Strategy and Tactics in Public Debt Management

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USD interest rates

Short-term yields are at historically low levels

In terms of deviations from the mean, until recently long term rates were even lower

rule of thumb
Key topics in the literature on PDM

Ideally, to issue securities whose payoffs are contingent on the relevant risks (Barro 1999) ... non-contingent debt of different maturities can offer a synthetic equivalent (Angeletos 2002, Buera and Nicolini 2004, Shin 2007)

In choosing a maturity mix the debt manager is effectively buying an insurance (Barro 1979, Lucas and Stokey 1983)

Two features in financial markets: maturity segmentation in financial market (Stigum 1990, Collins and Mack 1994) and investor clienteles (Modigliani and Sutch, 1966)
There is a gap between two strands in the literature on public debt management:

• Papers of scholarly nature (Barro 1990) ... not detailed enough to provide concrete guidance to the debt manager

• Papers which identify least-cost refinancing strategies through hard number crunching (Bolder 2008) ... lack of micro-foundations
The plot of our work

Task of the debt manager: to finance a 1-unit debt, by issuing a short-term bill and a long-term bond.

Through a cost-minimisation function, the debt manager solves for the optimal weights of the two securities in the long run but simultaneously s/he may enact a different set of weights in the current period.
Apparently, debt managers in US and Germany are not heeding to yield curve structure ... are they really?

Weighted average term to maturity (no. years)
Risks & opportunities

Debt managers could shop more along the yield curve ... but ...

- the Treasury is not a price taker in financial markets
- Gov’t securities enjoy a large liquidity premium (erratic supply does not bode well)
- principal (government) - agent (debt manager)
- management of public debt has implications on financial stability (does he care about it?)
Some basic algebra in PDM

Even small changes in public debt weighted average term maturity (WATM) may require heavy changes in issuance policy

\[ V = S + L = (1 - \beta) V + \beta V \]

\( V: \text{total stock of debt} \quad S: \text{stock of 1-year security} \)

\( L: \text{stock of T-year security} \quad \beta: \text{weight of long security} \)

\[ \text{WATM} = 0.5 ((1 - \beta) + T \beta) \]

if \( \beta = 0.8 \) and \( \text{WATM} = 5.5 \) years \( \Leftrightarrow \) \( T = 13.5 \) years

to increase WATM from 5.5 to 6 years, \((1-\beta)\) down to 0.12 (or \( T \) to almost 15 years \( \Leftrightarrow \) maturity of new gross issues of the long-term security approximately 30 years)
Our set-up (over a 4 period horizon)

The debt manager sets the weight of a one-period bill vs. a two-period bond. In doing so, he sets a long-term goal (strategy) while retaining the flexibility to offer a different mix in the short run (tactics).

\[
\begin{align*}
\text{Period 1} & \quad 1 - \beta - \gamma \\
\text{Period 2} & \quad 1 - \beta - \gamma \\
\text{Period 3} & \quad 1 - \beta \\
\text{Period 4} & \quad 1 - \beta
\end{align*}
\]

bill \([i, E(i), \sigma_i]\)

bond \([r, E(r), \sigma_r]\)
The objective function

\[
\min_{\beta, \gamma} \sum_{j=0}^{N-1} f_{\beta, \gamma}[j]
\]

\[
f_{\beta, \gamma}[j] = (\omega[j])' z[j] + \lambda (w[j])' \Omega[j] w[j]
\]

\[\omega[j]\] vector of weights at time j; e.g. \(w[0] = (1-\beta-\gamma \beta+\gamma)'

\[z[j]\] vector of yields at time j; e.g. \(z[1] = (E(i) \ r)\)

\[i, r\] short- and long-interest rate

\[\lambda\] risk shadow price (related to price aversion)

\[\Omega[j]\] variance-covariance matrix, e.g. \(\Omega[2] = \begin{pmatrix}
\sigma^2_i & \sigma_{i,r} \\
\sigma_{i,r} & \sigma^2_r
\end{pmatrix}\)
The optimal weight $\beta$ over the long-term

$$\hat{\beta} = \frac{\sigma_i^2 - \sigma_{i,r}}{\Sigma} - \frac{E(s)}{2\lambda \Sigma}$$

$$\Sigma \equiv \sigma_i^2 - 2\sigma_{i,r} + \sigma_r^2 > 0; \quad s \equiv r - i$$

**Risk hedging benefit:** volatility of the bill, net of the covariance

**Risk aversion:** downsizing effect on the relevance of yield costs. A highly risk averse issuer may prefer to bear the cost of lengthening debt duration

**Long-term slope:** yield premium to induce investors to buy the bond instead of the bill (related to: issuer’s credit merit, central bank’s reputation about inflation targets)
The tactical position $\gamma$ over the short-term

\[
\hat{\gamma} = 1 - \left[ \frac{\sigma_i^2 - \sigma_{r,i}}{\Sigma} - \frac{E(s)}{2\lambda\Sigma} + \frac{s - \frac{E(i) - i}{2}}{\lambda\sigma_i^2} \right] = 1 - \hat{\beta} - \frac{s - \frac{E(i) - i}{2}}{\lambda\sigma_i^2}
\]

