Unit 4. Consumer choice

Learning objectives

- to gain an understanding of the basic postulates underlying consumer choice: utility, the law of diminishing marginal utility and utility-maximizing conditions, and their application in consumer decision-making and in explaining the law of demand;
- by examining the demand side of the product market, to learn how incomes, prices and tastes affect consumer purchases;
- to understand how to derive an individual's demand curve;
- to understand how individual and market demand curves are related;
- to understand how the income and substitution effects explain the shape of the demand curve.

Questions for revision:

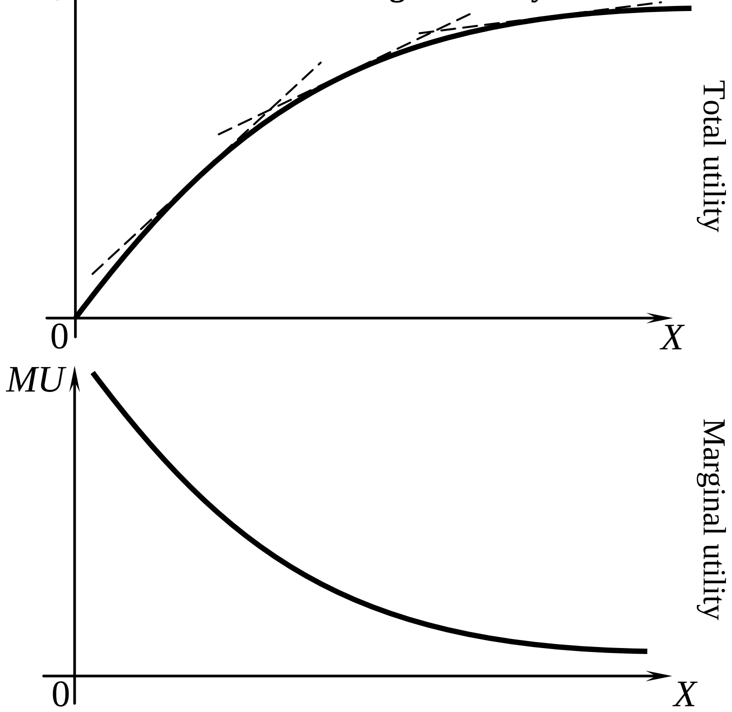
- ✓ Opportunity cost;
- ✓ Marginal analysis;
- ✓ Demand schedule, own and cross-price elasticities of demand;
- ✓ Law of demand and Giffen good;
- ✓ Factors of demand: tastes and incomes;
- ✓ Normal and inferior goods.

4.1. Total and marginal utility. Preferences: main assumptions. Indifference curves. Marginal rate of substitution

Tastes (preferences) of a consumer reveal, which of the bundles $X=(x_1,\ x_2)$ and $Y=(y_1,\ y_2)$ is better, or gives higher utility. Utility is a correspondence between the quantities of goods consumed and the level of satisfaction of a person: $U(x_1,x_2)$.

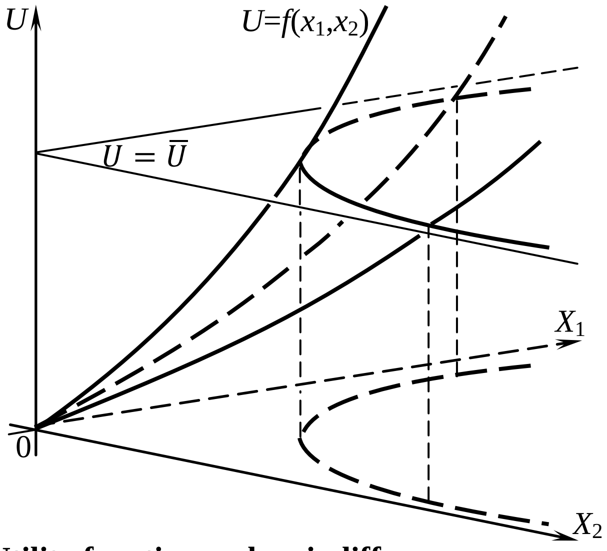
Marginal utility of a good shows an increase in total utility due to infinitesimal increase in consumption of the good, provided that consumption of other goods is kept unchanged. $MU_1 = \frac{\Delta U}{\Delta x_1}$ and $MU_2 = \frac{\Delta U}{\Delta x_2}$ are marginal utilities of the first and the second good correspondingly. Marginal utility shows the slope of a utility curve (see the figure below).

The law of diminishing marginal utility (the first Gossen law) states that each extra unit of a good consumed, holding constant consumption of other goods, adds successively less to utility. The slope of the utility curve is decreasing when more and more good is consumed – the tangent lines to utility curve become flater and flater (see the figure below). The principle of diminishing marginal utility has been originally based on Weber-Fechner's law in psychology and physiology: the power of succeeding disturbances is to increase to keep the level of reaction of a person unchanged.

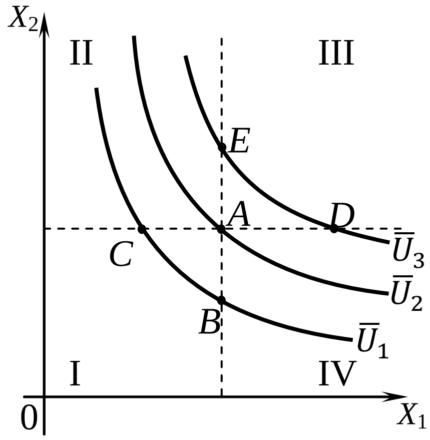


Total and marginal utility

A set of indifference curves is an alternative way to represent preferences of a consumer. An indifference curve shows all the consumption bundles that yield a particular level of utility (see the figure below).



