

# General Equilibrium

APEC 3001

Summer 2006

Readings: Chapter 16

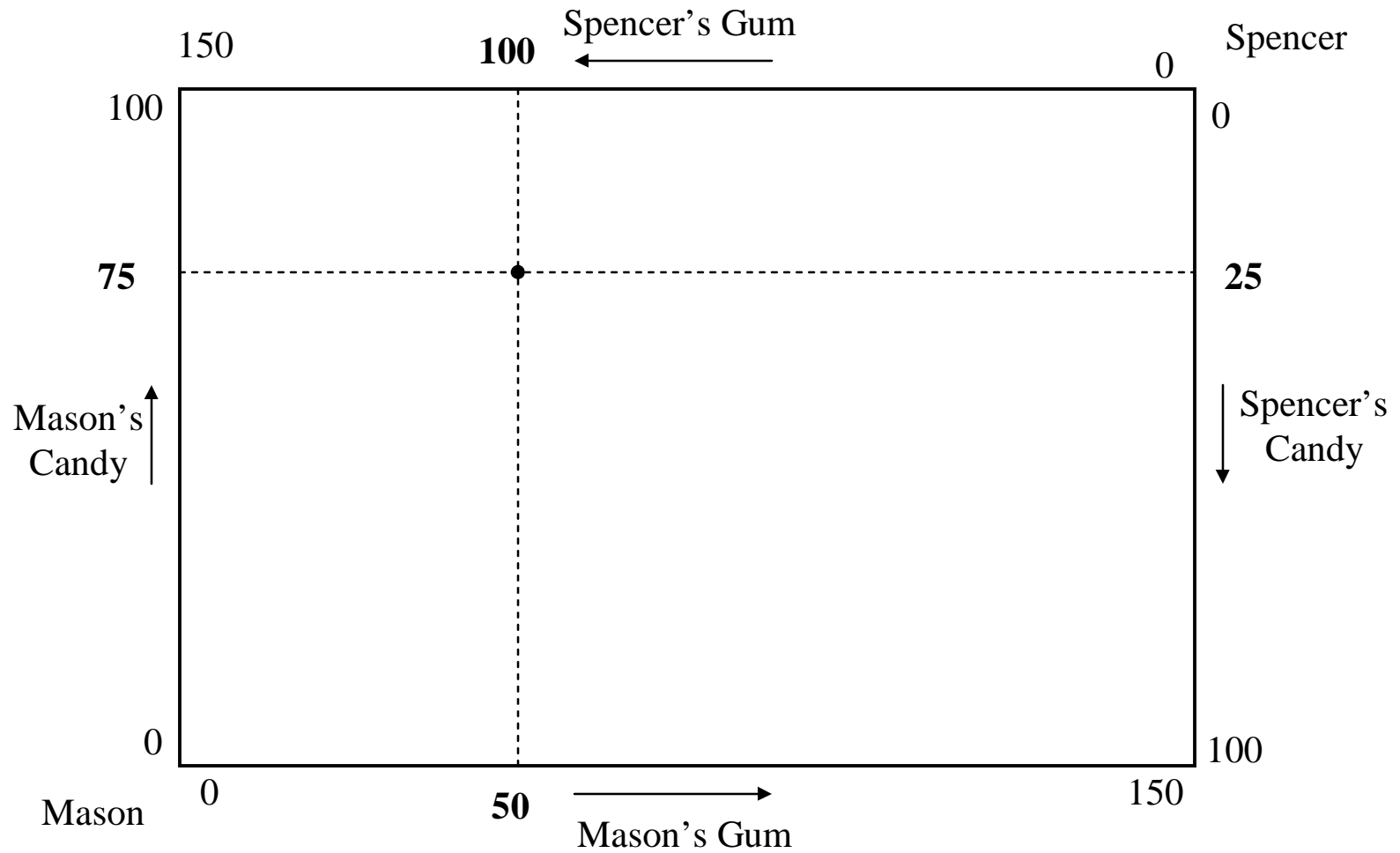
# Objectives

- General Equilibrium
  - Exchange Economy
  - With Production
- First & Second Welfare Theorems

# General Equilibrium

- Definition:
  - The study of how conditions in each market in a set of related markets affect equilibrium outcomes in other markets in that set.
- Example of Exchange Economy
  - Two people: Mason & Spencer
  - Initial Endowments:
    - Mason: 75 pieces of candy & 50 pieces of gum.
    - Spencer: 25 pieces of candy & 100 pieces of gum.
    - Total: 100 pieces of candy & 150 pieces of gum.
- Edgeworth Exchange Box:
  - A diagram used to analyze the general equilibrium of an exchange economy.

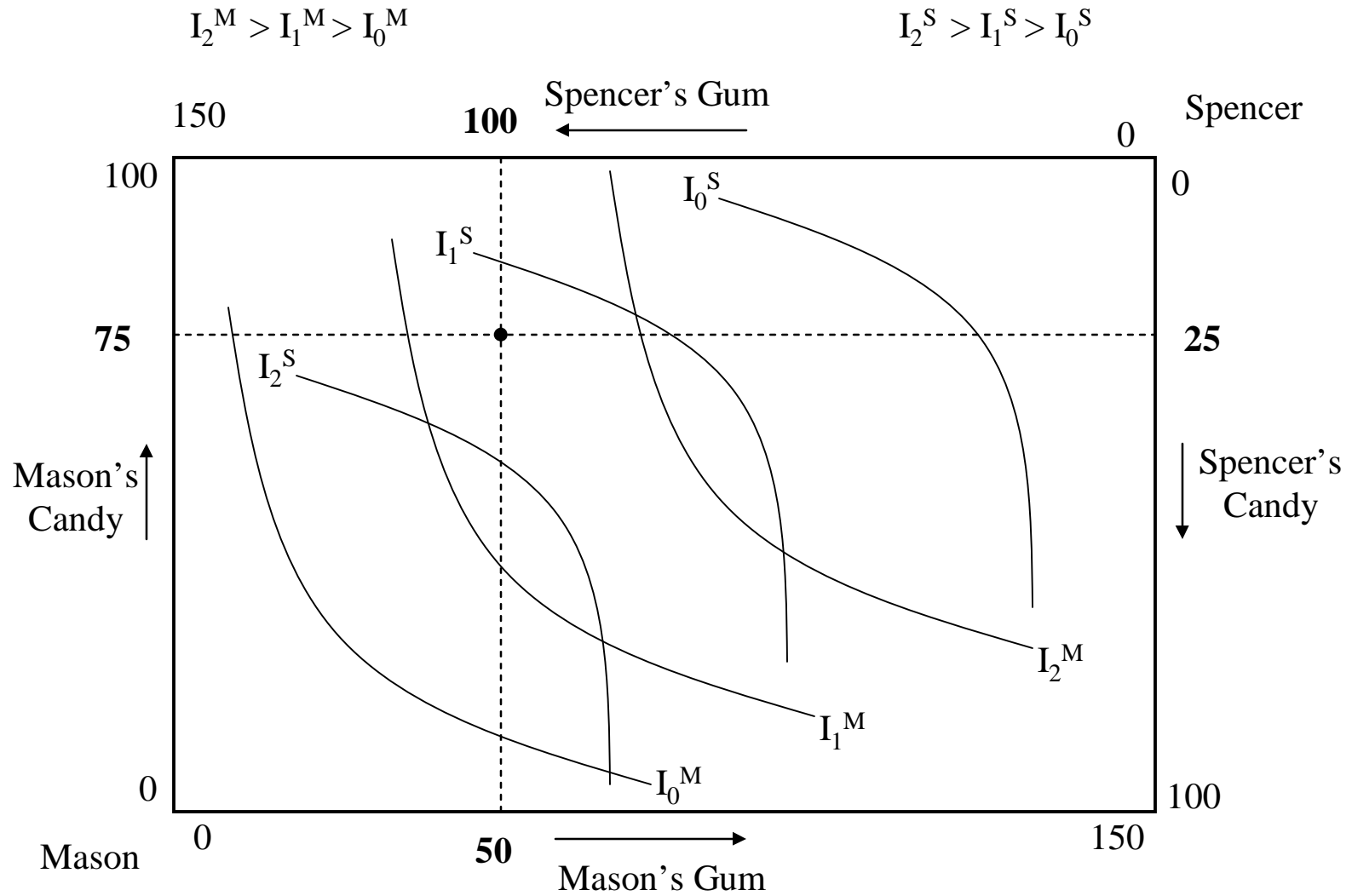
# Graphical Example of Edgeworth Exchange Box



