

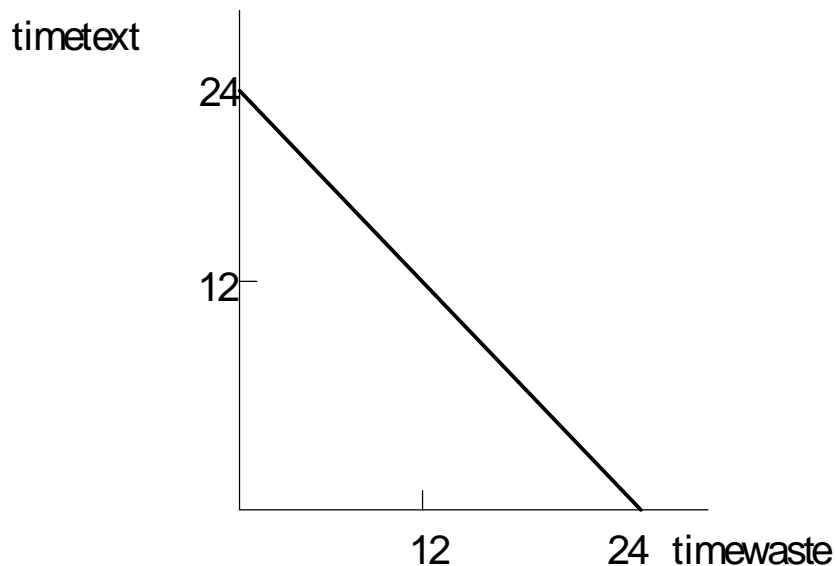
Time Constraint

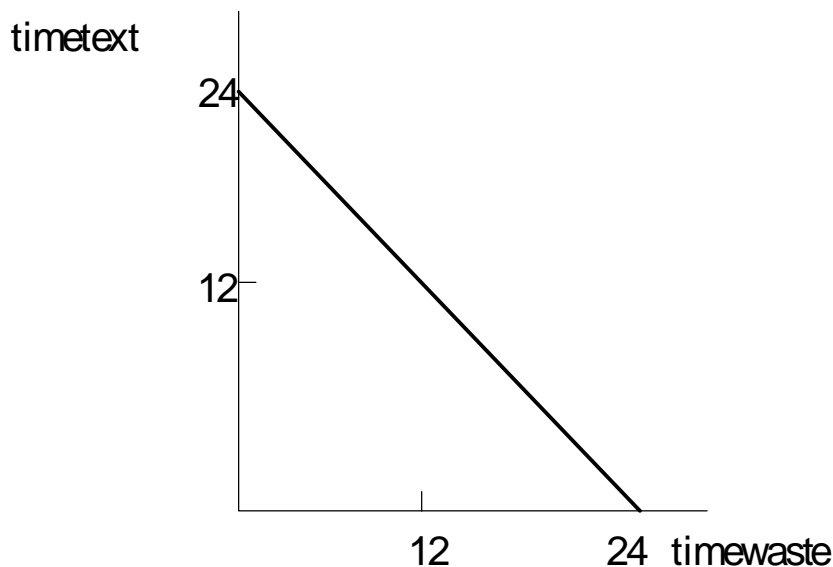
timetext = # hours per day spent reading
economics textbook

timewaste = # hours per day spent on lesser
activities

$$\text{timetext} + \text{timewaste} = 24$$

opportunity set or **feasible set** is the line:





- Slope of line = -1
- one must forego 1 hour of textbook reading for every 1 hour increase in timewaste
- **opportunity cost** of an additional hour of timewaste
 - = 1 hour of timetext or 1 hour of text reading
 quantifies “trade-off” between timetext and timewaste
- time constraint is straight line {constant slope} because
 - “opportunity cost is constant”
 - or “trade-off is the same”
 regardless of how large timetext is

