Allocating Stochastic Public Expenditures under Revenue Volatility

The Role of Strict Budget Constraints

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Fiscal Discipline

It is agreed upon by academics and practitioners there is a necessity for effective fiscal measures to safeguard the **sustainability of public finances** which should at the same time not hamper economic recovery.

- According to the S2-indicator, Belgium, for instance, needs to implement long-term sustainability enhancing policies equivalent to a permanent improvement of 7.4 pp. of GDP in the structural primary balance to close the fiscal gap (EC, 2012b);
- Davig et al. (2010) argue there is an economic fiscal limit - the peak of the Laffer curve - to revenue growth, at which governments are unwilling or unable to finance their entitlement commitments;
- Alternatively, there is the need for fiscal leeway to support demand in case the power of monetary policy is weakened due to the zero lower bound.

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Fiscal Discipline

Although fiscal sustainability has a well-developed economic logic, less consensus exists on the paradigm to be used for assessing the stringency of the instruments called upon.

- For example, Kopits and Symanski (1998), Kopits (2001), Auerbach (2006) and Alves and Afonso (2007) provide in a list of (qualitative) requirements for effective rules.
- Moreover, a vast number of studies have pointed to the positive impact of fiscal rules on fiscal balances:
  - both in Europe (EC, 2009; Debrun et al., 2008; Hallerberg et al., 2007; Krogstrup and Wälti, 2008)
  - as outside of it (Bohn and Inman, 1996; Auerbach, 2008; Alesina et al., 1999)
- Fiscal rules are perceived to enhance fiscal policy's credibility and predictability (Drazen, 2000; Kopits, 2001; Tomz, 2007) by:
  - preventing disruptive fiscal adjustments (Fernández-Huertas Moraga and Vidal, 2010)
  - and lowering interest rates (Poterba and Rueben, 1999, 2001)
  - as well as prevent coordination problems in a multitier setting.

Fiscal Discipline

Although fiscal sustainability has a well-developed economic logic, less consensus exists on the paradigm to be used for assessing the stringency of the instruments called upon.

- Nonetheless, serious criticism of the EMU rules' conception has been voiced (see e.g. Buiter et al., 1993) and identification problems remain a major concern.
- Additionally, fiscal rules' adverse impact on public investment is documented by, for example, Servén (2007) and Bacchiocchi et al. (2011).
- Finally, can lead to rigidities in case of asymmetric uncertainty in a multitier government structure, while a penalty based system would allow for more efficient outcomes (van der Wielen, 2014).

Purpose I: Look at the optimum budget process for the *allocation of public funds across expenditure categories* under market pressure for a **strict budget constraint**

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Uncertainty

Profound uncertainty surrounds fiscal policy. To compensate, **stochastic analysis** of public finances is now standard practice (see e.g. Chalk and Hemming, 2000; IMF, 2003; EC, 2012a; IMF, 2012), including:

- sensitivity analyses (or stress tests), shocking variables driving public debt by two standard deviations, i.e. providing a worst case scenario;
- scenario analyses, with less extreme assumptions about the driving processes; and
- constructing a probability function of public debt using Monte Carlo simulations of the underlying parameters.

In an uncertain setting fiscal rules are attributed a second role. They are considered a means of self-insurance: by forcing policy makers to build up reserves during booms they ideally prevent a procyclical bias in fiscal policy (Perotti, 2007).

Uncertainty

Given that preferences for public goods are rather stable, the most credible way to add *expenditure uncertainty* to the model is via their cost of provision. An uncertain cost might for instance result from shocks to wages, shocks to energy prices (e.g. the oil price) or a very harsh winter.

In reality budgetary policy is characterized with a considerable amount of *revenue uncertainty*. For example, public budgets are drawn up based on revenue projections. Yet, these projections are not necessarily realized ex post. Output fluctuations for instance are well known to affect revenue collections via corporate and personal income taxation.

Purpose II: To explore the **impact of budgetary uncertainty** on *the allocation of public expenditures* in case of a strict budget requirement.