## Question: Can Mason & Spencer do better?

- To answer this question, we need to know something about Mason & Spencer's preferences.
- Assume:
  - Complete
  - Nonsatiable
  - Transitive
  - Convex
- Implication:
  - Mason & Spencer have utility functions that produce indifference curves that
    - represent higher levels of satisfactions as we move away from the origin,
    - are ubiquitous,
    - are downward sloping,
    - cannot cross, &
    - are bowed toward the origin.

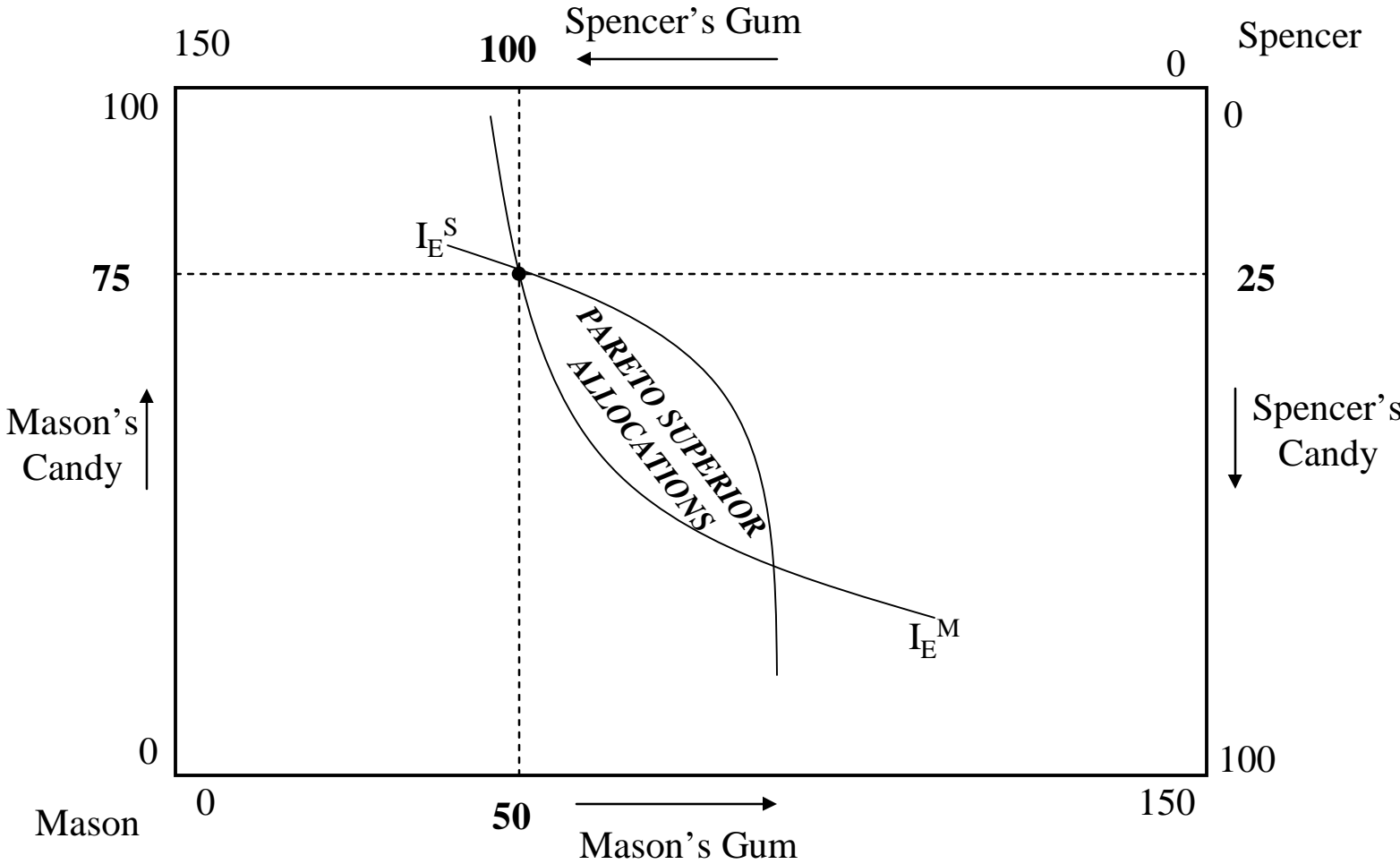
# Edgeworth Exchange Box With Indifference Curves



