

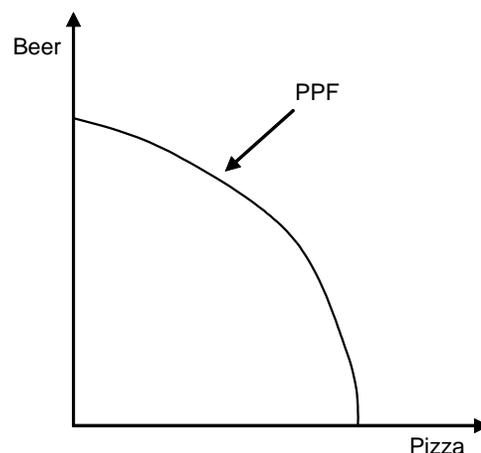
## Appendix Primer on microeconomics

This appendix provides an introduction to some of the economic tools used in this book. It is written for non-economists. There are three basic tools explained: the production possibilities frontier, the indifference curve, and producer and consumer surplus. An introduction to supply and demand is also provided. These tools are explained in the appendix using general examples and are applied to casino gambling throughout the book.

### A.1 The production possibilities frontier

Economists use the production possibilities frontier (PPF) to model production by an individual, group of people, or economy. For simplicity, we begin by considering an economy in which only two goods are produced: beer and pizza.<sup>1</sup> The production possibilities frontier (Fig. A.1) illustrates the production choices faced. Using all available input resources efficiently, the PPF shows all of the possible maximum combinations of beer and pizza that can be produced. The shape of the PPF – concave to the origin – implies an increasing opportunity cost of production as the quantity of production rises. That is, the cost of producing pizza in terms of beer sacrificed increases as the economy produces more pizza.<sup>2</sup> The reason is that resources are not equally well-suited for production of the different goods. So as the production of a particular good or service increases, the additional inputs are less suited to the production of that good. The result is increasing marginal (or incremental) production costs.

The slope of the PPF represents the opportunity cost of production. The steeper the PPF, the higher the opportunity cost of pizza, since more beer must be sacrificed to incrementally increase pizza production. The flatter the PPF, the higher the opportunity cost of beer in terms of pizza. The slope of the PPF is called the marginal rate of transformation (MRT).



---

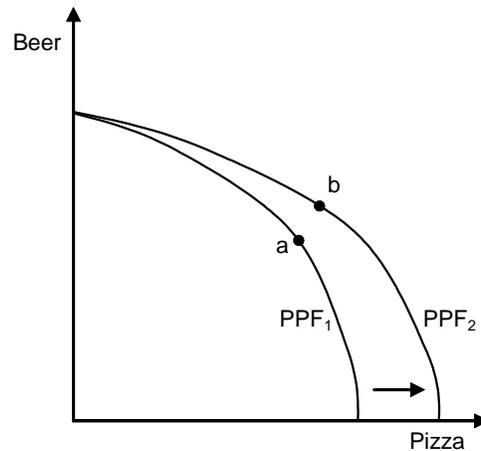
<sup>1</sup> The simplification of a two-good economy is not a serious problem. We could instead use beer and “all other goods,” which would be a perfectly realistic, though a more general, example.

<sup>2</sup> This PPF shape corresponds to the standard positive-sloped supply curve, discussed below.

**Fig. A.1.** Production possibilities frontier

A technological advance in pizza production (if, for example, an automatic dough machine is introduced) would cause the PPF to rotate out along the pizza axis (Fig. A.2). Note that an increase in pizza technology may allow society to produce and consume more pizza *and* beer by moving from point *a* to point *b*.<sup>3</sup>

