

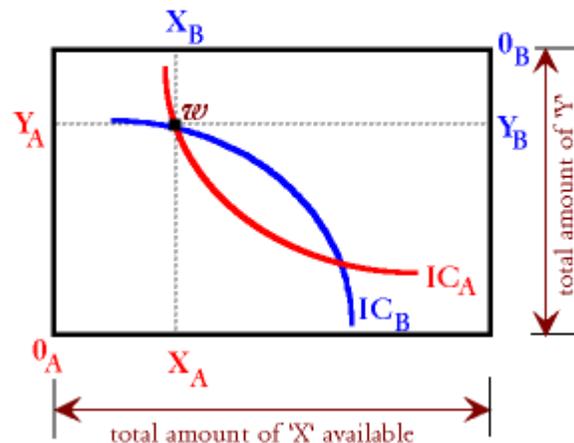
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Lecture 6 – Exchange

Usually, we study the behavior of the markets using the traditional supply and demand framework. Through the use of supply and demand, we have determined the equilibrium price and equilibrium quantity in different types of markets. This type of analysis of market conditions is called **partial equilibrium analysis** where we look at the determinants of price and quantity in a particular market holding all other markets constant.

A natural extension to the above type of analysis is **general equilibrium analysis** or how demand and supply conditions interact in several markets to determine the price of many goods. A common tool in general equilibrium analysis is the **Edgeworth box** that allows the study of the interaction of *two individuals* trading *two different commodities*. This type of analysis draws on the use of indifference curve analysis to analyze this trading behavior.

Figure 1, The Edgeworth Box



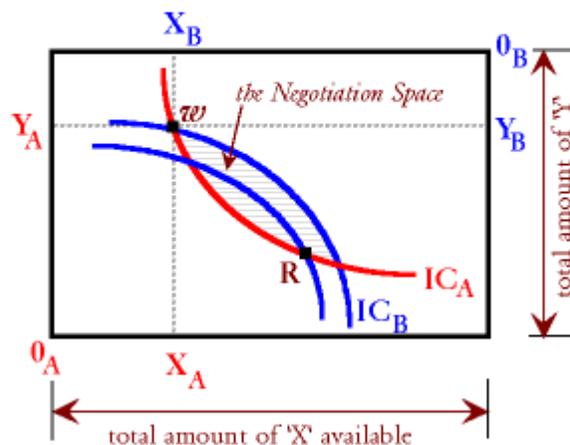
The lower left-hand corner represents the origin for consumer 'A' and the upper right-hand corner represents the origin for consumer 'B'. Person A's preferences (*indifference curves*) are convex to the origin O_A . Person B's preferences are convex to O_B .

Moving to the right means that person 'A' has more of commodity 'X' and person 'B' has less of that commodity. Moving upwards means that person 'A' has more of commodity 'Y' and person 'B' has less. Moving in the northeast direction makes person 'A' better off. Moving in the southwest direction makes person 'B' better off.

Rather than introduce budget lines for the two consumers, the Edgeworth box uses the concept of **initial endowments**. An initial endowment ' W ' represents the amount of commodities X & Y individuals A & B have available before trade. Thus $(X_A, Y_A) = W_A$ and $(X_B, Y_B) = W_B$ where W_A and W_B represents A's and B's initial *endowments* (or *income*). The height of the Edgeworth box represents the total amount of commodity 'Y' available and the width of the Edgeworth box represents the total amount of commodity 'X' available. In the absence of any production, the dimensions of the box remain constant.

One goal of general equilibrium analysis is to determine if it is possible to make individual 'A' and/or individual 'B' better off through the *process of exchange* given their initial endowments. For example a trade such that these two individuals move from ' W ' to point ' R ' in the diagram below would make person 'B' better-off with out harm to 'A':

Figure 2, A Pareto Improvement



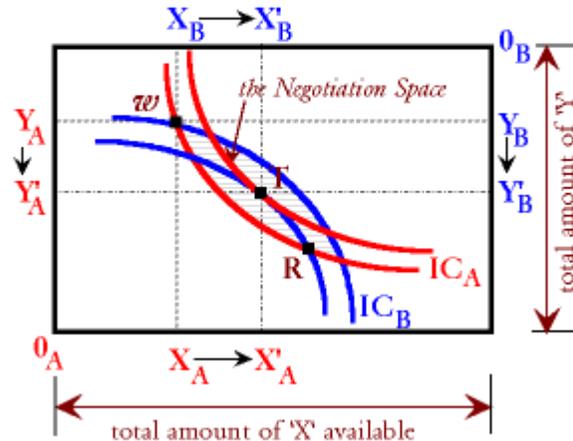
Any trade that puts these two individuals into, or on the border of, the shaded area will make one or both individuals better off. This is known as a **Pareto Improvement**. As long as any Pareto Improvements remain, an incentive for trade exists between these two agents.

