A Primer on Microeconomics

Aditya Naidu

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To the C programming language and the segfault for forcing me
to appreciate what really goes on in there.

Foreword

After hearing the words "free market" for the millionth time on *The Colbert Report* in some seriously confusing (read absurd) discussions, I finally decided to understand what it really meant. I was also motivated to understand things which are outside my professional realm. And generally find out that even though they are interesting, I still find my profession more interesting! This book is a product of notes I made when I took the course "Microeconomics Principles" by José J. Vázquez-Cognet on `https://www.coursera.org/` (and earned a Statement of Accomplishment). I think the book is missing a few chapters which I would love to add when I find the time. Please send comments to {first name} . {last name} {at} gmail . com.

This document is distributed for the benefit and education of all. That someone seeking education should have the opportunity to find it. May you learn from it in the spirit of goodwill in which it is given. [1]

Best Regards
Aditya Naidu

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[1] The last paragraph in the foreword shamelessly copied from "Linked List Problems" by Nick Parlante with permission.

Why Learn Microeconomics

Economics helps us in finding a good way to distribute scarce resources.

Consider the case of allocating radio spectrum. Usable radio spectrum is limited. But it has lots of applications. A few examples are cell phones, over the air TV, Wifi, satellite communication, FM, AM, etc. In short any radio transmitter requires radio spectrum to work. Around the world multiple ways are used to allocate spectrum. Some of them are

Auction Give spectrum to the highest bidder

Lottery Give spectrum to the lucky applicant

Best Proposal Give spectrum to the entity which can best utilize it

Economics helps us chose among such options. Economics can be applied in any situation - right from an individual level to a national or global level - where there are scarce resources involved. As an example at an individual level, given that you have 40 hours a week to work - here time is a scarce resource - what should you do

- Work on something interesting?
- Work on something which earns you the most money?

Microeconomics is involved in almost every decision you make, be it buying a car, personal relationships, taking up a job or going for higher education, etc.

Microeconomics also helps us understand some (seemingly weird) things like

- Why some airfares don't make sense?
- Why is healthcare so expensive in the US?
- Why do sellers offer discount coupons?
- Why do some loss making firms keep operating instead of shutting down?
- When tax is levied on a commodity who really pays the tax: seller or buyer?

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Chapter 1

Basic Principles of Microeconomics

1.1 Opportunity Cost

Opportunity cost is one of the fundamental concepts in economics. It is used to calculate the cost of choosing one of the potentially many mutually exclusive options. It is not what one might thing it is. Economists calculate the cost of anything as the benefits which are given up by not choosing the second best option one would have gone with.

As an example let say there is enough money (say \$ 1M) to either build a street or build a school, not both. If it is decided to build the street then the opportunity cost is the school which was given up. The opportunity cost is NOT \$ 1M.

1.2 Net Marginal Benefits

This is another fundamental concept in economics. Rational people make a cost benefit analysis of incremental changes to a system. If the net cost of an incremental change is less than its net benefit then that change is made.

Consider a car factory working at full capacity making 10,000 cars per month. So to make 10,001 cars per month will require constructing an additional factory. In this case it doesn't make sense to make this change since the cost of the incremental change of construction a factory is more than the benefit of making an additional car.

1.3 The Invisible Hand

The invisible hand principle says that when everyone acts selfishly the society as a whole benefits. As an example, consider multiple queues at ticket counters at a train station. People acting selfishly join the shortest line. This reduces the time required to buy a ticket for everyone.

1.4 Trade

This is a very intuitive principle. Trade benefits society. Instead of each entity making all products and services it needs, entities can specialize in specific products or services. Then these entities can trade among each other to get all that they require.

Chapter 2

The Model of Supply and Demand

In this chapter we will model a market with its two sides - supply and demand. We will build a model which combines supply and demand. The basic building blocks of the model are simple and intuitive. But when everything is combined and we need to apply the model to various situation it gets a little involved.

2.1 What is a Market?

Market is a place - physical or virtual - where supplier and customer can trade. Any market has two sides. The supply side and the demand side. In this chapter we will see what factors affect supply, demand, prices of goods and how they interact with each other. Examples of markets are farmers market, stock market, currency markets.