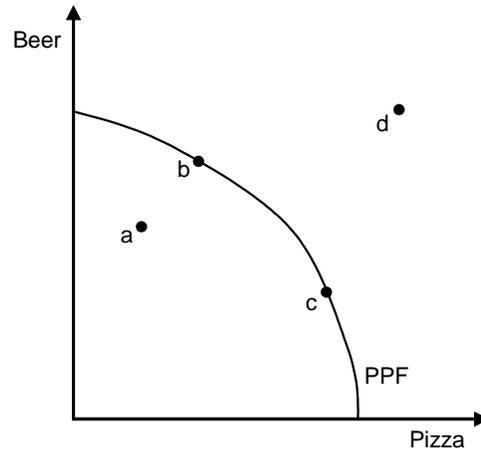
Without knowing something about the preferences of the individuals in society (discussed below) we cannot say that one point on the frontier is better than any other. For example, in Fig. A.3, we cannot say that point *b* is better than *c* or vice-versa. We do know, however, that each point on the frontier is, by definition, efficient. This type of efficiency is “technological,” referring to the situation in which output is maximized given inputs, technology, etc. Stated differently, technological efficiency occurs when a given level of output is produced with the least possible amount of resources. If production occurs on the PPF then input resources are not being wasted. Point *a*, on the other hand, exhibits waste, unemployment or inefficiency because with the level of technology and inputs, the economy could produce more (say at point *b*). However, it is not possible to produce at point *d* or any other point outside the PPF because of input and/or technological limitations.



**Fig. A.2.** Technological advance in the pizza industry

---

<sup>3</sup> This is because pizza production has become more efficient. The same amount of pizza can now be produced in less time or with less labor or other input resources.

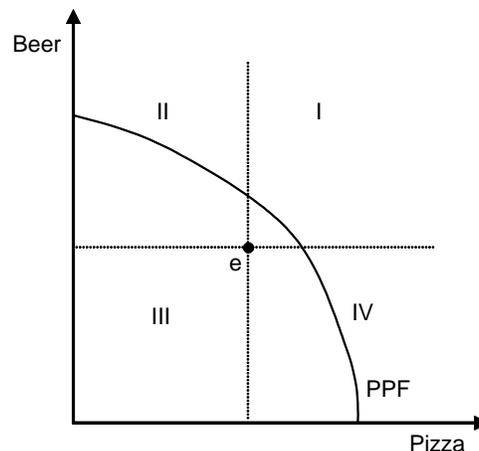


**Fig. A.3.** Efficient, inefficient, and unattainable production points

From the consumer perspective, we can compare the points on the frontier with many of the points off the frontier. For example, in Fig. A.3, *d* is preferred to *a*, *b* and *c*, since the former includes more of both goods than the other three points. But *d* is unattainable. We can also say that *b* is preferred to *a*. However, we cannot necessarily say *c* is preferred to *b* since it has more pizza but less beer.<sup>4</sup>

The ranking of various points can be summarized as in Fig. A.4. All points in quadrant *I* are preferred to point *e* and point *e* is preferred to all points in quadrant *III*. This is because each point in quadrant *I* either has more beer, more pizza, or more of both goods compared to point *e*. Similarly, bundle *e* contains either more pizza or beer, or more of both goods, compared to all the combinations in quadrant *III*.

We cannot legitimately rank the points in quadrants *II* or *IV* relative to point *e*. For example, all combinations represented in quadrant *II* have more beer than point *e* but less pizza. So unless we know something about preferences, we cannot compare points in *II* with point *e*. Similarly, combinations of goods represented in quadrant *IV* have more pizza but less beer than point *e* making a ranking of the points impossible without more information on preferences.



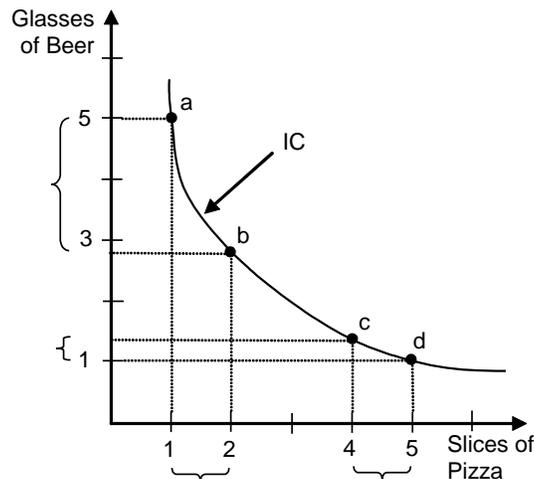
**Fig. A.4.** Ranking consumption points

<sup>4</sup> “Allocative” efficiency refers to the situation in which the market is producing the optimal mix of goods considering preferences.

