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 $X_t = 1.1X_{t-1} - 0.01X_{t-2}$. In an Excel spreadsheet, use this model to forecast energy consumption to 2025. Actual consumption (X_t) for 2015 and 2016 and the first forecast are shown in the spreadsheet below in millions of tonnes of oil equivalent.

	Xt	Xt-1	Xt-2
2016	**13105.00**		
2017	**13276.00**	13105.00	
2018	14472.55	13276.00	13105.00

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 jn an excel worksheet as follows:

	Pt	Pt-1	Pt-2	Yt	Yt-1
2009	61.920			73045.000	
2010	79.450	61.920		78897.000	73045.000
2011	95.040	79.450	61.920	83706.000	78897.000
2012					

2.2a Assume income grows continuously by 2.5 % per year. (i.e. $Y_t = Y_{t-1}e^{0.025}$). Compute the values for the missing blank cells for 2012.

2.2b Now let's continue the above worksheet to create an excel model to forecast out to 2060. If income continues to grow at a continuous growth rate of 2,5%, fill in the column under Y_t from 2013 to 2060. What is the income in 2060? Create a formula to fill in values for Yt-1.

2.2c. Create your columns for forecasted P_t, P_{t-1}, P_{t-2}. Graph P_{t-1} against time for 2013-2060. Paste in your model values for years 2059 and 2060.

2.2d. Graph the price from 2010 to 2060.

2.3 A firm owns a coal mine (X1) and an electricity generator (X2) with: $0.25 of coal required per dollar of coal, $0.25 of electricity required per dollar of coal, $0.30 of electricity required per dollar of electricity, and $0.10 of coal required per dollar of electricity. End-use demand for coal is $750 and end-use demand for electricity is $1500.

2.3a Represent this economy with two algebraic equations.

2.3b Solve the above two equations for how much coal and electricity have to be produced to satisfy the given end-use demands.

2.3c What is the A matrix and the d vector for the above model?

2.3d Write out the above model in matrix notation using A, x, and d.

2.3e 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.

		Buyers		
		B	M	E
	B	0.15	0.07	0.20
Sellers	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.

2.4d. For the solution in **2.4c** what are the direct purchases of energy for the production of **one** unit of B? Compute the total direct purchases of E by B.

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

2.5 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 2.5c.

2.6 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

2.6a In Excel, create a model to solve for end use demands of Food = 25, Housing = 50, Basic materials = 34, Energy = 10, Manufactured Goods = 20, and Services = 15. Provide a screen shot of your model solution

2.6b How much does each sector purchase directly from another? Provide a screen shot of your model solution to direct purchases.

2.6c What are the total cradle to grave use of each end use demand for each good. Provide a screen shot of your solution.