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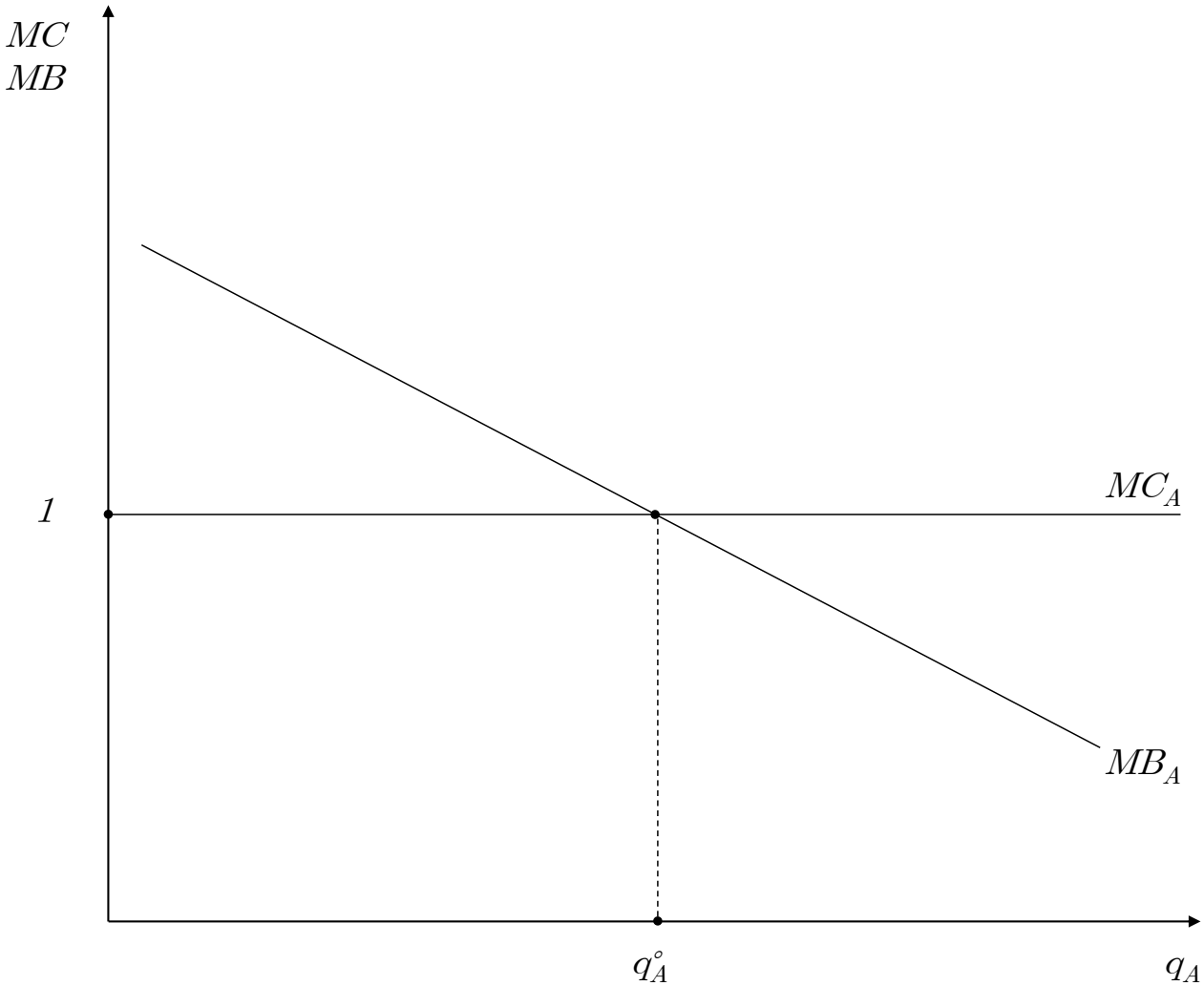
Basic Setup