Budget Constraint

Household can buy guns at fixed, given price: p_{gun}

Household can buy butter at fixed, given price: p_{butter}

Y = household income

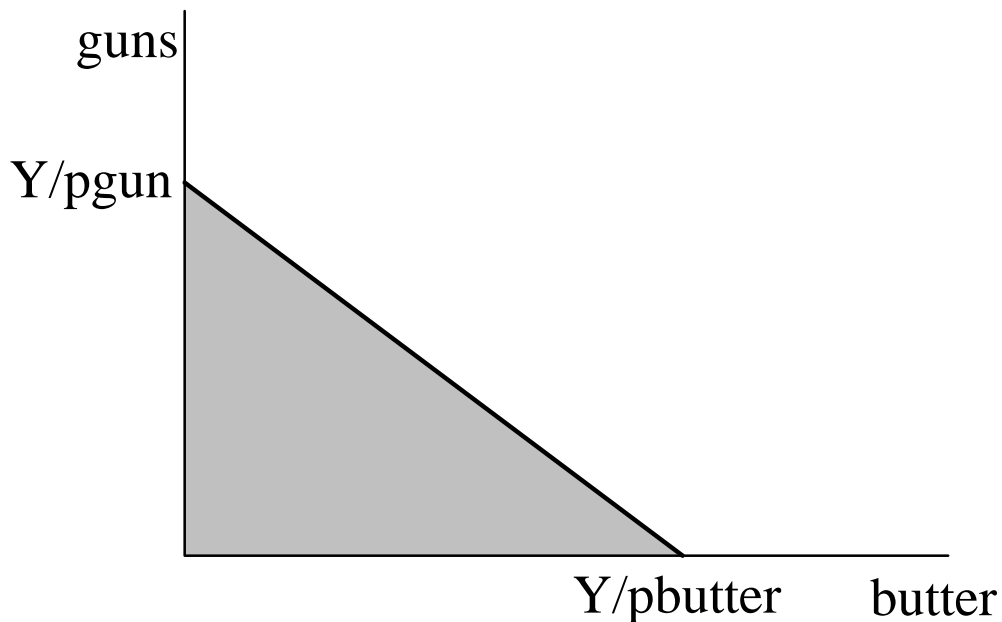
G = # guns household chooses to buy

B = # pounds of butter household chooses to buy

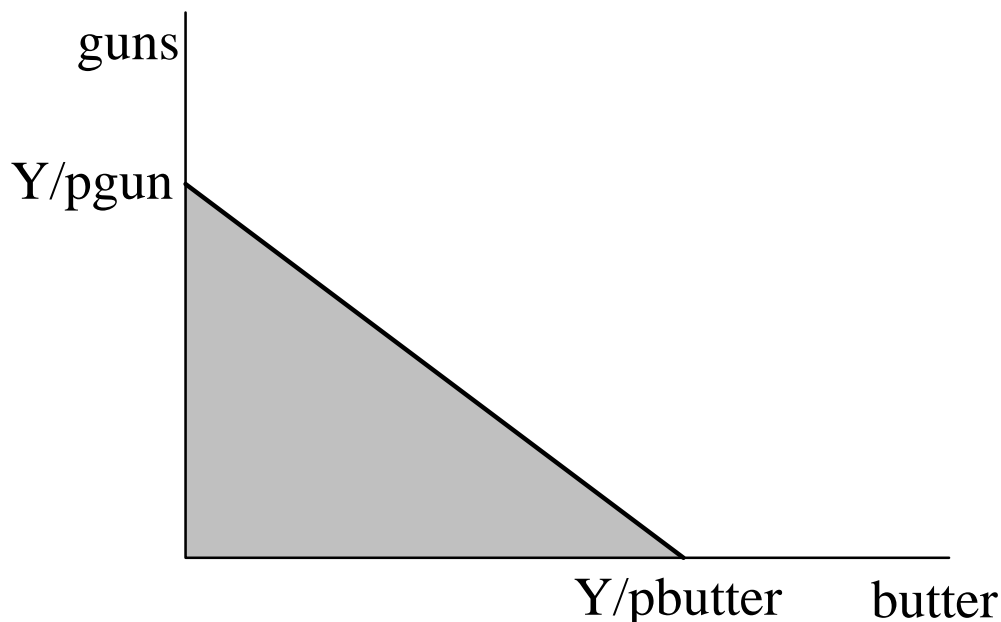
Household Budget Constraint:

$$G \cdot p_{\text{gun}} + B \cdot p_{\text{butter}} \leq Y$$

Opportunity Set or Feasible Set:



