Chapter 5: Approaches to Valuation

- Gives a nice overview of concepts of value
- Discusses principles of valuation used by the SNA and SEEA
- Lists approaches to pricing ecosystem services and ecosystem assets
- Lists some of the challenges faced when trying to price ecosystem services and assets

Initial thoughts

- physical dynamics
- economic dynamics
- likely to need more than a partial equilibrium framework to “model” values

Initial thoughts

- I would like to see an example of how any of the principles or approaches could be (or are being) used to
  - actually measure ecosystem service values or ecosystem asset values
  - measure the value of natural assets or ecosystem services embedded in GDP

Example of a valuation exercise

- Take the WAVES project – contribution of natural resources/assets to GDP
- Say you want to measure water and land's contribution to agricultural GDP

- Factor accounts in Tokyo IO table

Factor accts	Sector			
	Agriculture		Manufacture	Service
Labor Income	21332	0.5	3522172	43122708
Capital Income	8533	0.2	1408869	17249083
Other Income	12799	0.3	2113303	25873625
Value-added	42663		7044345	86245416

- No factor accounts for water or land

- Desired factor accounts

Table 2. I-O table

	Sector		
Factor accts	Agriculture	Manufacture	Service
Labor Income	wL_a	-	-
Capital Income	rK_a	-	-
Water rent	tH_a	-	-
Land rent	πZ_a	-	-
Value-added	42663		

- To get a rough estimate of the payment values to agriculture’s land and water accounts, my colleague, Masahiko Gemma, and I constructed a panel of data for agriculture

- Nine regions (Kinki, Kanto, …), years 1990 – 2008

- Variables
  - Value-added
  - Measure of capital stock
  - Labor hours
  - Cultivated area
  - Constructed agricultural water use estimates for each region

National Accounts Data

- Estimated a Cobb-Douglas technology using OLS

- All coefficients significant at the 99% level and had the expected sign, but R^2 was very high – suggesting possible problem with serial correlation

- Ran fixed-effect and random-effect models using region groups as the panel – coefficient estimates robust (virtually unchanged)

- Results similar whether imposing constant returns to scale or not

National Accounts Data

	ln(y)	Coefficient	Std. error	t-statistic
	Table 4. Regression results for Cobb-Douglas function (fixed effects estimate with 9 regional clusters)			
K	α_1	0.0519	0.0139	3.72
L	α_2	0.5848	0.0770	7.59
H	α_3	0.3094	0.0724	4.27
Z	α_4^*	0.0539	-	-
	t	0.0235	0.0016	14.96
	B	-47.090	4.5770	-10.29
	R^2 (overall) = 0.656, $F(4,8)$ = 49.15			

*Imposed CRTS; regional dummy coefficients not reported

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National Accounts Data

- “Adjusted” factor accounts for Tokyo

Factor accts	Sector		
	Agriculture	Manufacture	Service
Labor Income	24,949	5,206,759	46,240,157
Capital Income	2,214	1,800,834	40,005,259
Water rent	13,200	36,752	271,290
Land rent	2,300	-	-
Value-added	42,663	7,044,345	86,245,416

- Manufacturing (“estimated” cost share) and services

Theory Underlying Empirical Model
Economic Environment

- Three regions: Tokyo, the rest of Kanto, rest of Japan (ROJ)
  - each region has an agricultural, manufacturing and service sector
  - Tokyo and the rest of Kanto also have a municipal water sector
- Agriculture and manufacturing traded
- Service sector output non-traded
- Municipal water non-traded
- Labor augmenting technical change occurs at rate x per period, no labor force growth, capital depreciates at rate δ

Theory Underlying Empirical Model

Economic Environment

- The economy has four factor categories: capital, labor, land and water
  - Capital and labor are economy-wide factors
  - Treat land as specific to agriculture
  - In this model, water is specific to agriculture in each region, and to manufacturing, services and municipal water in Tokyo and the rest of Kanto
- Agriculture in each region uses capital, labor, land & water
- Manufacturing and services use
  - capital, labor & water in Kanto
  - capital & labor in the rest of Japan (ignore water)
- Municipal water uses capital, labor & water

