Derek Laing

Principles of Macroeconomics, Econ. 102

Midterm I

February 21, 2024

Instructions: Answer (all the short parts of) any two of the questions [Q1], [Q2], or [Q3].

Points. Each major question is worth **50 points.** The notation **[20] = 10 + 10** (see, for example, part *a*.) of Q1 below) just means, "Part ***a*** (of Q1) is worth a total of 20 points, with part ***a*1.)** comprising 10 points and ***a*2.)** comprising 10 points."

[Q1] Supply–Demand (Ch.4)

a.) Law of Demand. [20] = 10 +10

a1.) What is meant by the *law of demand*? Depict a negatively sloped demand curve for apples. Let the current price be P_0 and depict the corresponding quantity demanded, Q_0. If the price rises to P_1 what happens to the demand for apples, Q_1 ?

a2.) Briefly, what is the distinction between the *movement along* a demand curve versus a *shift* in a demand curve demand? Name one factor that might shift the demand for apples and illustrate its effect in your diagram you drew for part **a1)** .

b.) Supply Demand and Economic Shocks:The Market for Natural Gas. [30] = 5 × 6

The following exert is from the NY times:

> European natural gas prices, which soared last year after Russia's invasion of Ukraine, have now fallen well below their levels before the start of the war, reflecting the continent's success rounding up alternatives to Russian gas, widespread conservation efforts and a relatively mild winter. . . . Russia used to provide about 40 percent of Europe's consumption of gas, which is widely used to heat homes, run businesses and generate electricity.
>
> NYT, 01/03/2023

The price of natural gas between 2022 and 2023 is illustrated in Fig Q 1.1 on the following page. The goal of this question is to construct a simple supply–demand model to explain this evidence. To help you you tackle the question, it is in several very short parts—see below. Since I've done most of the writing, your answers can be correspondingly short. Let's begin, however, with the main facts.

The Main Facts: Fortunately, one need be no expert in the market for natural gas to answer the question. Consider,

F1.) Main Use. The main use of natural gas is to heat homes.

F2.) Supply. Russia is a major supplier of natural gas to Europe and the rest of the world

F3.) Geopolitics. Russia invaded Ukraine in February 2022

F4.) Sanctions Because of sanctions, the supply of natural gas from Russia fell in August–September 2022

F5.) Not the Winter of our Discontent . . . Europe had an extremely mild winter (2022-2023)

F6.) Winter is Coming. . . Time to Adjust. The invasion occurred in early February of 2022. This gave households, governments, and energy producers lots of time to prepare for the upcoming Winter of 2023.

Let N equal the quantity of natural gas, and let p equal its price (measured in euros per megawatt hour, €/MWH). To keep things manageable, the goal is just to explain those regions of the figure marked as **Spike II** and the **Extraordinary Declines** (in prices).

b1.) Stage "0" : Pre–Sanctions (June 2022) . Let S_0, D_0 represent initial—pre-invasion—demand and supply curves, given by

$$N^d = D_0(p, \quad ? \quad) \quad \& \quad N^s = S_0(p, \quad ? \quad),$$

and "?" stands for other potentially important variables. In addition to the price, give **one** example of a variable that influences the demand and another that influences the supply. Illustrate the initial equilibrium in the natural gas market in, say, June 2022. Let T_0 represent the warm July weather in Europe and let $R_0 = 0$ (no sanctions). In your diagram mark the initial equilibrium price and quantity $p_0{}^*$, $N_0{}^*$. [1]

Hint for Part *b1*). Use facts F1 and F4. You might want to let T represent the *average temperature,* and let R measure the *strength of sanctions* imposed on (R)ussia. Prior to July 2022 $R = 0$, since there were no sanctions.

b2.) Stage "1": Post–Sanctions (Summer 2022). The weather was warm over the summer, so assume the temperature remains unchanged, $T_1 = T_0$. However, sanctions really started to bite, so R_1 is now high. Illustrate the impact of this change in your diagram. Let $p_1{}^*$, $N_1{}^*$ represent the new equilibrium.

Continued . . .

[1] You will see I've labelled everything in sequence. Thus, 0 = initial stage; 1 = next stage, 2 = one after that, etc. Good notation is indispensable in this sort of problem.