Opportunity Set or Feasible Set:

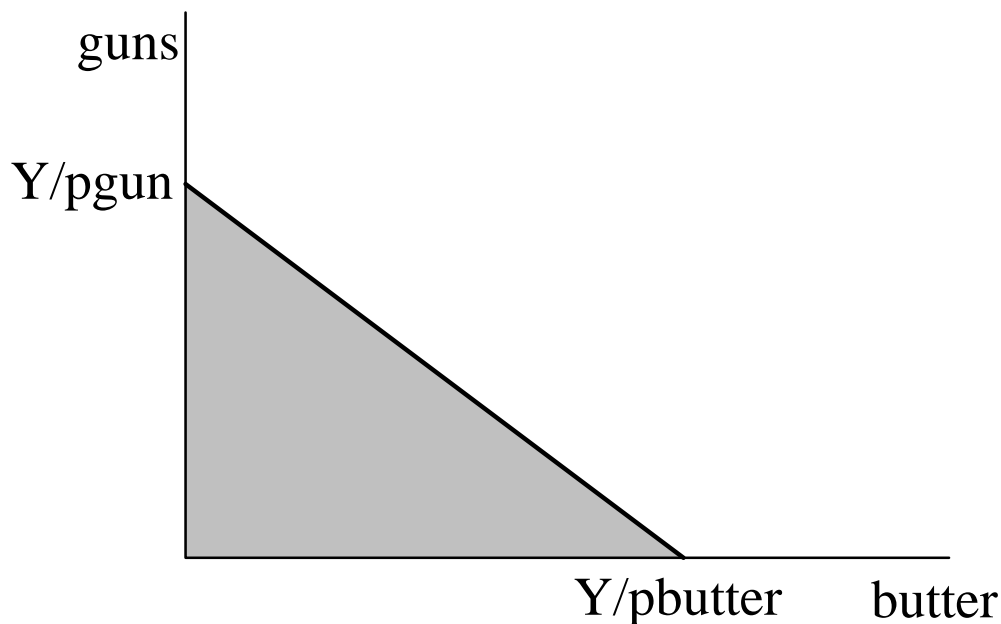


maximum feasible gun purchase = Y/p_{gun}

maximum feasible butter purchase = Y/p_{butter}

- any choice (guns, butter) **inside triangle** (including its edges) is **feasible**
- any choice **on budget constraint line** (upper right hand edge of triangle) **uses all income**
- any choice **below or to left of budget constraint line leaves some income unspent** (not spent on guns or butter, anyway)
- **if all income is spent** on guns or butter, household faces **trade-off** between gun and butter purchases.

Opportunity Set or Feasible Set:

