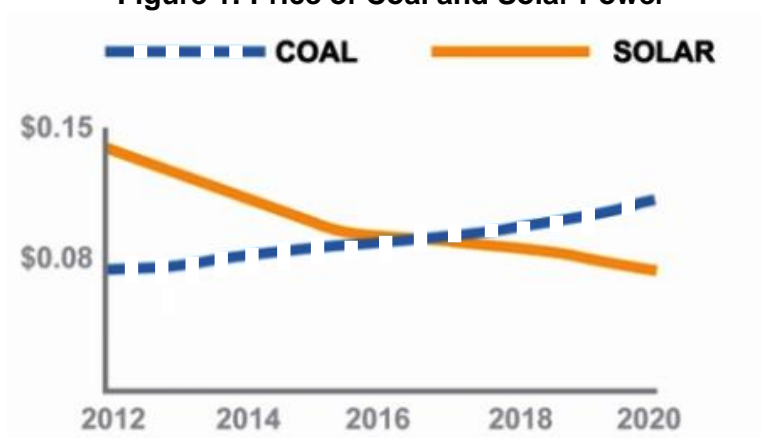


Section A

Answer **all** questions in this section.

Question 1 The Growth of the Solar Panel Industry

Figure 1: Price of Coal and Solar Power



*prices from 2016 onwards are projected.

Source: www.universalspowerandlight.com.au, 20 August 2014

Extract 1 How much do solar panels really cost?

Between 2009 and 2011, the price of solar panels decreased from A\$2.79 to A\$1.59 per watt. Chinese companies have argued that technical improvements are responsible for these dramatic price reductions. However, not everyone agrees. A MIT report suggested that “this price decline is from an overexpansion in global, primarily Chinese and Asian, production capacity of cells and modules, combined with a reduction in the appeal of solar panels in Europe caused by the financial crisis.”

One reason for the overexpansion by the Chinese producers is due to the financial subsidies the Chinese government has provided for domestic solar manufacturers. For example, Yingli Solar, a solar manufacturer, had secured a US\$5.3 billion loan from the China Development Bank. Such subsidies have caused a supply glut in the solar manufacturing sector and if this continues, it could help double the world’s solar manufacturing supply of solar panels.

Between 2009 and 2011, Chinese manufacturers quadrupled production of solar panels and exported them at prices sufficiently low to expand China’s market share in the solar sector dramatically. The U.S. Department of Commerce concluded that China has been illegally pricing solar exports below production costs to undercut foreign competitors and gain market share.

Source: Forbes, 24 June 2015

Extract 2 Why China is leading the world in solar power

China is the world's top energy consumer, with the vast majority of its electricity coming from domestically-mined coal. But the Asian nation is cutting its dependence on coal, oil and natural gas and replacing it with solar at a breakneck pace. Between January and the end of June, China added 3.3 gigawatts (GW) of solar capacity, double the additions over the same period last year. That brings China's total solar power supply up to 23 GW, second only to Germany's 36 GW.

The main reason, of course, is environmental. Choking clouds of pollution from vehicles and fossil-fueled power plants are the norm for residents of many Chinese cities, and the situation is only getting worse. Earlier this month, the Chinese government announced that it would ban the use of coal in Beijing by the end of 2020 although coal power use outside the capital is expected to continue.

While Germany and the rest of Europe have scaled back government incentives to install solar, in China, increased targets for solar power generation have been backed by subsidies to boost the use of solar power. There is no doubt that China's push to increase solar power is being driven by an acute and pressing national problem – air pollution. Solar offers a way out of the competing pressures China is under to fuel economic growth and also arrest deteriorating air quality. As long as China's solar competitors do not receive the same incentive, they will likely continue to lag behind China in new solar power additions. For that reason, the solar growth story is likely to be centred in China, at least for the foreseeable future.

Source: oilprice.com, 22 August 2014

Extract 3 The dirty side of a “green” industry

As people worldwide increasingly feel the heat of climate change, many are applauding the skyrocketing growth of China's fledgling solar-cell industry. However, it has been revealed that China's booming solar industry is not as green as one might expect. Many of the solar panels that now adorn European and American rooftops have left behind a legacy of toxic pollution in Chinese villages and farmlands. Some investigations have revealed how Luoyang Zhonggui, a major Chinese manufacturer of polysilicon, which is an important resource for the manufacture of solar panels, is dumping toxic factory waste directly onto the lands of neighboring villages, killing crops and poisoning residents. Firms like Luoyang Zhonggui, are cutting costs and corners by avoiding significant extra investment in pollution control. Other polysilicon factories in the country cause similar problems because they have not installed effective pollution control equipment.