The set of bundles that represent Pareto Improvements relative to the endowment point is known as the **Negotiation Space** and shown as the shaded (American) football shaped region in the above diagram. Any movement into, or on the border, of this region will make one or both individuals better off without any harm imposed on the other.

An optimal allocation of commodities is determined by the concept of **Pareto optimality**. A Pareto optimal allocation of commodities is that allocation where *it is not possible to make one person better off without making any other person worse off*. This is

shown graphically in the diagram below where the indifference curves of person 'A' are just tangent to person 'B' as occurs at point 'T'.

Figure 3, A Pareto Optimum



If, for example, the two consumers are at the initial endowment point 'W', it is possible to make person 'B' better off by moving to point 'R' without making person 'A' worse off (a movement along person A's indifference curve). A second trade could be the movement towards point 'T' that would make person 'A' better off without making person 'B' worse off. This trade (from W to T) would make both person 'A' and person 'B' better off.

You might remember that the slope of an indifference curve dy/dx is just the ratio of the marginal utilities of goods 'X' & 'Y' (or: $dy/dx = MU_x / MU_y = MRS^{xy}$) thus the condition for **Pareto Optimality** may be properly defined as that point where:

$$MRS_A = MRS_B .$$

The next step in general equilibrium analysis is the determination of how this movement actually takes place from the initial endowment to a Pareto efficient allocation. This movement is accomplished through the price system where the relative prices between goods 'X' & 'Y' represent the **terms of trade** between the two individuals. The slope of any line passing through the endowment point represents this price ratio of commodity X and commodity Y. Thus if that line is relatively steep, commodity X is relatively more expensive than commodity Y. If the line is relatively flat, then the opposite is true.

Through some hypothesized auction process (where different price ratios are called out), a market, or competitive, equilibrium will be established at that point (a **Pareto Optimum**), where:

$$MRS_A^{xy} = (MU_X^i / MU_Y^i) = MRS_B^{xy} = (P_x / P_y) \text{ for } i = A, B$$

Be sure that you are familiar with the following concepts and terms:

- Edgeworth Box
- Endowment (Point)
- General Equilibrium Analysis
- Indifference Curve(s)
- Marginal Rate of Substitution
- Negotiation Space
- Pareto Improvement
- Pareto Optimum
- Partial Equilibrium Analysis
- Relative Prices

Optimizing Conditions Discussed:

$MRS^i = P_x / P_y$ for $i = 1 \dots m$ Consumers.

$MRS^A = MRS^B \Rightarrow$ * A Pareto Optimum – Efficiency in Exchange*

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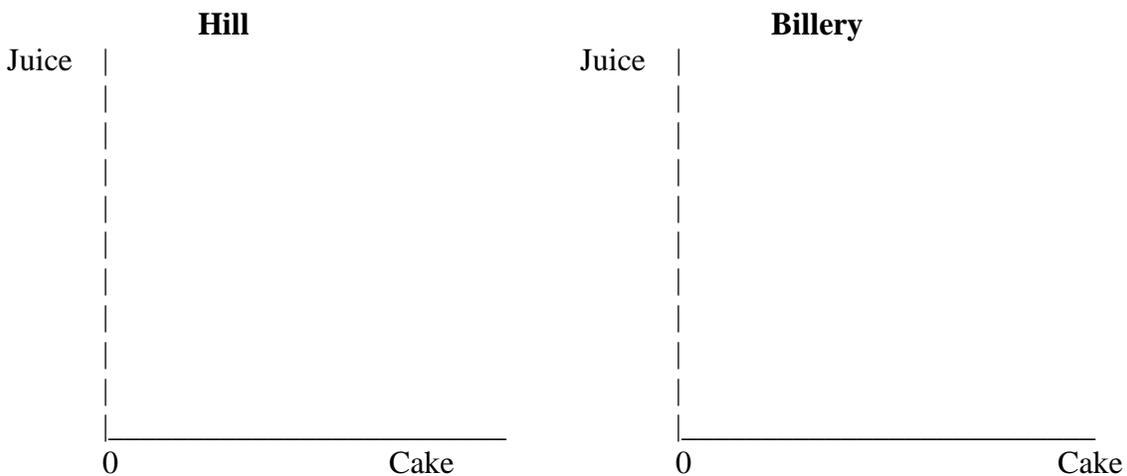
Worksheet #5: Consumer Theory & Exchange

The Adventures of Hill and Billery

Billery and Hill live in Pleasantown. Life is good, life is simple. Hill and Billery have just met. Hill says “I like juice”. Billery says “I like cake”. “Oh yes!” says Hill, “I like cake too”. Billery says “I also like juice”. Simple life, *simple* preferences.

