Public Investment under Debt, Tax and Money Financing

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Goal

- Evaluate the macroeconomic impact on the euro area of an increase in public investment in infrastructures under alternative assumptions about funding sources (fiscal side) and monetary policy stance.
Motivation

- Increase in public spending in infrastructure has been proposed as a way to address weak aggregate demand and low inflation
  - Sustain aggregate demand in the short term, expand supply capacity in the long run
  - Exploit exceptionally low levels of borrowing costs (role of monetary policy)
  - Cross-country coordination of fiscal stimuli may favor bilateral exports
- Cons: lack of fiscal space, implementation delays, inefficiencies
Contribution

- Model-based assessment: calibrated 3-region New Keynesian DSGE model: two euro-area (EA) regions ("Home" and rest of EA, "REA") and rest of the world ("RW")

- EA: monetary union, Home and REA share same monetary policy and exchange rate

- Fiscal policy is country-specific. Public sector levies distortionary taxes, issues debt, consumes and invests in infrastructure

- Public capital enters production function of domestic goods with private capital and labor

- Non-standard monetary policy measures (quantitative easing) have real effects via financial market segmentation
Preview of results

- Sizable medium-long term fiscal multipliers (> 1)
- If coupled with non-standard monetary policy (forward guidance and quantitative easing), fiscal multipliers become very large (> 3 at peak), fiscal stimulus is self-financing and inflation increases
- Cross-country coordination enhances expansionary effects
- Funding matters: Debt-financed fiscal stimulus is growth-friendly in the short run but not in the long run, compared to tax-financed
- In all cases, efficiency in public investment implementation is crucial for the stimulus to have sizable real effects
Related literature

- Elekdag and Muir (2014): macroeconomic impact of public investment in infrastructure in EA and Germany
- Blanchard et al. (2015): effects of fiscal expansions in European core economies
- Abiad et al. (2016): empirical evidence on public investment effectiveness (role of efficiency and financing)
- DeJong et al. (2017): effectiveness of public investment in the EU
Road map

- Model setup: most relevant features, calibration
- Simulated scenarios and results
- Conclusions
Model structure: standard building blocks

- World economy: two euro-area (EA) regions ("Home" and rest of EA, "REA") and rest of the world ("RW")
- Each region: final consumption and investment goods, intermediate tradable (T) and nontradable (NT) goods
- T and NT sectors use private capital, labor and public capital
- Nominal price and wage rigidities: forward-looking Phillips curve
- Monetary policy: standard and non-standard measures (forward guidance, quantitative easing)
- Financial market segmentation allows non-standard monetary policy to have real effects
Fiscal policy is country-specific. Public sector:

- Lump-sum transfers, public consumption, public investment in infrastructure
- Distortionary taxes on labor income, capital income, consumption
- Public debt stabilized via a fiscal rule that adjusts lump-sum transfers to achieve desired debt target

Government budget constraint:

\[ B_{G,t}^S - B_{G,t-1}^S R_{t-1} + P_{L,t} B_{G,t}^L - \sum_{s=1}^{\infty} \kappa^{s-1} B_{G,t-s}^L \leq P_{N,t} C_{G,t} + P_{I_G,t} I_{G,t} + T R_t - T_t, \]
Model setup: fiscal policy

- Public debt is stabilized via lump-sum transfers:

\[
\frac{TR_t}{TR_{t-1}} = \left(\frac{b_{G,t}^s}{b_G^s}\right)^{-\phi_1},
\]

- Public capital accumulation

\[
K_{G,t-1} = (1 - \delta_G) K_{G,t-2} + A_{I_G,t-1-N},
\]

where \( A_{I_G,t-1-N} \), with \( N \geq 1 \), is authorized government investment in period \( t - 1 - N \) (time-to-build lags).

