); Begeneau (2015))
1\textsuperscript{st} Stage solution: Choice of $d_t$, $e_t$, and $s_t^b$:

\[
\begin{align*}
    r_t^s &= r_t^m \\
    r_t^d &= r_t^m \\
    r_t^e &= (1 + \Delta_t)r_t^d
\end{align*}
\]

Equity frees up borrowing capacity ex post ("Shadow value of equity")
A competitive general equilibrium is:

- A sequence of prices $P_t \equiv \{r_{t+i}, r^m_{t+i}, r^d_{t+i}, \tilde{r}^b_{t+i}, \tilde{r}^\ell_{t+i}, r^e_{t+i}, w_{t+i}, \rho_{t+i}, p^x_{t+i}\}_{i=0}^\infty$;

- A sequence of quantities $Q_t \equiv \{y_{t+i}, c_{t+i}, i_{t+i}, x_{t+i}, k_{t+i}, h_{t+i}, \tilde{a}_{t+i}, d_{t+i}, e_{t+i}, s^h_{t+i}, b_{t+i}, s^b_{t+i}, \ell_{t+i}\}_{i=0}^\infty$

such that:

- For a given sequence of prices $P_t$, quantities $Q_t$ solve agents’ optimization problems
- For a given sequence of quantities $Q_t$, prices $P_t$ clear the markets.
Figure 2: Regulatory Frontiers (“Best Response Functions”)

- Liquidity frontier,
- Capital frontier,
- Optimal capital regulation w/o liquidity regulation,
- Optimal regulatory mix,
- Unregulated equilibrium,
- Outcome with two myopic regulators.

Orange area: capital requirements do not bind.
Bank balance sheet

<table>
<thead>
<tr>
<th>Ass.</th>
<th>Lia.</th>
</tr>
</thead>
<tbody>
<tr>
<td>([risky] cash) $n_t$</td>
<td>$d_t$ (deposits)</td>
</tr>
<tr>
<td>(gvt bonds) $s^b_t$</td>
<td>$e_t$ (equity)</td>
</tr>
<tr>
<td>$m_t$</td>
<td>$m_t$</td>
</tr>
</tbody>
</table>

Leverage: \[ \frac{e_t}{d_t + e_t} \geq \tau_C \]

Liquidity: \[ \frac{s^b_t}{d_t + e_t} \geq \tau_L \]

RW capital: \[ \frac{e_t}{n_t} \equiv \frac{e_t}{d_t + e_t} \left(1 - \frac{s^b_t}{d_t + e_t}\right) \geq \tau_W \]
## Table 2: Welfare Analysis

<table>
<thead>
<tr>
<th>Perm. cons. gain (%)</th>
<th>Regulation (%)</th>
<th>$\tau_W$</th>
<th>$\tau_C$</th>
<th>$\tau_L$</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR $\rightarrow$ RW</td>
<td>0.6576</td>
<td>19.81</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>NR $\rightarrow$ ORM*</td>
<td>0.6591</td>
<td>19.83</td>
<td>17.35</td>
<td>12.50</td>
</tr>
<tr>
<td>RW $\rightarrow$ ORM*</td>
<td>0.0014</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: NR $\rightarrow$ RW: Permanent Consumption gain (in percent) from the non-regulated (NR) economy to the economy with the risk–weighted capital requirements (RW). RW $\rightarrow$ ORM: Permanent Consumption gain (in percent) from the risk–weighted capital requirements (RW) economy to the economy with optimal regulatory mix (ORM). $\tau_W \equiv \tau_C/(1 - \tau_L)$. 

$\tau_W$
Dis–intermediation as a Safety Valve

**Households** $a_t$ → **Banks** $m_t$ → **Firms** $x_t$

$e_t, d_t$ → $b_t$ → $n_t$

$S_t^h$ → **Government** $\bar{s}$ → $S_t^b$
## Dis–intermediation as a Safety Valve

<table>
<thead>
<tr>
<th>Perm. cons. gain (%)</th>
<th>Regulation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\tau_C$</td>
</tr>
<tr>
<td>NR $\rightarrow$ ORM+TCBR</td>
<td>0.6604</td>
</tr>
<tr>
<td>ORM $\rightarrow$ ORM+TCBR</td>
<td>0.0013</td>
</tr>
</tbody>
</table>

**Note:** NR $\rightarrow$ ORM+TCBR: Permanent Consumption gain (in percent) from the non-regulated (NR) economy to the economy with both the optimal regulatory mix and the tax on corporate bond revenues (OMR+TCBR). ORM $\rightarrow$ ORM+TCBR: Permanent Consumption gain (in percent) from the economy with the optimal regulatory mix (ORM) to the economy with both the optimal regulatory mix and the tax on corporate bond revenues (OMR+TCBR).
Banks may mis-report their risk-weights (IRB approaches) and undermine risk-weighted capital regulation

\[ \frac{e_t}{\xi n_t} \geq \tau_W \text{ instead of } \frac{e_t}{n_t} \geq \tau_W, \text{ with } \xi \in [0, 1) \]

What is the welfare gain of using a leverage ratio as a backstop?

Compare welfare with \((\tau_W, \tau_C)\) and welfare with \((\tau_W, \cdot)\)
Leverage Ratio as a Backstop: Welfare Gains

The risk-weighted capital constraint (RWCC) binds, with or without backstop.
The RWCC is slack with or without backstop. The RWCC binds without backstop, but is slack with the backstop.