Utility function and an indifference curve



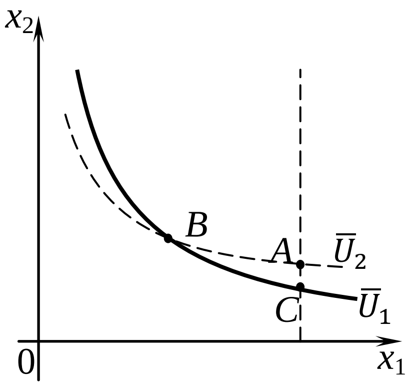
A set of indifference curves

Preferences are supposed to satisfy the following assumptions:

1. Completeness: Consumer can always make a choice between any two bundles *X* and *Y*.
2. Transitivity: If a bundle *X* is preferred to bundle *Y*, and *Y* is preferred to bundle *Z*, then *X* is preferred to *Z*.
3. Nonsatiation: More is preferred to less.
4. Continuity: in any neighborhood of a bundle (x_1,x_2) there are bundles that are superior and inferior to it as related to personal preferences.
5. Convexity: consumers prefer variety.

According to nonsatiation condition the bundles that lie above a given indifference curve are preferred to bundles on or below it. In other words, an indifference curve which is more distant from the origin corresponds to more preferable consumption bundles. It follows that the bundles which give the consumer the same level of utility as *A*, are situated either in the II or in the IV sections (see the figure at the right hand side above). Thus, an indifference curve is a decreasing correspondence between quantity of a good *y* and quantity of the other good (*x*).

Indifference curves cannot intersect



Transitivity assumption implies that indifference curves cannot intersect. Suppose, on the contrary, that indifference curves $\overline{U}_1$ and $\overline{U}_2$ intersect at the point *B* (see the figure at the left hand side). Nonsatiation assumption yields *U*(*A*)>*U*(*C*). The bundles *A* and *B* are situated on one and the same indifference curve $\overline{U}_1$, so consumer is indifferent which of the two to choose: *U*(*B*)=*U*(*C*).

The same consideration applies to the bundles *B* and *C*: the consumer is indifferent between them: *U*(*A*)=*U*(*B*). By transitivity assumption, the consumer has to be indifferent between *A* and *C* (*U*(*A*)=*U*(*C*)), so they should belong to one and the same indifference curve that contradicts the initial assumption (*U*(*A*)>*U*(*C*)). The contradiction proves that indifference curves cannot intersect.

According to convexity condititon indifference curves are assumed to be bowed inwards, or convex towards the origin.

Slope of indifference curve at a given bundle is given by the marginal rate of substitution (*MRS*) of the goods. *MRS* shows the quantity of good 2 consumer has to sacrifice to increase the consumption of good 1 by an infinitesimal unit, so as to keep total utility constant:

$$MRS_{12} = -\frac{\Delta x_2}{\Delta x_1}\bigg|_{U=const}.$$

Utility of the consumer is fixed on an indifference curve. For the change in total utility with a movement along an indifference curve to be zero, the utility gain (ΔU) due to the increase in consumption of the first good (Δx_1) should be equal in absolute value to the drop in utility ($-\Delta U$) caused by the decrease in consumption of the other one (Δx_2), i.e. $\frac{\Delta U}{\Delta x_1}\Delta x_1 = MU_1\Delta x_1 = -\frac{\Delta U}{\Delta x_2}\Delta x_2 = -MU_2\Delta x_2$. Rearrange to get:

$$MRS_{12} \equiv -\frac{\Delta x_2}{\Delta x_1}\bigg|_{U=const} = \frac{MU_1}{MU_2}.$$

The law of diminishing marginal rate of substitution: when the quantity a good consumed becomes smaller and smaller the consumer will have to give up with increasingly less amount of it to get an additional unit of the other good so as the level of utility to be kept unchanged. And vice versa: if consumption of a good goes up a consumer will have to give up with increasingly large amount of it for an additional unit of the other good to keep the level of satisfaction constant. The principle of diminishing marginal rate of substitution yields convex to the origin indifference curves.

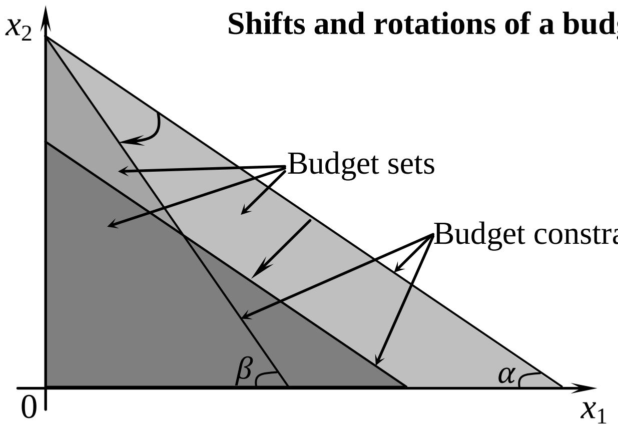
4.2. Budget constraint

Let's denote by $p_1 > 0$ the price of the first good, and by $p_2 > 0$ – the price of the second one. Let's denote by $M > 0$ the amount of money a consumer has got.

Budget constraint (line) is a combination of quantities of goods 1 and 2, that the consumer can just afford: $p_1x_1 + p_2x_2 = M$, or $x_2 = \frac{M}{p_2} - \frac{p_1}{p_2}x_1$. Budget constraint says that a consumer spends all her money to purchase the two goods. Budget set includes all the commodity buskets which are available to consumer. These are combinations of goods which lie on or below the budget constraint but above (or on) the horizontal and to the right of (or on) the vertical axis (see the figure below).

