1 Market failure and natural resource depletion

1.1 The ideal market

(...)

1.2 Well-defined property rights

(...)

1.3 Price formation in an ideal market

1.3.1 A simple example

Let's illustrate how prices are formed on a market with a simple example. Consider Antonio Stradivari, the legendary Italian violin maker whose violins are still, after hundreds of years, considered the finest violins ever made. One day six musicians show up at his workshop in the Italian town of Cremona:

- Antonio, who is willing to pay a maximum of 1200 Florins for a violin;
- Beata, who is willing to pay 1000 Florins;
- Cecilia, who is willing to pay 800 Florins;
- Donatello, who is willing to pay 600 Florins;
- Enzo, who is willing to pay 400 Florins;
- Francesca, who is willing to pay 200 Florins.

Note that these prices are the maximum that each musician is willing to pay. If, say, the price of a violin is 1100 Florins, then Antonio is willing to buy a violin, but all the others would think the price is too high. Antonio would be happy with his new violin, because he has just bought it at a price 100 Florins lower than what he would have been willing to pay at maximum.

Why is not everybody willing to pay the same amount? Perhaps Antonio is really Antonio Vivaldi. A high-quality violin can earn him a lot of money through concerts all over Europe. On the other hand, Francesca may be a local folk fiddler who would have been content with any fiddle to play her *tarantellas* at weddings and other parties. Cecilia and Donatello might be somewhere in between: violinists in a regional orchestra who can make a decent living of the violin, but no famous virtuosos or composers as Vivaldi. Figure 1 shows each musician's maximum willingness to pay for a violin.

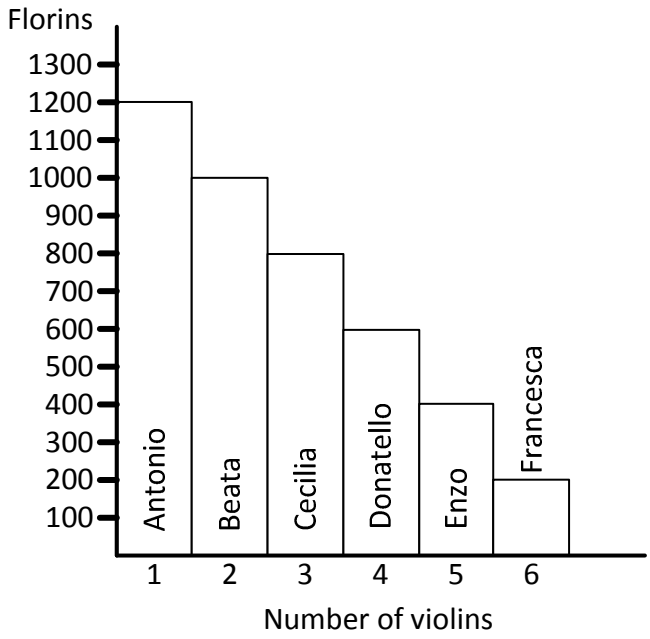

Figure 1: Potential buyers of one of Stradivari's violins, ranked by what they are willing to pay

Legend has it that Stradivari was very skilled at selecting the right trees for his violins: only the finest wood would be good enough. So he looks out of his window towards the forest and estimates:

- Making one violin will cost me about 300 Florins, including time spent on looking for the right wood, cutting the right pieces, polishing, etcetera.
- The second violin, however, will take more time because I have to go deeper into the forest. Therefore, it will cost about 500 Florins.
- For the third violin I have to go even deeper into the forest, pushing the costs up to about 700 Florins.
- Likewise for the fourth, fifth, and sixth violins, which will cost about 900, 1100, and 1300 Florins to produce, respectively.

The cost of producing an additional violin is also called the *incremental* cost. 'Increment' is a fancy word for 'change': the incremental cost of a violin is the extent by which total costs change if you produce another violin. Incremental costs do not cover fixed costs, like the rent of his workshop. After all, his rent will not go up if he produces more violins. Figure 2 shows the incremental costs of producing violins.