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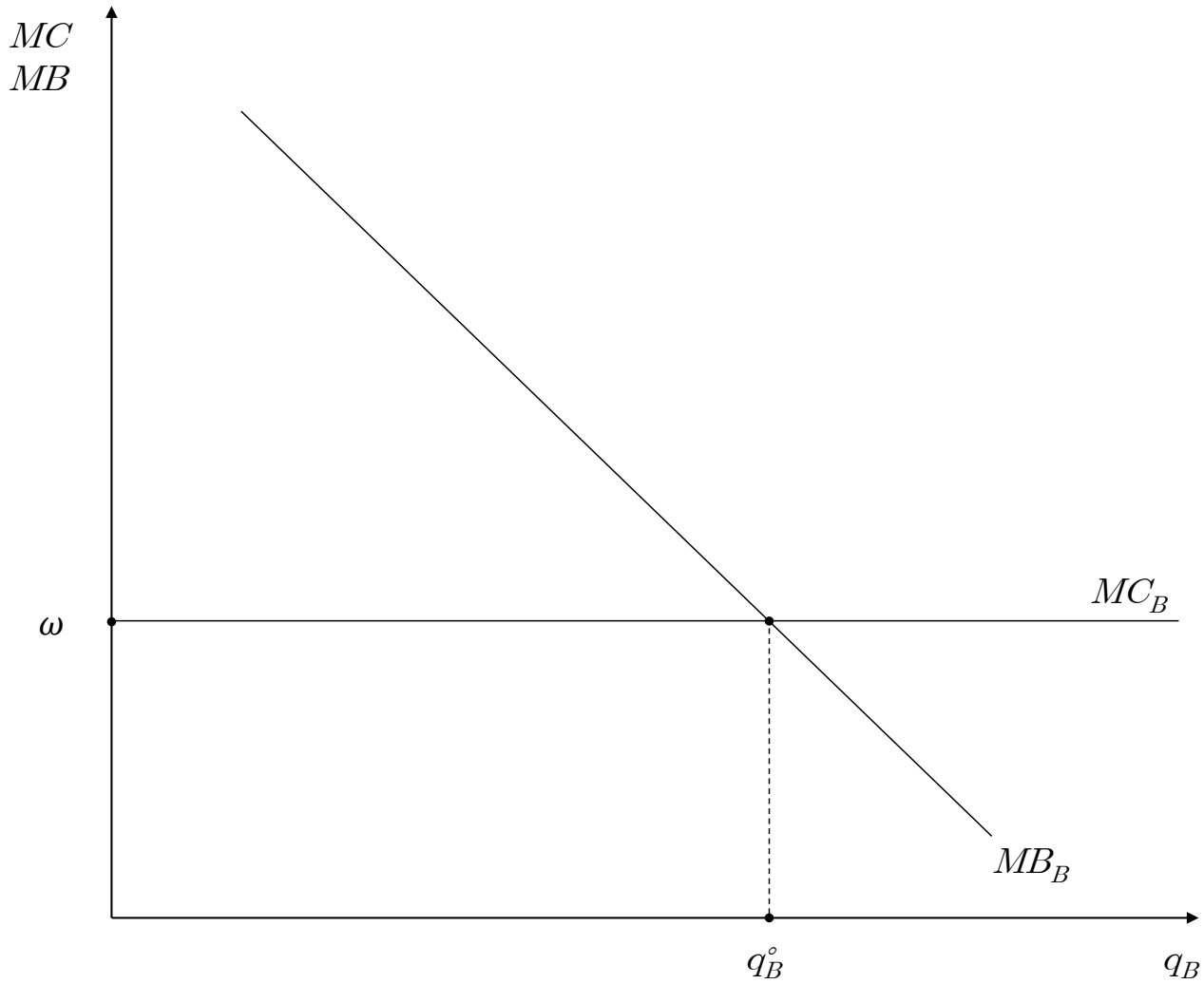