Slope of the budget line measures the rate at which the market is willing to substitute good 1 for good 2: $\frac{p_1}{p_2}$. It is equal to the relative price of the first good (with respect to the price of the second one). A change in price of a good is reflected by the rotation of the budget line around the intercept with the axis of the other good. For example, as a result of increase in the price of the first good the budget line rotates clockwise around the intercept with the vertical axis (see the figure below). The real (with respect to the price of the second good) income of the consumer gives an intercept of the budget constraint at the vertical axis: $\frac{M}{p_2}$. Variation of consumer's income results in a shift of the budget line. Its slope remains unchanged. For example, as a result of a cut in consumer's income the budget line shifts inwards (see the figure below). The intercepts at the vertical $\left(\frac{M}{p_2}\right)$ and horizontal $\left(\frac{M}{p_1}\right)$ axes will be closer to the origin.

Shifts and rotations of a budget line



4.3. Utility maximizing conditions

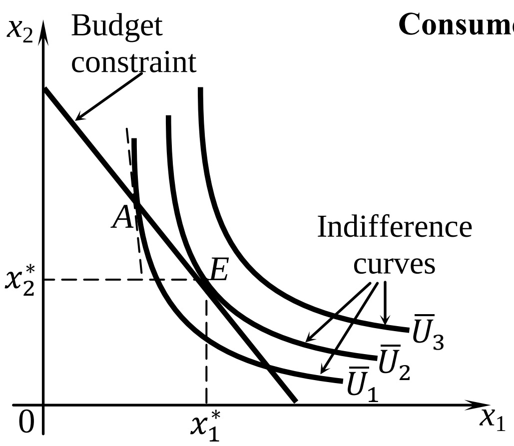
Consumer choise consists in maximizing utility under monetary budget constraint. Consumers choose the best bundle of goods they can afford. So there are two components of an optimal consumer's choice. A consumer is intended to choose the best and affordable consumption bundle (combination of two or more goods). The "best" bundle is characterized by preferences (indifference curves) and the corresponding utility functions. An affordable bundle is given by the budget constraint.

To maximize utility means to get onto the highest indifference curve which has at least one common point with the budget set. It is obvious that under the assumptions about preferences optimum of a consumer will be the tangency point of the highest affordable indifference curve and the budget line (see the figure below). So the slopes of the indifference curve and the budget line will be equal at the utility maximizing commodity bundle.

It follows that the optimum consumption bundle equates marginal rates of substitution in consumption $\left(MRSC_{12} = \frac{MU_1}{MU_2}\right)$ and exchange $\left(MRSE_{12} = \frac{p_1}{p_2}\right)$: $\frac{MU_1}{MU_2} = \frac{p_1}{p_2}$. The market trade-off is equal to the consumption trade-off required to maintain constant utility. A consumer is maximizing utility, when the marginal rate of substitution is equal to the price ratio (slope of the budget constraint):

$$MRS_{12} = -\frac{\Delta x_2}{\Delta x_1}\bigg|_{U=const} = \frac{MU_1}{MU_2} = \frac{p_1}{p_2}.$$

An indifference curve has the same slope as the budget constraint at the optimum consumption bundle. Nonsatiation condition implies that to maximize utility a consumer should spend this total income – the budget constraint holds as a strict equality.



It follows that the indifference curve is tangent to the budget constraint at the optimum consumption bundle. Indeed, suppose, for instance, that on the contrary, $\frac{MU_x}{MU_y} > \frac{p_x}{p_y}$, and the consumer is situated at the point *A*, where the slope of the budget constraint is less that the slope of the line tangent to indifference curve (see the figure above). In this case substituting the good *Y* for *X* in his commodity busket the consumer can increase the level of satisfaction and move along the budget line to the higher and higher indifference curves up to the point *E*, where the highest possible indifference curve is tangent to the budget constraint.

A consumer is maximizing utility, when the last ruble spent for each of the two goods should give the consumer one and the same additional utility: $\frac{MU_1}{p_1} = \frac{MU_2}{p_2}$. This is the so called second Gossen law.

In general, for a basket with arbitrary n number of goods the second Gossen law looks like the following:

$$\frac{MU_1}{p_1} = \cdots = \frac{MU_n}{p_n} = \lambda, \text{where } \lambda \text{ is a real number.}$$

It says that incremental utility of the last monetary unit spent for the good should be equal for all the goods consumed.

The expression $MU_i = \lambda p_i$, *i*=1,...,n, is the equation of marginal benefits (MU_i) and marginal costs (λp_i) of a consumer. It shows that marginal utility can be used to evaluate the price of demand for a good scaled by a multiplier λ.

4.4. Income effect and substitution effect. Normal and inferior goods. Substitutes and complements. Consumer choice and the law of demand

Adjustment to price changes can be decomposed into two effects: income effect and substitution effect. Due to substitution effect provided fixed personal welfare an individual increases consumption of the goods that become relatively cheaper and reduces consumption of the goods that become relatively more expensive. Income effect is a variation of purchasing power of a consumer's income caused by a fall or a rise in commodity prices. Due to income effect, for instance, as a result of fall in a price of a good a customer is able to increase consumption of the good without reducing consumption of another one.

