ECO 610
Problem Set #4
Fall 2020

KEY

1. (8 pts.) See the attached article from the WSJ 11/24/17. Describe the pertinent market structure characteristics of the paint industry, and explain what type of market structure you think it is. Then take the information on sales by each of the major paint producers and calculate the industry HHI. Explain how you get your answer and show your work. There are a number of smaller producers not listed in the chart, but you can ignore them for purposes of answering this question.

Total industry sales = 65.2

$$HHI = \sum_{i=1}^{n} s_i^2 = \left(\frac{15.8}{65.2}\right)^2 + \left(\frac{14.3}{65.2}\right)^2 + \left(\frac{10.7}{65.2}\right)^2 + \left(\frac{4.8}{65.2}\right)^2 + \left(\frac{4.3}{65.2}\right)^2 + \left(\frac{4.1}{65.2}\right)^2 + \left(\frac{3.6}{65.2}\right)^2 + \left(\frac{2.9}{65.2}\right)^2 + \left(\frac{2.6}{65.2}\right)^2 + \left(\frac{2.1}{65.2}\right)^2$$

$$HHI = .1551 * 10{,}000 = 1551.$$

Market Structure: three large firms, several smaller firms, differentiated product, non-trivial barriers to entry (??)

OLIGOPOLY

WSJ 11/24/17

Paint Industry Draws Excitement

The otherwise quotidian world of paint is turning into a feeding frenzy of merger activity. Money is to be made betting on the prime targets.

The latest news: Japan's **Nippon Paint** is interested in **Axalta Coating Systems**, pushing aside a bid by Dutch rival **Akzo Nobel**, which itself has been a target for industry leader **PPG Industries**. It is unclear what price Nippon has offered for Axalta, though it will need to be more than its current enterprise value of $11.7 billion including debt.

Akzo's retreat before a smaller rival isn't as odd as it sounds. This year, the Dutch company refused to negotiate over three separate bids from Pittsburgh-based PPG, which vies with Cleveland-based **Sherwin-Williams** for the top spot in the global paints industry. Investors, noisily led by New York activist **Elliott Management**, wanted Akzo to negotiate.

Chairman Antony Burgmans blocked PPG by invoking arcane clauses of Dutch law, leaving him little credit with investors to draw on in support of a punchy takeover. The Axalta deal, billed as a "merger of equals," always looked like a poison pill to keep PPG away, but investors were happy to swallow it as long as Akzo could promise merger synergies without a hefty takeover premium. Nippon's all-cash offer has made that impossible.

Nippon Paint is making a huge bet. With an enterprise value equivalent to $10.6 billion, it is slightly smaller than Axalta. The offer looks serious, though. The Japanese company has no net debt and a clear ambition to be a global player.

Crucially, Nippon Paint's key shareholder implicitly stands behind its management. Almost two-fifths of the company's shares belong to **Wuthelam Holdings**, the investment vehicle of Singaporean billionaire Goh Cheng Liang. Mr. Goh distributed Nippon paint for decades before his son, now director of the board, spearheaded a 2014 merger.

Akzo's inability to compete with Nippon Paint leaves it vulnerable. PPG has done its best to temper expectations of another round of bidding, but this could just be a negotiating ploy. The numbers should still work: The dollar has weakened against the euro this year, but PPG's share price has outperformed Akzo's, which is still 18% below the level of PPG's final bid. PPG's "put-up-or-shut-up" quiet period expires next month.

There is an outside chance **Sherwin-Williams** could also be interested in Akzo. In the spring it had its hands full with the acquisition of smaller rival Valspar, but this was completed in June.

In a consolidating market it makes sense to own the takeover targets. It is clearer than ever that these include Akzo Nobel as well as Axalta.

—Stephen Wilmot

Color Palette

Global coatings sales 2016, in billions

*Pro-forma including Valspar.
Sherwin-Williams's acquisition of Valspar completed in June 2017.
Sources: Coatings World, Sherwin-Williams