Sometimes the environmental costs of solar panel production can be lost among the drive to encourage the development of clean energy. Although China will eventually benefit from this green technology as costs decline further, for the time being, the industry continues to tread the traditional path of “pollute first, clean up afterwards.”

In China, there are a lot of solar panel makers, and it is something that has been encouraged by the government but there is a need now to regulate it by imposing a tax on carbon emissions involved in the manufacturing of solar panels to help encourage more sustainable production with potentially cleaner technologies. Improved waste treatment and environmental monitoring are essential to avoid the undesirable impact of these otherwise valuable technological advances.

Source: Worldwatch Institute, 2 June 2015

Extract 4 US-China solar products dispute heats up

Solar-energy products became a flashpoint in trade relations between China, the U.S. and the European Union as the global financial crisis slowed the implementation of big solar-energy projects just as production capacity for solar panels was growing sharply. In the latest move, the U.S. Department of Commerce said on Tuesday that it would seek to impose anti-subsidy tariffs ranging from nearly 19% to 35% on Chinese solar panels, even if the panels contained solar cells made outside of China. Solar panels are made from solar cells.

Although U.S. solar-equipment manufacturers have been hit by imports of cheap solar panels from China, falling prices have created a booming business for U.S. solar installers such as SolarCity Corp. The U.S.-based Coalition for Affordable Solar Energy described the latest decision on tariffs as a major setback for the U.S. solar industry that would raise the cost of solar power and cost jobs in “one of fastest-growing sectors of the U.S. economy.” However, the ruling may not hurt Chinese solar manufacturers that much. They are already pivoting away from the U.S., where demand is slowing, to feed a growing appetite for solar panels back home.

The U.S., China and the EU have been battling over the solar industry for several years. In 2012, the U.S. initially imposed tariffs on Chinese products containing Chinese solar cells after it determined that Chinese solar makers got illegal subsidies and sold the products in the U.S. at prices below cost. China retaliated a year later by announcing its own tariffs on raw materials from the U.S. and South Korea that are used to make solar panels.

Source: The Wall Street Journal, 4 June 2014

Questions

- (a) (i) Using Figure 1, compare the trends of coal prices with that of solar energy prices between 2012 and 2020. [3]

- (ii) Extract 1 mentions that the price of solar panels decreased between 2009 and 2011. With the help of a diagram, use supply and demand analysis to explain why this is so. [5]

- (b) Extracts 1 and 4 suggest that the Chinese government have been giving financial subsidies to Chinese solar manufacturers.

Explain how the concept of price elasticity of demand can determine the likely impact of such a move on total revenue earned by Chinese solar manufacturers. [4]

- (c) (i) Explain how market failure can arise in the production of solar panels. [4]

- (ii) Extract 3 highlights the use of imposing a tax on carbon emissions involved in the manufacturing of solar panels. Discuss the effectiveness of this in encouraging a more sustainable level of production. [6]

- (d) Discuss the extent to which the “anti-subsidy tariff” imposed by the US on Chinese solar panels is justified in terms of economic theory. [8]

[Total: 30 marks]

Suggested Answers for Year 5/6 H1

- (a) (i) **Using Figure 1, compare the trends of coal prices with that of solar energy prices between 2012 and 2020. [3]**

Coal price has increased throughout the period while solar energy price has generally decreased over the same period. [1]

Before 2016, solar energy prices were generally higher than coal prices. [1]

From 2016 onwards, solar power prices are projected to be lower than coal prices. [1]

- (ii) **Extract 1 mentions that the price of solar panels decreased between 2009 and 2011. With the help of a diagram, use supply and demand analysis to explain why this is so. [5]**

In extract 1, it was mentioned that there had been technological improvements in the solar panel industry. With that, costs of production of solar panels will decrease as producers of solar panels will find it relatively cheaper than before to produce the same amount of solar panels. As a result, supply of solar panels increase. [1.5]

On the other hand, the financial crisis in Europe is likely to imply a fall in the demand for energy to produce goods and services. Since the demand for solar panels is derived from the demand for energy to produce final goods and services, this is likely to translate to a fall in demand for solar panels. [1.5]

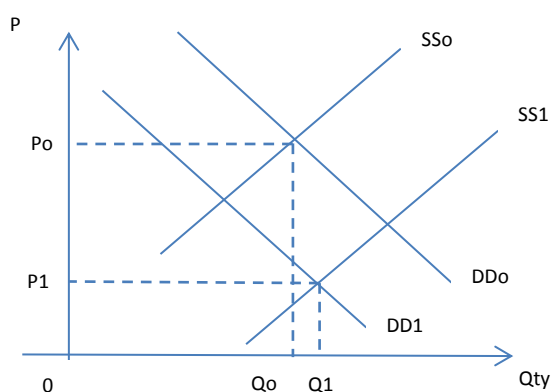


Figure 1: Market for Solar Panels [1]