Net effect of a price change is the sum of substitution effect and income effect:

$$\Delta x_p = \Delta x_{SE} + \Delta x_{IE}.$$

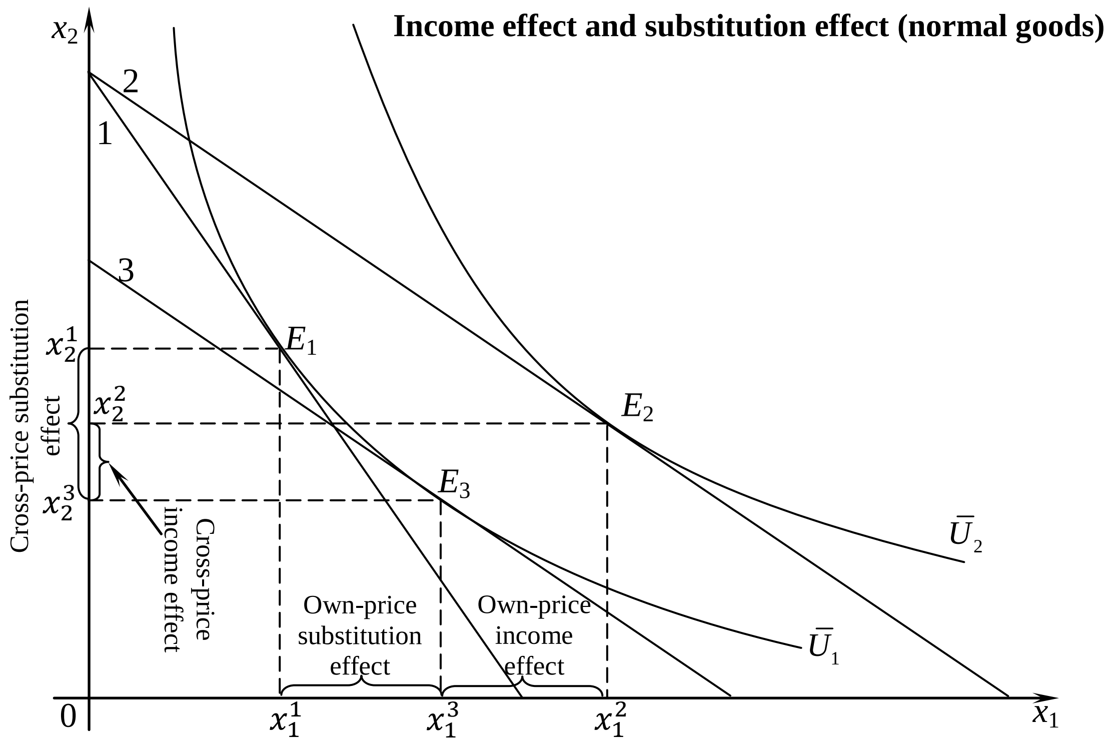
Let's consider the relative changes in consumption, i.e. changes with respect to variation of price:

$$\frac{\Delta x}{\Delta p} = \left.\frac{\Delta x}{\Delta p}\right|_{M=const} + \frac{\Delta x}{\Delta M}\frac{\Delta M}{\Delta p} = \left.\frac{\Delta x}{\Delta p}\right|_{M=const} - x\frac{\Delta x}{\Delta M}.$$

It should be noted here that a change in real income (purchasing power) can be treated as the ability to spend more (or less) money for the good *x*: $\Delta M = -x\Delta p$. Constant real income can be treated as the ability to achieve one and the same level of utility. As a result adjustment of a consumer's choise to a price change can be expressed by Slutsky equation:

$$\frac{\Delta x}{\Delta p} = \left.\frac{\Delta x}{\Delta p}\right|_{U=const} - x\frac{\Delta x}{\Delta M}.$$

Income effect and substitution effect (normal goods)

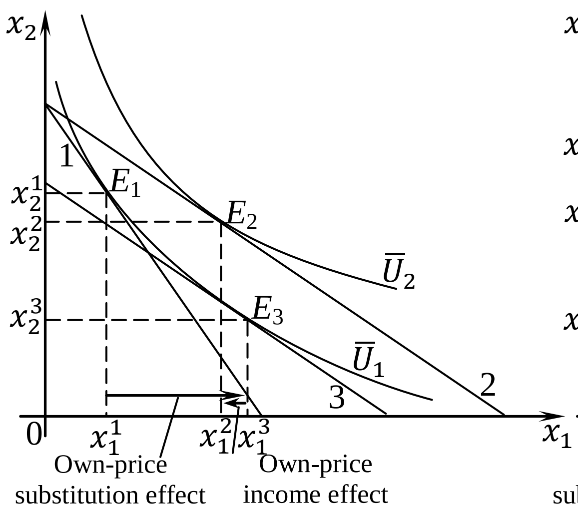


For any good (normal or inferior) substitution effect leads to reduction in quantity demanded in response to increase in own price.

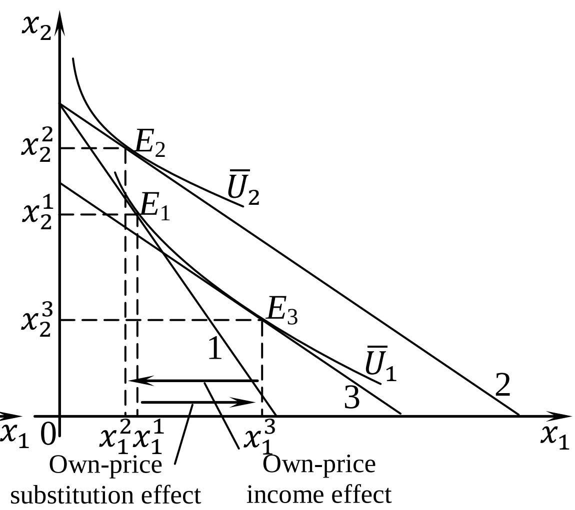
For an inferior good income effect leads to increase in quantity demanded in response to increase in own price. The figures at the left hand side of the graph below depict income and substitution effects for an inferior good that is not a Giffen good.

Giffen good is an inferior good, in case when income effect dominates substitution effect. Quantity demanded increases in response to increase in own price. The figures at the right hand side of the graph below depict income and substitution effects for a Giffen good.

