Valuing Government Obligations When Markets Are Incomplete

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Valuing Government Obligations

- Governments promise to make sure or risky payments to current and future generations

  (e.g., Social Security, medical benefits, etc.)

- Valuing them crucial to assess fiscal sustainability:

  Fiscal gap = discounted present value

  of projected spending – tax receipts

- Intuitively, this value may depend on the size, timing, reliability of promises, age of the recipient agent

Discounting Government Promises

- If markets are complete, use security prices (easy)
- But how to discount when markets are incomplete?
  - Assets don't span long-term states, contingencies
  - Social discount rate no good: feasibility vs. ethics
  - Using fixed interest rate common, but appropriate?

Our Work

- Simulate a multi-period GE OLG model

- Find immediate payments agents require to forego promised government payments => discount rates

  – Treat unborn as alive with no utility before birth

  E.g., expected utility of agent born in 20 years:

  $\beta^{20} E_t[u(c_1(t+20))] + \beta^{21} E[u(c_2(t+21))] + \ldots$

Do the Promises Include GE Effects?

- Need to specify precisely what the government is promising

- We are generating results with and without promises of general equilibrium impacts

Main Results

- Discount rates depend on state of the economy, age of the agent, size of promises
- Fiscal gap based on GE and PE promises can differ
- Discounting safe PE promises far in future with prevailing safe return may be OK

The Model

- 10-period overlapping generations model
  - Isoelastic preferences, risk aversion of 2
  - Inelastic labor: 1 for workers, 0 for retirees
  - Cobb-Douglas technology with realistic shocks
  - Bond market: one-period safe bonds

Solving OLG Model with Aggregate Shocks

- Bottleneck: Dimensionality curse due to many state variables

- Prior solution methods
  - Log-linearization (Rios-Rull, '94)
  - Krusell-Smith in OLG (Gourinchas, '00; Storeletten et al. '01)
  - Smolyak (Krueger and Kubler, '06)

- We use Hasanhodzic and Kotlikoff ('13), which builds on Judd, Maliar, Maliar ('09, '11)

Calculating Discount Rates in GE

- Solve the model without any government policy
- Solve the model assuming at time 0 government promises to make God-financed (sure or risky) payments to retirees
- For each agent, find how much the government needs to increase his assets to compensate him for not carrying out the policy => implied discount rate
- The sum total of compensations is the fiscal gap

Present Value of Promises in GE

- For an agent age a > 0 at time 0 when policy is evaluated:

$F_a = \Delta$ Expected Lifetime Utility / $U'(C_a(0))$

- For an agent age a < 0 at time 0 when policy is evaluated:

$F_a = \Delta$ Expected Lifetime Utility / $\beta^a EU'(C_1(-a))\pi_s(1+r_s)$

for s = 0, …, -a and r_s the random return on capital

Annual GE Discount Rates (in Percent)

Age	Benefit Size			
	Medium		Small	
	State			
	Good	Bad	Good	Bad
1	3.59	4.62	3.52	4.10
2	3.15	3.80	3.29	3.64
3	2.82	3.40	2.68	3.38
4	2.56	3.06	2.46	3.16
5	2.30	3.05	2.24	2.98
6	2.34	3.07	2.02	2.86
7	2.39	3.87	2.15	3.05
8	4.13	6.37	2.58	3.68
9	5.30	10.37	3.02	4.27
	Risk-free rate			
	3.06	4.39	3.25	4.41

Interpretation

- Discount rates decline for workers: policy lowers savings, hurts youngest workers most (GE effects)

- Elderly discount more heavily, especially in bad states: diminishing marginal utility

- Discount rates uniformly higher in bad states (low K):

  higher r => consume more in future => extra cons. not valued much

- Small benefit: discount close to, but not equal to the risk-free rate

Calculating Discount Rates in PE

- μ = amount agent age $a > 0$ willing to give up at time t to get a benefit at time $t+k$:

$$\mu = \beta^k \, EU'(C_{a+k}(t+k)) \,/\, U'(C_a(t))$$

- δ = implied discount rate:

$$\mu = 1 \,/\, (1 + \delta)^k$$

Annual PE Discount Rates (in Percent)

Typical State

Current Age	Periods Till Benefit Received								
	1	2	3	4	5	6	7	8	9
1	3.20	3.24	3.27	3.30	3.33	3.35	3.36	3.38	3.39
2	3.23	3.25	3.28	3.31	3.33	3.34	3.37	3.38	
3	3.23	3.25	3.28	3.30	3.32	3.34	3.36		
4	3.22	3.26	3.27	3.29	3.30	3.33			
5	3.22	3.25	3.26	3.27	3.29				
6	3.22	3.24	3.25	3.27					
7	3.21	3.24	3.26						
8	3.22	3.25							
9	3.21								

Risk-Free Rate

3.21

Annual PE Discount Rates (in Percent)

Bad State

Current Age	Periods Till Benefit Received								
	1	2	3	4	5	6	7	8	9
1	4.39	4.21	4.13	4.04	3.97	3.90	3.84	3.78	3.75
2	4.41	4.23	4.14	4.04	3.97	3.90	3.82	3.77	
3	4.52	4.31	4.19	4.08	4.01	3.91	3.84		
4	4.57	4.35	4.21	4.11	4.01	3.92			
5	4.58	4.35	4.21	4.07	3.99				
6	4.54	4.35	4.10	4.00					
7	4.76	4.35	4.14						
8	4.42	4.22							
9	4.27								

Risk-Free Rate

4.57

Fiscal Gap (in Percent)

PV of Obligations By Age and In Total as Share of GDP

			Current Age										Fiscal
			-10	-9	…	-1	1	2	…	7	8	9	10	Gap
Small Benefit	Bad State	GE	-0.01	-0.01	…	0.13	0.40	0.65	…	1.99	2.23	1.65	1.04	**13**
		PE	-0.02	-0.03	…	0.14	0.31	0.42	…	1.79	2.40	1.82	1.04	**11**
	Good State	GE	-0.01	-0.01	…	0.18	0.48	0.72	…	1.73	1.80	1.29	0.70	**12**
		PE	-0.02	-0.02	…	0.20	0.90	1.02	…	1.82	2.05	1.44	0.76	**14**
Large Benefit	Bad State	GE	-0.07	-0.08	…	0.24	1.15	2.09	…	5.87	5.40	4.54	2.71	**38**
		PE	-0.13	-0.16	…	0.26	0.80	1.15	…	6.82	9.74	7.56	4.44	**41**
	Good State	GE	-0.05	-0.07	…	0.49	1.63	2.65	…	6.02	5.74	4.43	2.53	**42**
		PE	-0.11	-0.12	…	0.53	3.55	4.06	…	7.94	9.08	6.45	3.44	**57**

Benefits Provides in Periods 8, 9, and 10. Small Benefit is 10 Percent of Average Wage. Large Benefit is 40 Percent of Average Wage.

PV < 0 => implied GE discount rates not well defined

Conclusion

- Building on Judd, Maliar, and Maliar ('09, '11)

  can solve large-scale OLG models for the first time

- Discount rates depend on state of the economy, age of the agent, and size and riskiness of gov promises

  Fiscal gap based on GE and PE promises can differ

- Governments can use realistic versions of this model to value their obligations

Thank you!