

PetraEnergy

PetraEnergy is an oil refiner based in Petra, Jordan. Since its establishment in 1983, the company has operated three refineries: one in Amman, one in Zarqa, and one in Irbid. Unlike other oil refiners in the Middle East, PetraEnergy does not produce petroleum products for industrial usage (e.g. plastics, rubber, fertilizer, etc.) Rather, PetraEnergy solely refines oil into gasoline and diesel grade fuel used for transportation.

Each of PetraEnergy's refineries is divided into three separate divisions, which include gasoline, diesel fuel, and a general division that supports the former two. PetraEnergy purchases raw crude oil from the Saudi government. The crude oil is pumped to the refineries and from there it undergoes atmospheric distillation and is then allocated to each of the three divisions. At the divisional level, the oil is cleaned of dry gas, and enriched with hydrogen gas (H₂), in a process known as hydrodesulfurization (HDS).

In Jordan, Egypt, Syria, and Lebanon, PetraEnergy is the established leader among refineries who supply and operate nationwide gas stations. Following the 1994 peace treaty between Jordan and Israel, the company entered the highly competitive Israeli market, which had been previously dominated by both local and Turkish oil refiners.

PetraEnergy's preeminent leadership position is based on its cost structure. Its low transportation costs, derived from its refineries' proximity to oil fields in Saudi Arabia, coupled with its relatively low labor and machinery costs in Jordan, have given PetraEnergy a clear cost advantage over its competitors.

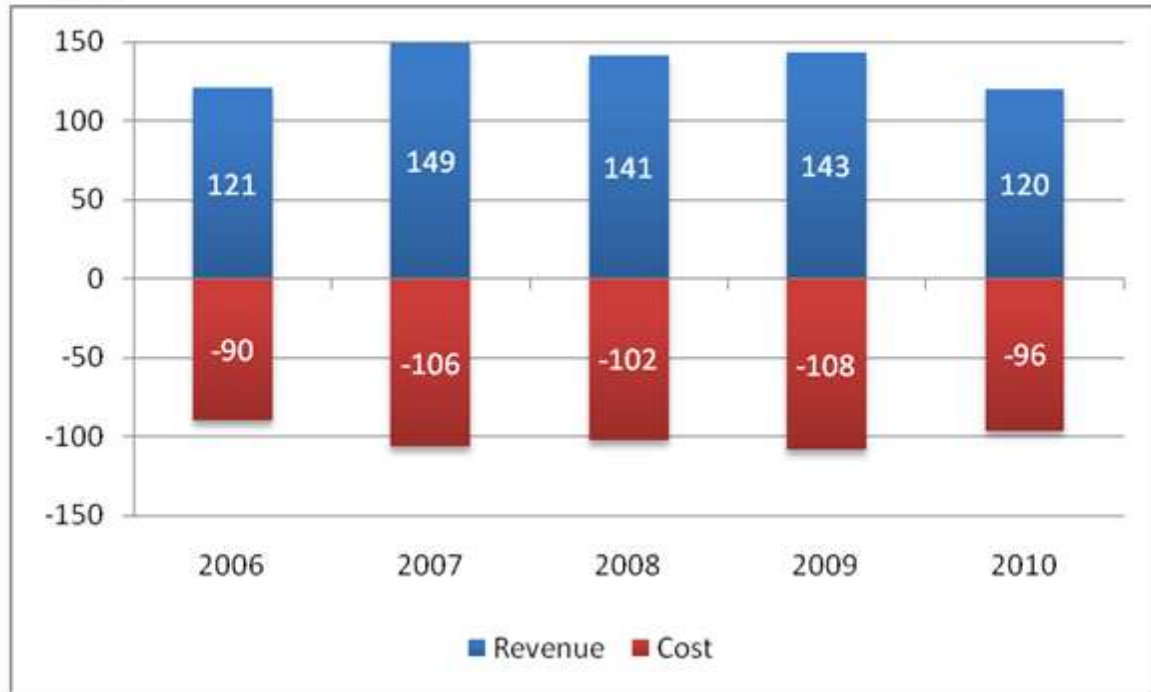
Despite its strong position in Middle Eastern markets, and because it is not an oil producer, the company has little control over oil prices, either as a buyer or as a seller. Crude oil prices are set by the Organization of the Petroleum Exporting Countries (OPEC). As a cartel, OPEC manages the supply of oil output in order to maintain high prices. Alternatively, as an independent refiner, PetraEnergy cannot control price, but rather faces fierce price competition in a market generally characterized by product homogeneity.