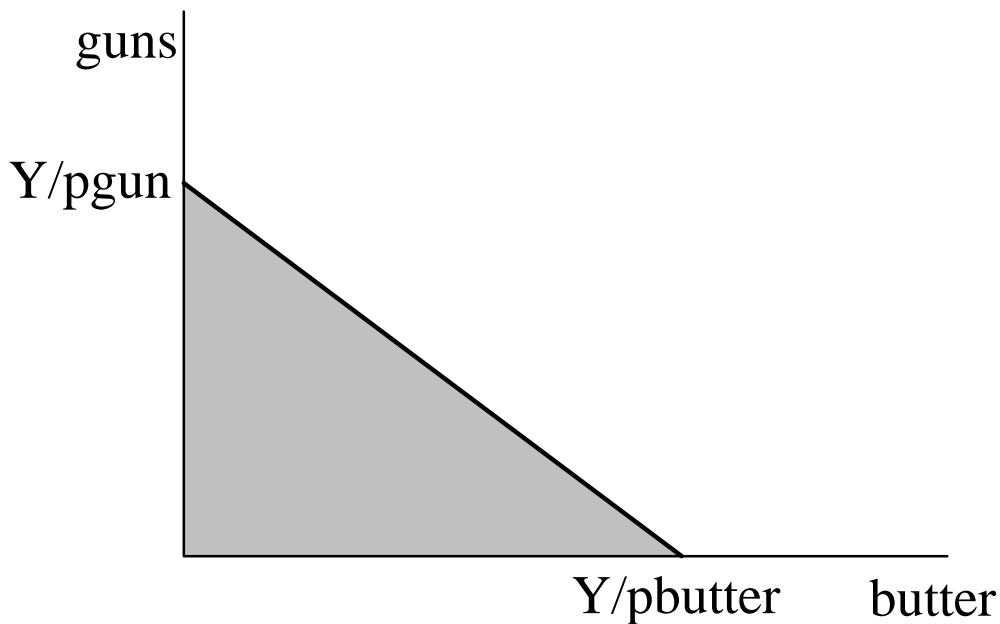


maximum feasible gun purchase = Y/p_{gun}

maximum feasible butter purchase = Y/p_{butter}

- terms of trade-off quantified by slope of budget constraint line:

$$\begin{aligned}\text{slope} &= \text{rise/run} = -\text{fall/run} \\ &= - Y/p_{\text{gun}} / Y/p_{\text{butter}} \\ &= - p_{\text{butter}} / p_{\text{gun}} \\ &= \text{constant (so boundary is straight line)}\end{aligned}$$



maximum feasible gun purchase = Y/p_{gun}

maximum feasible butter purchase = Y/p_{butter}

slope = rise/run = -fall/run

= $- Y/p_{\text{gun}} / Y/p_{\text{butter}}$

= $- p_{\text{butter}} / p_{\text{gun}}$

= constant (so boundary is straight line)

So

- **slope** = $p_{\text{butter}} / p_{\text{gun}}$

= # of guns household must forego purchasing
to be able to buy one more pound of butter

= **opportunity cost** of a pound of butter

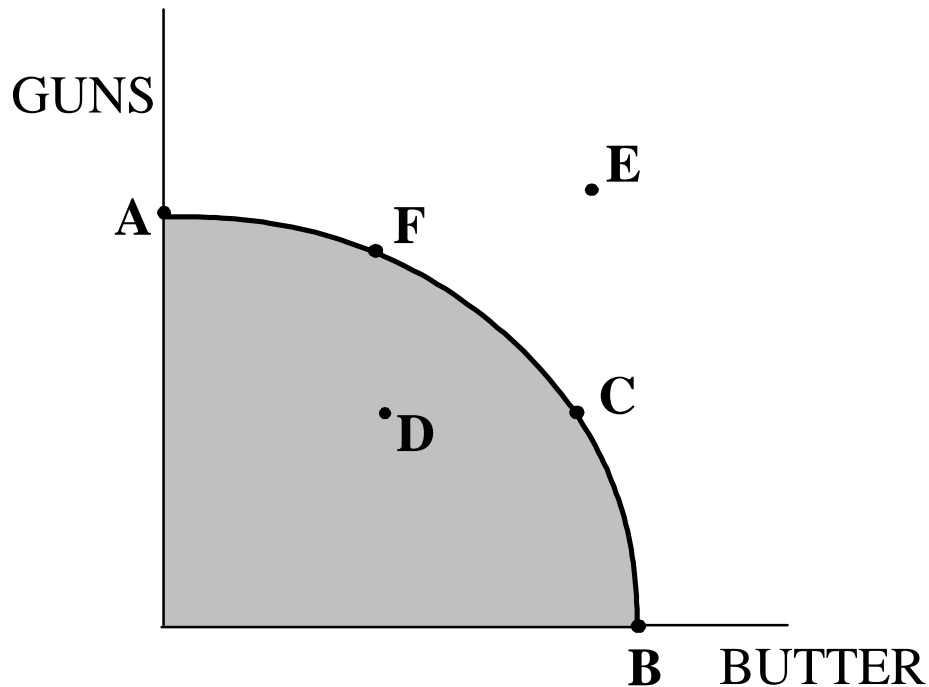
= relative price of butter in gun units

quantifies terms of guns vs. butter trade-off.