## A.2 The indifference curve

An indifference curve (IC) for an individual or society is the collection of points that represent indifferent combinations of two goods. We can develop an IC using the information in Fig. A.4. Any point in quadrant *I* is preferred to *e* and *e* is preferred to any point in quadrant *III*. More is always better than less. If society is initially producing and consuming at point *e* then we would be better off given more pizza. For us to be indifferent between this new situation and the original one at *e*, we must give up some beer which would reduce well being. So the IC must have a negative slope.

The specific shape of the IC results from the law of decreasing marginal utility, the idea that each additional unit of consumption tends to provide less and less additional (marginal) benefit. With pizza and beer, the IC would appear as indicated in Fig. A.5.



**Fig. A.5.** Indifference curve for beer and pizza

Four example points are shown. Since they all lie on the same IC, the consumer is indifferent among them. The law of decreasing marginal utility can be illustrated by considering how much beer the consumer would be willing to give up for another slice of pizza and remain as well off. Consider two cases: movement from point *a* to *b* and from point *c* to *d*; each move represents a one unit increase in the amount of pizza. Recall that a person must remain as happy as before getting the additional slice of pizza in order to remain on a given IC. When a person has little pizza and a lot of beer, the marginal utility of beer is low and for pizza it is high. This suggests the willingness to give up a lot of beer for another slice of pizza. But if a person has more pizza, say at point *c*, his willingness to sacrifice additional beer for another slice of pizza is lower. The result is a convex shape for an IC between the two goods.<sup>5</sup>

Since the gambling issue is social in nature (i.e., whether or not to legalize it is not an individual decision), it will be useful to think of a “community indifference curve” rather than an individual IC.<sup>6</sup>

Now that the shape of the IC has been explained, there are several important characteristics to keep in mind. As Ferguson (1966) explains, every point in commodity space lies on one (and only one) IC, and there is an infinite number of ICs for any two goods. Furthermore, ICs cannot intersect. The proof is simple. In Fig. A.6, note that point *a* lies on both  $IC_1$  and  $IC_2$ . Ignore for a moment that this violates the

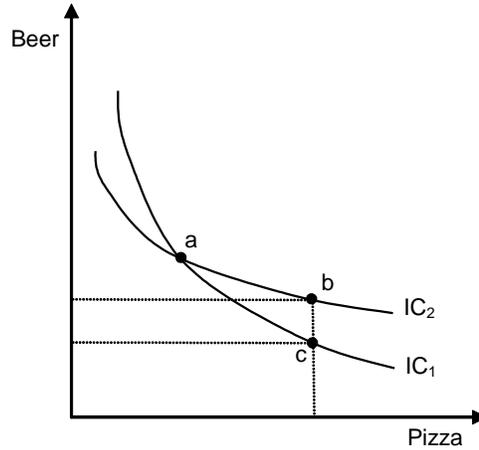
<sup>5</sup> The slope of the IC is referred to as the marginal rate of substitution (MRS). The MRS of beer for pizza, i.e., the willingness to sacrifice beer for pizza, falls as one moves down and right along the IC. If one of the products on the axes is a “bad” then the slope of the IC will be positive. This is a special case that we need not deal with here.

<sup>6</sup> For more detail on community indifference curves, see Henderson and Quandt (1980, pp. 310–319).