2.2 Demand

The demand curve gives the relationship between the price of a commodity and the quantity demanded. Generally, with everything else remaining constant, the quantity demanded of a commodity decreases as the price of a commodity increases. This intuitive relation is shown in 2.1. This relationship is also known as the demand schedule.

There are factors other than price of the commodity which can change its demand schedule. In this case the demand curve shifts. Hence there is a new demand curve as shown in 2.1. There are many reasons for such a change in the demand curve. Some of them are

- Change in population
- Change in prices of related goods (substitutes and compliments)

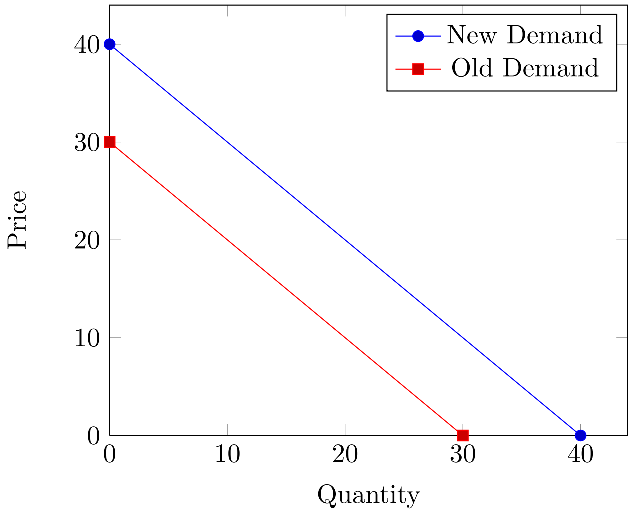

Figure 2.1: Demand Curve

- Change in preferences

As an example when the population increases the demand for a commodity increases for all price points. This shift in the demand curve is shown in 2.1

2.3 Supply

The supply curve gives the relationship between the price of a commodity and the quantity supplied. Generally, with everything else remaining the same, the quantity of a commodity supplied increases as its price increases. This intutive relationship also known as the supply schedule is shown in 2.2.

There are factors other than price of the commodity which change its supply schedule. These will lead to shifts in the supply curve. Some of the factors are

- Change in technology
- Change in cost of inputs required to make the commodity

As an example, when the cost of inputs reduce, supply increases for all price points. This new supply curve is shown in 2.2

2.4 Equilibrium

Now let us combine the supply and demand curve into a single graph. This graph shown in 2.3 is used extensively in economics.

The point at which the supply and demand curves intersect is called the equilibrium point. At this point the quantity supplied by the suppliers is equal

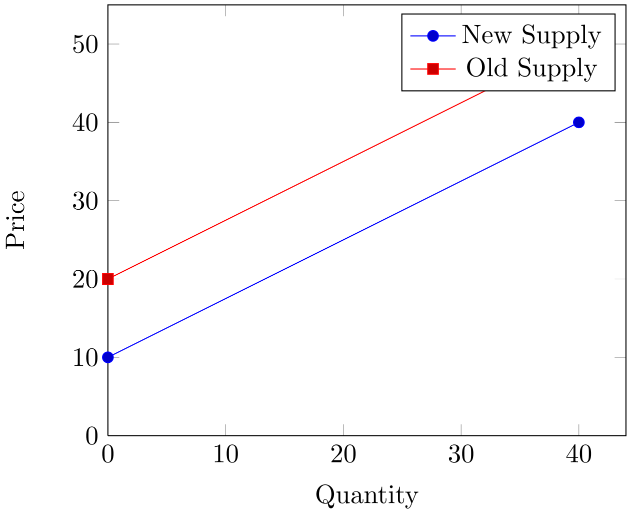

Figure 2.2: Supply Curve

to the quantity demanded by the consumers at the price which is agreeable to both. The price at equilibrium is called the market clearing price. We will see further in the text how this is an ideal condition which maximizes welfare.