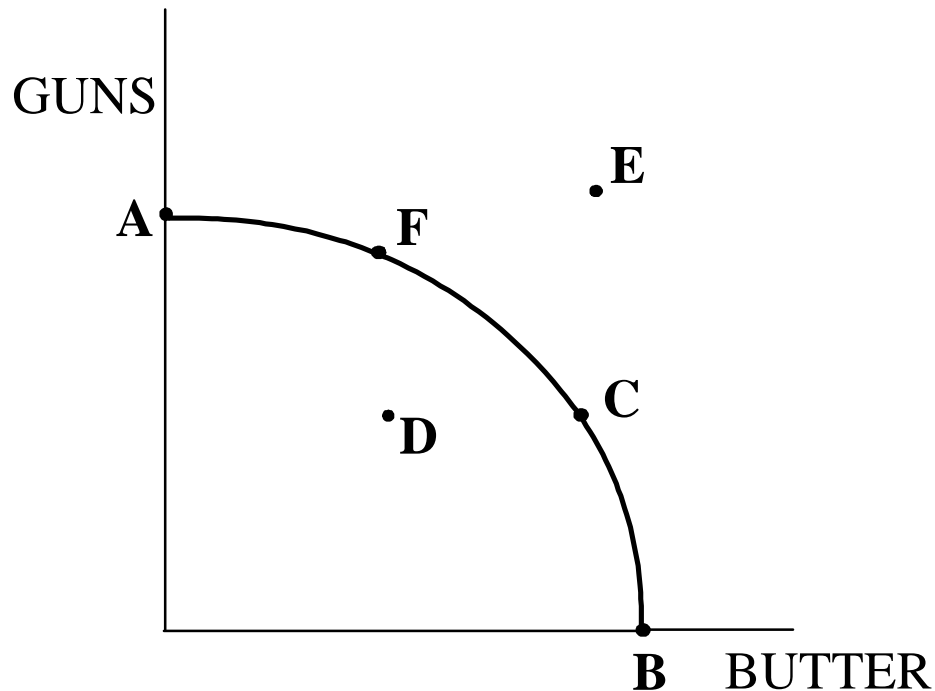
Production Possibility Frontier

- An economy has given labor force and capital stock (factories and machines).
- Some labor and capital can be used to produce either defense goods & services {guns} or non-defense goods & services {butter}.
- Most labor and capital pretty specific to guns or butter and much less useful in producing the other:
 - dairy farmers not very effective at producing sophisticated weaponry
 - rocket scientists not very effective at milking COWS
 - barns not best place to assemble rockets, etc.

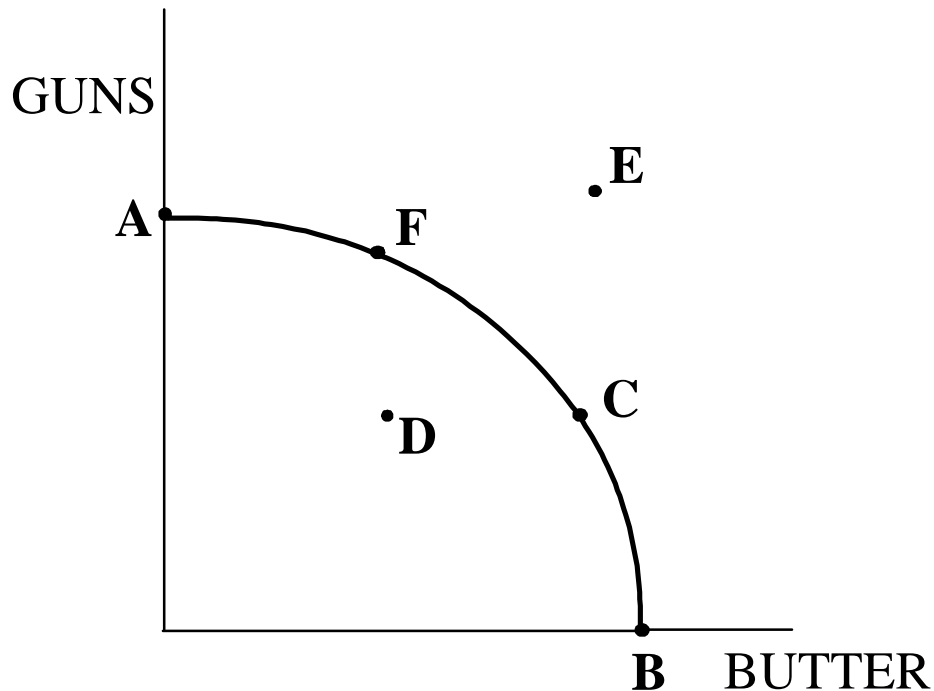
Opportunity Set (Feasible Set) For Economy