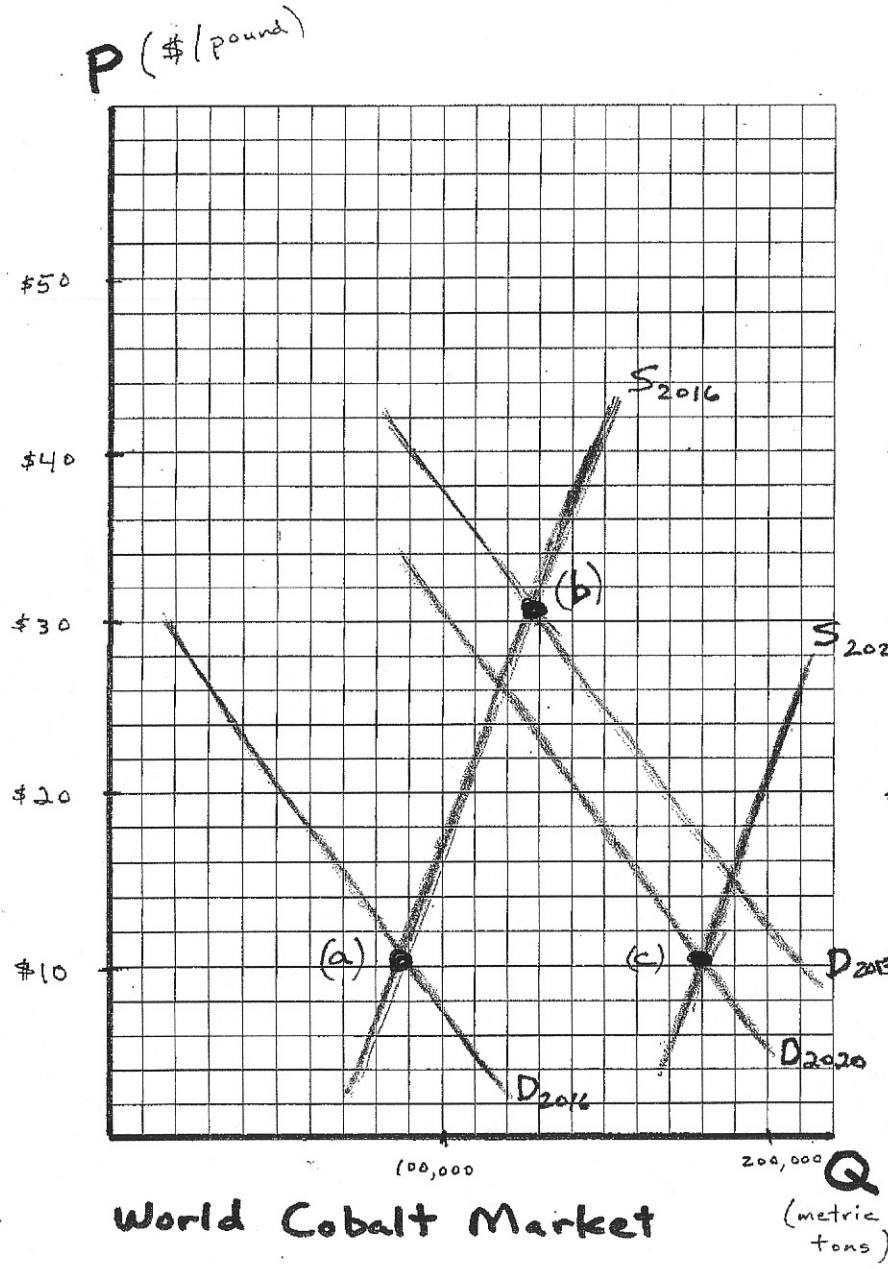
THE WALL STREET JOURNAL.

2. (12 pts.) Read the attached article on the global cobalt market from the WSJ 11/30/17. Cobalt is mined by a number of companies in different places around the globe. Since the beginning of the year, cobalt prices have increased from around $10/lb to $30/lb. As you can see in the attached chart, cobalt prices had been in the $10 to $15 range for a number of years. Since you work for a major battery manufacturer supplying automobile manufacturers in North America, your bosses have asked you to explain what is going on. The CEO and most of the board members have MBA's, so they understand commodity market models. Now for the framework of your report:
   a) What does long-run equilibrium look like in the global cobalt market? Is long-run equilibrium price closer to $10 per pound or $30 per pound? What does that suggest to you about minimum LRAC for producing cobalt? Draw diagrams for the market and for a typical cobalt mining company that are consistent with your description of long-run market equilibrium.