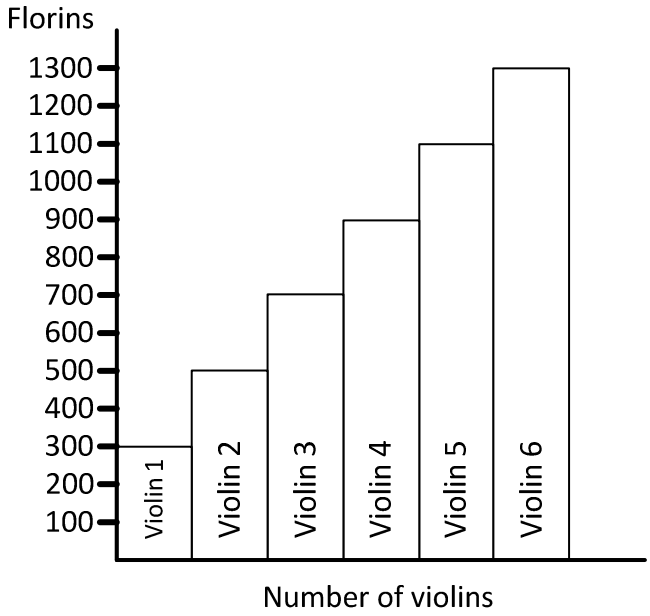

Figure 2: Incremental costs of producing violins

It is important to distinguish incremental costs from total costs. If Stradivari produces two violins, his total costs will be 300 + 500 = 800 Florins, plus the rent of his workshop. But on the short term, the rent of his workshop is irrelevant to the decision how many violins to make: after all, the rent does not change with the number of violins he makes. He can only hope he will make enough short-term profits to be able to pay the rent. To calculate that we need to know the price.

As regards that price, suppose that the violin market in Cremona is not an entirely free market. The mayor of Cremona has decreed that violins should cost exactly 550 Florins, no more, no less. At that price Antonio, Beata, Cecilia, and Donatello would be willing to buy a violin, but Enzo and Francesca would think the price is too high (Figure 3).

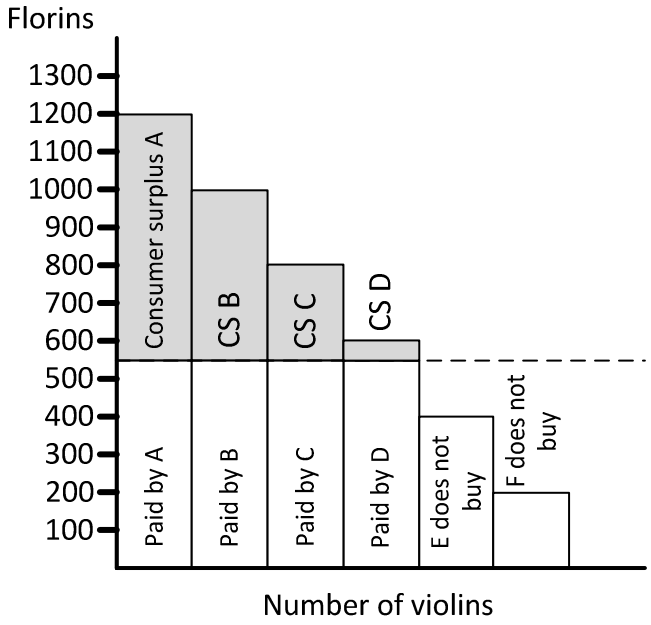

Figure 3: Musicians willing to buy a violin from Stradivari, and their consumer surplus, at a price of 550 Florins per violin

Note that Antonio must be very happy in this situation: he can buy a violin at a price that is less than half of what he would have been maximally willing to pay for it! The difference between what he pays and what he would have been maximally willing to pay is called the consumer surplus. Antonio's consumer surplus is 1200 - 550 = 650 Florins. Beata would have been willing to pay less than Antonio, but 550 Florins is still less than she would maximally be willing to pay. The consumer surplus is 1000 - 550 = 450 Florins. Likewise, Cecilia's and Donatello's consumer surplus is 250 Florins and 50 Florins, respectively. Enzo and Francesca do not buy any violin, so their consumer surplus is zero. The total consumer surplus is 650 + 450 + 250 + 50 = 1400 Florins.