Referring to Figure 1, the original equilibrium price was at Po and Qo. A fall in demand causes DD0 to shift left to DD1, whereas a rise in supply causes SSo to shift right to SS1. As a result, prices will fall from Po to P1 but the impact on quantity might be indeterminate, depending on the extent of the shifts of demand and supply. It is likely that increase in supply is greater than the fall in demand as evident from the global glut of solar panels. In this case, the quantity of solar panels will likely increase. [1]

- (b) **Extracts 1 and 4 suggest that the Chinese government have been giving financial subsidies to Chinese solar manufacturers.**

Explain how the concept of price elasticity of demand can determine the likely impact on total revenue earned by Chinese solar manufacturers as a result of such a move.

[4]

Price elasticity of demand (PED) measures the degree of responsiveness of the quantity demanded of a good given a change in its price, *ceteris paribus*.

Subsidies given by the Chinese government will lower the cost of production to the solar panel manufacturers and therefore increase the supply of solar panels. This will result in a fall in the price of solar panels. [1]

It is likely that the PED of the Chinese solar panels is more than 1 [1] due to the availability of many other close substitutes such as solar panels from the US and EU. [1]

Since $PED > 1$, the fall in price will lead to a more than proportionate increase in quantity demanded of solar panels in China as many consumers will likely switch to buy Chinese solar panels now. This will cause an increase in the total revenue earned by Chinese solar manufacturers. [1]

- ci)

Explain how market failure can arise in the production of solar panels.

[4]

In Extract 3, it was mentioned that the manufacture of polysilicon, which is an important resource for the production of solar panels, is causing adverse environmental concerns for the country. There exist negative externalities.

Negative externalities are harmful side effects of production or consumption on persons other than the consumers and the producers themselves. The third parties are not compensated for the external costs.

In the production process of solar panels, the Chinese manufacturers would be facing the marginal private cost such as the amount needed to acquire the raw materials and the salaries needed to pay the workers etc. At the same time, the act of dumping toxic factory waste into the lands of neighbouring villages, destroying crops and poisoning residents. These residents are the third parties who have to incur unnecessary medical bills when they seek medication after drinking the contaminated water or breathing the polluted air, incurring these external costs which are not compensated for. [2]

Since there are negative externalities, MEC is more than 0. This will then create a divergence between MPC and MSC. Specifically, $MSC = MPC + MEC$

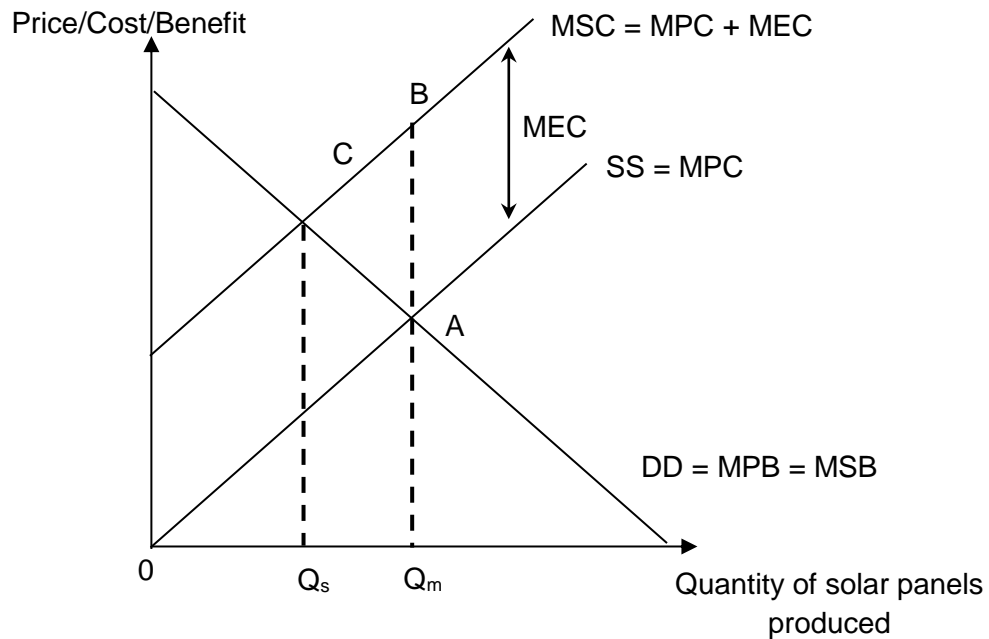


Figure 2: Overproduction of solar panels due to negative externalities

Referring to Figure 2, assuming there is no positive externalities, $MSB = MPB$. The market output is at Q_m where $MPC = MPB$ as individuals only consider their private costs and benefits. On the other hand, the socially optimal output is at Q_s where $MSC = MSB$. At this point, society's welfare is maximised. Since Q_m exceeds Q_s , there is an overproduction of solar panels resulting in deadweight loss of area ABC. i.e market failure exists [2]