Until 2005, PetraEnergy was a privately held firm. Later that year, it decided to expand its operations by tapping into the capital markets and going public. Today the firm is traded on the Amman Stock Exchange (ASE) under the ticker symbol: PET.

One of the consequences of having gone public is that PetraEnergy now faces growing pressure from its shareholders to increase profits. This has led the company's executive team to seek the support of a management consulting firm. You are part of the consulting team hired by PetraEnergy to find new ways to increase the company's profits.

The following chart depicts PetraEnergy's revenues and costs over the past five years:

Chart 1:



1. Which of the following best approximates the compound annual growth rate in PetraEnergy's profit margin from the years 2006 to 2010?
 - a. -4.5%
 - b. -5%
 - c. -5.25%
 - d. -5.5%
 - e. -6%

2. Which of the following is a likely consequence of an increase in the market price of crude oil?
- I. Decrease in PetraEnergy's number of tons sold
 - II. Decrease in PetraEnergy's revenues
 - III. Increase in PetraEnergy's depreciation costs
 - IV. Decrease in PetraEnergy's operating cash flow
 - V. Increase in PetraEnergy's operating costs
- a. I, III, V
 - b. II, IV
 - c. I, III
 - d. I, V
 - e. I, II, V

The following table depicts data on the production of Atmospheric Distillation Units (ADUs) and the production of Hydrodesulfurization units (HDSUs) in each of PetraEnergy's refineries.

Table 1: PetraEnergy Inputs and Outputs

Refinery	Division	Number of employees	Number of ADUs	Number of HDSUs	Yield (tons, thousand)
Amman	General	42	84		4,200
	Gasoline	20		40	3,600
	Diesel Fuel	12		15	800
Zarqa	General	35	60		2,800
	Gasoline	15		20	2,200
	Diesel Fuel	10		12	600
Irbid	General	20	35		2,000
	Gasoline	12		16	1,800
	Diesel Fuel	8		12	200

3. Comparing the three refineries, while assuming all other things remain equal, what can be said about PetraEnergy's returns to scale (the ratio of change in a unit of output per unit of input)?
 - a. Decreasing returns to scale (DRS) for human capital in the general divisions
 - b. Constant returns to scale (CRS) for machinery in the general divisions
 - c. Decreasing returns to scale (DRS) for human capital in the diesel fuel divisions
 - d. Increasing returns to scale (IRS) for machinery in the gasoline divisions
 - e. Decreasing returns to scale (DRS) for machinery in the gasoline divisions

4. Which of the following can best explain some of the variations in efficiency across divisions and refineries?
- I. The HDSUs used by the gasoline division in Amman are of a better quality than those in Zarqa and Irbid
 - II. The gasoline staff in Amman is better trained to run HDSUs than are their counterparts in Zarqa and Irbid
 - III. The company failed to recruit experienced staff for the diesel fuel divisions in Zarqa and Irbid
 - IV. Twenty-five Zarqa employees were laid off in 2009
 - V. The same machinery for all of the diesel fuel divisions was bought at the same time
- a. I, II
 - b. II, V
 - c. II, III
 - d. II, III, V
 - e. I, II, III
5. Ibrahim Abdullah, the VP of operations at PetraEnergy, has laid out five scenarios that he fears might pose a threat to PetraEnergy's business. Which of the following proposed scenarios is a valid reason for PetraEnergy to be concerned?
- a. OPEC increases the supply of oil resulting in a lower price per barrel
 - b. Social turmoil in Egypt might result in the nationalization of "strategic assets" such as oil
 - c. An economic downturn might increase consumers' price elasticity of demand for oil
 - d. Military operations in Libya might slow production in the country's sweet oil fields known for its high-energy efficiency
 - e. A decline in disposable income for Arab countries might result in a fall in demand for oil

The following chart shows PetraEnergy's average purchase price of crude oil, average selling price of refined oil, and sales volume (indicated by the circles' radius length) for the years 2005-2010.

