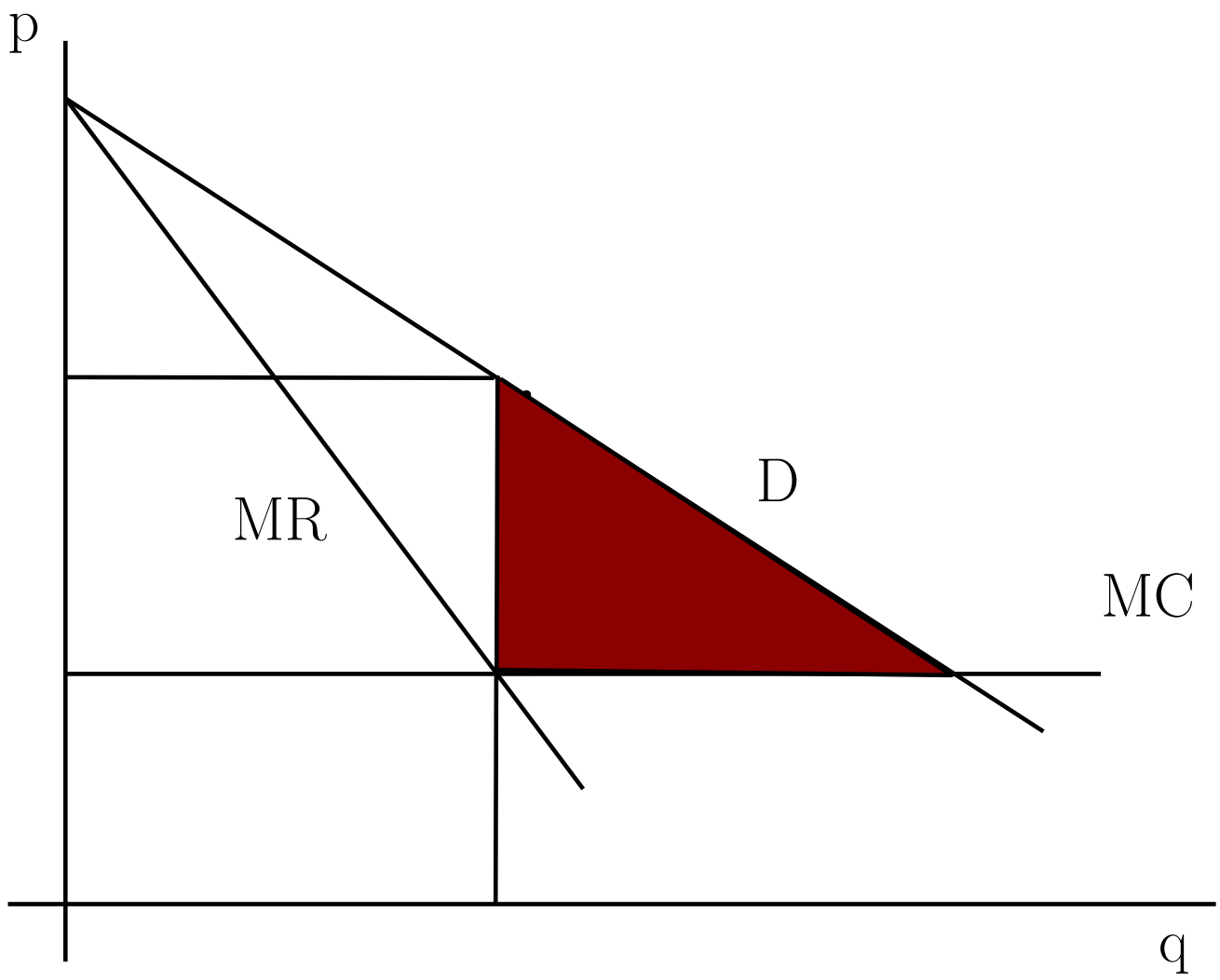
14.581 International Trade
— Lecture 15: Markups (Theory) —

Today's Plan

1. Markups, Misallocations, and Trade
2. The Role of Markups in Krugman (1979)
3. The Role of Markups in ACDR (2018)

1. Markups, Misallocations, and Trade

The Monopoly Distortion



Why Markups and Trade?