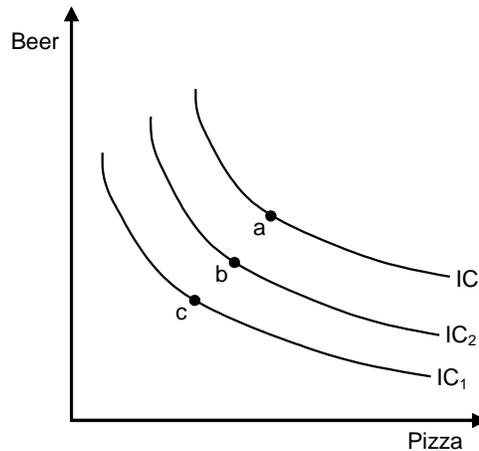
condition that each point lies on a single IC. Then  $a$  must be indifferent to  $c$ , and  $a$  must be indifferent to  $b$ . This implies that  $b$  is indifferent to  $c$ . But  $b$  must be preferred to  $c$  since  $b$  has more beer and no less pizza than  $c$ , and more is always better. Hence, ICs cannot intersect.

One final point is that higher ICs indicate higher utility or satisfaction. In Fig. A.7, every point on  $IC_2$  is preferred to every point on  $IC_1$  and every point on  $IC_3$  is preferred to all points on  $IC_1$  and  $IC_2$ . This is because  $a$  is preferred to  $b$ , and  $b$  is preferred to  $c$ , and all points on a particular IC are valued equally. So consumers prefer to be on higher, rather than lower, ICs.

Using ICs we can now rank all possible combinations of the goods represented in the graph. This will be a useful tool for demonstrating economic growth and the social costs of gambling. It is important to understand that this is the standard tool used in economics for the analysis of individual welfare related to consumption choices.



**Fig. A.6.** Proof that ICs cannot intersect



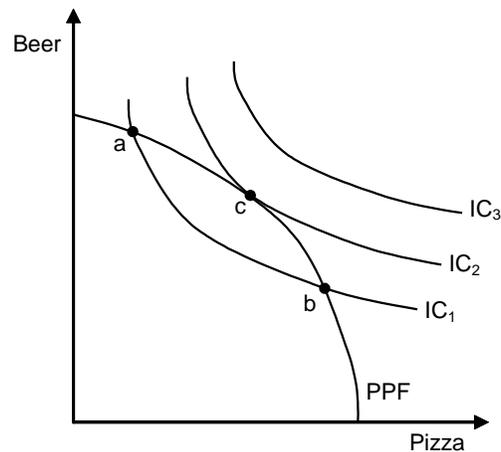
**Fig. A.7.** Indifference map

### A.3 Allocative efficiency

Technological efficiency occurs when production takes place on the PPF so that no input resources are wasted or unemployed and production is maximized given technology and input quantities. Once we consider preferences given by the IC, we can describe allocative efficiency.

It is important that what is produced is what people want to consume. Now that we have considered the supply side of the market (or costs represented by the PPF) and the demand side (or preferences represented by the IC) we can put the two sides of the market together and illustrate economic efficiency, technological and allocative.

In Fig. A.8 each point on the PPF is technologically efficient. However, only point *c* is allocatively efficient. That is, only at point *c* is the optimal *mix* of goods produced. From a social perspective, we want consumers to be on the highest possible IC. This is done by producing at the point on the PPF that allows us to be on the best possible IC, in this case  $IC_2$ . That point represents the optimal combination of beer and pizza given preferences.<sup>7</sup> Points *a* and *b* are inferior to point *c* because they are on a lower IC. Using ICs and PPFs together, we can rank different points on the PPF.



**Fig. A.8.** Technological and allocative efficiency

Consumer preferences will affect the production that takes place in society. If consumers have a relatively strong preference for pizza, the ICs would appear steep, indicating a willingness to sacrifice more beer for an additional unit of pizza. The resulting tangency between the IC and PPF would then be closer to the pizza axis (more pizza and less beer). On the other hand, a relatively strong preference for beer would be represented by flat ICs and the resulting tangency with the PPF would be nearer to the beer axis with more beer and less pizza production and consumption.