- Government investment actually implemented at time \( t \) is

\[
l_{G,t} = \sum_{n=0}^{N-1} b_n A_{I_G,t-n}
\]

\[
\sum_{n=0}^{N-1} b_n = 1
\]
Model setup: public capital in production

- Home intermediate tradable sector: production function of generic firm \(i\):

\[
Y_{T,t}(i) = K_{T,t}(i)^{\alpha_1} L_{T,t}(i)^{\alpha_2} L_{T,t}(i)^{\alpha_3} (K_{G,t-1})^{1-\alpha_1-\alpha_2-\alpha_3}
\]

- Similar production function holds in the intermediate nontradable sector

- Public capital taken as given by firms
Model setup: financial segmentation

- Following Chen et al. (2012): imperfect substitutability among financial assets, to relax Wallace neutrality

- In each EA region, two types of households:
  - Restricted households only invest in domestic long-term sovereign bonds and own share of domestic capital producers
  - Unrestricted households have access to multiple financial assets and invest in physical capital (through capital producers, along with the unrestricted)

- Long-term sovereign bonds are perpetuities paying exponentially decaying coupon (see Woodford 2001)

- Non-standard monetary policy: purchases by central bank ↓ long-term interest rates ⇔ restricted households ↑ consumption and investment
Model setup: capital producers

- Capital producers accumulate physical capital by demanding final investment goods subject to quadratic adjustment costs on investment change.
- Rent out capital to the domestic firms.
- Maximize profits with respect to capital and investment taking prices as given.
- Evaluate returns according to a weighted average of restricted and unrestricted households’ stochastic discount factors (weights are the corresponding population shares).
- Net revenues are rebated (lump-sum) to domestic restricted and unrestricted households according to their corresponding shares.
Model setup: monetary policy

▶ Standard (Taylor-rule based) monetary policy

\[
\left( \frac{R_t}{\bar{R}} \right)^4 = \left( \frac{R_{t-1}}{\bar{R}} \right)^4 \rho^R \left( \frac{\Pi_{EA,t,t-3}}{\Pi^4} \right)^{(1-\rho_R)\rho_\pi} \left( \frac{GDP_{EA,t}}{GDP_{EA,t-1}} \right)^{(1-\rho_R)\rho_{GDP}}.
\]

▶ Non-standard monetary policy measures: forward guidance (FG) on policy rate and purchases of EA long-term sovereign bonds

▶ Home long-term sovereign bonds:

\[
\int_{0}^{n\lambda_R} B_{R,t}^L(j')dj' + \int_{n\lambda_R}^{n} B_{U,t}^L(j)dj + B_{PSPP,t}^L = B_{G,t}^L.
\]

▶ A similar condition holds for the REA region
Long-term sovereign bonds market clearing

Unrestricted \[\xrightarrow{\text{sovereign long-term}}\] Foreign Households

PSPP

Restricted \[\xleftarrow{\text{sovereign long-term}}\] Government
Calibration

- Parameters set in line with literature and to match EA great ratios. Home region is a relatively small country (20% of EA GDP)

- Set restricted households’ discount factor to obtain a long-short term spread of 1.8pp on sovereign bonds

- Share of restricted households: 0.25 (in Home and REA). Lack of micro-evidence

- Short-term public debt (ratio to GDP): 13% in Home, 8% in REA. Long-term: 120% in Home, 93% in REA. Average duration: 8 years

- Central bank purchases are proportional to GDP share of each region in EA (PSPP follows capital keys of Eurosystem members)
Simulated scenarios

1. Home increase in public investment (debt financed). Monetary policy:
   ▶ Taylor rule
   ▶ 2-year forward guidance (FG)

2. EA-wide increase in public investment. Monetary policy:
   ▶ Taylor rule
   ▶ 2-year forward guidance (FG)
   ▶ FG + Quantitative easing

3. Alternative forms of financing (EA-wide increase in pub. inv.):
   ▶ Distortionary tax-financed increase
   ▶ Monetary accommodation

4. Sensitivity analysis: efficiency in public investment increase (no direct supply-side effect, time-to-build)
Home increase in public investment