Water Rental Values

Year	Ag_Tokyo	Ag_ROK	Ag_ROJ	Manuf-Tokyo	Manuf-ROK	Serv-Tokyo	Serv-ROK
2008	2126.69	929.22	1574.95	3103.14	1297.27	6364.62	2706.87
2013	2274.70	993.89	1684.56	2727.78	1406.92	7191.25	3059.35
2018	2367.80	1034.57	1753.50	2571.28	1476.03	7731.01	3289.60
2023	2427.28	1060.56	1797.56	2494.31	1520.23	8083.78	3440.11
2028	2465.64	1077.32	1825.96	2452.47	1548.75	8314.51	3538.57
2033	2490.52	1088.19	1844.39	2428.21	1567.26	8465.49	3603.00
2038	2506.71	1095.26	1856.38	2413.55	1579.30	8564.30	3645.17
2043	2517.27	1099.88	1864.20	2404.44	1587.15	8628.98	3672.78
2048	2524.16	1102.89	1869.30	2398.67	1592.28	8671.32	3690.85
2053	2528.66	1104.85	1872.63	2394.98	1595.63	8699.03	3702.68
2058	2531.60	1106.14	1874.81	2392.59	1597.82	8717.16	3710.42
2063	2533.52	1106.98	1876.23	2391.04	1599.25	8729.02	3715.48
2068	2534.77	1107.52	1877.16	2390.02	1600.18	8736.76	3718.78
2073	2535.58	1107.88	1877.76	2389.35	1600.79	8741.80	3720.93
2078	2536.10	1108.11	1878.14	2388.90	1601.18	8745.07	3722.33
2083	2536.43	1108.25	1878.39	2388.60	1601.43	8747.18	3723.23
2088	2536.64	1108.34	1878.54	2388.39	1601.58	8748.52	3723.80
2093	2536.76	1108.39	1878.63	2388.24	1601.68	8749.35	3724.16
2098	2536.82	1108.42	1878.68	2388.13	1601.73	8749.84	3724.37
2103	2536.85	1108.43	1878.69	2388.04	1601.75	8750.10	3724.48
2108	2536.84	1108.43	1878.69	2387.96	1601.75	8750.19	3724.52

NA Shadow Prices

- Shadow price equation

$$P_{\zeta Z}(t) = \int_t^{\infty} e^{-\int_t^{\tau}\left[r(v) - x - \frac{\dot{P}_k(v)}{P_k(v)}\right]dv} \frac{\Pi_Z(\tau)}{P_k(\tau)} d\tau$$

$$P_{\zeta H}(t) = \int_t^{\infty} e^{-\int_t^{\tau}\left[r(v) - x - \frac{\dot{P}_k(v)}{P_k(v)}\right]dv} \frac{\Pi_H(\tau)}{P_k(\tau)} d\tau$$

Water Unit Asset Prices

Year	Ag-Tokyo	Ag-ROK	Ag-ROJ	Manuf-Tokyo	Manuf-ROK	Serv-Tokyo	Serv-ROK
2008	93.89	41.02	69.53	311.31	52.44	189.35	80.33
2009	91.93	40.17	68.08	270.76	51.94	194.95	82.72
2010	90.21	39.42	66.81	239.00	51.50	200.10	84.93
2011	88.70	38.76	65.69	213.71	51.11	204.83	86.97
2012	87.37	38.17	64.70	193.28	50.76	209.19	88.84
2013	86.18	37.65	63.82	176.57	50.44	213.20	90.56
2014	85.12	37.19	63.04	162.73	50.16	216.89	92.14
2015	84.18	36.78	62.34	151.17	49.91	220.28	93.60
2016	83.34	36.41	61.72	141.41	49.68	223.40	94.94
2017	82.58	36.08	61.16	133.11	49.48	226.26	96.17
2018	81.90	35.78	60.65	126.01	49.29	228.90	97.30
2019	81.29	35.52	60.20	119.88	49.13	231.32	98.34
2020	80.73	35.27	59.79	114.57	48.98	233.55	99.30
2021	80.23	35.06	59.42	109.94	48.84	235.60	100.18
2022	79.78	34.86	59.08	105.89	48.71	237.48	100.99
2023	79.36	34.68	58.77	102.32	48.60	239.21	101.73
2024	78.99	34.51	58.50	99.17	48.49	240.81	102.42