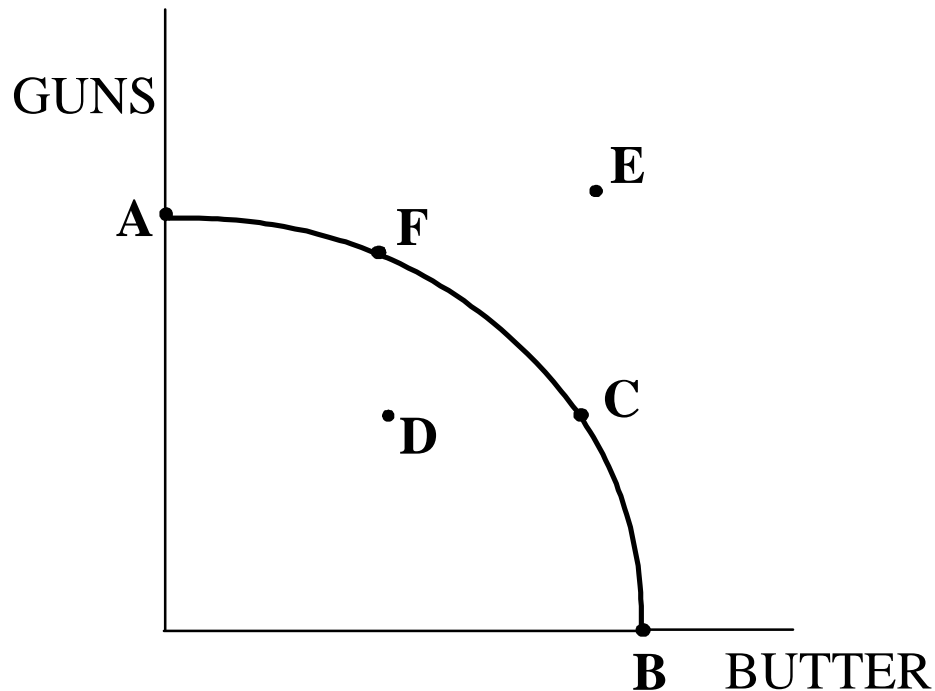
- Each point is an allocation of the economy's resources.
- Shaded area contains all of the **feasible** allocations.
 - points like A, B, C, D, and F are feasible
 - points like E are **infeasible** – the economy has insufficient labor and/or capital to produce these combinations of guns and butter.
- Curved boundary of feasible region is “production possibility frontier” or ppf.