Chart 2:



6. Assuming all other exogenous variables remain constant, which of the following is FALSE:
- a. Sales volume reached its peak in 2006
 - b. Profit margin reached its peak in 2007
 - c. Sales volume reached its low in 2008
 - d. Profit margin reached its low in 2009
 - e. Profit margin reached its low in 2010

7. The Jordanian minister of transportation is considering a reform in the transportation industry. Which of the following steps is LEAST likely to have a negative effect on PetraEnergy's profitability?
- Increase the subsidy on trains
 - Raise the fees on toll roads across Jordan
 - Impose a significant congestion charge on car drivers during rush hours in Amman
 - Raise the excise tax on oil and diesel
 - Exempt new coach bus operators from corporate taxes for the next five years

You are given the following information. Let:

(R) be PetraEnergy's gross revenues in 2010

(V) be the Value Added Tax (VAT) rate in Jordan

(T) be the corporate tax rate for infrastructure companies in Jordan

(E) be PetraEnergy's costs, other than taxes, in 2010

(S) be Jordan's share of the company's total sales volume in 2010

8. Which of the following represents the company's profit margin in 2010?
- $(R-E) \times (1-V-T)$
 - $(R-ERV)/(1-V-T)$
 - $1 - [(E+SV-T)/R^2]$
 - $(R-SRV-E) \times (1-T)/R$
 - $(R-V+SV) \times (1-E-T)/R$

The following table depicts PetraEnergy's current sales volume, profit margins and compound annual growth rate (CAGR) for the countries in which it operates:

Table 2: PetraEnergy Sales Volume, Profit Margin and Market Share by Country

Country	Sales Volume	Profit Margin	Market Share
Lebanon	8%	12.9%	17%
Syria	17%	15.4%	8%
Israel	7%	16.7%	2%
Egypt	45%	14.5%	6%
Jordan	23%	12%	42%

The Jordanian government recently initiated an incentive plan for international corporations with the following terms: a company that generates over 40% of its revenues in Jordan will be exempted from the 16% VAT for those revenues generated in Jordan. Moreover, a company that generates over 50% of its revenues in Jordan will also receive a 2% corporate tax reduction on profits generated abroad.

9. Assuming that PetraEnergy optimizes its allocation of oil between these markets, in order to take advantage of the benefits outlined in this incentive plan, which of the following best approximates its market share in the Egyptian market for next year?
- a. 0%
 - b. 1.5%
 - c. 2.5%
 - d. 3.5%
 - e. 5%

PetraEnergy - ANSWERS

1. E is correct.

In 2006, PetraEnergy's profit margin was slightly over 25.5% $[(121-90)/121]$; in 2010 it was 20% $[(120-96)/120]$. This means that the growth rate went down by slightly more than 22% $[(+25.5\%-20\%)/25.5\%]$, which is slightly more than an average decline of 5.5% per year, over 4 years. However, since we are talking about compound annual growth rate (CAGR), this means that each year, the profit margin by which we multiply gets slightly smaller year after year. Therefore the 5.5% growth rate calculation, as a fixed rate, needs to be compensated by a slightly lower growth rate, which in this case is 6% (a negative number).

2. D is correct.

An increase in the market price of crude oil is likely to be followed by a price increase in refined oil products. PetraEnergy will pass on this price increase to the consumer, a step that will likely yield a decrease in the number of tons sold (I) - (as those who studied micro-economics will recall, the demand curve in most cases, and certainly for oil products, slopes downwards from left to right). With a higher price and a lower quantity sold (exact numbers not specified), it is unclear what will happen to revenues (II) and consequently the cash flow (III). Revenues are a function of price and quantity; the former increased, while the latter decreased, but by how much is unknown. The revenues can therefore increase, decrease, or maintain the same level. Depreciation costs (IV) have to do with inputs (means of production) rather than with outputs (products), and thus are not likely to be affected by the price increase. Finally, an increase in transportation costs for the delivery of fuel to gas stations will likely rise with the increase in crude oil prices. This will impact PetraEnergy's operating costs (V), which are therefore likely to increase.