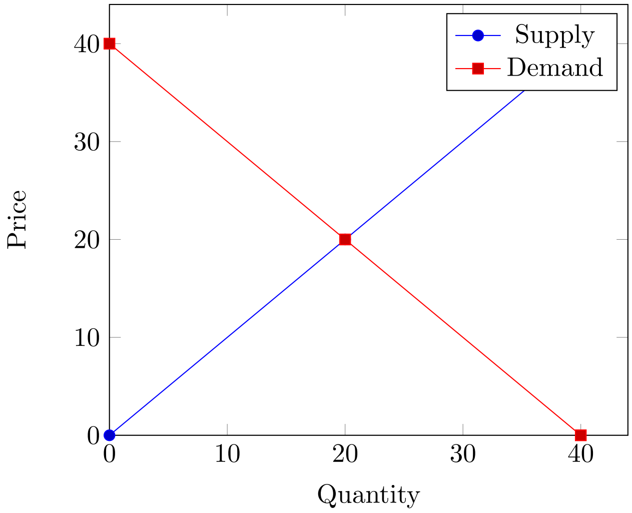

Figure 2.3: Supply and Demand Curve

Chapter 3

Measuring Welfare

In this chapter we introduce the concepts of customer and producer surplus. And how the amount of surplus changes in different scenarios using the demand and supply model. We will use the words surplus and welfare interchangeably.

3.1 Customer Surplus

Customer surplus is given by the difference between what the customer is willing to pay for a certain commodity and what the customer actually pays. A scenario where there is potentially high customer surplus is the contact lens market. The customer who really needs contact lens for proper vision would be willing to pay a high price for it compared to the actual price paid.

Based on the discussion above, the customer surplus is the shaded portion in the demand supply graph in 3.1. Obviously the customer surplus increases as the equilibrium price reduces.

3.2 Producer Surplus

On the other side of the market there is producer surplus. In this case the surplus is tangible. The producer actually has money in his pocket to show as producer surplus. Producer surplus is what the producer gets paid minus the cost of producing.

The producer surplus is given by the shaded region in Fig. 3.2

3.3 Total Surplus

The total surplus is given by the sum of the customer surplus and the producer surplus. And is given by the total shaded area - blue for customer and green for producer. We will see that when the market is at equilibrium the total surplus is maximized in the next couple of sections.