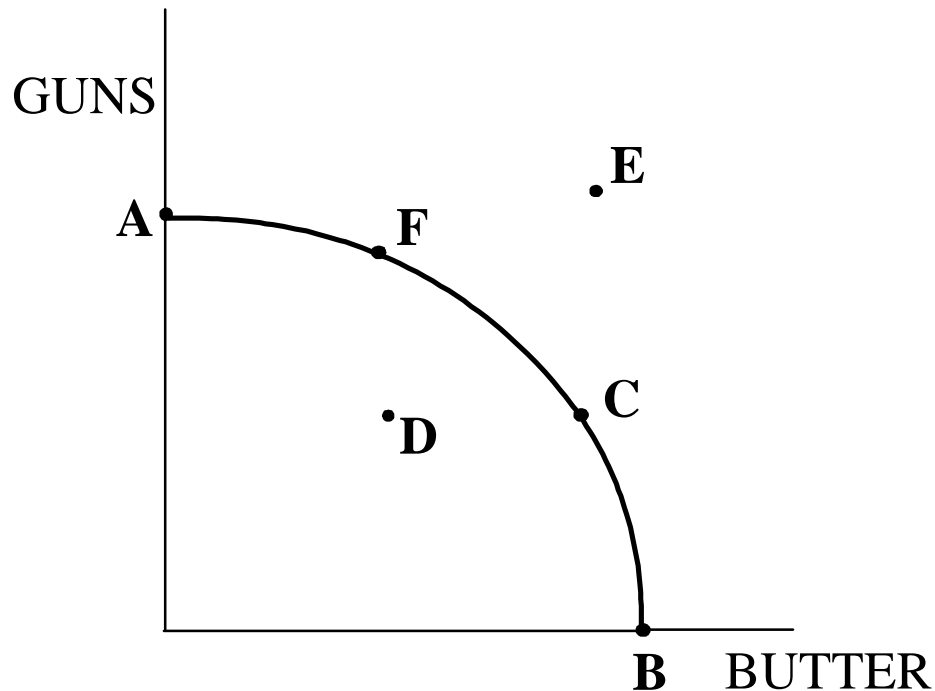
- if all resources used to make guns, economy produces A guns & no butter
- if all resources used to make butter, economy produces no guns & B units of butter
- points like D are **inefficient** – economy could produce more butter and same amount of guns or more guns and same amount of butter or more of both.



- points like D are **inefficient** – economy could produce more of both goods.
- at points like D: opportunity cost of guns = 0 since economy does not need to give up **any** butter production to get an additional unit of guns.
- at points like D: opportunity cost of butter = 0 since economy does not need to give up **any** gun production to get an additional unit of butter.



- All points like A, F, C, and B are **efficient** – economy cannot produce more of one good without reducing production of the other.
- **production possibility frontier = ppf =**
 - set of all feasible and efficient allocations
 - boundary between feasible and infeasible allocations
- The **opportunity cost** of an additional unit of **butter** is **positive** at points like F, C, and B.

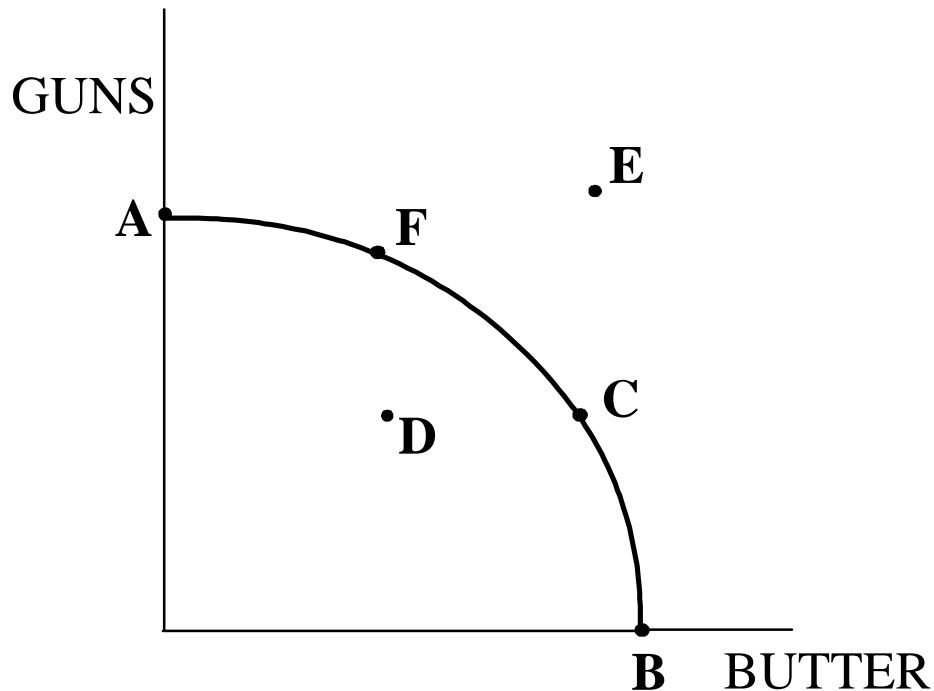


The **opportunity cost** of an additional unit of **butter** is **positive** at points like F, C, and B:

= amount of **gun production** one must **give up** in order to produce one more unit of butter **and stay in the feasible set**.