- Markups $\Rightarrow$ Misallocation
  - Trade liberalization affects markups, and in turn, affects misallocation (+ or -?)
  - Trade liberalization affects allocation, even if markups are fixed, and in turn affects misallocation (+ or -?)
- Markups $\Rightarrow$ Terms-of-trade
  - If a country raises its tariff, and foreigners charge a markup, then markup may change in response to the tariff
  - If there is incomplete pass-through from tariff to markup, rationale for a positive optimal tariff (absent GE effects)

A Refresher on Growth Accounting

- Suppose that we are interested in the welfare impact of a TFP shock
  - Think of trade liberalization as a particular type of TFP shock
  - In a standard trade model, this would be a change in iceberg trade cost
  - But for now, let us just index technology by T
- Consider the representative agent's utility maximization problem:

$$U(T) \equiv \max_{c} \; u(c)$$
$$s.t.: \; p(T) \cdot c \leq R(T)$$

where $R(T) \equiv p(T) \cdot y(T)$ denotes revenue/GDP function, as in Dixit and Norman (1980)

  - $R(T)$ = net value of output for domestic consumption + exports
  - $R(T)$ = aggregate profits (zero under CRS) plus total factor payments

First-Best Benchmark, without Distortions

- Firms maximize revenues:

$$R(T) \equiv \max_y p(T) \cdot y$$
$$s.t. : F(y, T) \leq 0$$

- The Envelope Theorem therefore implies:

$$U'(T) = \lambda[-p'(T) \cdot c(T) + R'(T)]$$
$$R'(T) = p'(T) \cdot y(T) - \mu F_T(y, T)$$

  where λ and μ are the associated Lagrange multipliers

- Combining these two expressions:

$$\frac{U'(T)}{\lambda} = p'(T) \cdot [y(T) - c(T)] - \mu F_T(y, T)$$

- First-term = TOT effect; Second term = Productivity effect

Comments

1. In a closed economy, market clearing requires $y(T) = c(T)$
   - Thus first term is equal to zero
   - One only needs to know the direct effect of the productivity shock and the initial allocation to compute its welfare impact
2. In an open economy, international trade implies $y(T) \neq c(T)$
   - Thus country now gains if country exports good i ($y_i(T) - c_i(T) > 0$) and its price increases ($p_i'(T) > 0$)
   - But now we need full model to compute price changes and, in turn, welfare impact
3. Of course, the world economy is closed
   - So Solow residulal is all that is needed at the world level
   - See Atkeson and Burstein (2010) and Burstein and Cravino (2015)

An Example with Domestic Production Network

- Input-output linkages + no joint-production
  - Acemoglu, Carvalho, Ozdaglar, Tahbaz-Salehi (2012), Caliendo and Parro (2015), Kikkawa, Mogstad, Tintelnot, Dhyne (2018)
- In each sector i, gross output is given by:

$$y_i + \sum_j x_{ij} = z_i(T) f_i(l_i, k_i, x_{1i}, ..., x_{ni})$$

  where:
  - x_{ij} = inputs from sector j used in sector i
  - l_i = labor demand in sector i
  - k_i = capital demand in sector i
- Factor resource constraints:

$$\sum_i l_i \leq L$$

$$\sum_i k_i \leq K$$

An Example with Domestic Production Network

- The aggregate production possibility frontier:

$$F(y, T) = y_1 - G(\{y_i\}_{i \neq 1}, T)$$

with

$$G(\{y_i\}_{i \neq 1}, T) = \max_{x,l,k} z_1(T) f_1(l_1, k_1, x_{11}, ..., x_{n1}) - \sum_j x_{1j}$$

$$s.t. : y_i + \sum_j x_{ij} \leq z_i(T) f_i(l_i, k_i, x_{1i}, ..., x_{ni}) \text{ for all } i \neq 1,$$

$$\sum_i l_i \leq L,$$

$$\sum_i k_i \leq K$$

An Example with Domestic Production Network

- Envelope Theorem implies

$$F_T(y, T) = -\sum_i \nu_i z_i'(T) f_i$$

where:

  - ν_i = Lagrange multiplier associated with good i resource constraint (with the convention ν_1 equal to one)