Basic Setup

$$\underset{\{q_A,q_B\}}{\text{Max}}\Big[B(q_A,q_B)-C(q_A,q_B)\Big] \tag{1}$$

with

$$C(q_A,q_B)=q_A+\omega q_B$$

$$MB_A(q_A)=a+bq_A$$

$$MB_B(q_B)=c+dq_B$$

Thus

$$q_A^0=\frac{1-a}{b} \quad \text{and} \quad q_B^0=\frac{\omega-c}{d} \tag{2}$$

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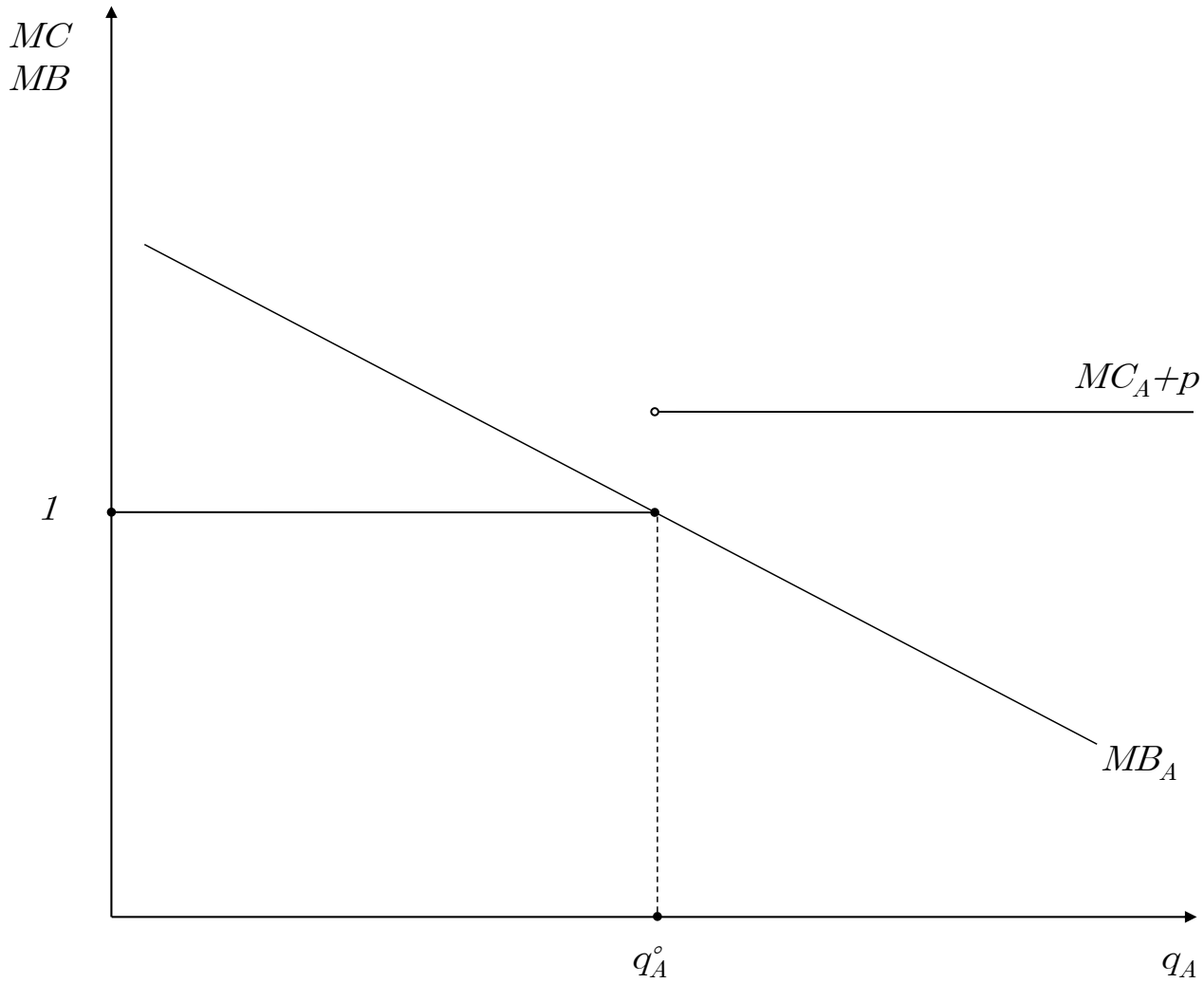
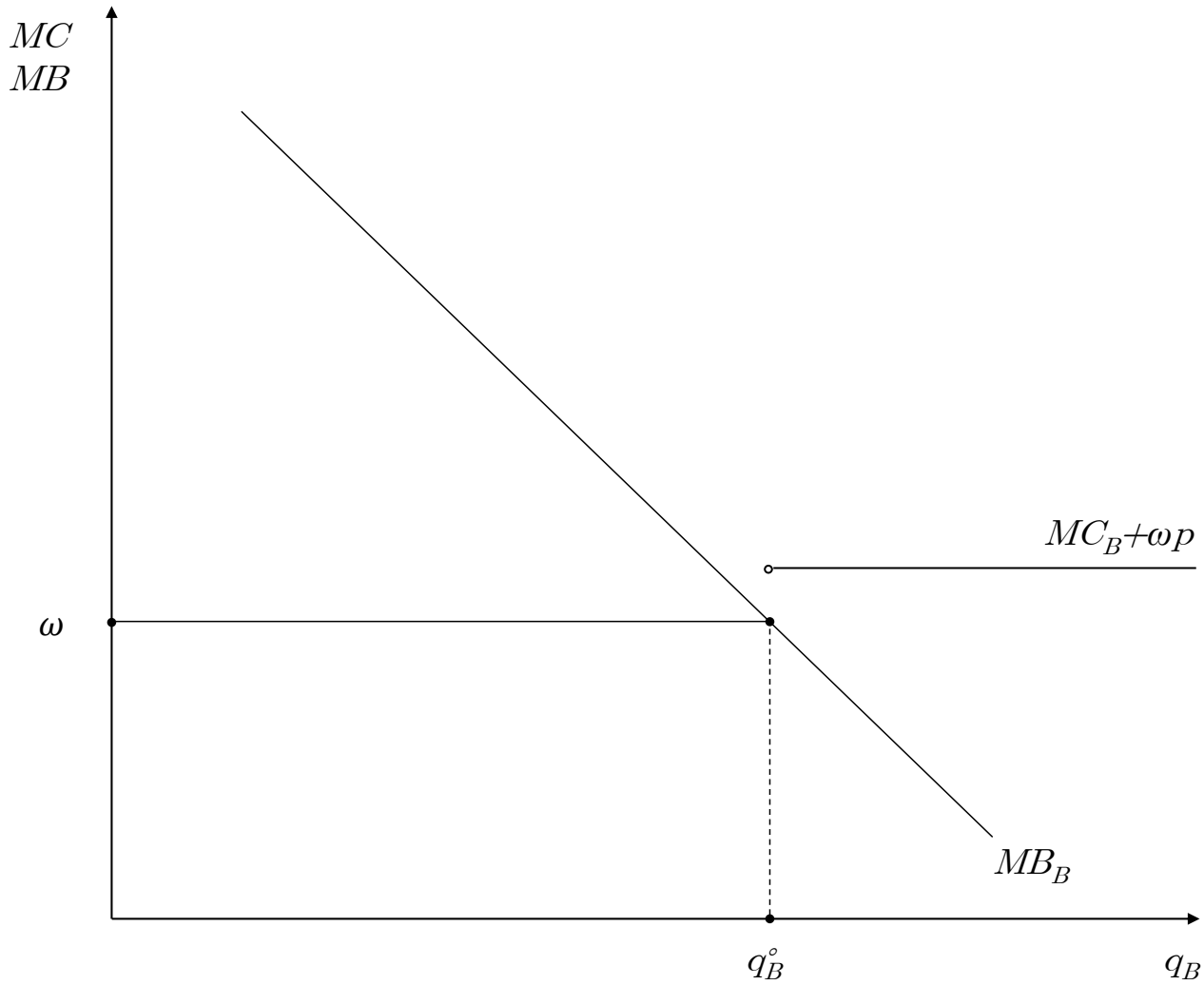
Strict Budget Constraint