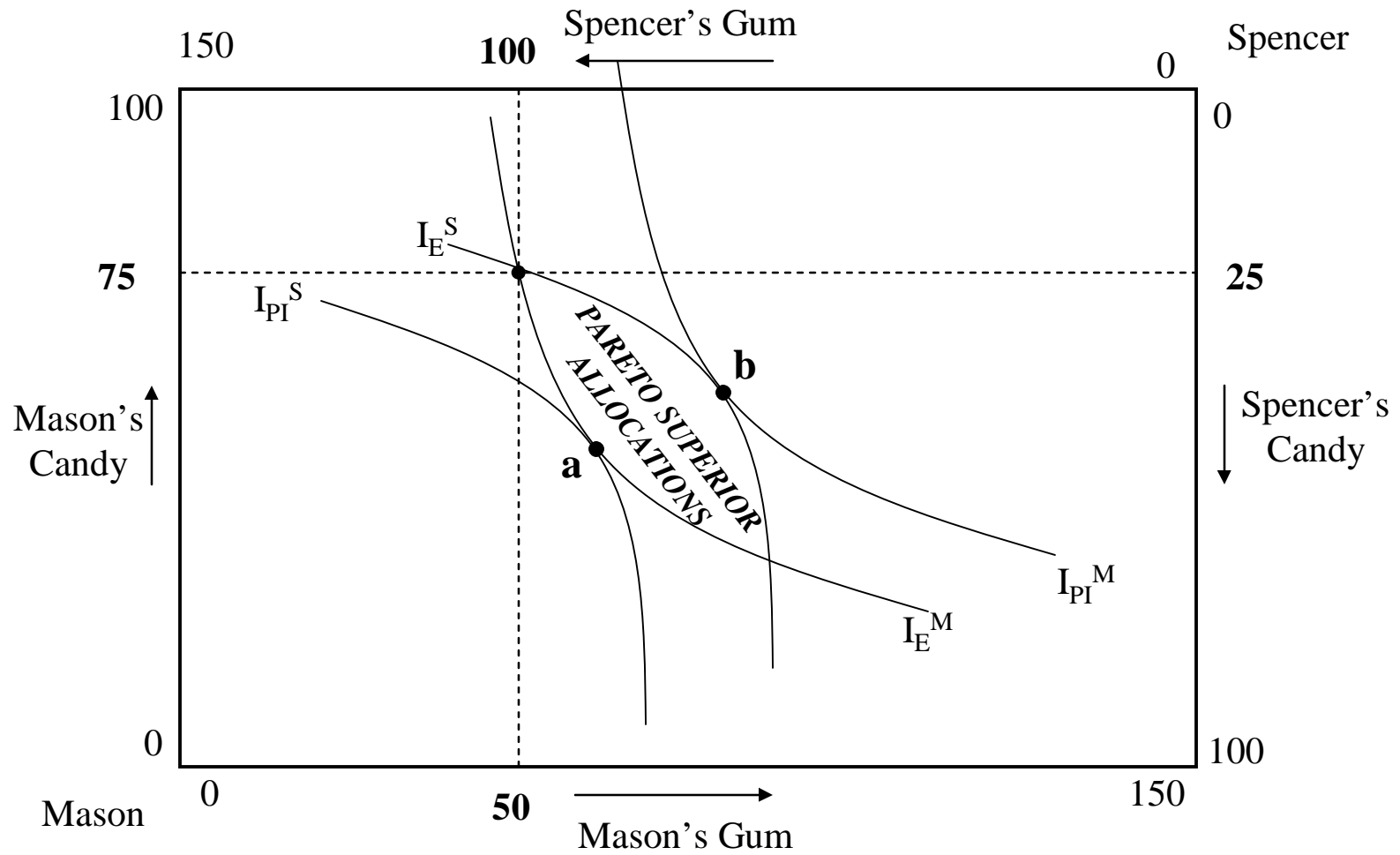
## How can Mason & Spencer do better?

- Pareto Superior Allocation:
  - An allocation that at least one individual prefers and others like at least equally as well.
- Pareto Optimal Allocation:
  - An allocation where it is impossible to make one person better off without making at least one other person worse off.
- Consider the indifference curves for Mason & Spencer that intersect the initial endowment.

# Gains From Trade



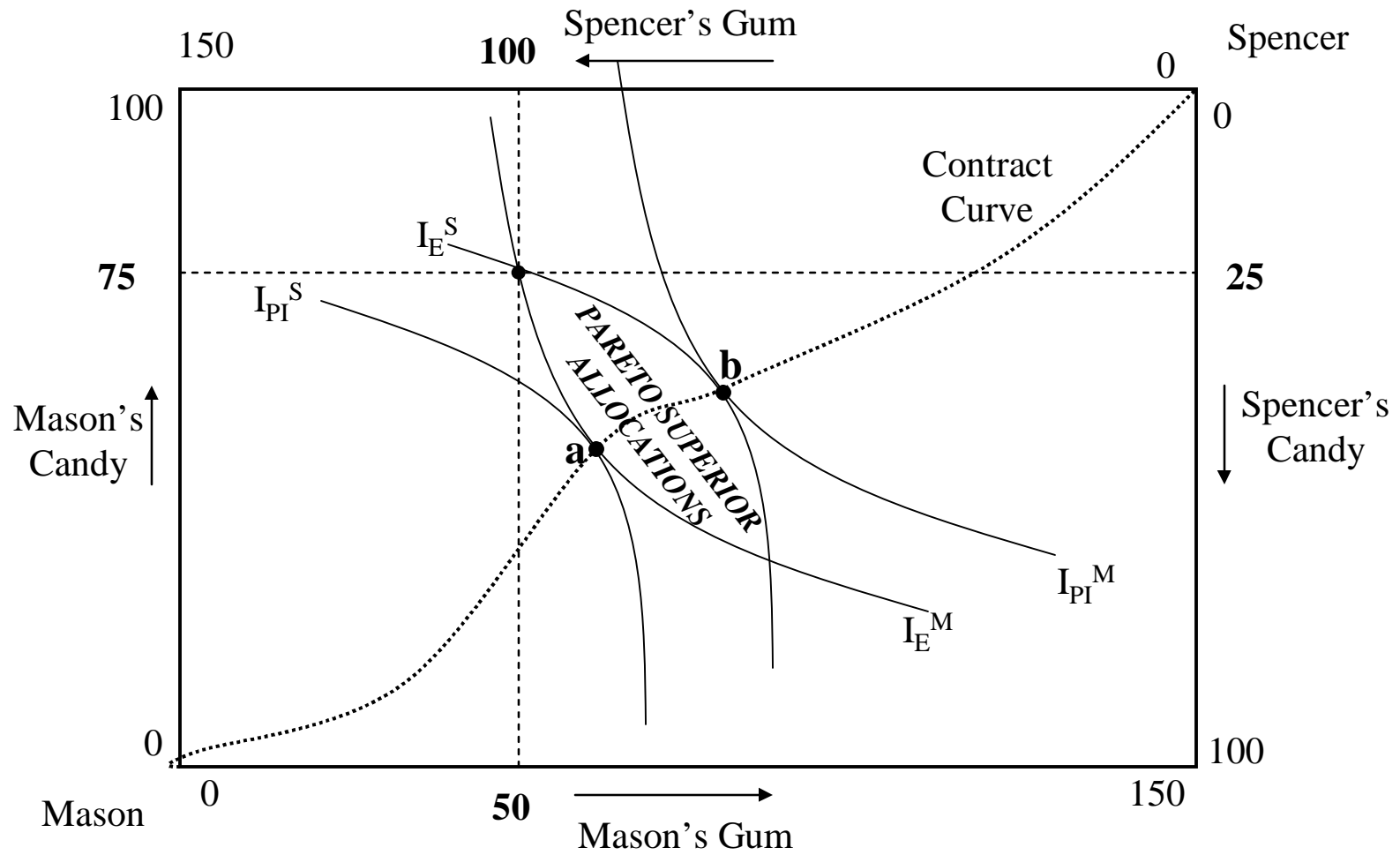
# Pareto Optimal Allocations



# What are the Pareto Optimal allocations?

- Contract Curve:
  - The set of all Pareto optimal allocations.