(2m for explanation of MEC and third parties of the context, with reference to the extract. AND 2m for explanation of how negative externalities can cause the market to fail, with diagram.)

(cii)

Extract 3 highlights the use of imposing a tax on carbon emissions involved in the manufacturing of solar panels.

Discuss the effectiveness of this in bringing about a more sustainable production.

[6]

Thesis: Imposition of a tax leads to a more sustainable level of production. Why? How so?

From Extract 3, it can be seen that China is aiming for sustainable production of solar panels, i.e. a level of production which can be maintained in the long run, without the undesirable effects on the environment, and with the use of cleaner technologies. The Chinese government is looking to reduce the negative externalities from the over-production of solar panels.

Referring to Figure 2, the tax will increase the MPC of production faced by the

solar panel manufacturers. Ideally, the tax imposed should be equal to the amount of marginal external costs inflicted on third parties. In this way, the producers will be made to internalize the MEC of producing the solar panels. As MPC coincides with MSC after the tax, Q_m moves closer to Q_s , eliminating the deadweight loss as the optimal level of production is achieved.

In addition, taxes is actually a short term measure and if the manufacturers of solar panels find that paying for the tax is not cost effective over the long term, they might hopefully be motivated and spurred on to embark on research and development, to come up with cleaner and sustainable methods to produce the solar panels. If so, the production of solar panels can be more sustainable in the long run.

Anti-thesis: No, tax may not bring about a more sustainable level of production. Why not?

However, it is difficult to estimate accurately the size of MEC in reality. If the tax is too high, it might deter potential solar panel firms from setting up in China and this will cause under-production which might result in a bigger deadweight loss to the country but if it's too little, the problem of over-production persists. i.e. not easy to set a level of tax which will be just right in pushing the solar panel makers to start research and development using cleaner technologies.

Also, the extent of the success of the tax to bring about a sustainable production of solar panels also depends on the current level of technology used in production; it may not be easy for solar panel manufacturers to make a very big change to the current way of manufacturing, especially if some types of production are inherently "dirty" or if it requires complete overhaul of current methods.

Synthesis

Whether the tax will effectively prompt more producers to manufacture solar panels depends on the likely outcome of the research and development as the result of research and development is usually unpredictable. This deters existing solar panel firms from wanting to invest in new technologies of production and compounded with the high costs, few firms will be willing to embark on the more sustainable methods of producing solar panels.

Looking ahead, they may need to weigh the costs and benefits between paying the tax against spending on research to change to cleaner production methods before deciding what to do.

LORMS		
L3	Developed discussion on the effectiveness of the imposition of the tax on manufacturers of solar panels AND a discussion of the sustainable methods of producing solar panels in the long run. Developed discussion:	5-6m

	<ul style="list-style-type: none"> - constitutes a clear explanation of how the tax on carbon emissions works to eliminate the MEC with reference to the diagram. Also needs to include a well- reasoned limitation to prove that the tax initiative might not be effective to curb carbon emission. - Need to include a clear explanation of how tax can encourage solar panel producers to produce solar panels with sustainable methods. Also should include a limitation about the long term measure. 	
L2	<p>Undeveloped discussion on whether the tax is effective to reduce over-production and lacks consideration of a long term sustainable method.</p> <p>Undeveloped discussion:</p> <ul style="list-style-type: none"> - attempts to explain how the tax works but with little reference to the economic framework or diagram - Limitations are not provided - Lack of clear explanation of how taxes can motivate solar panel producers to embark on long term sustainable production + no reference made to diagram drawn earlier in part ci. 	3-4m
L1	Smattering of valid points	1-2m

(d) **Discuss the extent to which the “anti-subsidy tariff” imposed by the US on Chinese solar panels is justified in terms of economic theory. [8]**

The theory of comparative advantage states that the country with the lower opportunity costs in the production of a good should specialize and export that good while importing those which they incur higher opportunity costs in production. The anti-subsidy tariff would have been justified if USA truly has comparative advantage in producing solar panels but had not been able to export and sell as much solar panels as she could have, due to unfair dumping practices by the Chinese firms.