3. E is correct.

There are no shortcuts here: we need to solve for each option.

- a. Human capital in the general divisions: 100 ($=2,000/20$) in Irbid; 80 in Zarqa; 100 in Amman >>> inconsistent returns to scale (it goes down when we scale up from Irbid to Zarqa, but then goes up again when we scale up from Zarqa to Amman).
- b. Machinery in the general divisions: more than 50 ($=2,000/35$) in Irbid; less than 50 ($=2,800/60$) in Zarqa; 50 ($=4,200/84$) in Amman. Therefore, inconsistent returns to scale.
- c. Human Capital in the diesel fuel divisions: 25 ($=200/8$) in Irbid; 60 ($=600/10$) in Zarqa; 66.66 ($=800/12$) in Amman. Therefore, increasing not decreasing returns to scale.
- d. Machinery in the gasoline divisions: Irbid $1,800/16 = 112.5$; Zarqa $2,200/20 = 110$; Amman $3,600/40 = 90$. Or to make things easier on us, we can use the same denominator: $2,250/20$ in Irbid; $2,200/20$ in Zarqa; $1,800/20$ in Amman. Therefore decreasing returns to scale.
- e. Irbid $1,800/16 = 112.5$; Zarqa $2,200/20 = 110$; Amman $3,600/40 = 90$. Therefore, decreasing returns to scale for machinery in the gasoline divisions.

4. C is correct.

If (I) were true, we would expect the HDSUs in Amman to yield more oil per unit than what is yielded elsewhere, which is not the case here (they actually yield less than Irbid). FALSE.

If (II) were true, we would expect the gasoline staff in Amman to yield more oil per person than what is yielded elsewhere, which is the case here. TRUE.

If (III) were true, we would expect the diesel fuel staff in Amman to yield more oil per person than what is yielded elsewhere, which is the case here. TRUE.

If (IV) were true, we would not know what to expect (we don't know what impact this layoff had, and we don't know what to compare it to). FALSE.

If (V) were true, it would not help to explain the variation but rather could be used to rule out other possible explanations. FALSE.

5. E is correct.

(A) is incorrect: Lowering the price of oil should not concern PetraEnergy for two reasons. As a refiner, they are not a price setter and therefore cannot control either supply or price. Secondly, a decrease in the price of oil will likely increase consumer demand for their product, thereby positively impacting the refining business by providing increased sales.

(B) is incorrect: we have no solid base to believe that the nationalization of foreign held oil refineries will make them more or less competitive with PetraEnergy.