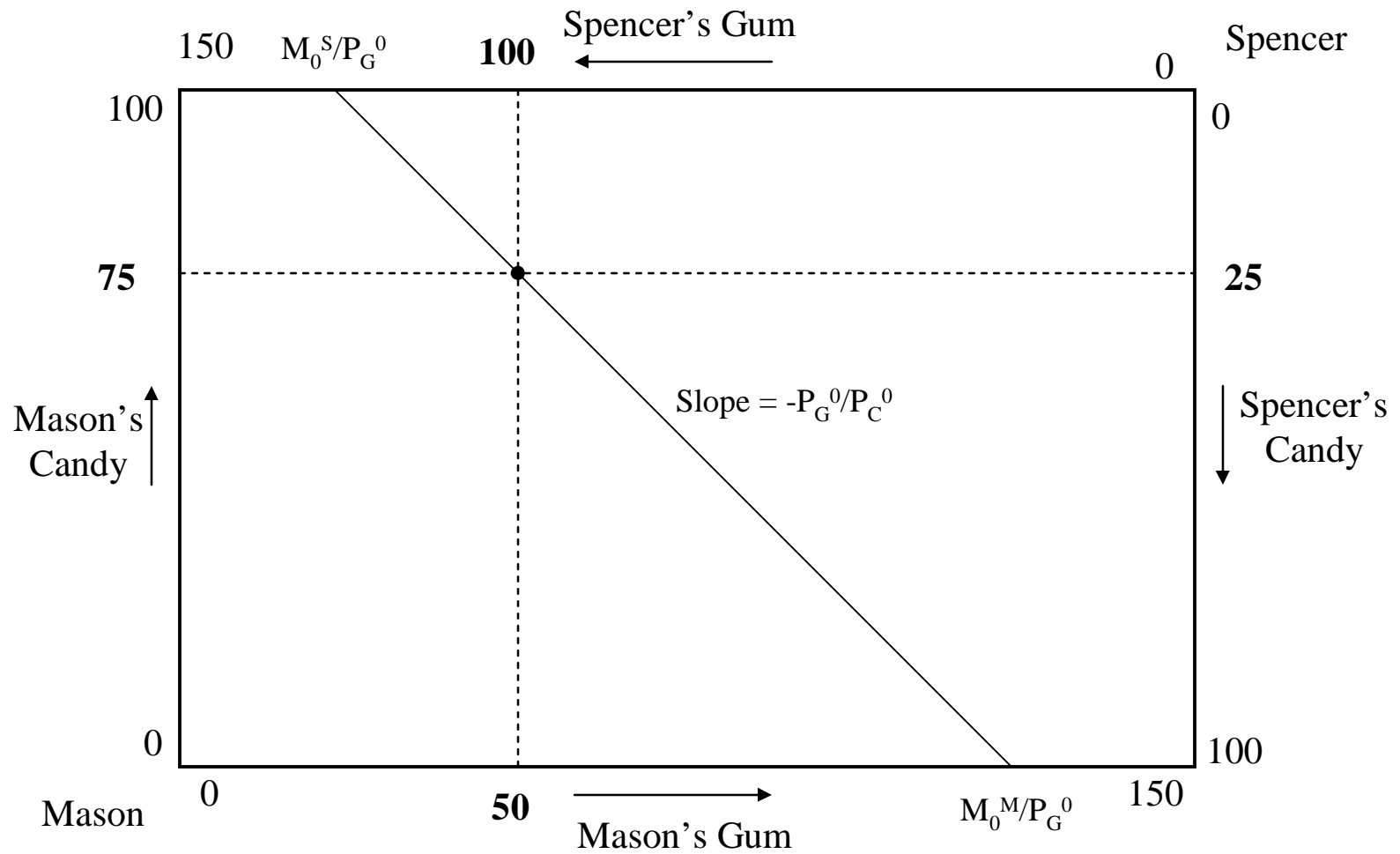
# The Contract Curve



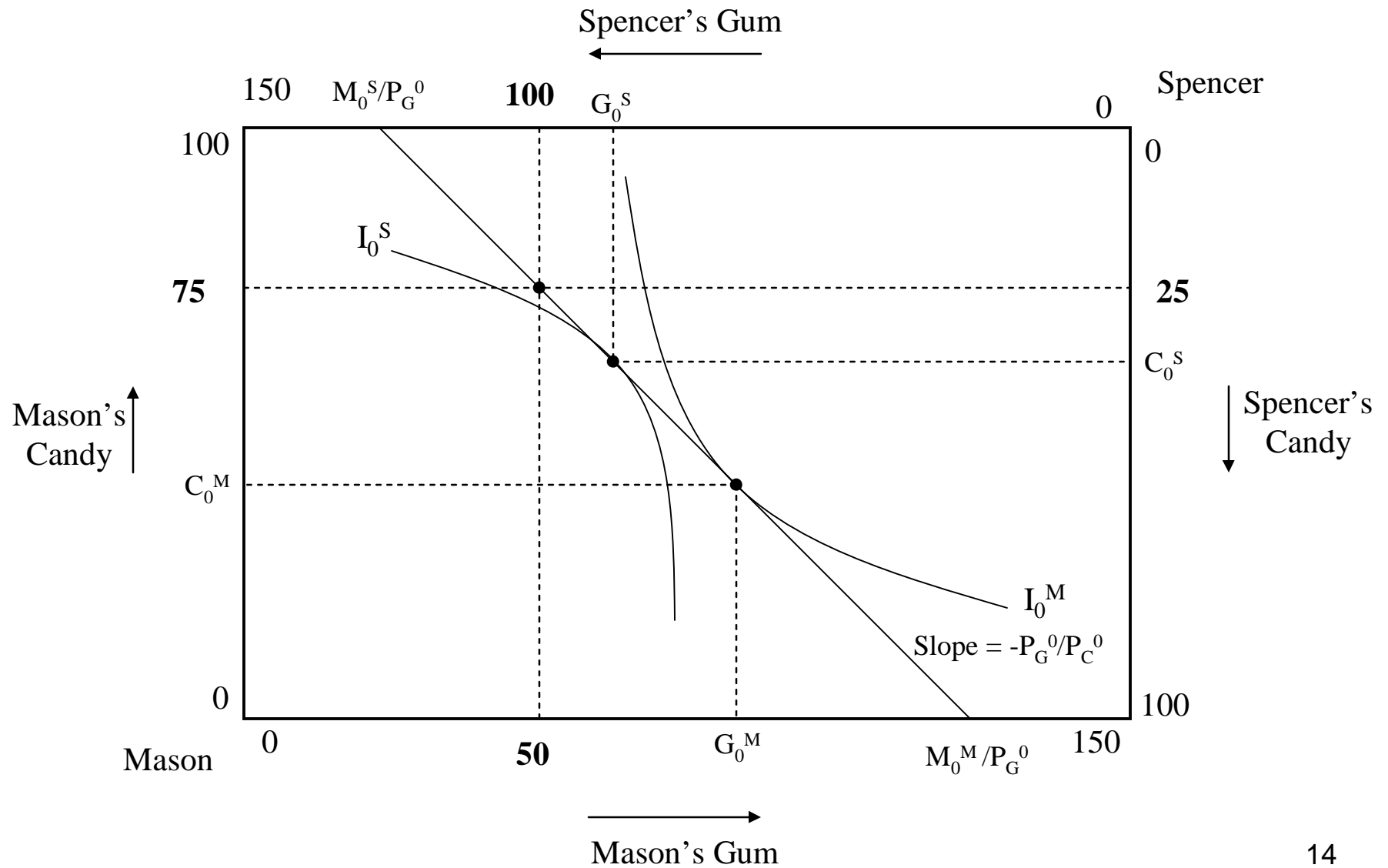
## How can Mason & Spencer get to a Pareto Optimal allocation?