So at this price Stradivari could sell four violins, but would he be willing to make them? Figure 4 shows how many violins Stradivari would make at a price of 550 Florins. The first violin would cost 300 Florins, so he would make a short-term profit of 250 Florins from making it. By short-term we mean not considering the rent of his workshop. Actually, there is a better word for it: the producer surplus. For the second violin, however, he would have to go deeper into the forest to look for the right wood, driving up the incremental costs to 500 Florins. Nevertheless, he could still make a producer surplus of 50 Florins from making it. The third violin, however, would cost him more than he could earn from selling it at 550 Florins. So at a price of 550 Florins per violin he would make two violins; the incremental costs of making those two violins would be 800 Florins; he would earn 1100 Florins from selling them, so his total producer surplus would be 300 Florins.

Be aware that producer surplus is not the same as profits! After all, we have not yet considered the rent of his workshop. If that rent is 400 Florins he would still not be able to stay in the violin-making business.

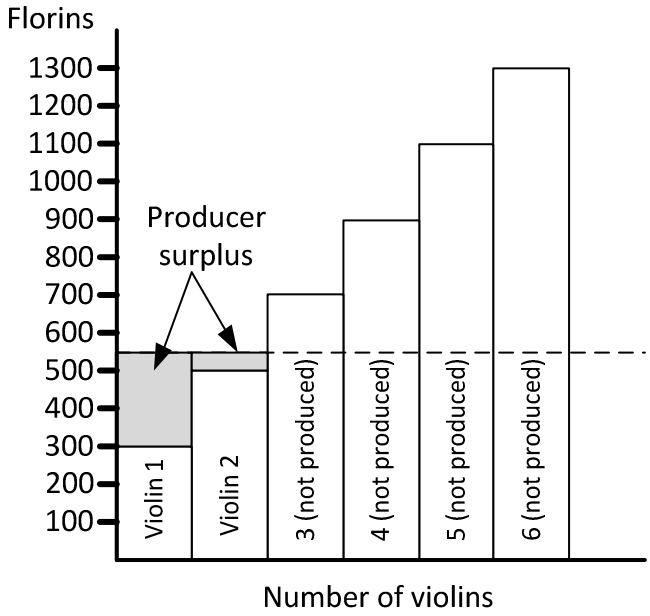

Figure 4: Violins produced by Stradivari, and his producer surplus, at a price of 550 Florins per violin

So far we have considered the consumers and the producer separately, but it is much more helpful to consider them in one graph. Figure 5 depicts the incremental costs of producing violins as a supply curve: this curve shows for each number of violins the incremental costs of the last violin produced. You can interpret it as the price at which Stradivari is willing to produce that number of violins.

Likewise, Stradivari's six customers are depicted in a demand curve. This curve shows, for each number of violins produced, the maximum willingness to pay of the most stingy consumer. So if Stradivari goes from, say, three violins to four violins, the demand curve tells him (or the Mayor of Cremona) what the buyer of that fourth violin is maximally willing to pay.

We see that although Antonio, Beata, Cecilia, and Donatello would all be willing to buy a violin at a price of 550 Florins, Stradivari would only be willing to produce two. Although it is not clear who will be the happy buyers, let's assume that Antonio and Beata make the most effort to get their hands on a real Stradivarius; after all, they are willing to pay most for it even though the price is fixed at 550 Florins. Together, they would have been willing to pay a maximum of 1200 + 1000 = 2200 Florins; but because the violin price is fixed at 550 Florins they pay only 1100 Florins, leaving them a consumer surplus of 2200 - 1100 = 1100 Florins. Together with Stradivari's producer surplus of 300 Florins, this puts total surplus at 1400 Florins.

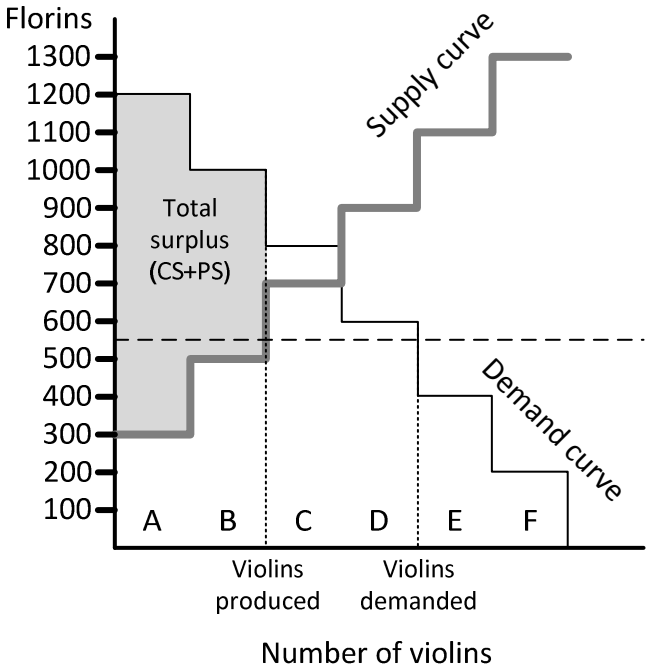

Figure 5: Violin supply, violin demand, and total surplus under a price of 550 Florins per violin