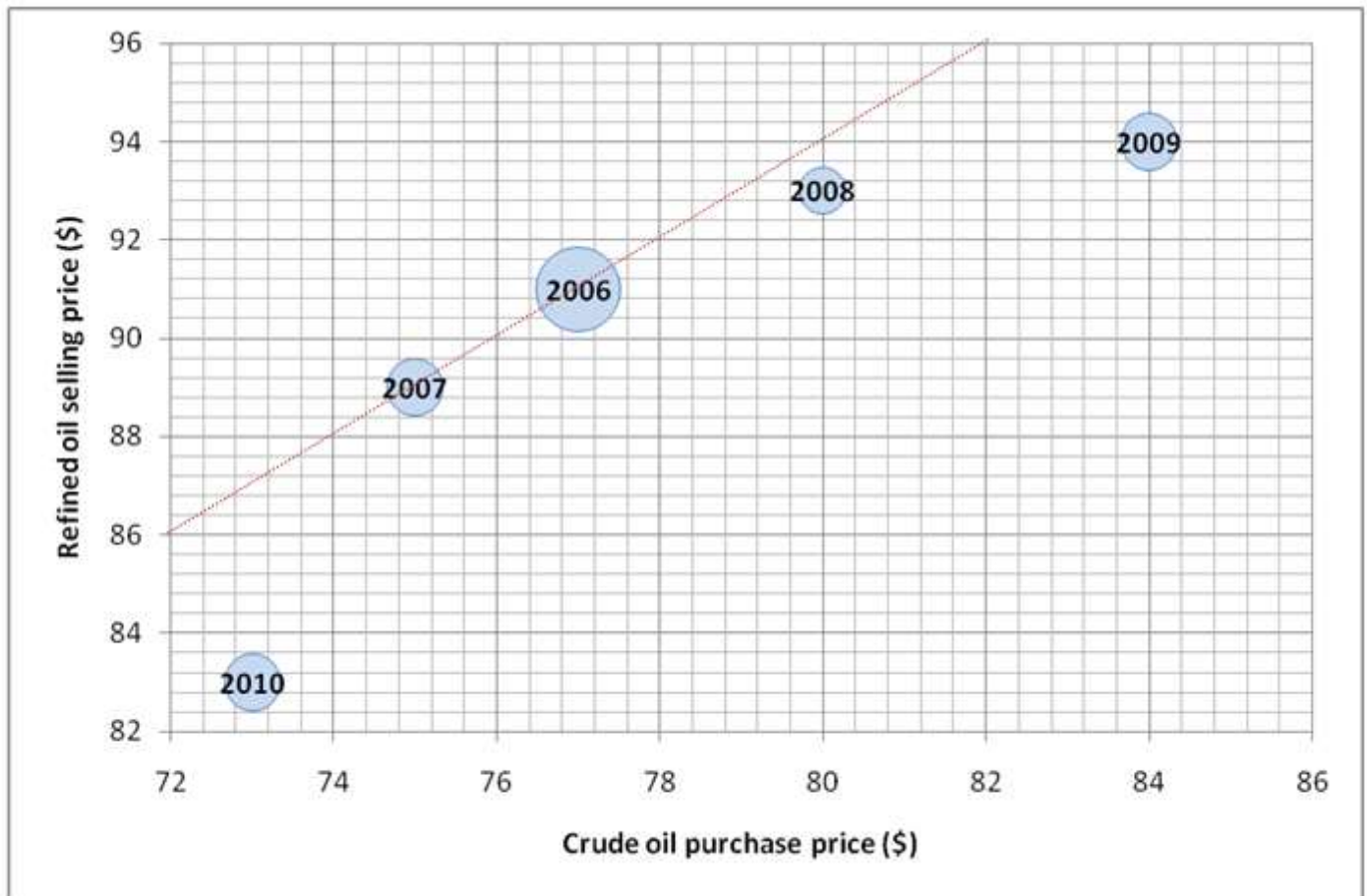
(C) is incorrect: there is no clear cause and effect for why an uprising should result in any change in the elasticity of demand for oil, since we do not know of any change in the prices of substitute products and/or complementary products.

(D) is incorrect: a slowdown in the production of a superior substitute product (eg a product that provides a competitive advantage to others "sweet oil") is likely to make competition easier on businesses in the "regular oil" industry, which PetraEnergy is a part-of.

(E) is correct: political instability often can result in an economic downturn and consequently a decline in the disposable income of people in the region. When people have less money in their hands, their consumption of any "normal product" (that is, a product that people buy more of when their incomes rise), including oil, is likely to go down.

6. E is correct.

Since the Y-axis indicates the selling price and the X-axis indicates the purchase price, the marginal profit is the difference between the Y-value and X-value of each Harvey ball. Thus, the closer a Harvey ball is to the top left hand corner of the graph (example coordinates: \$96, \$72; or marginal profit of \$24), the greater the marginal profit is. In a similar fashion, we can draw a diagonal line that indicates an average marginal profit of \$14 per barrel, to differentiate the marginal profit of one Harvey ball from that of another. Any circle below this line indicates an average marginal profit of less than \$14. This means that the marginal profit in 2006 and 2007 were greater than any other year. Since 2006 enjoyed a far greater sales volume than any other year, (A) is true. Since 2007 also saw the highest marginal profit but a lower volume (or denominator in the profit margin quotient), (B) is true. From the diagram one can clearly see that the 2008 circle is the smallest (the only circle that cannot contain the four digits for the year), and this indicates that (C) is also true. 2009 and 2010 saw the lowest profits per barrel (\$10) and shared the same sales volume (size of the ball). However, 2009 saw higher price per barrel and thus had a lower profit margin (e.g. the margin, a \$10 profit on a sales price base of \$94 is less than a that of \$10 profit on a sales price base of \$83), therefore E is correct.