Income effect and substitution effect (inferior but not Giffen good)

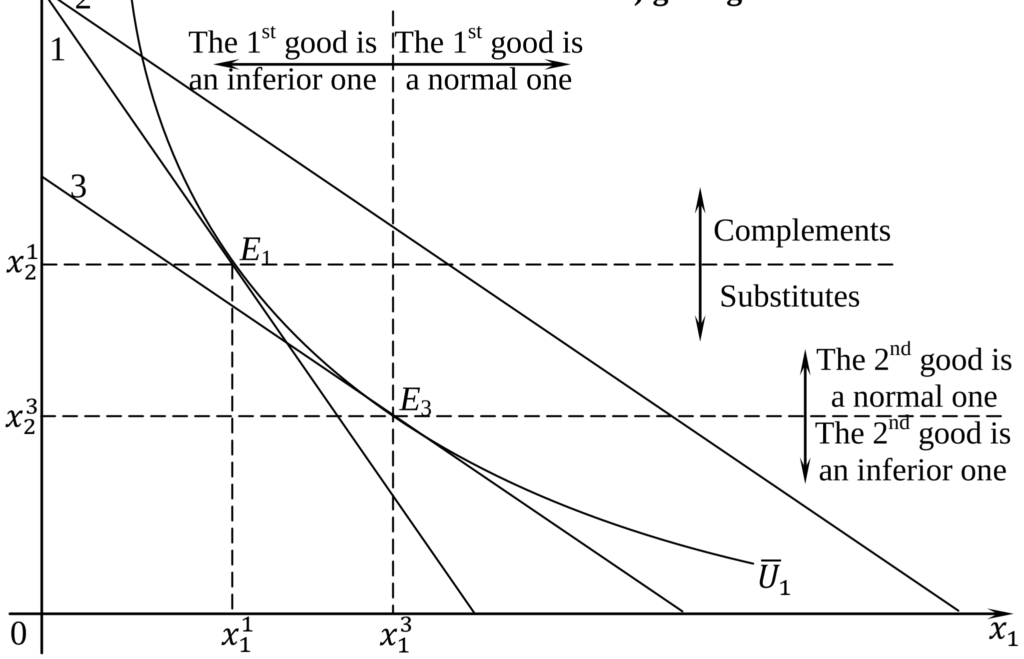


Income effect and substitution effect (Giffen good)



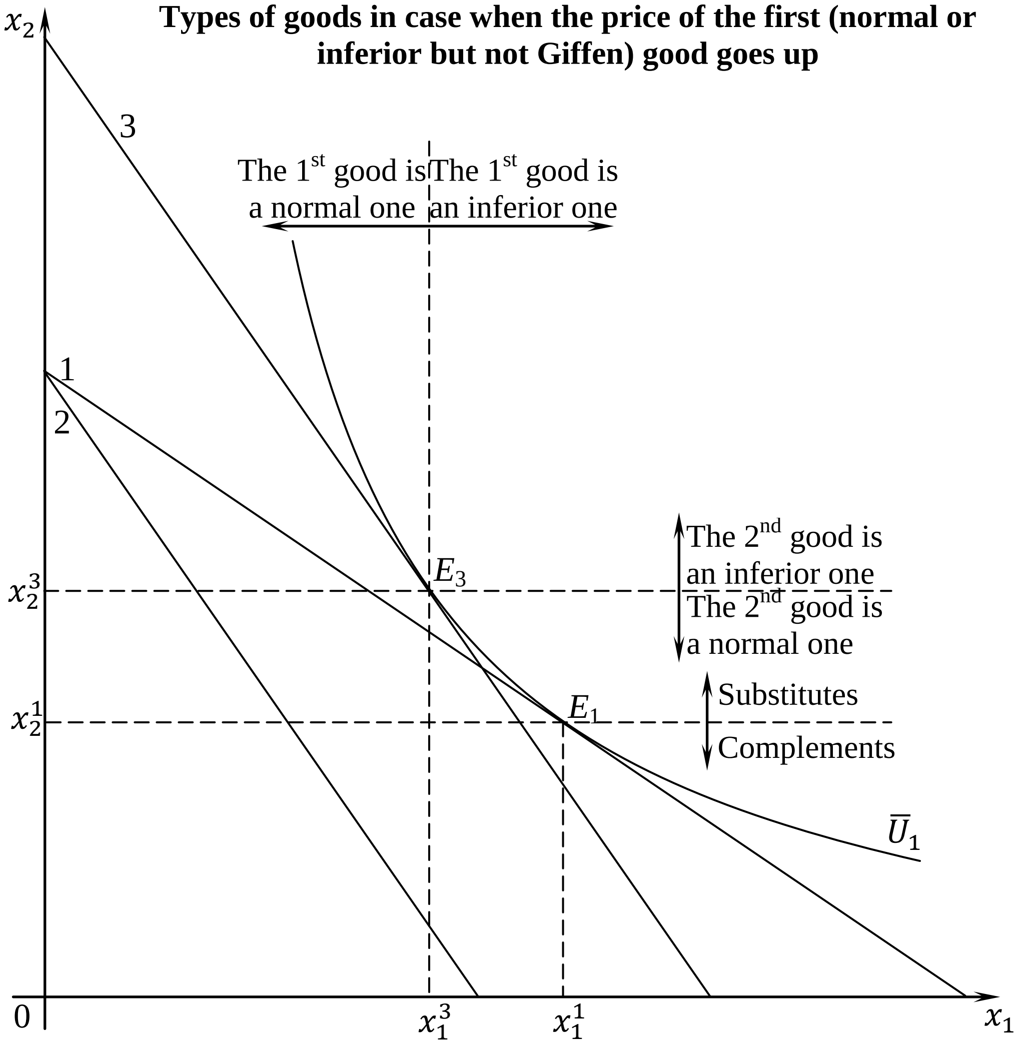
If the goods are substitutes and the law of demand is valid, quantity of the first good demanded changes in the same direction as price of the second one[1]. In case of complements quantity of the first good demanded and price of the other good move in opposite directions if the law of demand is valid (see the two figures below).