- Suppose the price of candy is  $P_C^0$  & the price of gum is  $P_G^0$ .
- Implications:
  - Mason's Income:  $M_0^M = P_C^0 75 + P_G^0 50$
  - Spencer's Income:  $M_0^S = P_C^0 25 + P_G^0 100$

# Income Constraint With Prices $P_C^0$ and $P_G^0$ for Candy and Gum



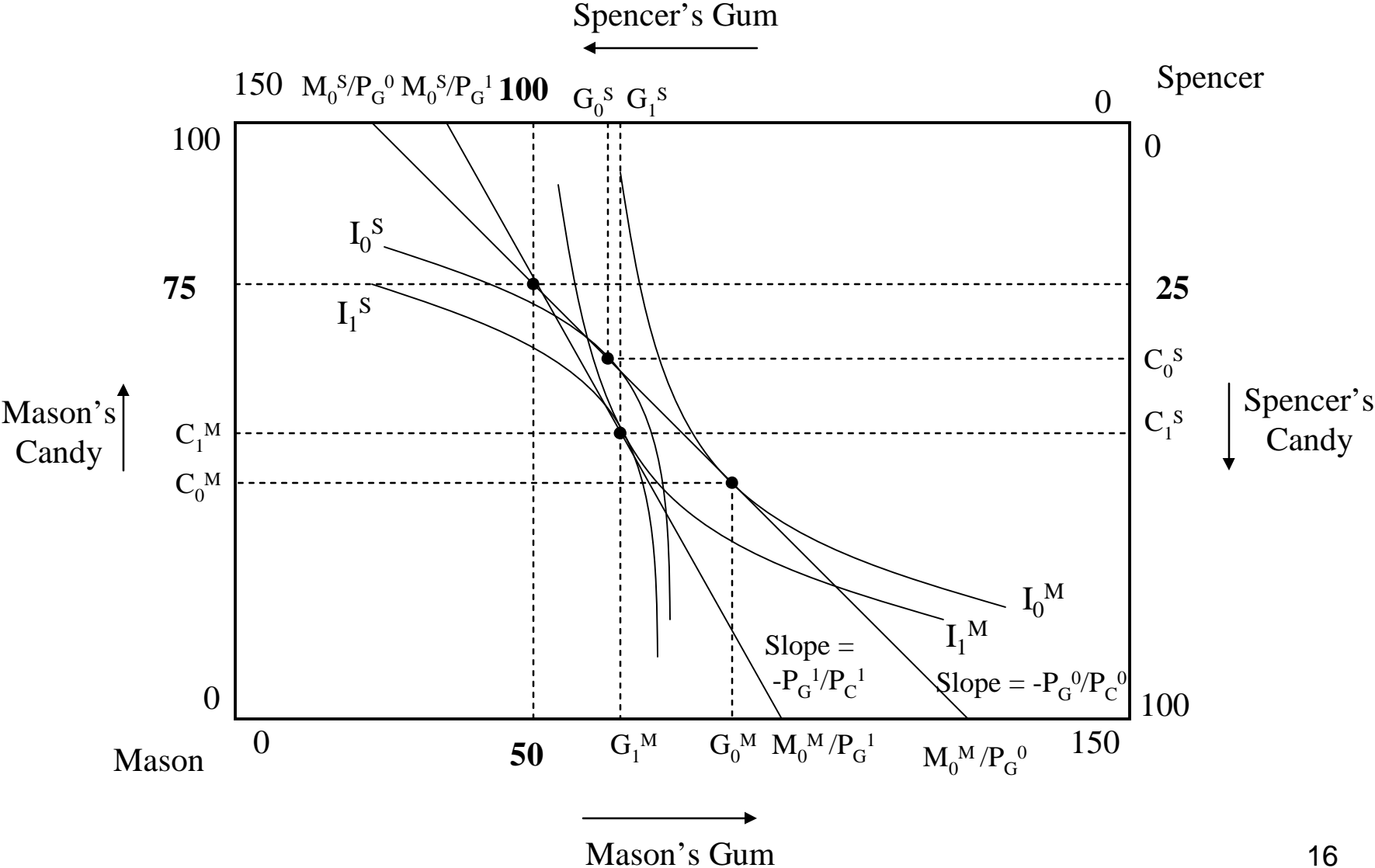
# Mason's and Spencer's Optimal Consumption Given Prices $P_C^0$ and $P_G^0$



## Is this a market equilibrium?

- No!
  - $C_0^M + C_0^S < 100 \Rightarrow$  Excess supply of candy!
  - $G_0^S + G_0^D > 150 \Rightarrow$  Excess demand for gum!
- So now what can we do?
  - Offer a higher price for gum or lower price for candy!
  - For example,  $P_C^1 < P_C^0$  &  $P_G^1 > P_G^0$ .

Mason's and Spencer's Optimal Consumption Given Equilibrium Prices  $P_C^1$  and  $P_G^1$