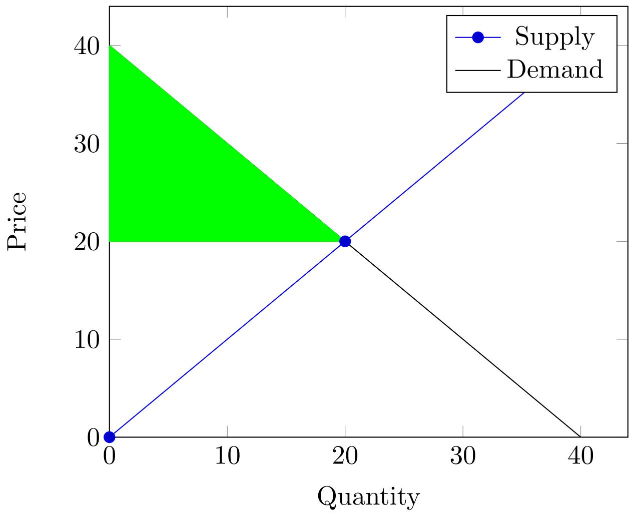

Figure 3.1: Customer Surplus

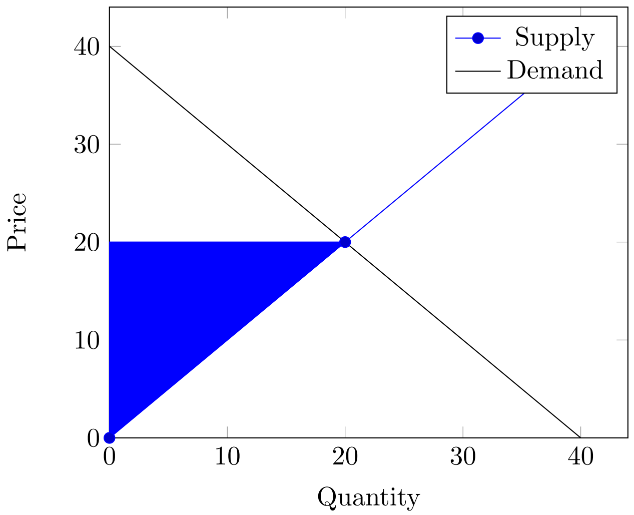

Figure 3.2: Producer Surplus

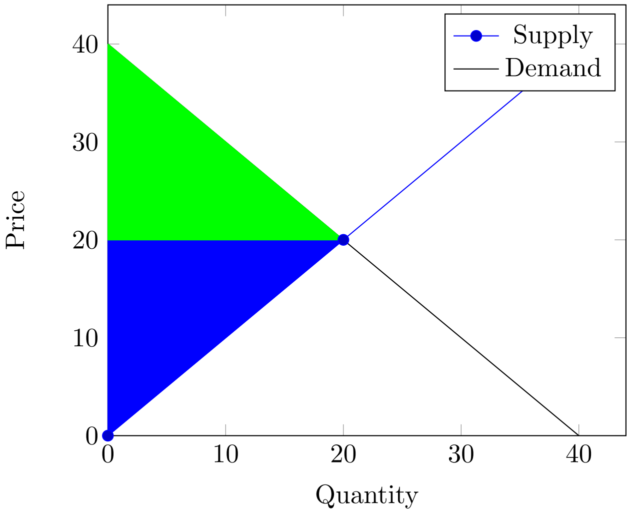

Figure 3.3: Total Surplus at Equilibrium

3.4 Interference with Markets

We will now discuss a couple of ways government interferes with the market and not let it operate at equilibrium. We will see what effect this has on the total surplus in the market.

3.4.1 Price Ceiling

Price ceiling is when the government sets a maximum price for a commodity. A well known example of a price ceiling is rent control. Numerous local government in urban areas set the maximum rent which can be charged. In these cases the rent is less than the market clearing rent. Such a situation is shown in Fig. 3.4. If the price ceiling is greater than the market clearing price then the price ceiling has no effect on the market.

In Fig. 3.4 the price ceiling is set to 10 meaning the rent can't go above 10. So the market is not able to reach the equilibrium point which is to the right of the price ceiling. We see that the producer surplus - blue shaded region - in this case reduces. Also the red shaded region which could be have been a surplus at equilibrium is not realized in this case. One more important observations is that there is a difference in supply and demand. The supply at the price ceiling is 10 while the demand is 30. So there is a demand surplus of 20 units.

3.4.2 Price Floor

Another interference in the market is a price floor. In this the government sets a minimum price at which a commodity can be traded. A well known price floor

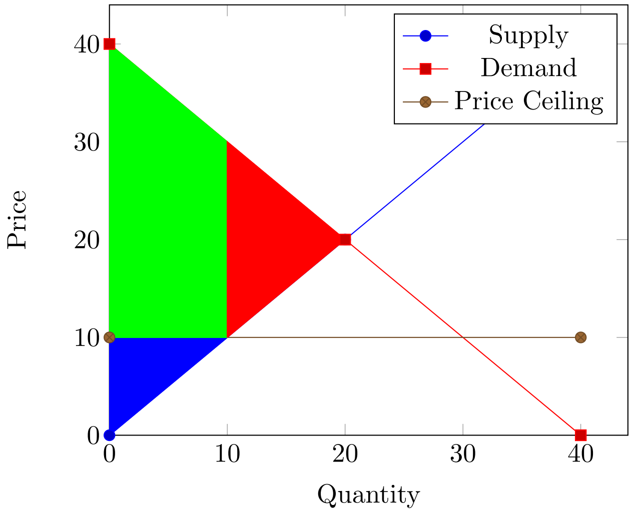

Figure 3.4: Total Surplus with Price Ceiling

is the minimum wage. In this the government sets the minimum wages which are higher than what the market can support. This situation is shown in Fig 3.5. If the price floor is less than the market clearing price then it doesn't have any effect on the market.

The minimum wage in Fig 3.5 is set to 30, meaning wages can't go below 30. The plot shows that the consumer - in this case the employer - surplus goes down. Also the red regions which could have been a surplus at equilibrium is not realized in this case. Another important observation is that the supply is 30 units and the demand is only 10 units. So there is a supply surplus. This means there are people who are willing to work but don't find employment which will lead to higher unemployment.