Types of goods in case when the price of the first (normal or inferior but not Giffen) good goes down

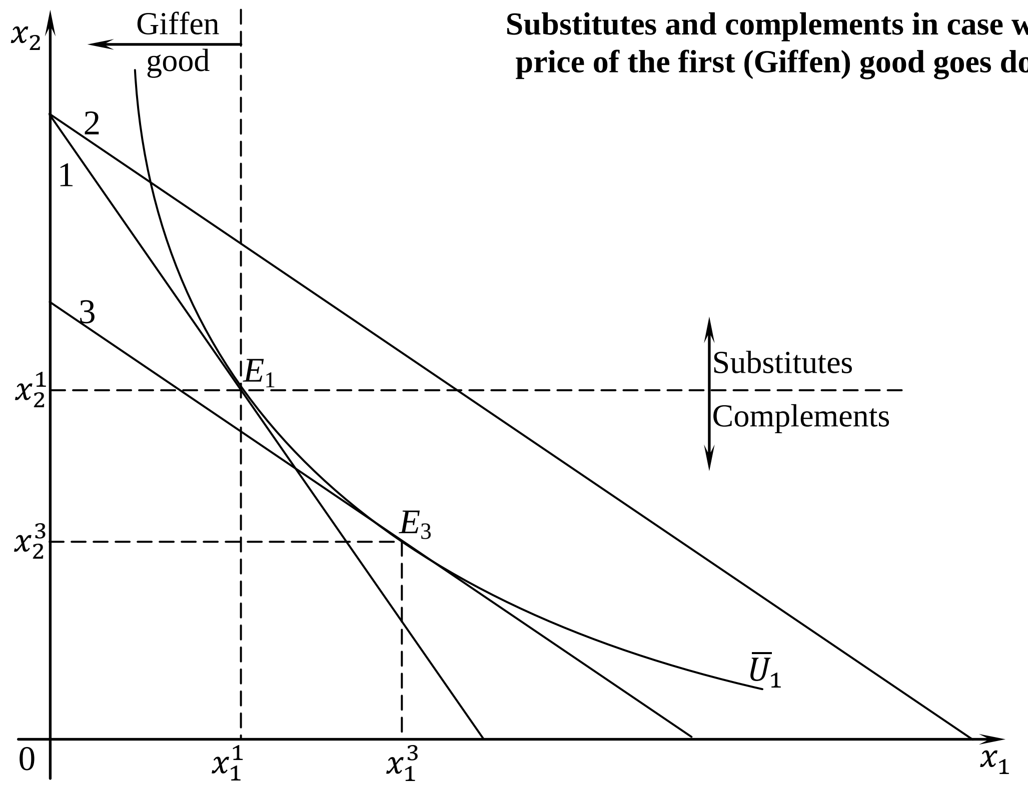


[1] Recollect discussion of demand shifters in unit 2 "Supply and demand".

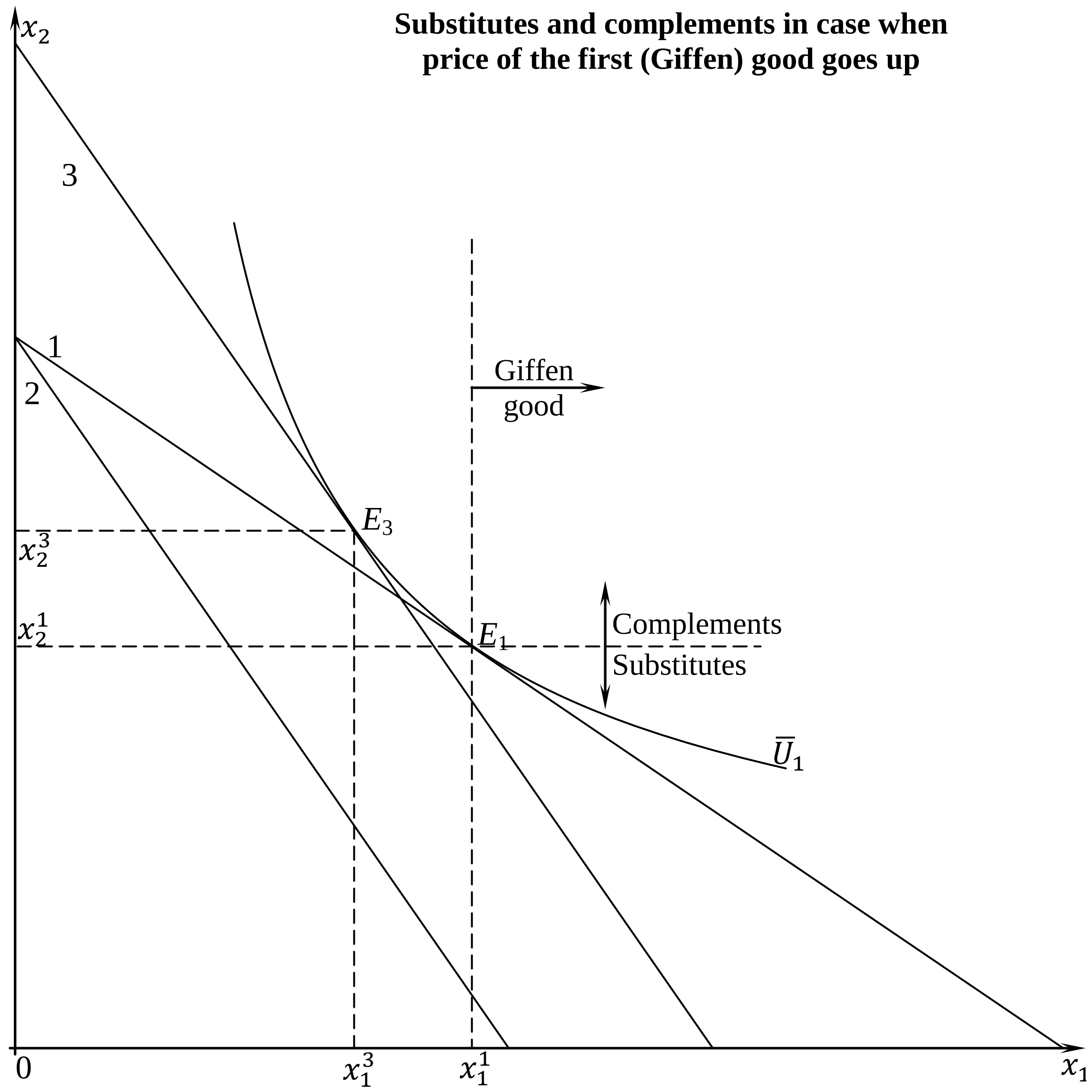
Types of goods in case when the price of the first (normal or inferior but not Giffen) good goes up