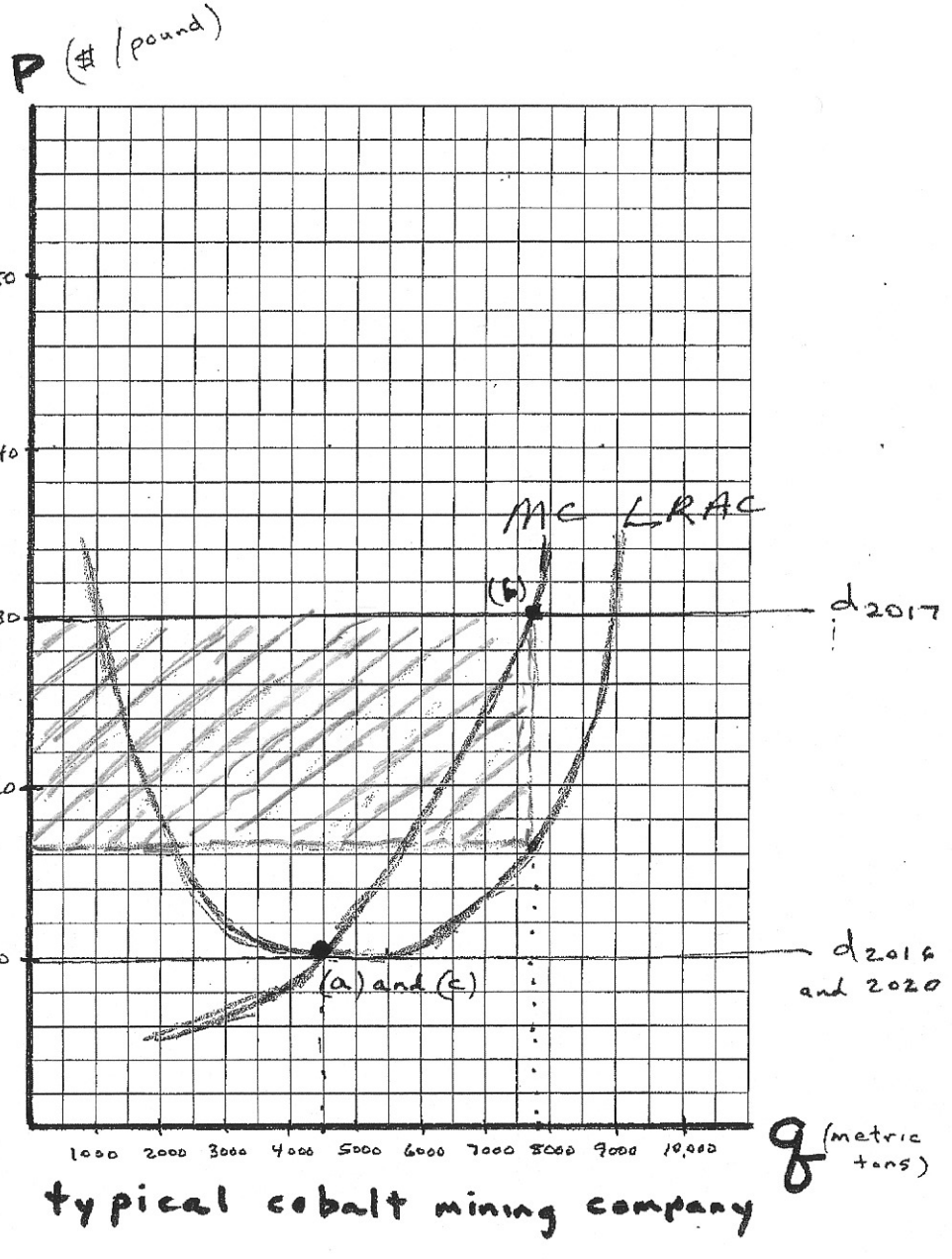
From 2007 until 2016 cobalt prices hovered between $10 and $15 per pound. Prior to 2006 they were in the same range. After a short run-up in 2006 and 2007, they returned to what appears to be the long-run norm. That would suggest that mining firms can produce cobalt for $10-$15 per pound and earn a normal return on their investment, i.e. the minimum long-run average cost of producing cobalt is in that range. The long-run equilibrium in the cobalt market in 2016 is labeled (a) in the diagrams.

   b) What does the future hold? Do you anticipate that prices will stay at $30 per pound, or do you see them returning to a lower level? If so, what level? And how long do you think the adjustment process will take? Draw diagrams for the market and for a typical cobalt mining company consistent with your explanation of 2016 prices being $10/lb, 2017 prices being $30/lb, and 20?? prices being whatever you are predicting.

There has been a surge in demand for cobalt in 2017, as the article describes. Prices have tripled from their 2016 level. At these prices, cobalt miners will earn significant economic profits, as indicated by the shaded area in the firm diagram. The 2017 short-run equilibrium is labeled (b) in the diagrams. Over time, we would expect new firms to enter the market and for existing firms to expand their capacity. The result is a shift to the right of the market supply curve. Another phenomenon that may occur is the development of alternatives to cobalt for automobile batteries. If this happens, the market demand for cobalt may shift back somewhat to the left. Both the increase in supply and decrease in demand will have the effect of lowering the price of cobalt. We predict that prices will eventually return to the $10-$15 range. (labeled (c) in the diagrams.)



World Cobalt Market



typical cobalt mining company