Study Questions to Accompany International Energy Markets

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Chapter 2. Energy Lessons from the Past and Modeling the Future

2.1 Suppose that you have estimated the following time series model for world energy consumption $X_t = 0.9X_{t-1} - 0.4X_{t-2}$. In an Excel spreadsheet, use this model to forecast energy consumption for 100 years. Actual consumption for 1998 and 1999 are 379.77 and 388.88.

2.2 Suppose that you have estimated the following time series model for world oil price

$$P_t = 0.9P_{t-1} - 0.8P_{t-2} + 0.0002Y_t + 0.0001Y_{t-1}$$

You have the starting values for price per barrel and world income in billions of dollars for 2009, 2010, and 2011 as follows:

	P_t	P_{t-1}	P_{t-2}	Y_t	Y_{t-1}
2009	61.92			73045	
2010	79.45	61.92		78897	73045
2011	95.04	79.45	61.92	83706	78897
2012	**47.51161**	**95.04**	**79.45**	**85825.03**	**83706**

In Excel create a simple forecasting model to forecast oil price from 2012 to 2013 in the column under P_t. Note I have included the forecasts for 2012 so you can check if you are doing the problem correctly.

2.2a First assume that income grows by 2.5 % per year with continuous growth rate (i.e. $Y_t = Y_{t-1}e^{0.025}$). Fill the column under Y_t using this formula. Create the values in the column for Y_{t-1}. What is income in 2100?

2.2b What is income in 2100, if you use discrete annual compounding. (i.e. $Y_t = Y_{t-1}(1+0.025)$)?

2.2c. Create your columns for forecasted P_t, P_{t-1}, P_{t-2}. Graph P_{t-1} against time.

2.3 A firm owns a coal mine (X1) and an electricity generator (X2) $0.23 of coal is required per dollar of coal, and $0.25 of electricity is required per dollar of coal. $0.30 of electricity is required per dollar of electricity and $0.15 of coal is required per dollar of electricity. End-use demand for coal is $700 and end-use demand for electricity is $2000.

2.3a Compute how much coal and electricity have to be produced using algebra.

2.3b Compute how much coal and electricity have to be produced using matrix algebra.

2.4 You live in an economy with three industries - non-energy basic resources (B), manufacturing (M), and energy (E). The following A matrix represents the input-output coefficients for this economy. The matrix is represented in $input/$output.

	B	M	E
B	0.15	0.07	0.20
M	0.01	0.20	0.06
E	0.09	0.01	0.05

2.4a Explain the coefficients 0.05 and 0.07.

2.4b Compute value added per unit of output in each of the three industries?

2.4c. If end use demand for (B, M, E) = (2,3,8), how much total B, M, E must be produced? You can use the programs in ch02m.xlsx for your solution. Copy in a screen shot of the solution.

2.4d. For the solution in 2.3c what are the direct purchases of energy for the production of B?

2.4e. What is the cradle to grave use of E in the production of **one** unit of B?

2.4f. Suppose that the production of each of these products generates carbon dioxide. The pounds of carbon dioxide per $ of B, M, E are: 0.02, 0.03, 0.04, respectively. Compute the total amount of CO_2 generated by the total output vector you found in part 2.3c.

2.5 The following is an input output coefficient matrix for a six sector economy.

	Food	**Housing**	**Basic materials**	**Energy**	**Manufactured**	**Services**
Food	0.10	0.03	0.04	0.01	0.02	0.01
Housing	0.05	0.20	0.06	0.05	0.03	0.20
Basic Materials	0.02	0.07	0.30	0.07	0.04	0.01
Energy	0.01	0.06	0.09	0.22	0.02	0.07
Manufactured	0.02	0.03	0.03	0.13	0.17	0.05
Services	0.04	0.02	0.02	0.05	0.06	0.25

2.5a In Excel, solve the model for end use demands of Food = 25, Housing = 50, Basic materials = 34, Energy = 10, Manufactured Goods = 20, and Services = 15. 5. You should submit screenshots of your solution for the questions below.

2.5b How much does each sector buy from another?

2.5c. What is the total cradle to grave use of each sector in another?