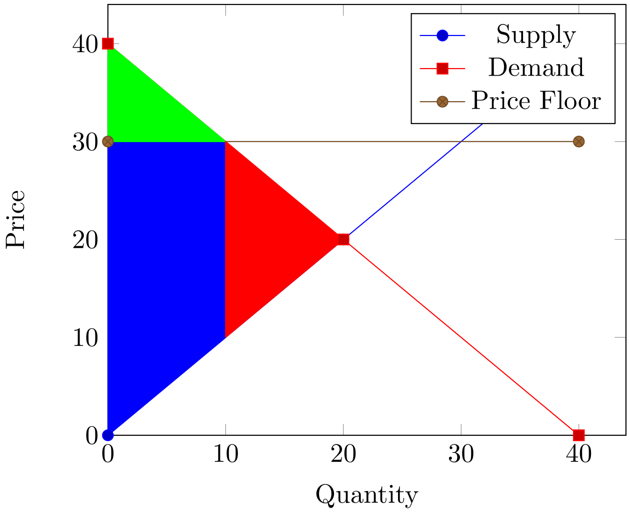

Figure 3.5: Total Surplus with Price Floor

Chapter 4

Elasticity

Elasticity formalizes the relation between change in an economic factor when some other factor changes. The equation 4.1 gives elasticity of a generic economic factor x when another factor y changes. Its a ratio of percentage change in x by the percentage change in y. In essence it tells us how responsive one factor is when a different factor changes. A higher ratio signifies higher responsiveness.

$$\frac{\%\triangle x}{\%\triangle y} \tag{4.1}$$

Elasticities are classified based on the absolute value of this ratio

Elastic when the absolute value of elasticity is greater than 1

Inelastic when the absolute value of elasticity is less than 1

Unitary when the absolute value of elasticity is exactly 1

We will briefly look at the elasticity of demand of a commodity with respect to change in its price, customer income and price of related commodities, namely

1. Price elasticity of demand
2. Income elasticity of demand
3. Cross price elasticity of demand

4.1 Price Elasticity of Demand

The price elasticity of demand (PED) of a commodity x, is a ratio of percentage change in demand by the percentage change in price of the same commodity as shown in equation 4.2. As the price increases the demand decreases hence this is a negative number.

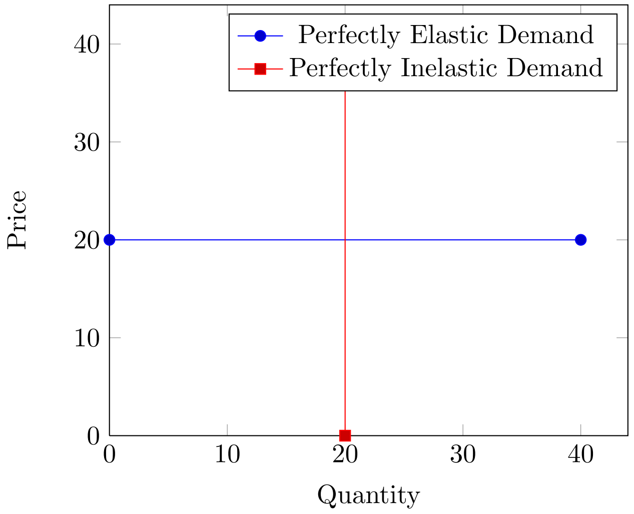

Figure 4.1: Extreme Demand Curves

$$\frac{\%\triangle D_x}{\%\triangle P_x} \tag{4.2}$$

Figure 4.1 shows two extremes cases of demand curves. In the perfectly inelastic case the demand remains the same irrespective of the price. Whereas in the other extreme case of perfectly elastic demand, the demand changes by a large amount for an infinitesimally small change in price.

In real life actual price elasticity of demand is somewhere between these two extremes. Intuitively the price elasticity of demand for cars will be high and that for medical services is low. We will see how this intuition holds up in subsequent sections.

4.1.1 Determinants of Price Elasticity of Demand

There are two primary factors which determine the price elasticity of demand

Substitutes If there are no substitutes available then the elasticity of the commodity is very low. As an example if the price of food, which has no substitute (as far as keeping us alive is concerned), changes the demand for it will not change by much. But in case of cars their price elasticity is high since they have substitutes like bikes, public transportation, walking, etc.