$\beta$ sets a ceiling to $\gamma$

Movement *along* the curve – its slope $s$ – and movement *of* the curve – the difference $E(i) - i$

If the time horizon stretches out to $N = 6$ periods, $\hat{\beta}_6 = \hat{\beta}$

but $\hat{\gamma}_6 \geq \hat{\gamma}$
Conditions for a neutral tactical position

\[ \hat{\gamma} = 0 \iff r^e = \frac{1}{2} i + \frac{1}{2} \theta \mathbb{E}(r) + \frac{1}{2} (1 - \theta) \mathbb{E}(i) + \theta \left( \sigma_r^2 - \sigma_{r,i} \right) \lambda \]

\[ \hat{\gamma} > 0 \iff r < r^e \quad \text{while} \quad \hat{\gamma} < 0 \iff r > r^e \quad \theta = \frac{\sigma_i^2}{\Sigma} \]
When to deviate from the neutral position?

Example 1. not-so-good outlook for growth, $E(i)$ revised downwards

- $r$ rises above $r^e$ (provided correlation is not high)
- increase now the supply of bills

Example 2. central bank engages in outright purchases and checks $\sigma_r$

- $r$ falls under $r^e$ (provided correlation is not too low)
- increase now the supply of bonds
Calibration of the model

Parameters are calibrated on data for zero yields of 1- and 10-year US benchmarks (1995-2013; 228 end-of-month obs.)

<table>
<thead>
<tr>
<th></th>
<th>E(i)</th>
<th>E(r)</th>
<th>(\sigma^2_i)</th>
<th>(\sigma^2_r)</th>
<th>(\rho)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>3.12%</td>
<td>4.60%</td>
<td>2.28</td>
<td>0.44</td>
<td>0.74</td>
</tr>
</tbody>
</table>

E(i), E(r) statistics over full sample

\(\sigma^2_i, \sigma^2_r, \rho\) average of five-year rolling windows

\(\lambda\) we set it so as to push the model to yield a WATM as in end-2012 US stock of debt
Playing with parameters

Results when the selected parameter is increased by 50 bp

\[ E(i) \uparrow = E(r) \uparrow \]

\[ \sigma^2_i \downarrow \]
The rule of thumb

1) does not return quantitative implications for the tactical position

2) leaves a wider region for long tactical positions

and ...
(continues) The rule of thumb
3) may send wrong signals
The principal-agent problem

Within-the-model issues:
- length of planning period matters
- assigning a value to the shadow price parameter $\lambda$ (few governments bother to quantify their risk aversion)

Signal extraction issues:
- rules of thumb may send wrong signals
- few statistics on cost & risk (many on average term to maturity and weight of securities)
Some well known criticisms to CAPM

Two tenets of CAPM: the investor is a price-taker AND no transactions costs

IN FACT

- the yield-to-maturity set at auctions tends to rise with the volume being offered (Guibaud, Nosbuch and Vayanos, 2013, Greenwood, Hanson and Stein, 2012, Fleming, 2002)

Removing the assumption of exogenous interest rates

$r$ increases by 35 bp per each increase of 100% in the supply of the bond

$i$ varies with the supply as in Greenwood, Hanson and Stein (2010)

$E(i)$ increases if liquidity premium shrinks when stock of bills decreases

The optimal $\gamma$ goes down from 12.6% to 6-8%
Debt management and financial stability

Reducing too much the pool of T-bills brings about risks:

- **the private sector** is expected to fill in the vacuum (Holmstrom and Tirole 1998, Greenwood, Hanson and Stein 2010b); its balance-sheet becomes more fragile

- **the shift from government-to-private short-term issues** may be non-neutral for the economic system as a whole (Angeletos et al., 2013, Farhi and Tirole, 2011, Tirole 2011 and Stein 2012), not least because Treasury bills act as money-like instruments (Greenwood, Hanson and Stein, 2010a)
more on PDM and financial stability

Issuing too much bonds can be harmful too:

- it adds duration risk to banks’ balance sheets (Bernanke and Gertler, 1989, and Kiyotaki and Moore, 1997, Martin and Ventura, 2011)


- by issuing too much too long, the Treasury steepens the yield curve and provide further incentive for agents to issue short-term debt (Stein, 2012)

- banking/financial crises may turn costly for the tax-payer (Goodhart and Schoenmaker, 1995)
Concluding remarks

In public debt management even a simple CAPM can provide quite a rich set of results

Removing the price taking assumption, allowing for transaction cost, and introducing financial stability risks “complicate things”

Warnings and agenda:

✓ this is just a model ..

✓ which is (implicitly) designed for a top-rating sovereign issuer

✓ shall we manage to bring financial stability risks within the model?
E(r) ↑
E(i) ↓
E(i) ↑ = E(r) ↑

σ^2_r ↑
σ^2_i ↓
λ ↓

More comparative statistics