= minus the slope of the production possibility frontier (ppf) at that point

So the magnitude of the slope of the ppf is the opportunity cost of an additional unit of the good on the horizontal axis.



| ppf slope| tiny at A

{ a unit of additional butter production can be obtained at little or no drop in gun production by shifting some technically inept dairy farmers out of gun production and back into dairy farming. }

| ppf slope| very large at B

{ a unit of additional butter production causes a relatively large drop in gun production as the last, most cow-phobic, rocket scientist is taken out of gun production and sent to a dairy farm. }

Even if all labor were the same, opportunity cost of butter would still blow up as economy approaches point B

{and opportunity cost of guns would blow up as economy approaches point A }

due to “**Law of Diminishing Returns**”:

Given fixed capital stock, as more and more labor is applied to butter production, the additional butter output per additional unit of labor applied becomes smaller and smaller.

Therefore opportunity cost of butter production (in terms of gun production foregone) must rise as butter production gets so large that economy runs out of capital stock useful for making butter.

Opp. cost of butter (in units of gun production foregone) rises as butter production increases because either

a. economy runs out of capital suitable for butter production

and/or

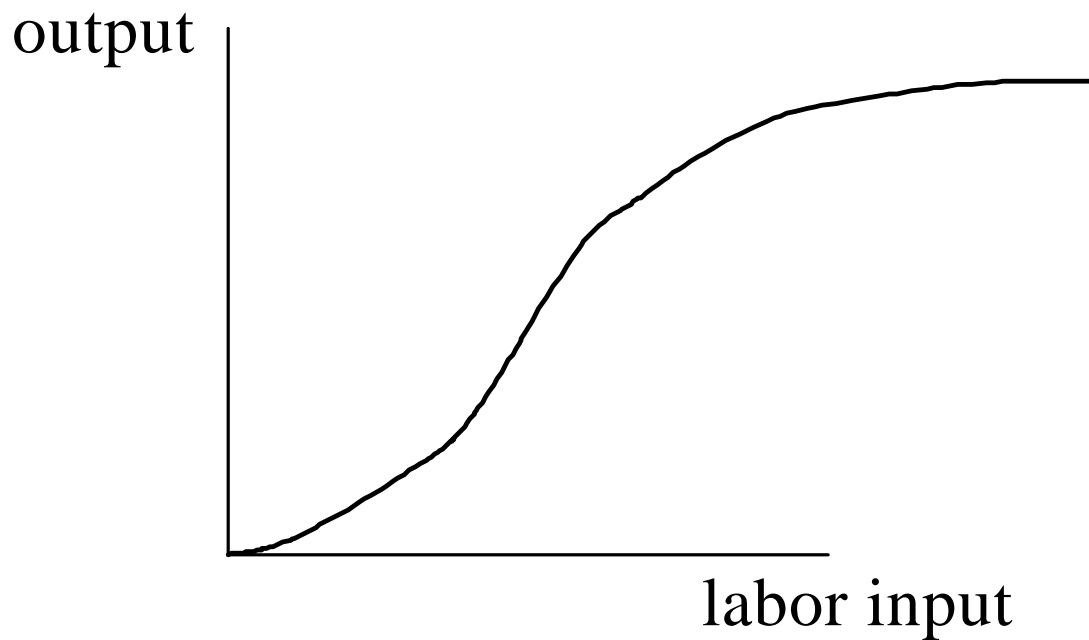
b. even if capital all the same (homogeneous) its **marginal product** falls;

marginal product =

addnl output per unit addnl labor used

or slope of production function:

Production Function for given capital stock:



note slope = marginal product of labor
(eventually) falls as labor input increases.

—> “law of diminishing returns”

Crudely: diminishing returns to capital (and running out of “right” kind of labor) is why the shaded area is infeasible:

