

**THE UNIVERSITY OF MICHIGAN**  
**Gerald R. Ford School of Public Policy**

**PubPol/Econ 541**

**Paper #1 Assignment**  
**Due Wednesday, October 2, 2024**

In this assignment, you are asked to analyze and to calculate the costs and benefits of a particular trade policy program in the United States – the import quota restriction on sugar for 1983. This analysis will include a calculation of the aggregate welfare effects for the U.S. economy, together with the decomposition of the costs and benefits for producers (domestic and foreign) and U.S. consumers.

In order to maintain a certain level of domestic production and employment in the U.S. sugar industry, the federal government in 1983 guaranteed U.S. sugar producers a minimum (“market stabilization”) price for their sugar. The price support program involved both a tariff and a quota, as well as federal subsidies. For the purpose of this assignment, however, we will focus only on the import quota alone, since it was the major restraint. The quota licenses involved in the U.S. sugar program were distributed free to foreign suppliers.

The basic data that you will need are provided as follows, representing (hypothetical) quantities, prices, and elasticities for the 1983 U.S. sugar industry in the presence of an import quota that has restricted imports to 7 billion pounds of sugar per year.

Domestic production (billions of pounds)	12.43
Domestic consumption (billions of pounds)	19.43
Volume of imports (billions of pounds)	7.00
Employment (thousands of workers)	36.9
Land used in production (millions of acres)	2.4
World price (cents per pound)	24.1
Domestic (U.S.) price with quota (cents per pound)	29.8
$\eta$ : elasticity of (U.S. domestic) demand	-0.35
$\varepsilon$ : elasticity of (U.S. domestic) supply	2.17

Your assignment is to prepare a policy memorandum that uses the above information and that presents calculations and discusses the policy implications of the U.S. sugar import-quota restraint.

**Structure of Assignment:**

1. See “Format Instructions for Papers” and be sure to follow all of the guidelines.
2. The paper should be between 3 and 5 pages long – definitely **no longer** than 5 pages including any tables and graphs.
3. The paper should include a cover sheet (unnumbered, and does not count as part of the page limit), plus all of the elements listed below. The cover sheet should have a title for the paper plus the names of the authors.
4. Tables and graphs may be presented either along with the text or on separate pages at the end (included in the 5-page limit), as you prefer or find more convenient.
5. Remember that you are providing a policy memorandum, not a course paper or homework assignment. Be sure to write clearly and report things so that they can be understood easily. For example, if you report a column of numbers, align them so that it is easy to see which is larger, and do not include more significant digits than needed to get their message. I will be giving separate scores for content and presentation.

**Contents:**

Your paper should be organized as follows:

1. **Statement of what is to be done.**
2. **Presentation of the model to be used.** For this purpose, you should use the partial equilibrium model of a “small country” that faces a given world price. This model is the same model that we have used in class, and it is also presented in the appendix to this assignment. In your paper, you should depict graphically the demand and supply conditions for sugar, based on the above information.

You should also discuss briefly the limitations of the “small country” model as applied to the U.S. economy and the extent to which the results might have to be changed if you were to take markets other than sugar (such as the prices of sugar substitutes) into account. I really do mean “briefly” and do not want anything formal. Just a few sentences suggesting what results might be different or missed because of these assumptions.

3. **The results of your analysis.** This will include some indication of how you calculated the costs and/or benefits of the sugar import quota for U.S. consumers, domestic producers, foreign supplies, and the deadweight loss to the U.S. economy. You should present the results in a table that clearly identifies the effects involved and the units of measurement. Your calculations should be explained clearly with reference to your diagram. You need not include the equations that you have used, unless you do something that would not be obvious from what appears in the appendix to this assignment. Be sure to check your arithmetic in doing the calculations, including by thinking about whether the sizes and signs of your results make sense.

You will be using the elasticities provided in the assignment to calculate changes in prices and/or quantities. The percentage changes that appear in the elasticities could be relative to either the before or after prices and quantities. Feel free to use whichever choice is easier (it matters, and I have answers in my own spreadsheet for both), but be consistent.

There is no need to report separately the amounts represented by triangles  $b$  and  $d$  in the diagram. These do have economic meaning, as I hope you know, but they would not be of interest to a policy maker. You should however report the sum of the two, which is the net welfare effect of the policy, also known as the dead-weight loss.