Note, however, that Cecilia would have been willing to buy a violin at a price high enough for Stradivari to produce it. After all, if the price would have been, say, 750 Florins, Cecilia would have bought it and still have a consumer surplus of 800 - 750 = 50 Florins, whereas Stradivari would have made it at a cost of 700 Florins and still earn a producer surplus of 50 Florins. Suppose that Cecilia has asked the mayor of Cremona to set the price at 750 Florins. Assume that neither Antonio, nor Beata have yet bought their violin (they will not be happy with having to pay a higher price for their violin, but they would still buy it). Figure 6 shows the number of violins produced and demanded under this price.

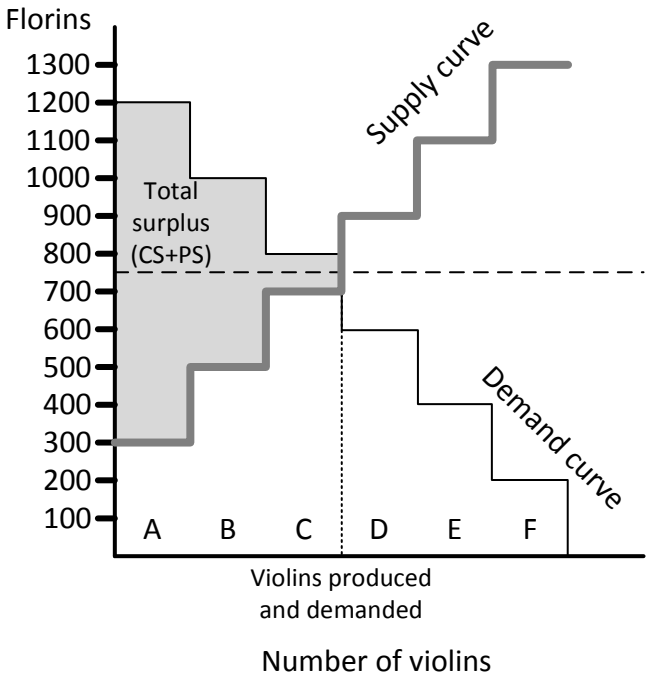

Figure 6: Violin supply, violin demand, and total surplus under a price of 750 Florins per violin

Note that under the new price of 750 Florins, we have three buyers (Antonio, Beata, and Cecilia), whereas Stradivari is willing to produce three violins. So at this price the market *clears*, as economists like to call it: supply exactly equals demand. Antonio's consumer surplus is smaller than what it was under a price of 550 Florins: it is now 1200 - 750 = 450 Florins, where it was 650 Florins under the old price. The difference has gone into Stradivari's pockets: from Antonio's violin he makes a producer surplus of 750 - 300 = 450 Florins, where he made 250 Florins under the old price. Likewise with Beata, whose consumer surplus has decreased from 450 Florins to 250 Florins: Stradivari now earns 250 Florins from her violin where it first was only 50 Florins. Cecilia's consumer surplus is 50 Florins, whereas Stradivari makes a producer surplus of 50 Florins from her violin.

Although total consumer surplus has declined from 1100 Florins to 450 + 250 + 50 = 750 Florins, total producer surplus is increased from 300 Florins to 750 Florins. Total surplus has therefore increased from 1400 Florins to 1500 Florins.

1.3.2 Price formation in a somewhat more realistic market

The example in Section 1.3 deals with only six consumers and one producer, but a realistic, well-functioning market consists of many more consumers and many more producers. So how do we deal with that?