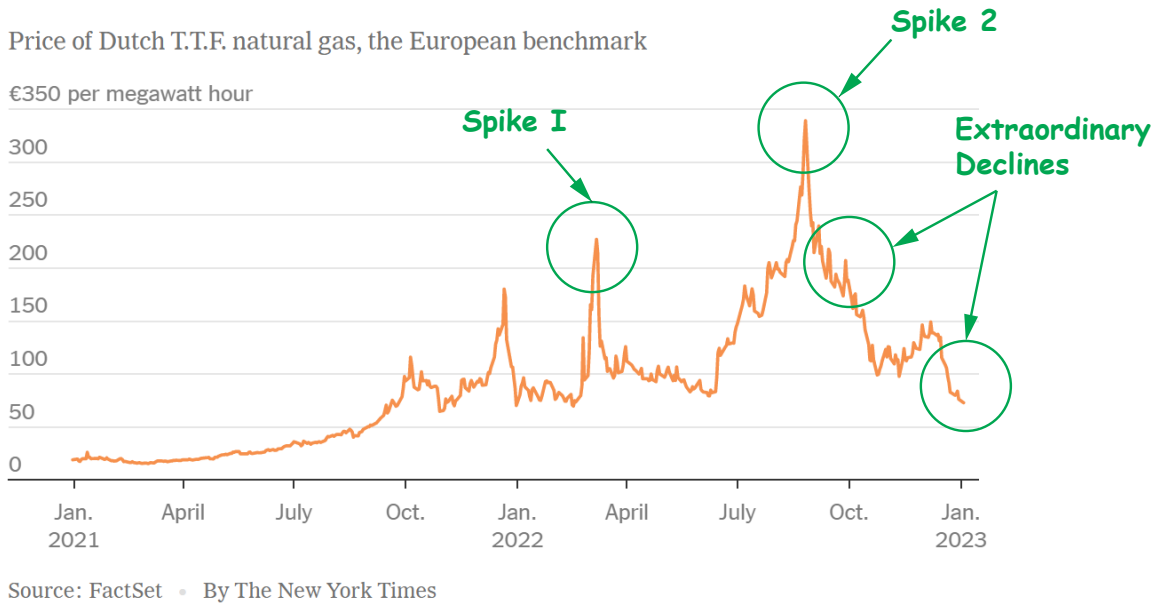

FIG. 1.1: NATURAL GAS PRICES

b3.) Stage "2": (September 2022—January 2023). Now just focus on fact F6—*time to adjust.* Assume the weather is still warm, so $T_2 = T_1 = T_0$. Everybody anticipated and so responded to the impending increase in prices during the Winter months of 2023. For example, households had time to insulate their homes. In your figure, illustrate the impact of these changes and how they influenced the equilibrium price and quantity, p_2^*, N_2^*. (Reuse your Figure if you want.)

b4.) Stage "3": (Winter 2022–2023). Europe had an extremely mild winter in 2022–2023. The actual winter temperature, T_3, was only slightly below T_0 (July 2022). Illustrate the effect of the warm winter, on the market equilibrium, p_3^*, N_3^*.

b5.) Success? Very briefly, did the model succeed in its main goals? I.e., did it explain *Spike II* and the *extraordinary decline in prices* shown in the figure?

[Q2] Elasticity (Ch.5)

***a*.) Computation.** **[15] = 7 + 8**

a1.) Figure 1.2(*a*) depicts demand curve for pears. Does it represent a highly inelastic demand curve or a highly elastic demand curve?

a2.) Figure 1.2(*b*) depicts the relationship between income, *Y*, and the demand for *turnips (aka rutabagas) T*, Does it indicate the link **from** income, *Y*, **to** demand, *T*, is highly elastic or inelastic?

***b*.) Price Elasticity and Demand Curves.** **[15] = 5 + 5 + 5**

Use Figure 1.3 on the next page to answer the following questions. To save time, elaboration or explanation of your answer is unnecessary. Thus, for example, if you think the answer to part **b1** of the question is, "*portion* **BC**," just write in your answer booklet, " **b1, BC**"

b1.) The elastic section of the graph is represented by section **?**

b2.) The unit elastic section of the graph is at **?**

b3.) The part of the graph where a decrease in price would result in an increase in total revenues is **?**

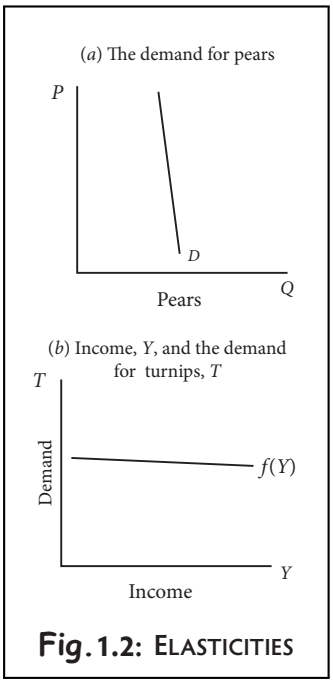

Fig. 1.2: ELASTICITIES

***c*.) Elasticities: Economic Application— OPEC** **[20] = 5 + 7 + 8**

Background. OPEC—Organization of the Petroleum Exporting Countries—was formed in the early nineteen sixties among major exporting nations with the goal of stabilizing crude oil prices. Let P represent the price of oil and let Q represent the quantity of oil.