- 4. Implications for U.S. agricultural land use and employment.** You should discuss how the sugar quota restriction would affect the utilization of the agricultural land devoted to the U.S. production of sugar cane and beet sugar, and the extent to which producers may have the option of switching to alternative crops. Also, the employment effects of the sugar quota should be considered. Assuming that the ratio of output to employment is fixed, calculate the number of jobs that were being “saved” by the quota, and use your estimate of costs to consumers to determine the “consumer cost per job saved.”
- 5. Conclusions.** Summarize briefly your conclusions concerning the economic and political implications of the U.S. sugar import-quota restraint, including the effects on the sugar-producing industry directly and the effects on the production and consumption of sugar substitutes. Also, discuss other policy options available to the U.S. government, including the use of an equivalent tariff to replace the import quota and simply removing protection altogether, being sure to indicate how the distribution of the welfare effects would differ for the various policy options.

## APPENDIX

### Welfare Effects of a Tariff

The following description is intended to help explain the derivations of the formulas used to calculate the various welfare effects resulting from import restrictions. The analysis considers an *ad valorem* tariff,  $t$ , but it could be adapted to apply to a quota for which  $t$  is the percentage quota premium.

#### I. THE BASIC MODEL IS:

$$Q^m = Q^d - Q^s = D(p^h) - S(p^h)$$

where “ $m$ ” denotes imports and “ $h$ ” home,

$$p^h = (1 + t)p^w$$

where  $p^w$  is the world price, exogenous because the country is assumed to be too small to affect it.

Thus, without a tariff ( $t=0$ )  $p^{h0} = p^w$  and

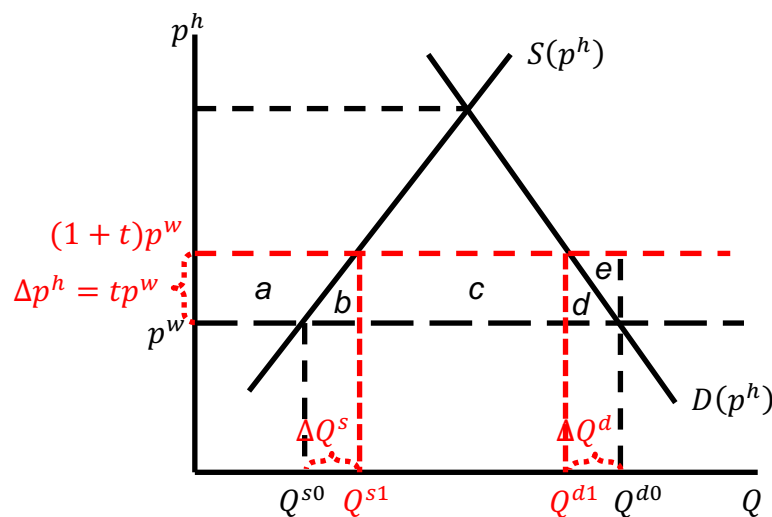
$$Q^{m0} = D(p^w) - S(p^w)$$

With a tariff,  $t > 0$ ,

$$p^{h1} = (1 + t)p^w$$

$$Q^{m1} = D((1 + t)p^w) - S((1 + t)p^w)$$

The effects of the restraint are illustrated below:



**Notation:**

Let  $\Delta Q^d = Q^{d1} - Q^{d0}$  (S1)

$$\Delta Q^s = Q^{s1} - Q^{s0} \quad (S2)$$

$$\Delta p^h = p^{h1} - p^{h0} = (1 + t)p^w - p^w = tp^w \quad (S3)$$

$$t = \frac{\Delta p^h}{p^w} = \frac{\Delta p^h}{p^{h0}}$$

We will also use the substitutions:

Elasticity of (home) demand,  $\eta$ :

$$\eta = \frac{\Delta Q^d / \Delta p^h}{Q^{d0} / p^{h0}} \quad \text{or} \quad \frac{\Delta Q^d}{Q^{d0}} = \eta \frac{\Delta p^h}{p^{h0}} \quad (S4)$$