For Hill, juice and cake are *perfect complements* such that she likes to consume 1 bottle of juice while eating one cake. Billery treats these two goods as *perfect substitutes* such that his marginal rate of substitution for juice and cake is always 1:1.

The price of juice (P_j) is \$2.00 and the price of cake (P_c) is \$4. Hill and Billery each have the same income of \$60.00. Identify an individual consumer optimum for each person by drawing the budget line and indifference curve that corresponds to the highest level of utility in the diagrams below:



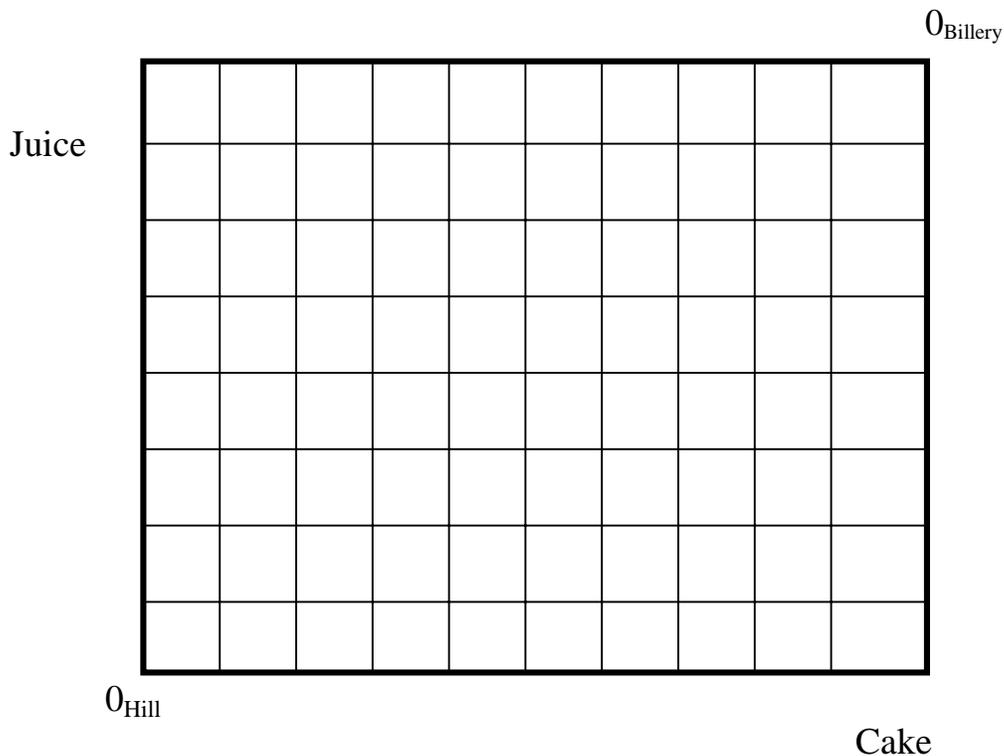
In the above diagrams, show how Hill and Billery will respond to a reduction in the price of Cake to \$3 ($P_c' = \3).

In Pleasantown, life is *always* pleasant. Nothing is inferior. Discuss why both goods for Hill and Billery must always be *normal goods*.

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2. As two people often do, Hill and Billery enter into a courtship. Courtship involves negotiation. Hill has an endowment of 6 bottles of juice and 2 units of cake. Billery enters the union with an endowment of 2 bottles of juice and 8 units of cake. There is no production of either of these two goods.

Using this information, identify the endowment point for Hill and Billery in the Edgeworth box diagram below. Draw in appropriate indifference curves for each person passing through this endowment point. Remember that Hill's preferences are perfect complements and Billery's preferences are perfect substitutes. (*Life is still practically perfect in every way* -- identify the negotiation space defined by the initial endowment point.



Will these two individuals trade with one-another? _____ If so, what are the potential outcomes of trade?

Suppose that Hill offers Billery a terms of trade of 1 juice for 3 units of cake. Would Billery accept these *terms*? _____ Explain.