- Home government increases public investment by 1% of GDP for 5 years, then gradually back to baseline level
- During fiscal stimulus, fiscal rule not active: after 5th year lump-sum transfers stabilize public debt

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<thead>
<tr>
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<th>Home increase</th>
<th>Home increase + FG</th>
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Home public investment and FG: Home variables
EA increase in public investment

- Increase in public investment (1% of GDP) simultaneously implemented in Home and REA
- Same assumptions as above

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EA public investment and FG: Home variables
EA public investment and FG: REA variables
EA public investment and quantitative easing

- Same assumptions as above, plus quantitative easing (Public Sector Purchase Programme)
  
  - EA’s central bank purchases: euro 180 billion per period for seven quarters (January 2015 Eurosystem PSPP)

- Long-term sovereign bond purchases in Home and REA proportional to corresponding region size as a share of EA
Table: EA public investment, FG, and PSPP

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EA public investment, FG, and PSPP: Home variables
EA public investment, FG, and PSPP: REA variables

- GDP
- Annualized inflation
- Consumption
- Private investment
- Exports
- Imports
- Labor
- Real wage
- Interest rate
- Nominal exchange rate (increase=appreciation)
- Public deficit
- Long-term interest rate
- Total (ST+LT) public debt
- Private holdings of long-term debt

Graphs show the impact of PSPP on various economic indicators.
EA public investment: distortionary taxes and money

- EA increase in public investment + FG
- Increase in public investment financed by ↑ distortionary tax rates on labor, capital, and consumption
- Increase in taxes lasts for 5 years, then lump-sum transfers are used
- Alternatively: central bank buys and permanently rolls over an amount of sovereign bonds equal to increase in EA public investment
- Additional supply of base money - used by fiscal authorities to buy additional goods - contributes to keep interest rates low
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Sensitivity analysis

- Efficiency in implementing public investment decisions is key.

- Lack of efficiency associated with:
  - no accumulation of public capital (no direct impact of public investment on supply-side)
  - or: slow accumulation of public investment (time-to-build, more gradual impact on supply side)
Table: EA public investment and PSPP: no-public capital accumulation and time-to-build

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Conclusions

- Benefits of fiscal policy cooperation, synergies between fiscal and monetary policy

- Fiscal multiplier can be $> 1$ and close to 2: large GDP gains, but not enough to reduce debt-to-GDP ratio

- Larger GDP gains with simultaneous fiscal stimulus in whole EA and monetary policy accommodation

- Monetary policy role is crucial: \( FG + QE \implies \text{fiscal multiplier} > 3 \) at peak and investment spending is self-financing

- Financing method is relevant: tax-financed stimulus is less effective; debt financing more growth-friendly in the short run but not in the long run

- Effectiveness of fiscal stimulus enhanced if implementation occurs efficiently and without delays
Model setup: fiscal policy

- The short-term bond is a one-period nominal bond issued in the domestic bond market that pays the (gross) monetary policy interest rate $R_t$.

- The gross yield to maturity at time $t$ on the long-term bond is

$$R_t^L = \frac{1}{P_t^L} + \kappa.$$
Model setup: restricted households

- Restricted households have access only to the market of long-term sovereign bonds. The budget constraint is

\[
P_t^L B_{R,t}^{L} (j') - \sum_{s=1}^{\infty} \kappa^{s-1} B_{R,t-s}^{L} (j') = \Pi^\text{prof}_t (j') + W_{R,t} \left( 1 - \tau_t^\ell \right) (j') L_{R,t} (j') - P_t (1 + \tau_t^c) C_{R,t} (j') - AC_{R,t}^W (j'),
\]

where \( B_{R,t}^L \) is the amount of long-term sovereign bonds, \( \Pi^\text{prof}_t \) is profit from ownership of the Home capital producers. The long-term sovereign bonds have price \( P_{L,t} \) and are formalized as perpetuities paying an exponentially decaying coupon \( \kappa \in (0, 1] \), following Woodford (2001).