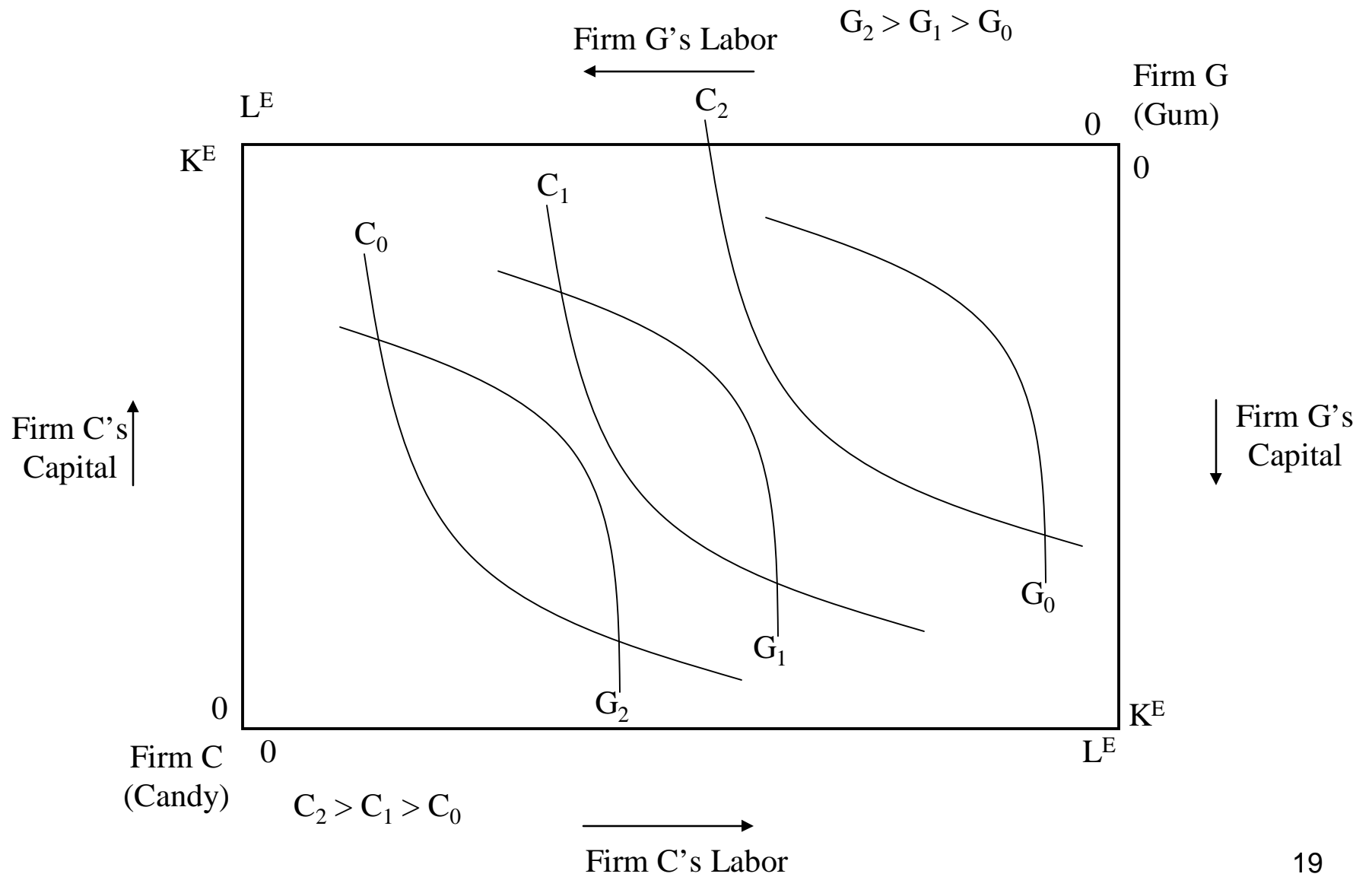
## Is this a market equilibrium?

- Yes!
  - $C_0^M + C_0^S = 100 \Rightarrow$  There is no excess demand or supply of candy!
  - $G_0^M + G_0^S = 150 \Rightarrow$  There is no excess demand or supply of gum!
- What is true at this point?
  - $MRS_M = MRS_S$
  - We are on the contract curve, so we are at a Pareto Optimal allocation!
- First Welfare Theorem:
  - Equilibrium in competitive markets is Pareto Optimal.
- Second Welfare Theorem:
  - Any Pareto optimal allocation can be sustained as a competitive equilibrium.

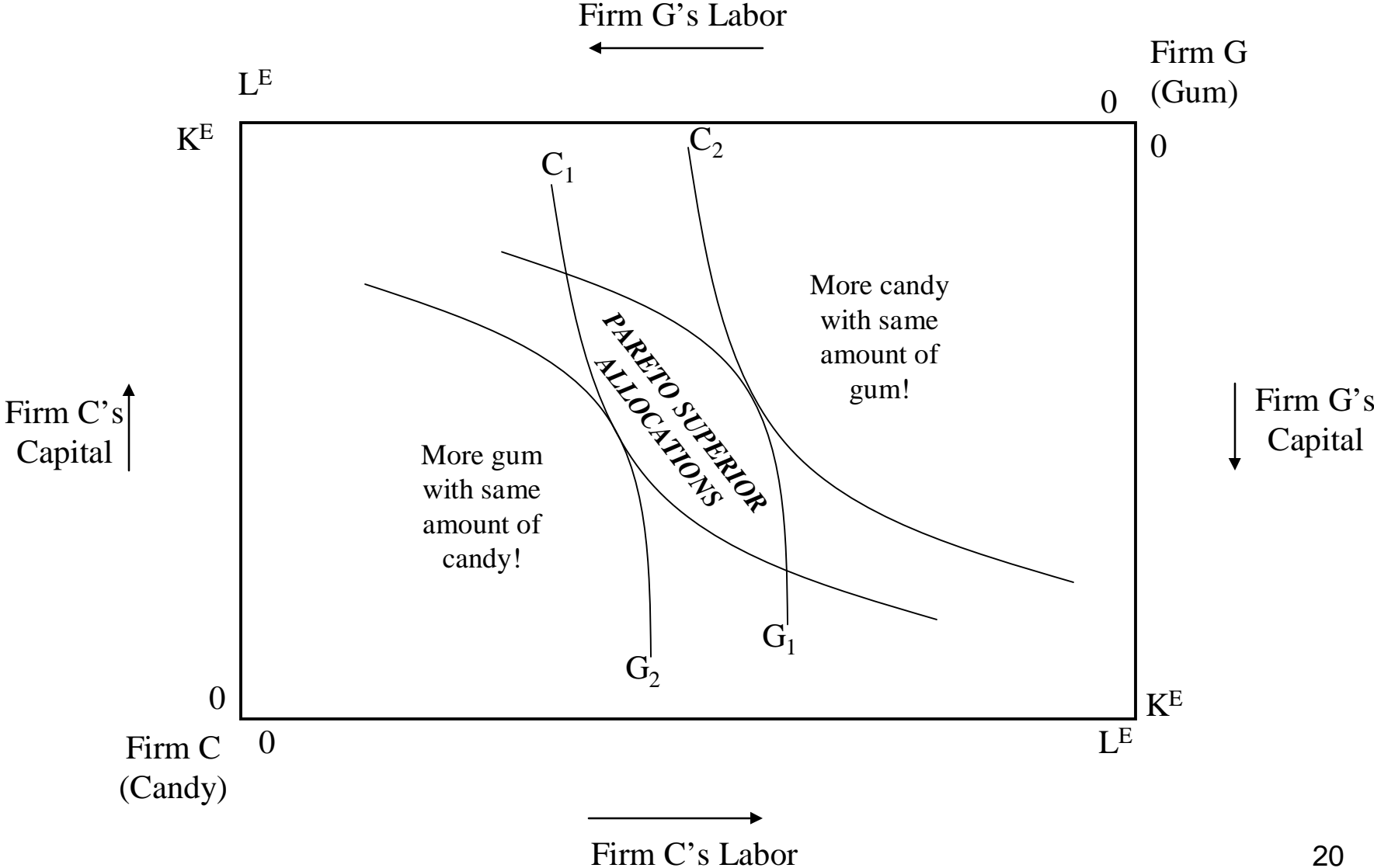
# General Equilibrium with Production

- Production Possibility Frontier:
  - The set of all possible output combinations that can be produced with a given endowment of factor inputs.