- FOC of revenue maximization problem w/ respect to y_i implies

$$p_i(T) = \mu \nu_i$$

- Combining we get

$$-\mu F_T(y, T) = \sum_i p_i(T) z_i'(T) f_i$$

or in log changes

$$-\mu F_T(y, T) = \sum_i p_i(T)(z_i(T) f_i) \frac{d \ln z_i}{dT}$$

Relationship to Solow Residual

- Solow Residual ($d \ln Z$) = Percentage change in aggregate productivity = Percentage change in GDP (at fixed prices) minus percentage change in factor payments (at fixed prices)
- Totally differentiating revenue function, and using Envelope Theorem:

$$dR = dp \cdot y - \mu[F_T dT - \lambda_L dL - \lambda_K dK]$$

where:

  - ν_L = Lagrange multiplier associated with labor constraint
  - ν_K = Lagrange multiplier associated with capital constraint

- This implies

$$\begin{aligned} d \ln Z =& d \ln R|_{dp=0} - s_L d \ln L + s_K d \ln K \\ =& -\frac{\mu F_T}{R} dT = \sum_i \omega_i d \ln z_i \end{aligned}$$

where:

  - $s_L = (\mu \nu_L L)/R$ = labor share, $s_K = (\mu \nu_K K)/R$ = capital share
  - $\omega_i = \frac{p_i(T)(z_i(T) f_i)}{R}$ = ratio of gross output in sector i to GDP

Relationship to Solow Residual

- This establishes that:

$$d \ln Z = \sum_i \omega_i d \ln z_i$$

- Up to a first-order approximation, changes in aggregate productivity are equal to the average of "good-specific" productivity shocks
- This specific application of the Envelope Theorem is often referred to as Hulten's (RES, 1978) Theorem
  - The consequences of iceberg trade costs shocks are already covered: reinterpret goods sold in different destinations as different i, then changes in z_i is equivalent to change in trade cost
  - Restriction to two primary factors plays no role (DRS by adding more factors).
  - One can relax no-joint production and Hicks-neutral technical change
    - Dropping no joint-production useful to study economic geography models with amenities and compensating wage differentials

Adding Distortions

- Suppose that firms have market power
- In equilibrium, they therefore charge a markup over marginal cost
- It is *as if* we had $\tilde{p}(T) \neq p(T)$ such that firms solve:

$$\begin{aligned} \tilde{R}(T) \equiv & \max_y \tilde{p}(T) \cdot y \\ & s.t. : F(y, T) \leq 0 \end{aligned}$$

- Markup on good i is given by $m_i \equiv p_i / \tilde{p}_i$
- This is no different at if we were taxing good i at rate $t_i = 1 - 1/m_i$
  - Previous approach more general than markups
  - Markups simply act as "wedges" in the Hsieh and Klenow sense
- Note that for firms to take prices as given, we need CRS or DRS

Growth Accounting Revisited

- The Envelope Theorem now implies:

$$\tilde{R}'(T) = \tilde{p}'(T) \cdot y(T) - \mu F_T(y, T)$$

- By definition, we also know that:

$$\tilde{R}'(T) = \tilde{p}'(T) \cdot y(T) + \tilde{p}(T) \cdot y'(T)$$
$$R'(T) = p'(T) \cdot y(T) + p(T) \cdot y'(T)$$

- We therefore obtain:

$$\begin{aligned}\frac{U'(T)}{\lambda} &= [-p'(T) \cdot c(T) + R'(T)] \\ &= p'(T) \cdot [y(T) - c(T)] + p(T) \cdot y'(T) + \tilde{R}'(T) - \tilde{R}'(T) \\ &= p'(T) \cdot [y(T) - c(T)] - \mu F_T(y, T) + [p(T) - \tilde{p}(T)] \cdot y'(T)\end{aligned}$$

- New term = Distortion term (Basu Fernald 2002, Baeqee Farhi 2017)
  - Reallocation ($y'(T)$) now has a first-order effect on welfare
  - > 0 if good i is under-supplied ($p_i > \tilde{p}_i$) and output increases ($y_i' > 0$)
  - Solow residual now picks up $-\mu F_T(y, T) + [p(T) - \tilde{p}(T)] \cdot y'(T)$

Comments

1. Although $p(T) - \tilde{p}(T)$ appears in the previous expression, it is relative, not absolute prices that matter
   - Firms' supply is homogeneous of degree zero in prices