Let's now consider the exception of the law of demand. If the price for the Giffen good goes up, its consumption will go up as well. The demand for its substitute will go down, and the demand for its complement will go up (see the two figures below).



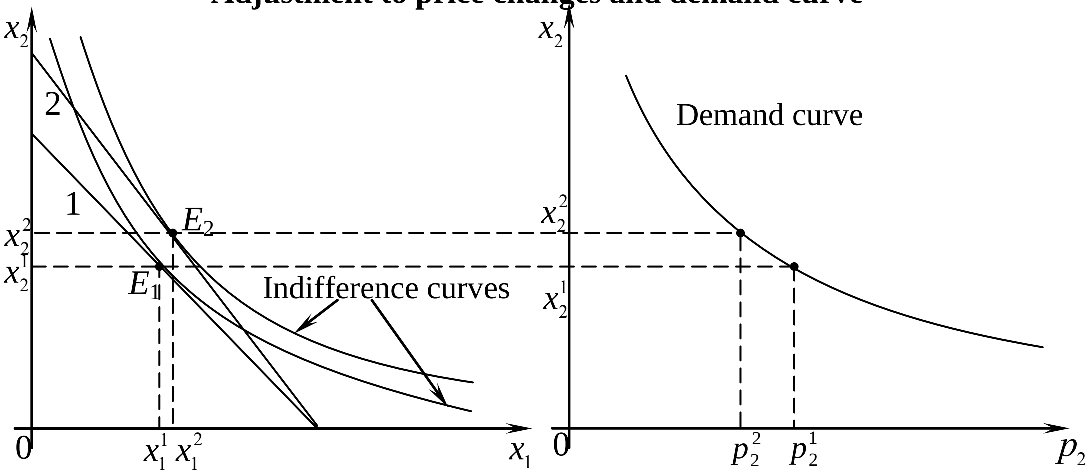
Substitutes and complements in case when price of the first (Giffen) good goes down



Substitutes and complements in case when price of the first (Giffen) good goes up

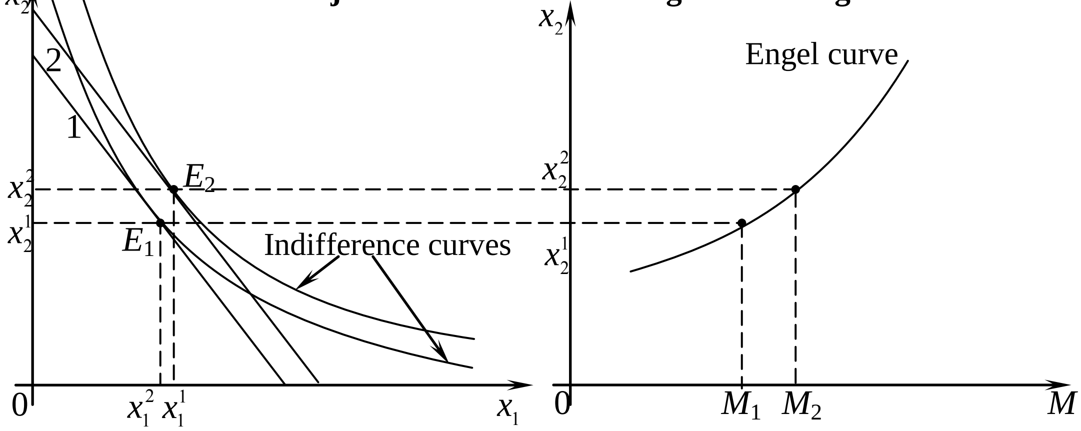
Individual demand curve shows quantity demanded of a good at every possible price of this good, keeping everything else (prices of other goods and income of the consumer) fixed.