Strict Budget Constraint



Strict Budget Constraint

$$\underset{\{q_A,q_B\}}{\text{Max}}\Big[B(q_A,q_B)-C(q_A,q_B)-p\big(C(q_A,q_B)-T^0\big)\Big]. \tag{3}$$

with

$$p=\begin{cases}\bar{p}, & \text{if } \big(C(q_A,q_B)-T^0\big)>0\\ 0, & \text{if } \big(C(q_A,q_B)-T^0\big)\leq 0\end{cases}$$

$$T^0=q_A^0+\omega q_B^0$$

$$C(q_A,q_B)=q_A+\omega q_B$$

$$MB_A(q_A)=a+bq_A$$

$$MB_B(q_B)=c+dq_B$$

Thus

$$q_A^{00}=\frac{(1+p)-a}{b} \quad \text{and} \quad q_B^{00}=\frac{(1+p)\omega-c}{d} \tag{4}$$

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Expenditure Shocks

The uncertainty in costs is presumed to take the form of a disturbance term, Θ_i, to marginal costs, with $i \in \{A, B\}$. In other words, an unexpected shock is assumed to be restricted to shifts in the marginal curves.

$$\underset{\{q_A, q_B\}}{\text{Max}} \; \mathbb{E}\Big[B(q_A, q_B) - [C(q_A, q_B, \Theta_A, \Theta_B)]\Big] \tag{5}$$

More specifically:

$$\underset{\{q_A, q_B\}}{\text{Max}} \Big[B(q_A, q_B) - \mathbb{E}\left[(1 + \Theta_A)q_A + (\omega + \Theta_B)q_B\right]\Big]$$

Expenditure Shocks

Assume the shocks have a simple discrete probability distribution:

$$\Pr[\Theta_i] = \begin{cases} \frac{1}{2}, & \text{if } \theta_i = \theta_i^L \\ \frac{1}{2}, & \text{if } \theta_i = \theta_i^H \end{cases}$$

For succinctness, $\mathbb{E}[\Theta_i] = 0$ is assumed to hold, i.e. policy makers do not expect the shock upfront. Then tbe government solves

$$\underset{\{q_A, q_B\}}{\text{Max}} \left[B(q_A, q_B) - \sum_{j \in \{L,H\}} \sum_{j \in \{L,H\}} \frac{1}{4} \left[(1 + \theta_A^j) q_A - (\omega + \theta_B^j) q_B \right] \right]$$

which results in ex ante allocation:

$$q_A = \frac{\overbrace{\sum_j \frac{1}{2}(1 + \theta_A^j)}^{=1+\mathbb{E}[\Theta_A]} - a}{b} = \frac{1-a}{b} = q_A^0 \quad \text{and} \quad q_B = \frac{\omega - c}{d} = q_B^0$$

Expenditure Shocks

In case of a punishment for deficits the government solves

$$\underset{\{q_A,q_B\}}{\text{Max}}\ \mathbb{E}\Big[B(q_A,q_B)-C(q_A,q_B,\Theta_A,\Theta_B)-p(C(q_A,q_B,\Theta_A,\Theta_B)-T^0)\Big] \tag{6}$$

with

$$p=\begin{cases}\bar{p}, & \text{if } \left(C(q_A,q_B,\theta_A,\theta_B)-T^0\right)>0\\ 0, & \text{if } \left(C(q_A,q_B,\theta_A,\theta_B)-T^0\right)\leq 0\end{cases}$$

Expenditure Shocks

Suppose that only in the case of the combinations of shocks $\{\theta_A^H, \theta_B^H\}$ the state of the world is such that a deficit is insurmountable. Then the government solves

$$\underset{\{q_A,q_B\}}{\text{Max}} \Bigg[B(q_A,q_B) - \sum_{j\in\{L,H\}} \sum_{j\in\{L,H\}} \frac{1}{4}\Big[(1+\theta_A^j)q_A - (\omega+\theta_B^j)q_B\Big] - \frac{1}{4}\Big[\bar{p}\big((1+\theta_A^H)q_A + (\omega+\theta_B^H)q_B - T^0\big)\Big] \Bigg]$$

which results in ex ante allocation:

$$q_A = \frac{\overbrace{\sum_j \frac{1}{2}(1+\theta_A^j)}^{=1+\mathbb{E}[\theta_A]} + \overbrace{\frac{1}{4}\bar{p}(1+\theta_A^H)}^{>0} - a}{b} < q_A^0 \quad \text{and} \quad q_B < q_B^0$$

Expenditure Shocks

Consequently, if the expenditure allocation of goods A and B is fixed ex ante and can only be adjusted in the long run, the first-best optimum

$$q_A^1 = \frac{(1+p)(1+\theta_A) - a}{b} \tag{7}$$

$$q_B^1 = \frac{(1+p)(\omega+\theta_B) - c}{d} \tag{8}$$

will not be attained.