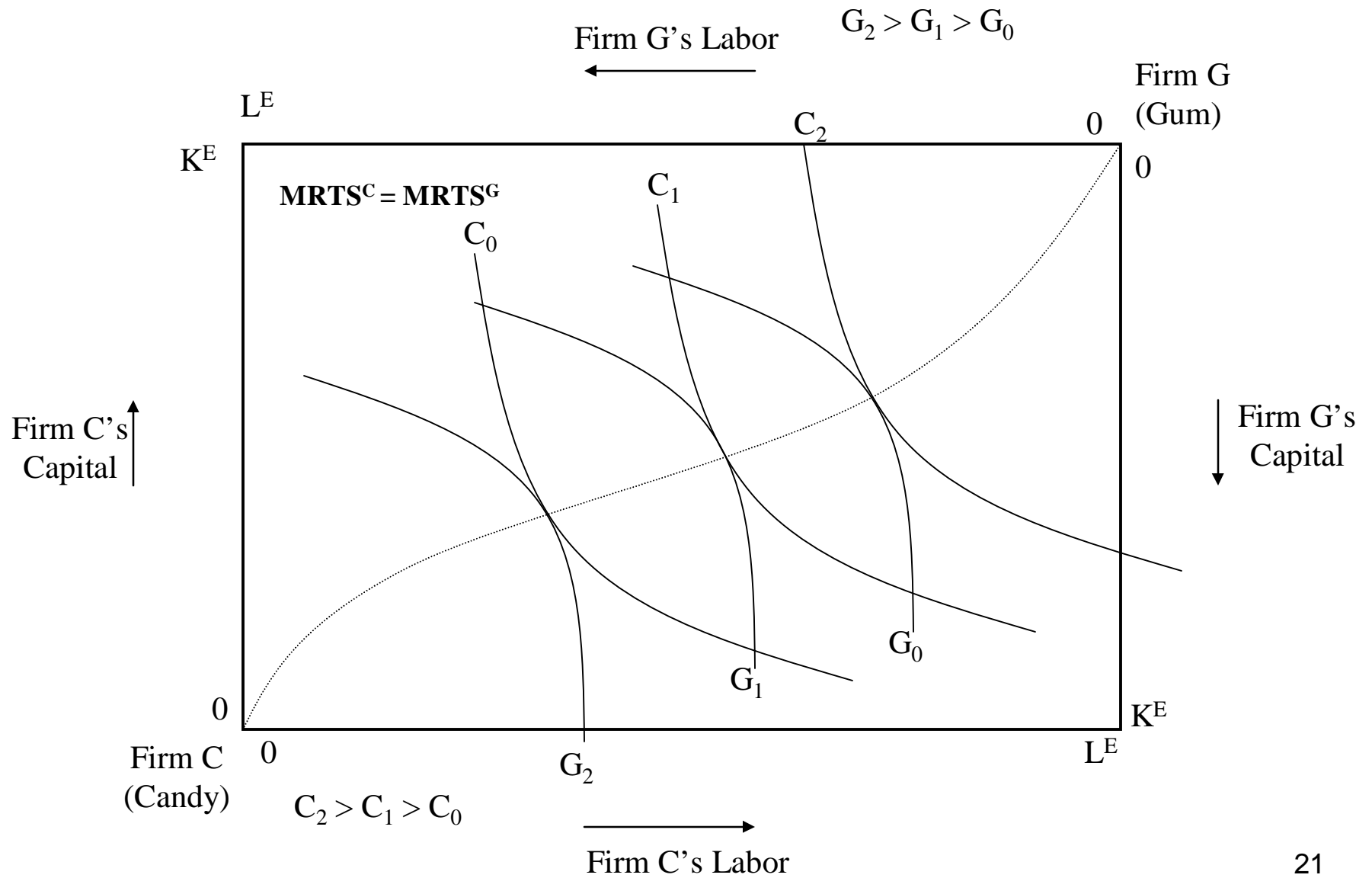
# Edgeworth Box for Candy and Gum Production



# Efficient Production of Candy and Gum Production



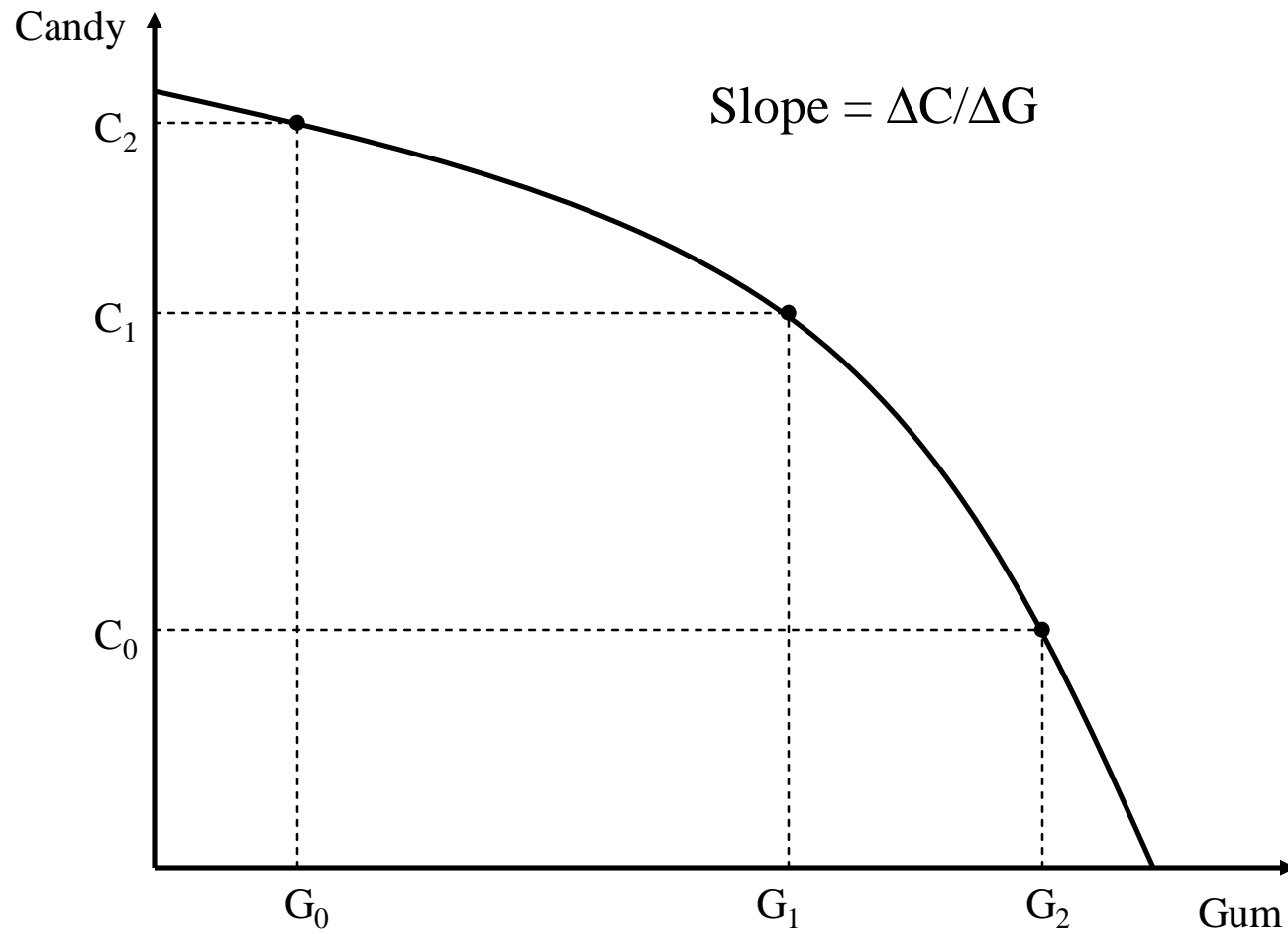
# Contract Curve for Candy and Gum Production



## Competitive Cost Minimizing Production

- $MRTS_C = MP_L^C / MP_K^C = w/r$
- $MRTS_G = MP_L^G / MP_K^G = w/r$
- So,  $MRTS_G = w/r = MRTS_C$
- Competitive production will result in Pareto Efficient production!