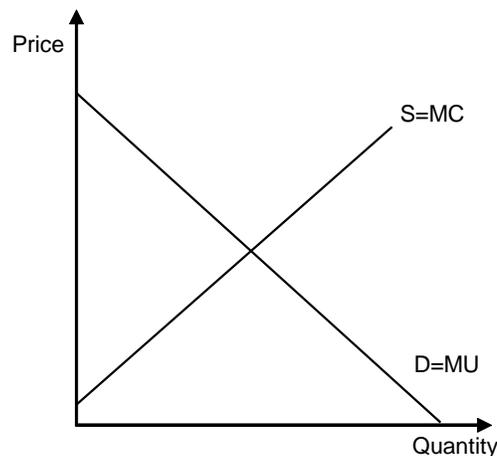
---

<sup>7</sup> A complete treatment of consumer choice would require consideration of relative prices of the goods, preferences, and a budget constraint.

## A.4 Supply, demand, and markets

The previous sections of this appendix explain production based on opportunity cost and consumption based on preferences. These concepts are the basis for the supply and demand curves, the two major components of market models.<sup>8</sup>

The supply curve represents the marginal opportunity cost of production. Recall that the PPF has a concave shape that represents an increasing opportunity cost of production. That is, as production of one of the goods increases, its marginal opportunity cost (MC) rises in terms of the other good. If we graph the positive relationship between cost of production and quantity, the result is a supply curve as illustrated in Fig. A.9. A more simple explanation for the positive slope of the supply curve is that as price rises sellers wish to sell greater quantities. This is because the increase in price makes each sale more profitable.



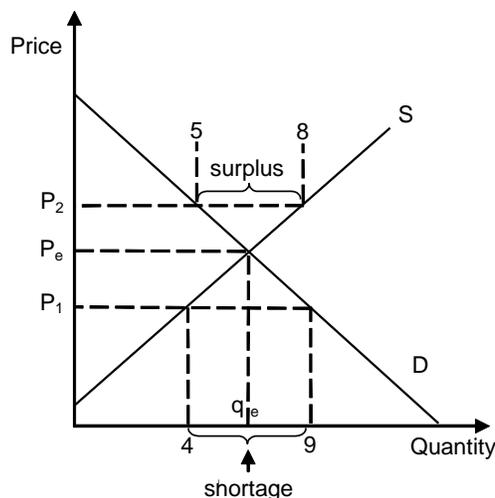
**Fig. A.9.** Supply and demand curves

The demand curve represents the marginal utility (benefit) from consumption. Recall the law of decreasing marginal utility which says that each additional unit of consumption (of a good or service) yields less and less marginal utility (MU). If each additional unit of consumption provides less utility, then each additional unit will be valued less than the previous one. A rational person's willingness to pay for additional units would therefore be expected to decline. This negative relationship between quantity and willingness to pay is illustrated in the demand curve of Fig. A.9.

When the two sides of the market, supply and demand, are put together, the result is a market model (Fig. A.10). The equilibrium price ( $P_e$ ) is the only price at which the quantity demanded is equal to the quantity supplied (called the equilibrium quantity  $q_e$ ). If the current price in the market is *not* the equilibrium price, the self-interested motivations of buyers and sellers in the market push the price toward this equilibrium price.

---

<sup>8</sup> The discussion of supply and demand here is very brief. For a complete treatment consult a principles of microeconomics text such as Mankiw (2007).



**Fig. A.10.** Prices and quantities in the market model

Consider a price such as  $P_1$  in Fig. A.10. At a price below  $P_e$  the quantity demanded in the market exceeds the quantity supplied. This situation is called a shortage. In the example there is a shortage of five units. With a shortage, buyers and sellers in the market will bid the price up toward  $P_e$  and the shortage disappears. Alternatively, at  $P_2$  or any price above  $P_e$  a surplus exists. That is, quantity supplied exceeds quantity demanded. In Fig. A.10 there is a surplus of three units at  $P_2$ . In this case, the buyers and sellers act in their self interest and bid the price down. Hence, when  $P \neq P_e$ , market forces push the price toward the equilibrium level. In this way, prices are determined in markets.<sup>9</sup>