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Revenue Volatility

If policy makers do not know the exact realization of fiscal revenues ex ante, they are uncertain about the realized fiscal balance too. In case there is no strict budget constraint such uncertainty does not result in an allocation different from the benchmark allocation, $\{q_A^0, q_B^0\}$.

If a penalty is in force, however, the picture is different. As T is no longer fixed at $T^0 = q_A^0 + \omega q_B^0$, p is now also conditional on the realized value of T, characterized by disturbance term Λ. The government will thus solve

$$\underset{\{q_A, q_B\}}{\text{Max}} \Big[B(q_A, q_B) - (q_A + \omega q_B) - \mathbb{E}\big[p(q_A + \omega q_B - T^0 - \Lambda)\big] \Big]$$

Revenue Volatility

Consider, for example,

$$\Pr[T(\Lambda)] = \begin{cases} \frac{1}{2}, & \text{if } T(\Lambda) = T^0 + \lambda^L \ << q_A^0 + \omega q_B^0 \\ \frac{1}{2}, & \text{if } T(\Lambda) = T^0 + \lambda^H \ >> q_A^0 + \omega q_B^0 \end{cases}$$

Then government will solve

$$\underset{\{q_A, q_B\}}{\text{Max}} \left[B(q_A, q_B) - (q_A + \omega q_B) - \frac{1}{2}\bar{p}(q_A + \omega q_B - T^0 - \lambda^L) \right]$$

resulting in

$$q_A = \frac{1 + \frac{1}{2}\bar{p} - a}{b} < q_A^0 \quad \text{and} \quad q_B < q_B^0$$

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Rainy-day Funds

So far, there was no other uses for the fiscal funds than for expenditure based benefits. Nonetheless, governments might be interested to shift expenditures through time via buffers (ϵ).

Nevertheless, extending the framework to a multiperiod setting, allowing for the anticipatory reduction in public expenditures to be employed as rainy-day funds, does not entirely dispel the possible distortions.

After all, the buffers' success is dependent on the government's knowledge of the respective probability density functions.

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Discussion

Optimal Budget Process

Relaxing the assumption of a government's inability to adjust the expenditures ex post, raises the pressing question for practitioners in public administrations which expenditure category is best adjusted if there are multiple options.

Analysis shows three factors to be taken into account:

- the respective realized shocks of the categories
- their relative marginal cost
- their relative elasticities

Discussion

Deficit Bias

Three main causes of deficit and debt bias in democracies have been well documented:

- time inconsistencies: Kydland and Prescott (1977), Lucas (1976); includes strategically running up debt for electoral purposes (Persson and Svensson, 1989, Glazer, 1989, Tabellini and Alesina, 1990 and Aghion and Bolton, 1990) and lack of knowledge (Buchanan and Wagner, 1977)
- a common pool problem: Weingast et al. (1981), von Hagen and Harden (1995); Velasco (1999); Krogstrup and Wyplosz (2010);
- fiscal opacity and rent-seeking politicians: Kopits and Craig (1998)

Discussion

Deficit Bias

Manasse (2005) concludes that uncertainty about cyclical outcomes leads to governments choosing higher budget deficits provided that the deficit bias is sufficiently strong, the (probability of) sanction low and output volatility high, causing policy makers to speculate on a favorable outcome to reach instead of breach the target.

Can accomodate for rent-seeking behavior by governments. Whether the above results still hold depends on the relative size of the rent-seeking component vis-á-vis the penalty for a deficit, p.

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Concluding Remarks

1. Welfare losses as a consequence of both sources of uncertainty in combination with the government's inability to adjust allocations in the short run
2. Given the market pressure for fiscal discipline, fiscal revenue uncertainty, however, is also found to have a hedging impact, albeit possibly at the cost of larger welfare losses
3. Buffers or rainy-day funds does not entirely dispel the possible distortions
4. Allowing partial contemporaneous adjustments gives directions towards an optimal budget process

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