7. **B** is correct.

Lowering the cost of public transportation - either directly through increasing a subsidy on trains (A) or indirectly through exempting coach bus operators from taxes (E) - means bad news for an oil refiner. In the case of the former, trains consume less oil and are a substitute product for personal automobiles; hence consumers will use less oil. In the case of the latter, a tax break for bus companies will lower their cost and encourage consumers to take their services – again an overall reduction in total oil consumed. In a similar manner, imposing a significant congestion charge on car drivers during rush hour (C) and raising the excise taxes on oil and diesel (D) makes driving in private cars much less appealing, much more expensive, with fewer, cheaper driving specific alternatives. All four of the aforementioned options reduce a consumers overall consumption. While an increase in tolls (B) might change the route drivers choose to take, they do not necessarily change the decision to use a car or for that matter reduce overall fuel consumption. While toll roads may increase a driver's transportation cost, they often offer more direct routes to and from locations and thus promote driving a car. If a driver doesn't want to pay for the toll, they may simply take an alternative (longer) route that actually consumes more fuel. Either way, toll roads are unlikely to reduce overall fuel consumption.

8. **D** is correct.

If we deduct from the revenues (R) the costs (E) and VAT on transactions in Jordan (SRV) [because VAT is imposed on inland transactions only], we are left with the company's earnings before taxes. If we deduct the corporate tax from earnings before taxes, we get: $(R - E - SRV) * (1 - T)$, yielding profit. Dividing the profits by the revenues (R) will yield the profit margin.

9. **A** is correct.

Crossing the 40% bar will increase PetraEnergy's profit margin in the country to 33.3% [let "X" be PetraEnergy's costs in Jordan; after deducting 16% off VAT charges to sales in Jordan, the new profit margin will be $(1.12X - 0.84X) / 0.84X$], which is the highest profit margin out of the five countries listed (Lebanon 12.9%, Syria 15.4%, Israel 16.7%...etc.) Because Jordan has the highest profit margin it pays for PetraEnergy to reallocate its oil refining from any of those countries to Jordan.

Lebanon has the lowest profit margin (12.9%). It therefore pays to start by reallocating all the oil from the Lebanese market to the Jordanian market first. However, this will only take the Jordanian sales volume to 31% ($= 23\% + 8\%$). Hence, in order to achieve the 40% sales volume mark that would entitle PetraEnergy to receive a 16% VAT reduction, the company will need to reallocate 9% more of its total sales volume from the next least profitable country – Egypt (14.5% profit margin).

PetraEnergy has a second decision to make, which consists of determining whether it benefits the firm to seek the 50% internal Jordanian production bar that would entitle the firm to 2% tax reduction on all revenues generated abroad. If it reallocates an additional 10% more of the total sales volume from Egypt to Jordan, it would lose the product of 10% of its volume at a 14.5% profit margin and will gain the product of 10% sales at a 33% profit margin plus an additional 2% reduction in tax on 50% of its profits. This corresponds to the following inequality:

$$14.5\% \times 10\% <?> 33.3\% \times 10\% + 2\% \times (17\% \times 15.4\% + 7\% \times 16.7\% + 26\% \times 14.5\%)$$

$$1.45\% <?> 2\% \times (17\% \times 15.4\% + 7\% \times 16.7\% + 26\% \times 14.5\% + 5 \times 33.3\%)$$

$$1.45\% <?> 2\% \times (\sim 3\% + \sim 4\% + \sim 3\% + 167\%)$$

$$1.45\% <?> 2\% \times \sim 177\%$$

$$1.45\% < 3.5\%$$

This means that it's best for the company to direct oil from Egypt to Jordan. For Egypt, this is equivalent to over 40% ($= 19\% / 45\%$) of sales volume, which corresponds to a decrease in Egypt's market share from 6% to $\sim 3.5\%$.