c1.) Oil Demand: Pre–OPEC. Why is it realistic to think the short-run demand curve for oil is **highly inelastic**? Accordingly, draw a highly inelastic demand curve. Mark a point A in the diagram on the **inelastic portion** of the demand curve. Let the price at point A be P_0 and the demand for oil Q_0. Use your diagram depict the revenues accruing at A to oil exporters. **Continued. . .**

c2.) Origins of the Cartel. Building on the previous answers, now suppose OPEC forms and *raises* the price of oil from P_0 to P_1. What happens to total oil revenues? Why does this result help explain the fact OPEC was a powerful organization when it first formed?

c3.) The Swing of the Pendulum. . . . In part *c*1 of the question, we began with the premise that the demand for oil is highly inelastic in the *short run*. Very briefly, why might the situation change radically for OPEC in the long run? What is the likely effect of these changes on both OPEC and the long-run price of oil?

Hint: *Fuel efficiency, green energy,* and *fracking*.

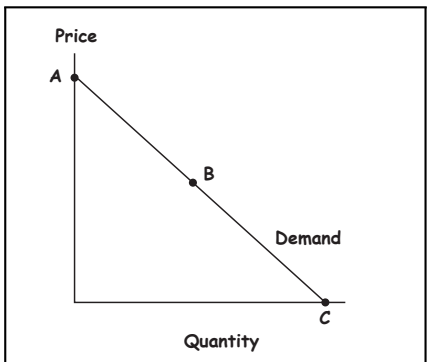

Fig. 1.3: PRICE-ELASTICITY OF DEMAND

[Q3] Measuring a Nation's Income (Ch.10)

a.) GDP: Nuts and Bolts. [15] = 5 +10

Let the relevant time period be a year. Suppose an economy produces N different goods and services. Let q_i^t equal the quantity of good i produced in year t. Let p_i^t equal the corresponding price of good i in year t. The collection of **newly produced** goods and services and their corresponding prices, during year t, are then,

$$\text{Quantities in year t} = \left\{q_1^t, \ldots, q_N^t\right\} \quad \& \quad \text{prices in year t} = \left\{p_1^t, \ldots, p_N^t\right\}$$

a1.) . . . Newly Produced . . . Why the emphasis on *newly produced* goods and services?

a2.) Economic Activity. Dougal—an armchair economist—thinks the obvious way to measure economic activity is just to add up all of the dollar values of *all* of the newly produced goods and services produced during a given year. Dougal (D) therefore proposes the following measure, Y^D,

$$Y_t^D = p_1^t q_1^t + \cdots + p_N^t q_N^t.$$

He argues, "clearly my measure of economic activity is excellent because it includes the dollar value of all of the output produced during the year." Nevertheless, Dougal's measure contains a fatal flaw. What is it? Given this, how is *nominal* GDP, Y_t computed? Does the measure of nominal GDP provide an accurate measure of actual economic activity? If not, what is the fundamental problem.

b.) The National Accounts [20] = 5 + 7+8

b1.) A Fundamental Identity. Every $1 spent by a "buyer" must be received by a "seller." How does this apparently trivial observation help explain a fundamental identity in the National Accounts?

b2.) The Components of Expenditure. The following identity connects total nominal income (GDP), Y, with total aggregate expenditure broken down by category,

$$\mathrm{Y} \equiv C + I + G + NX.$$

What does "C" represent? Briefly, what is the motive for introducing the **four** separate decision-makers (agents): households, firms, government, and foreign buyers of US goods. In other words, why not just use the identity $\mathrm{Y} \equiv E$—income is equivalent to expenditure—and posit there just is one representative/average buyer of US goods (rather than the four different buyers actually used)?

b3.) Net Exports. The level of *net exports*, NX, is exactly what it claims to be: $NX \equiv X - M$; i.e., it is exports, X, net of imports, M. We can write the GDP identity just given in part 2 as,

$$Y \equiv C + I + G + X - M. \quad (*)$$

Some policymakers have looked at equation (*) and concluded imports into the US are harmful because the equation seems to suggest an increase in imports, M, causes a reduction in U.S. GDP. Are they right?

c.) Real and Nominal GDP. [15] = 10 +5

Consider an economy producing only two goods—milk and honey. The price of milk is p_m, the price of honey, p_h, and the quantities are q_m and q_h respectively. Suppose,

Year	p_m	q_m	p_h	q_h
2020	$2	200	$2	100
2021	$3	200	$3	100
2022	$3	400	$3	200

c1.) Suppose the base year is **2021.** Use it to calculate the levels of nominal GDP and real GDP in each of the years 2020–2022

c2.) Calculate the percentage change in real GDP between 2020–2021 and 2021–2022. Why do these measures of the change in economic activity make perfect sense?