Price If the price of the commodity is low then its elasticity is low. As an example if price of candy goes up from \$1 to \$1.50 (a 50% increase in price) the demand will not change by much. On the other hand if the price of a already expensive commodity say a car goes up by 50%, there will be a much more drastic change in the demand.

4.1.2 Elasticity and Revenue

From the supplier's point of view a question here could be: If I increase the price of a commodity will it increase revenue (where $Revenue = Price \times QuantityDemanded$) ? The answer depends on the price elasticity of demand. If the demand is elastic (> 1) then the increase in price is less than the decrease is demand, hence revenue will go down. On the other hand if the demand is inelastic (< 1) then the increase in price is greater than the decrease in quantity demanded, hence the revenue increases.

4.2 Cross Price Elasticity of Demand

The cross price elasticity is a bit more involved. It gives the responsiveness of demand when the price of related goods - supplements and compliments - change.

Lets consider the case of cars and gas [1] which are complimentary i.e. when we buy a car we also buy gas. What happens to the demand for cars when the price of gas changes? If the price of gas increased then the demand for cars will go down. Thus the cross price elasticity of complimentary goods in negative.

When commodities are supplements of each other, the cross price elasticity of demand is positive. Consider the case of air and rail travel which can be considered substitutes. When the cost of one lets say air travel increases then the demand for the other - rail travel - increases. Hence the positive elasticity.

4.3 Income Elasticity of Demand

The Income elasticity of demand measures the responsiveness of demand to changes in income. It is positive for normal goods and negative for inferior goods [2].

4.4 Elasticity of Supply

Just like elasticity of demand, there are elasticities on the supply side of the market. We won't be going through these since they are counterparts of the elasticity on the demand side. What we will talk about is determinants of elasticity of supply

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[1] Gas, the liquid, which fuels most of the cars today is also known as Petrol in many countries.

[2] Goods perceived to be inferior like public transportation, cheap fast food

4.4.1 Determinants of Supply Elasticity

The following are determinants of supply elasticity from Wikipedia [3]. These are self-explanatory in nature and hence won't be elaborated on.

- Availability of raw materials
- Length and complexity of production
- Mobility of factors
- Time to respond
- Excess capacity
- Inventories

4.5 Application of Elasticity

4.5.1 Taxes

We will see how taxes affect supply, demand and social welfare in a market taking into consideration the elasticity of demand and supply. Also, we will see which side of the market is burdened by taxes.

Consider the case of sales tax of say \$10 for every item purchased. This is a per unit tax and not a percentage tax. When the buyers have to pay the tax the demand decreases by exactly the amount of tax imposed.

This scenario is shown in Fig. 4.2. The demand curve has shifted downwards by \$10. This gives a new equilibrium point at $(15, 15)$. The buyers pay a \$10 tax on top of that equilibrium price of \$15. So the buyers are now paying \$25 instead of \$20 before. On the supply side the producers are now receiving \$15 instead of \$20 before. Thus both the sellers and buyers are worst off by \$5 each. Also since the price elasticity of supply and demand are unitary the burden of tax is evenly distributed between sellers and buyers.

Now consider a case when the demand is inelastic and the supply is elastic like in the case of gas. In this case the supply and demand curves will be as shown in Fig. 4.3.Before taxes the market clearing price is \$11.60. This is the amount received by the sellers and paid by the buyers.

After taxes are imposed the market clearing price reduces to \$10. On top of that the buyers pay a tax of \$10 for a total of \$20. Thus the buyers are worst of by $20 - 11.60 =$ \$8.40. In case of the sellers they receive only \$10 instead of \$11.60 making them worst of by \$1.60.