# Graphical Example of Production Possibility Frontier



# Production Possibility Frontier

- Marginal Rate of Transformation:
  - The rate at which one output can be exchanged for another at a point along the production possibility frontier:  $|\Delta C/\Delta G|$ .

Note that  $TC_G = wL_G + rK_G$  and  $TC_C = wL_C + rK_C$

$$\begin{aligned}\Rightarrow \Delta TC_G &= w\Delta L_G + r\Delta K_G \text{ and} \\ \Delta TC_C &= w\Delta L_C + r\Delta K_C\end{aligned}$$

Also,  $L_G = L^E - L_C$  and  $K_G = K^E - K_C$

$$\Rightarrow \Delta L_G = -\Delta L_C \text{ and } \Delta K_G = -\Delta K_C$$

Therefore,  $\Delta TC_G = -w\Delta L_C - r\Delta K_C = -\Delta TC_C$

$$\Rightarrow \Delta TC_G / (\Delta G \Delta C) = -\Delta TC_C / (\Delta C \Delta G)$$

$$\Rightarrow MC_G / \Delta C = -MC_C / \Delta G$$

$$\Rightarrow |\Delta C / \Delta G| = MC_G / MC_C$$

***The Marginal Rate of Transformation is the ratio of Marginal Cost!***

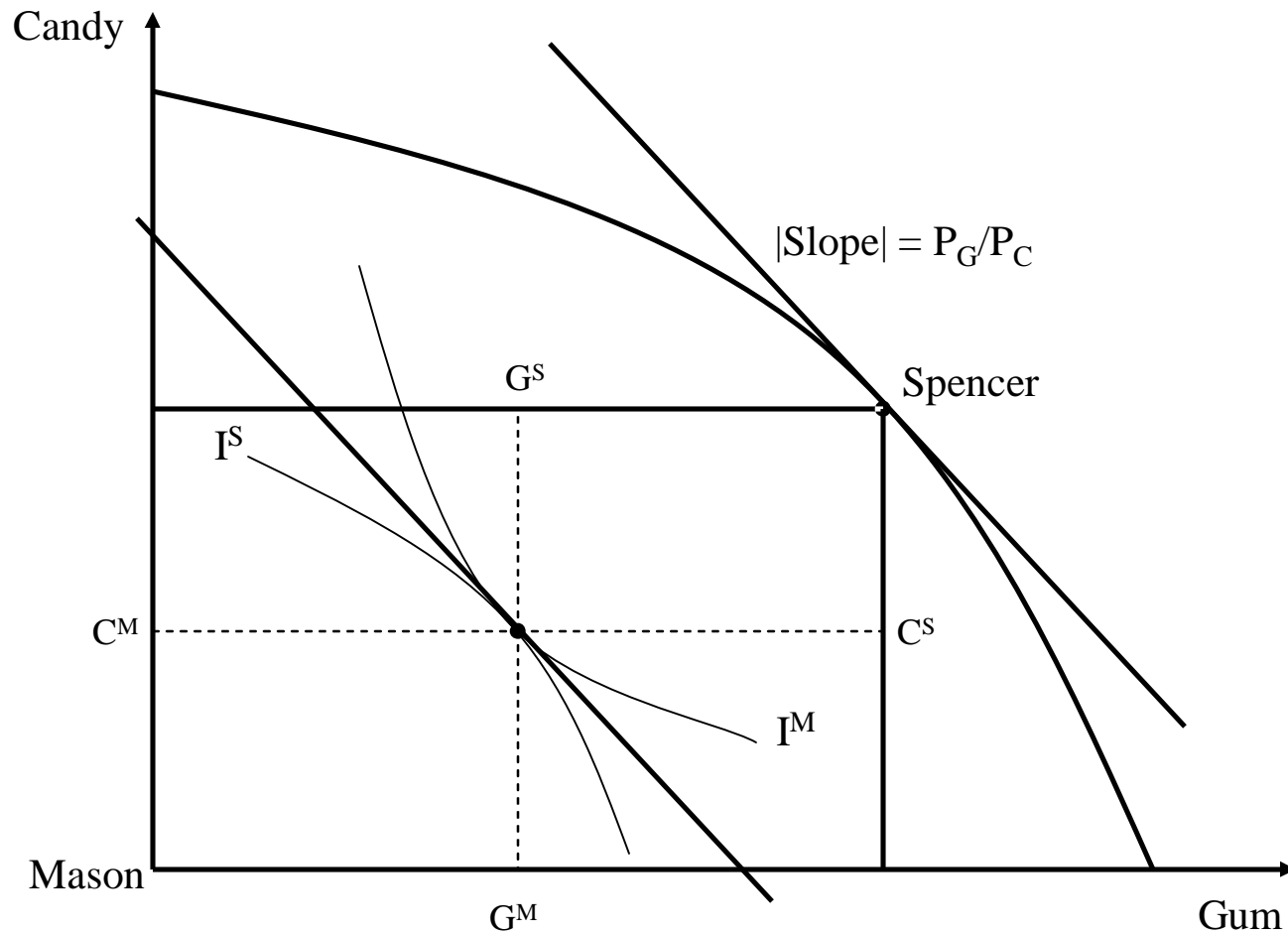
# Profit Maximization in Competitive Industry

- $MC_C = P_C$
- $MC_G = P_G$
- Implications:
  - $MRT = MC_G/MC_C = P_G/P_C$

# Utility Maximization with Competitive Markets

- $MRS_M = P_G/P_C$
- $MRS_S = P_G/P_C$
- Implications:
  - $MRT = MRS_M = MRS_S$

# Competitive Equilibrium with Production



# Summary

- For a general equilibrium with production to be Pareto Efficient, three types of conditions must hold:
  - Firms must equate their marginal rates of technical substitution.
  - Consumers must equate the marginal rates of substitution.
  - Consumers' marginal rates of substitution must equal the marginal rate of transformation.

***Competitive Markets Yield This Outcome!***

## *Adding Production Does Not Change The Implications of The First and Second Welfare Theorems!*

- Competitive markets result in the Pareto efficient production and distribution of goods and services!
- Any Pareto efficient production and distribution of goods can be supported by a competitive market.

# So, is there anything that can mess up these welfare theorems?

- Yes!
- Government Intervention
  - Taxes
  - Subsidies
- Market Failure
  - Externality: Either a benefit or a cost of an action that accrues to someone other than the people directly involved in the action.
  - Public Goods: (1) nondiminishability and (2) nonexcludability of consumption.
- Noncompetitive Behavior
  - Monopoly
  - Oligopoly

# What You Should Know

- General Equilibrium Conditions
  - Exchange Economy
  - With Production
- Pareto Optimal Allocations
- First & Second Welfare Theorems & Caveats