Thesis: The “anti-subsidy tariffs” imposed by the US on Chinese solar panels is justified based on the comparative advantage theory.

Suppose US solar panel manufacturers do have comparative advantage in making solar panels, but are unable to compete because the Chinese solar panels manufacturers indeed received financial subsidies from the Chinese government that allowed them to sell solar panels at a price below their marginal cost, it would be justifiable for the US to impose such a tariff. From extracts 1 and 3, it seems that Chinese government did give a substantial amount of subsidies to their solar panel makers.

Hence, this tariff will raise the price of the Chinese solar panels and will thus make it fairer for US solar panels to compete with China solar panels. With imported Chinese solar panels now becoming more expensive and comparable to US panels in terms of price, domestic US firms that used to purchase solar panels from China will likely purchase those made in the US.

In Extract 3, it added that the Chinese producers of the solar panels are also cutting corners and not doing enough to ensure that they are producing the solar panels in a responsible and efficient manner, which are resulting in pollution. The fact that China has to cut corners might imply that they are unlikely to truly have comparative advantage in the production of solar panels, if so, then USA is justified to impose protectionist measures against China.

Anti-Thesis: The “anti-subsidy tariffs” imposed by the US on Chinese solar panels is not justified.

One reason why the US shouldn't impose such a tariff is because doing so might possibly lead to certain negative impacts on other industries in the economy. For example, extract 4 mentions how US solar installers have benefitted from cheaper imported solar panels from China all this while hence it can be inferred that the tariff might therefore cause solar panel installers to experience a higher cost of production as they procure solar panels which are relatively more expensive than before, affecting their profit margins and possibly sales volume as consumers are deterred by the overall higher costs of installing solar panels at their homes. This would be a blow to “one of the fastest-growing sectors of the US economy”, as highlighted in Extract 4

At the same time, while jobs might be saved in the US's solar panel industry, the higher prices of solar panels might cause the costs of production of other industries which make use of solar panels for generation of power to increase. This would then ultimately result in an increase in the prices of these finished goods, which would cause US consumers to be paying higher prices for goods and services in general.

Another reason why the US shouldn't impose such a tariff on China is because such a move could spark off retaliation from China. For example, China might also impose tariffs on raw materials or goods imported from the US. This would reduce the quantity demanded of US's goods in China and affect the revenue of US producers. If this really happens, the world output will decrease and it will be detrimental for both economies.

Synthesis

Ultimately, it might be justified to some extent that the anti-subsidy tariff is imposed, because evidence from the extracts seem to point that China's solar panel manufacturers have no comparative advantage in the production of solar panels. It would have been justified to a greater extent if US have had comparative advantage in production of solar panels but are unable to realise their potential or gain sufficient market share due to the unfair advantages that the Chinese producers have. However, the tariff also resulted in adverse effects on the economy, which may make it seem less justified to impose the tariff.

On deciding whether the move is justified, it is also important to take into account the consequences and implications on other industries in the country and the government would have to make a decision based on weighing which industry might be more important to the overall economy of the US. .i.e. more important to protect jobs of which industry. They also have to decide when to lift the protection as well since this initiative

might have perpetuated inefficiencies among the domestic solar panel producers, causing them to be unable to compete effectively when protection is removed. This is therefore not sustainable.

Moreover, the use of the tariff by the US is to threaten China to put a halt to its dumping practice. However, such a move will not inflict much damage on Chinese solar panel manufacturers. This is because they have started to tap on the growing domestic demand instead. Therefore it may not be wise for the US to be imposing the tariff on China.

LORMS		
L3	<p>Developed discussion on why the US should and should not impose the tariff on China based on the theory of comparative advantage.</p> <p>Developed discussion:</p> <ul style="list-style-type: none"> - A clear and explicit link to theory of comparative advantage and provides a substantial connection to why it might be justified to protect US solar panel makers. - Well-reasoned arguments on why the US should not impose the tariff with clear analysis on the negative impacts on other sectors of the economy. 	5-6m
L2	<p>Undeveloped discussion on why the US should <u>and</u> should not impose the tariff on China</p> <p>OR</p> <p>Developed explanation on why the US should <u>or</u> should not impose the tariff on China but with little link to the theory of comparative advantage</p> <p>Undeveloped discussion:</p> <ul style="list-style-type: none"> - Explanations of comparative advantage and protectionism are not connected and synthesized properly for a coherent response. 	3-4m
L1	Smattering of valid points	1-2m

Evaluation		
E2	For a developed evaluative answer.	2m
E1	Unsubstantiated evaluative comment	1m