Elasticity of (home) supply,  $\varepsilon$ :

$$\varepsilon = \frac{\Delta Q^s / \Delta p^h}{Q^{s0} / p^{h0}} \quad \text{or} \quad \frac{\Delta Q^s}{Q^{s0}} = \varepsilon \frac{\Delta p^h}{p^{h0}} \quad (S5)$$

Value of demand:

$$V^{d0} = p^{h0} Q^{d0} = p^w Q^{d0} \quad (S6)$$

Value of supply:

$$V^{s0} = p^{h0} Q^{s0} = p^w Q^{s0} \quad (S7)$$

**II. WELFARE LOSS OF (HOME) DEMANDERS**

Demanders are consumers if this is a final good and include downstream purchasers if it is an input to other production. The loss of “consumer surplus” equals the sum of areas  $(a+b+c+d)$  from the figure. This is calculated most easily as the entire rectangle out to  $Q^{d0}$  minus the area “ $e$ ”. I will represent these areas as  $\langle abcd \rangle$ ,  $\langle e \rangle$ , etc.

$$\begin{aligned} WLD &= \langle abcd \rangle = \langle abcde \rangle - \langle e \rangle \\ &= (Q^{d0})(\Delta p^h) - \frac{1}{2}(|\Delta Q^d|)(\Delta p^h) \\ &= \left(1 - \frac{1}{2} \frac{|\Delta Q^d|}{Q^{d0}}\right) Q^{d0} \Delta p^h \\ &= \left(1 + \frac{1}{2} \frac{\Delta Q^d}{Q^{d0}}\right) p^{h0} Q^{d0} \frac{\Delta p^h}{p^{h0}} && \text{(since } \Delta Q^d < 0 \text{)} \\ &= \left(1 + \frac{1}{2} \eta \frac{\Delta p^h}{p^{h0}}\right) V^{d0} \frac{\Delta p^h}{p^{h0}} && \text{(using S4)} \\ &= \left(1 + \frac{1}{2} \eta t\right) t V^{d0} && \text{(using S3 and S6)} \end{aligned}$$

**III. WELFARE GAIN OF (HOME) SUPPLIERS**

The gain in “producer surplus” is shared by producers of the product itself and perhaps the upstream suppliers of inputs. It is represented by region “a” in the figure:

$$\begin{aligned}
 WGS &= \langle a \rangle \\
 &= (Q^{s0})(\Delta p^h) + \frac{1}{2}(\Delta Q^s)(\Delta p^h) \\
 &= Q^{s0}\Delta p^h + \frac{1}{2}\frac{\Delta Q^s}{Q^{s0}}Q^{s0}\Delta p^h \\
 &= \left(1 + \frac{1}{2}\varepsilon\frac{\Delta p^h}{p^{h0}}\right)p^{h0}Q^{s0}\frac{\Delta p^h}{p^{h0}} && \text{(using S5)} \\
 &= \left(1 + \frac{1}{2}\varepsilon\frac{\Delta p^h}{p^{h0}}\right)V^{s0}\frac{\Delta p^h}{p^{h0}} && \text{(using S7)} \\
 &= \left(1 + \frac{1}{2}\varepsilon t\right)tV^{s0} && \text{(using S3)}
 \end{aligned}$$

#### IV. REVENUE GAIN OF DOMESTIC GOVERNMENT

This is area “c” in the figure, simply the size of the tariff multiplied by the quantity of imports in the presence of the tariff:

$$\begin{aligned}
 R &= \langle c \rangle \\
 &= (Q^{d1} - Q^{s1})\Delta p^h \\
 &= (Q^{d0} + \Delta Q^d - Q^{s0} - \Delta Q^s)tp^w \\
 &= \left(Q^{d0}\left(1 + \frac{\Delta Q^d}{Q^{d0}}\right) - Q^{s0}\left(1 + \frac{\Delta Q^s}{Q^{s0}}\right)\right)tp^w \\
 &= \left(Q^{d0}\left(1 + \eta\frac{\Delta p^h}{p^{h0}}\right) - Q^{s0}\left(1 + \varepsilon\frac{\Delta p^h}{p^{h0}}\right)\right)tp^w \\
 &= \left(V^{d0}(1 + \eta t) - V^{s0}(1 + \varepsilon t)\right)t
 \end{aligned}$$