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[3] `http://en.wikipedia.org/wiki/Price_elasticity_of_supply`

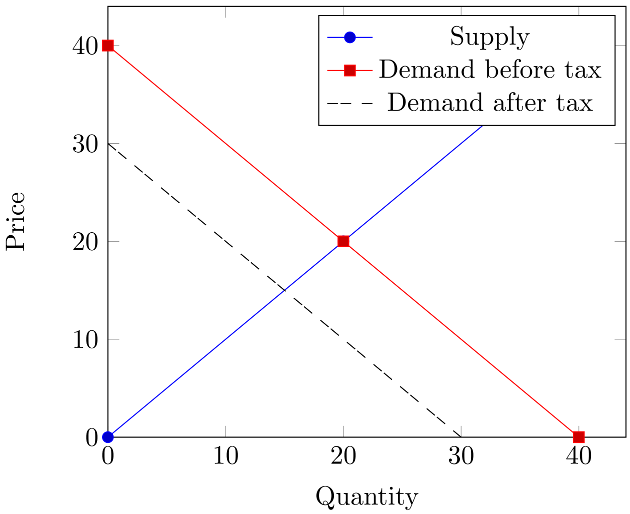

Figure 4.2: Change in Demand Curve after tax of $10 per unit

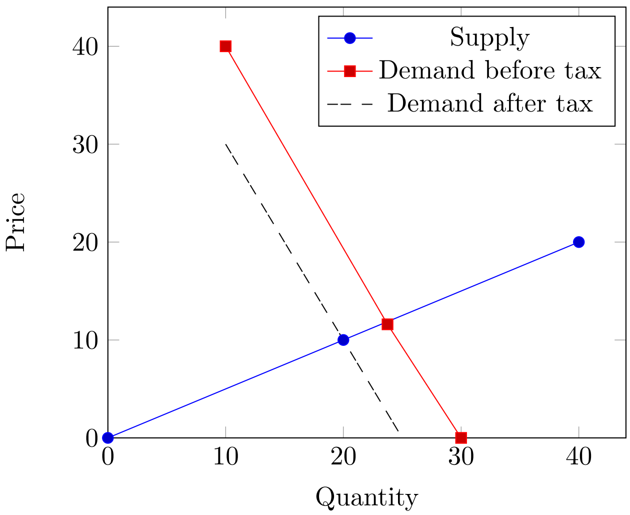

Figure 4.3: Change in Inelastic Demand Curve after tax of $10 per unit

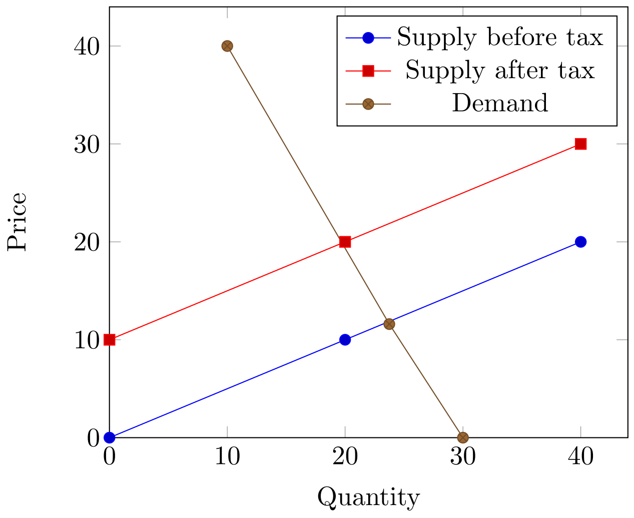

Figure 4.4: Change in Inelastic Demand Curve after tax of $10 per unit. Seller pays tax

4.5.2 Farming

We will see why farmer are making a lot less money and exiting the market over the past years. Here the commodity is food. As mentioned previously the demand for food is highly inelastic. Thus the demand curve here is very steep. On the other hand the supply curve is elastic. Over the years due to advances in technology the cost of producing food has reduced significantly. A few examples of advances are heavy mechanization, fertilizers. This situation is shown in Fig. 4.5. In the case with no technological advances (Old supply) the equilibrium price is $20 and the quantity is 20 units. With the new supply curve the price went down to $10 and the equilibrium quantity increased only slightly to 24. Such a huge reduction in price coupled with very small increase in quantity reduced the revenues (and profits) of the farmers.