   $\Rightarrow$ variation of markups across goods matters, not absolute level
   - A uniform tax is not distortionary
   - "Decrease in markups is good" is a partial equilibrium intuition where one good is subject to a markup and the other is not
2. Changes in markups are *not* required for them to affect the consequences of productivity shocks and hence trade liberalization
   - Once there is a wedge, reallocations have first-order effects...
   - even if the wedge is not affected by the shock
3. First-order type result less useful once there are distortions:
   - Formula still provides intuition, but in order to be implemented, we now need $y'(T)$, which requires the full structure of the model...
   - True even in a closed economy where terms of trade can be ignored

2. The Role of Markups in Krugman (1979)

- Model = Dixit-Stiglitz (1977) with symmetric firms
- c and p/w are simultaneously characterized by

$$\text{(PP):} \qquad \frac{p}{w} = \left[\frac{\sigma(c)}{\sigma(c)-1}\right]\frac{1}{\varphi}$$

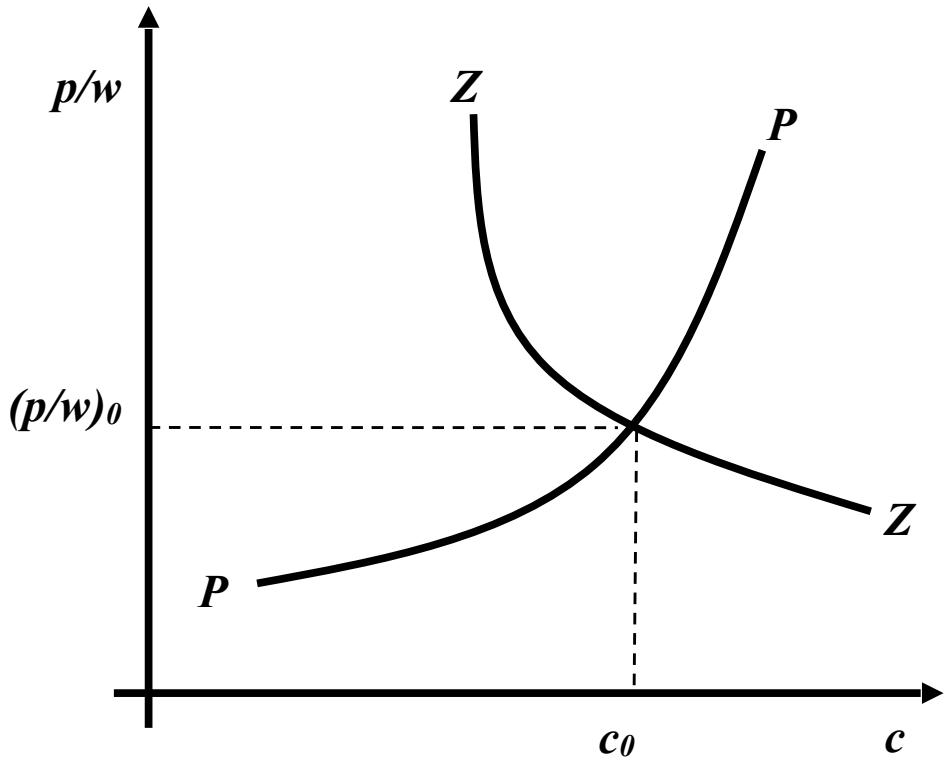
$$\text{(ZP):} \qquad \frac{p}{w} = \frac{f}{q} + \frac{1}{\varphi} = \frac{f}{Lc} + \frac{1}{\varphi}$$

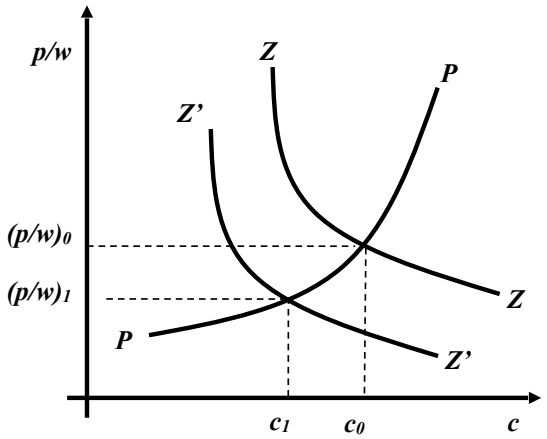
- n can then be computed using market clearing conditions

$$n = \frac{1}{f/L + c/\varphi}$$

Refresher

Graphical Analysis





- Suppose that two identical countries open up to trade
  - This is equivalent to a doubling of country size (which would have no effect in a neoclassical trade model)
- Because of IRS, opening up to trade now leads to:
  - **Increased product variety**: $c_1 < c_0 \Rightarrow \frac{1}{f/2L+c_1/\varphi} > \frac{1}{f/L+c_0/\varphi}$
  - **Pro-competitive/efficiency effects**: $(p/w)_1 < (p/w)_0 \Rightarrow q_1 > q_0$