Adjustment to price changes and demand curve

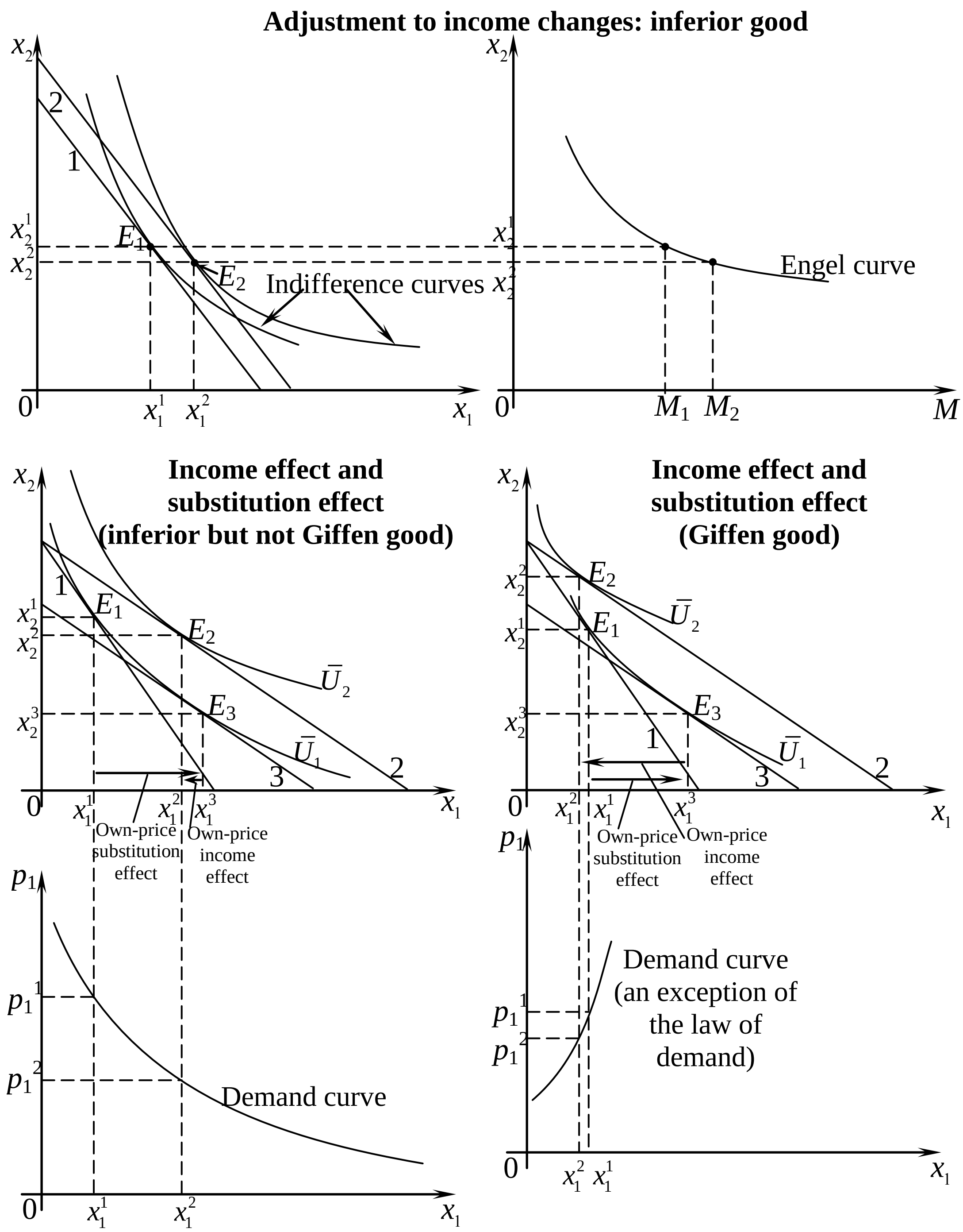


Income is a factor that shifts demand curve. A good is normal if the quantity demanded goes up with an increase in consumer's income. A good is inferior if the quantity demanded goes down with an increase in consumer's income.

Adjustment to income changes: normal good

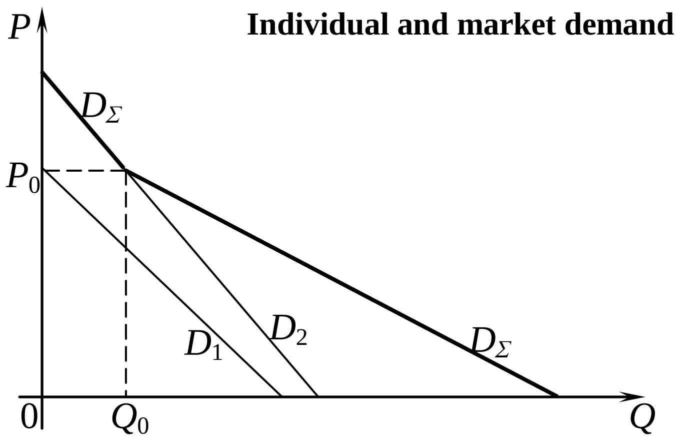


For an inferior good Engel curve is downward sloping (see the figure below).



Market demand curve for a particular good is the sum of quantities demanded by all consumers at each price, i.e. horizontal sum of individual demand curves (see the figure below). With a large number of consumers one can get a smooth curve.

Individual and market demand



Suppose, for example, that there are three groups of consumers in the market with the following inverse demand curves: P_d=10–2,5Q, P_d=7,5–3,75Q, P_d=5–Q. The corresponding direct demand curves are: Q_d=4–0,4P, Q_d=2–$^4/_{15}P$, Q_d=5–P. If 7.5<P⩽10 (0⩽Q<1) market demand coincides with individual demand of the first group: P_d=10–2,5Q. If 5<P⩽7.5 market demand is the horizontal sum of the first two groups: Q_d=6–⅔P, i.e. P_d = 9–1.5Q when 1⩽Q<2⅔. If 0<P⩽5 market demand is the horizontal sum of demand schedules of all three groups: Q_d=11–1⅔P, i.e. P_d = 6.6–0.6Q when 2⅔⩽Q⩽11. Thus, the market demand curve consists of three segments (see the figure below):

$$P = \begin{cases} 10 - 2{,}5Q, \text{if } 0 \leqslant Q < 1; \\ 9 - 1.5Q, \text{if } 1 \leqslant Q < 2⅔; \\ 6.6 - 0.6Q, \text{if } 2⅔ \leqslant Q \leqslant 11. \end{cases}$$