Suppose we have about four times as many musicians wanting to buy a violin. Let's also assume that their maximum willingness to pay for a violin is neatly distributed over the range of buyers, so that, for instance, between Antonio and Beata we have three additional musicians whose maximum willingness to pay is 1050, 1100, and 1150 Florins, respectively. Likewise, assume that besides Stradivari there are three other violin makers, each with some form of access to a piece of forest where they get the wood for their violins. The cheapest violin to made in this economy is still made by Stradivari at a cost of 300 Florins. The second cheapest violin, however, is made by Carlo Bergonzi, who also has a forest of his own but he needs a bit more time than Stradivari to make a

violin. So the incremental cost of Bergonzi's first violin is 350 Florins. The third cheapest violin is the first violin that a third maker can make at 400 Florins, etcetera.

If you put the demand and supply curves of all these consumers and producers in one graph, then this graph would look like Figure 7.

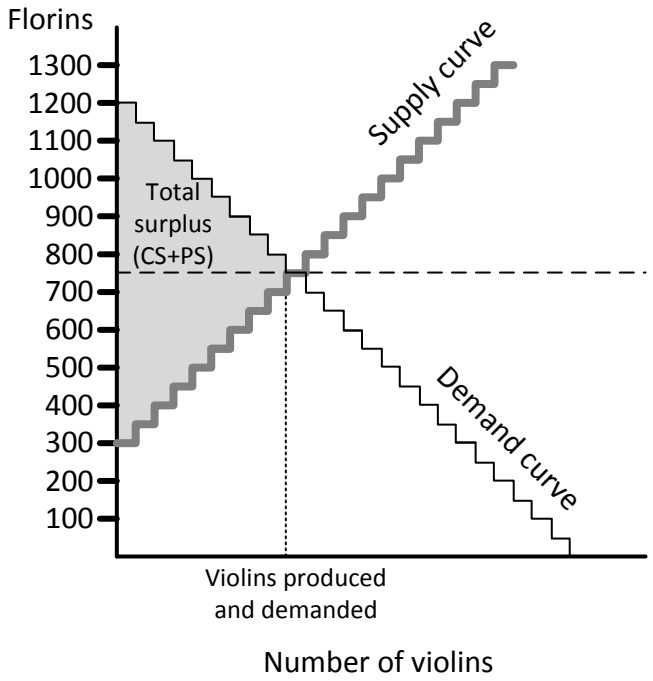

Figure 7: Supply and demand curves with many more consumers and producers

If we increase the numbers of producers and consumers even more, the steps in the supply and demand curves would get smaller and smaller, and both curves become smoother and smoother. If we assume an infinite number of producers and consumers (which is a helpful assumption in many economic analyses) the supply and demand curves would actually become smooth lines.

Moreover, many products can be divided in very small quantities. This does not hold for violins[1], but it does hold for many other products like water, fish meal, oil, fertilizer, and so on. For these products, the supply and demand curves can also be drawn as straight lines (Figure 8).

[1] Violin players know that there are also such things as 1/2 violins or 3/4 violins, but they also know that these are small violins, mostly for children. What I mean is that you cannot play *half* a violin like you can drink half a litre of water.

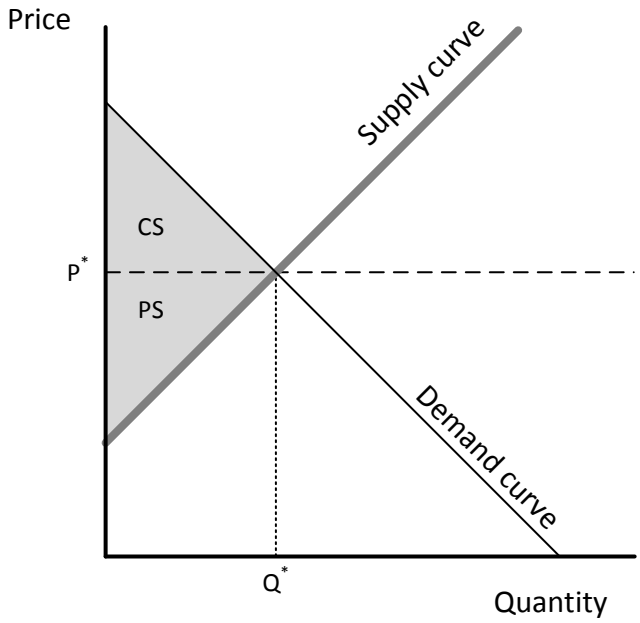

Figure 8: Supply and demand curves of infinitely divisible products

1.4 Market failures

1.4.1 Externalities

1.4.2 Public goods

1.4.3 Open access resources

1.4.4 Market power