Comments

- It is common in the literature to present the two previous channels as two new sources of GT absent from neoclassical models
- Two issues with this view:
  - New varieties could appear under perfect competition (Armington)
  - Markups and new varieties are tied together by free entry condition: when markups go down, entry decreases and vice versa
- Note also that markups do not vary across goods in Krugman (1979):
  - There is therefore no misallocation across goods that are produced
  - The only distorted margin here is entry (it is as if goods that are not produced had infinite markups relative to other goods)
  - If entry was fixed, then increasing country size would affect markups, and profits, but not the allocation...
  - From welfare standpoint, key questions = Is entry too low or too high? Does an increase in country size increase or decrease entry?

3. The Role of Markups in ACDR (2018)

Background: ACR (2012)

- Next lecture = Arkolakis, Costinot, and Rodriguez-Clare (2012)
- They have shown that for fairly large class of trade models, welfare changes caused by trade shocks only depend on two statistics:

  1. Share of expenditure on domestic goods, λ
  2. Trade elasticity, ε, in gravity equation

- Assume small trade shock so that, $d \ln \lambda < 0$: associated welfare gain is given by

$$d \ln W = -\frac{d \ln \lambda}{\varepsilon}$$

What About the Pro-Competitive Effects of Trade?

- Important qualification of ACR's results:
  - All models considered in ACR feature CES utility functions
  - Thus firm-level markups are constant under monopolistic competition
  - This de facto rules out "pro-competitive" effects of trade
- Recall monopolistic competition with CES leads to efficient allocation:
  - Envelope theorem implies that starting from initial allocation, the effect of productivity shocks are the same as under perfect competition
  - If we relax CES, gains from trade may be very different

ACDR (2018): Overview

- **Goal:** Study the pro-competitive effects of trade, or lack thereof
  - Depart from CES demand and constant markups.
  - Consider demands with variable elasticity and variable markups
- **Focus:** Monopolistic competition models with firm-heterogeneity
- **Experiment:**
  - Consider two classes of models with CES and without
    - Impose restrictions so that all these models have same macro predictions (Pareto distributions of productivity)
    - What are the welfare gains under these two scenarios?

ACDR (2018): Main Results

- Characterize welfare gains in this environment
  - Suppose small trade shock, $d \ln \tau$, raises trade openness, $d \ln \lambda < 0$
  - Welfare effect is given by

$$d \ln W = -(1-\eta) \frac{d \ln \lambda}{\varepsilon}$$

  - $\eta \equiv$ structural parameter depends on
    - Degree of pass-through
    - Magnitude of GE effects

ACDR (2018): Main Results (cont)

- Whether models with variable markups lead to larger or lower gains from trade liberalization depends on sign of η

- **What is the sign of η in theory?**
  - Under common alternatives to CES: $\eta \geq 0$
  - *Intuition:*
    Incomplete pass-through (Trade costs affect TOT)
    GE effects (Trade costs also affect misallocations)
    Direct effect dominates GE effect (Non-homotheticity is key)

- **What is the sign of η in the data?**
  - Direct demand estimation and existing pass-through estimates point to $\eta \geq 0$, but small. Hence the "elusive" pro-competitive effects.

Comments

- Focus of ACDR is on misallocations:
  - Distribution of markups is fixed (because of Pareto)
  - ... and does not vary across origin countries (because of Pareto)
  - Misallocations is across varieties from the same origin country
  - Entry is fixed too (because of Pareto)
- In general,if distribution of markups is fixed, reallocations require sector-specific productivity shocks
  - In ACDR, though, trade costs do not vary across firms/varieties
- This explains the role of non-homothetic preferences in ACDR:
  - With homotheticity = back to first best results and ACR formula
  - Without homotheticity = if trade costs go down and country gets richer, consumers change shares of expenditure on different varieties
  - This is good if reallocation leads to expansion of high-markup varieties
  - But under common alternative to CES, marginal varieties tend to have lower markups and richer consumers tend to buy more varieties...