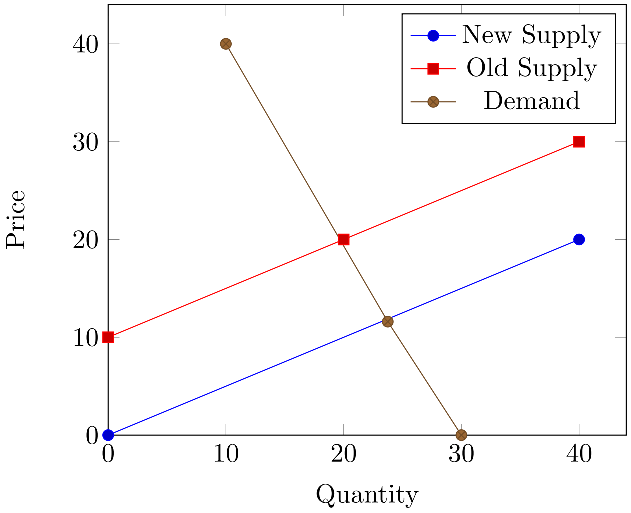

Figure 4.5: Supply of Food before and after technological advances

Chapter 5

The Production Process

The production process discussed can be applied to any kind of product. We will first make a table and related graphs and then explain the numbers and how the trends of the numbers make sense in any production scenario.

For the sake of concreteness consider a fast food joint selling burgers. The output in this case is the burgers sold. There are two types of costs involved. First is the fixed cost like rent, equipment used, etc also known as capital. Second is the variable cost like raw materials, labor, etc also known as labor. We assume the fixed cost is \$200. And the variable cost we consider is the wages which are \$100 per day per worker.

The table 5.1 shows the various costs for different number of workers. The table uses the following abbreviations

NoW Number of workers

FC Fixed Cost. Costs which are fixed at least for some time like rent

Output Number of burgers produced

AFC Average fixed cost. $FC/Output$

VC Variable cost. Cost which can vary even in the short term like number of workers

AVC Average Variable cost. $VC/Output$

TC Total cost. $FC + VC$

ATC Average total cost $TC/Output$

The incremental increase in output when an additional worker is hired initially increases (when the first and second worker is added), but start to decrease when more workers are added (third, fourth and fifth). This is called the marginal product of labor. Formally its defined as the change in output when an additional worker is added.

NoW	Output	FC	AFC	VC	AVC	TC	ATC
0	0	200	∞	0	0	200	∞
1	50	200	4	100	2	300	6
2	110	200	1.81	200	1.81	400	3.63
3	150	200	1.33	300	2	500	3.33
4	170	200	1.17	400	2.35	600	3.52
5	180	200	1.11	500	2.77	700	3.88

Table 5.1: Various Production Numbers

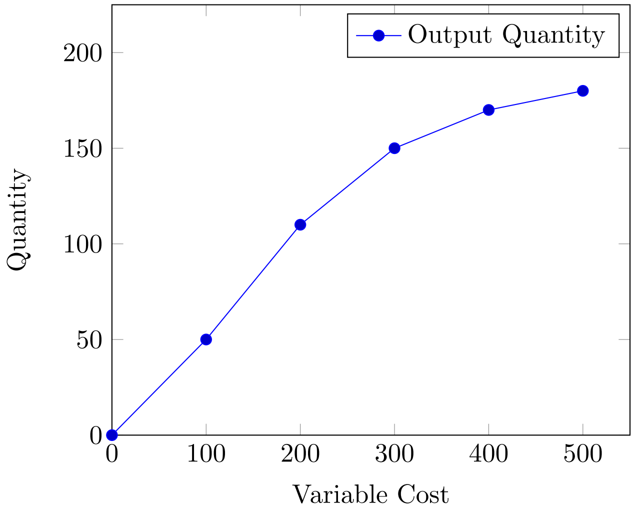

Figure 5.1: Output vs. Variable Cost

As we can see the fixed cost is independent of the output and the number of workers. The variable cost increases in proportion to the number of workers. Now for the less obvious trends, the rate of increase of output reduces as the variable cost i.e. the number of workers increases. The trend is shown in Fig 5.1. This is due to the fact that the fixed resources (kitchen and tables in this case) are being used by increasing number of workers. So the rate of increase of productivity will be high as we start adding workers. After a certain number, the workers (cooks, server in this case) will just step on each others toes and hence become inefficient. Hence the reduction in the rate of increase of productivity.

To be continued . . .

5.1 Marginal Costs

5.2 Cost Curves

Chapter 6

Firms in a competitive environment