The degree to which, and speed at which, prices adjust depend on the number of buyers and sellers in the market, the extent to which the products are homogeneous, and other market conditions. In any case, economists generally point to freely functioning markets as the most efficient mechanism for allocating scarce resources and producing what consumers want.<sup>10</sup>

## A.5 Producer and consumer surplus

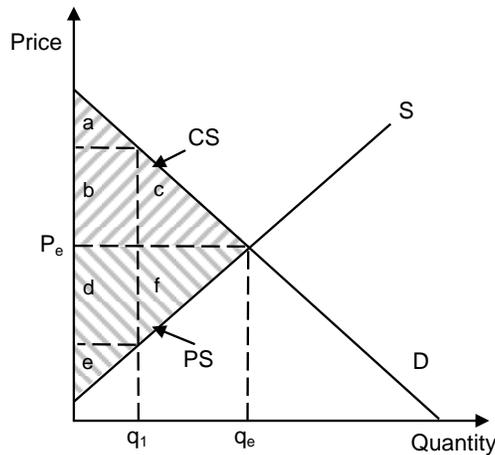
Economists gauge welfare or well being using producer surplus (PS) and consumer surplus (CS). Obviously, firms benefit from selling their products for prices in excess of their cost of production. This is typically referred to as “profit” conceptually similar to PS, simply the difference between the price they receive for producing and selling (the market price) and the minimum price they would be willing to accept (the cost of production, represented by the supply curve). So for all the transactions that occur in the market at the market equilibrium price, the PS is represented by the value of the triangle lying above the supply curve and below the horizontal line indicating the price. This is area  $(d+e+f)$  in Fig. A.11.

Consumers benefit when they engage in market transactions. Indeed, in order to willingly make a purchase, the consumer must expect the benefits from consumption to exceed the market price they pay. The difference between what a consumer is willing to pay (the expected benefit from consumption,

<sup>9</sup> This is true in competitive markets. For a discussion of the assumptions underlying this model, see Mankiw (2007).

<sup>10</sup> There are exceptions, however. They include externalities, public goods, and monopolies. These are typically considered to be cases in which government intervention can improve the efficiency of the free market. However, sometimes the government “solutions” to market failures are worse than the original problem (“State and Market” 1996).

represented by the demand curve) and what must be paid (the market price) is the CS. In other words, CS represents the value of the product to the consumer in excess of its price. For all consumers who make purchases at the market price, total CS is represented by the value of the triangle lying below the demand curve and above the market price line. This is shown as area  $(a+b+c)$  in Fig. A.11.



**Fig. A.11.** Producer and consumer surplus

The sum of the PS and CS areas is called the “social” or “total” surplus. It is a measure of the net benefits to consumers and producers who are engaging in transactions in the market. It is important to recognize that both parties – consumer and producer – benefit from these transactions. As a result, the maximization of market transactions tends to maximize welfare in society. (This assumes that transactions do not harm other parties not involved in the transactions. Such third party harms are called “externalities” and are discussed in Chap. 6.) So any restriction on the number of transactions leads to a reduction in the size of the social surplus. This is important in considering legal restrictions on gambling, for example. When the quantity of transactions,  $q_e$  in Fig. A.11, is artificially restricted to  $q_1$  the amounts of CS and PS are reduced. The social surplus that remains at the restricted quantity of  $q_1$  is  $(a+e)$ . The difference between initial levels (their sum) and the resulting sum represents the social cost of the quantity restriction.<sup>11</sup> Some of the benefits that would have occurred in a free market are now lost. (Social costs are discussed in detail in Chap. 6.)

## A.6 Summary

The PPF, IC, CS and PS are standard tools of economic analysis described in this appendix. We can analyze many of the economic and social costs and benefits of casino gambling using these tools. However, for more details on these and other important economic concepts, readers should consult an economics text such as Ferguson (1966) or Mankiw (2007).

<sup>11</sup> This statement is somewhat simplistic. There is no doubt that the social surplus and overall well being is lower than in an unrestricted market, but some of the benefits probably go to the sellers or the government from restricting quantity.