Universität Zürich[UZH]

Topic 7 – New Trade Theory

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Introduction

- The unifying theme of the Ricardian model and the Heckscher-Ohlin model is that trade is driven by comparative advantage

- Models based on comparative advantage can explain trade in different goods between different countries. Such trade is called **inter-industry trade**

- However, much of actual trade is in similar goods between similar countries. Such trade is called **intra-industry trade**. Similar goods are also sometimes referred to as **varieties** of the same good

- For example, Germany exports cars to Japan and imports cars from Japan, which is difficult to explain with the Ricardian or Heckscher-Ohlin model

Introduction (contd.)

- In this lecture, we will introduce the Krugman (1980) model which explains intra-industry trade by combining increasing returns to scale technologies and love-of-variety preferences

- As will become clear shortly, the main idea is that increasing returns to scale technologies imply specialization while love-of-variety preferences bring about trade

- Besides explaining intra-industry trade, the Krugman model delivers two main results: (i) trade can generate import variety gains and (ii) having a large home market for a good can result in becoming a net exporter of that good

- Paul Krugman received the 2008 Nobel Prize for pioneering such “new” trade (and closely related “new” economic geography) models which had an enormous impact on the field

Overview of the lecture

- Krugman model
- Import variety gains
- Home market effect
- Extensions

Krugman model – Increasing returns to scale

- A production technology is said to feature **increasing returns to scale** (IRS), if an x% increase in inputs leads to a more than x% increase in output

- This just says that production becomes more efficient if it takes place at a larger scale and implies that average costs are decreasing in output

- Notice that fixed costs are an easy way to generate IRS because they get spread over more units as output increases

- We therefore assume that a per-unit amount a and a fixed amount f of labor are required to make q_i units of variety i resulting in the IRS technology

$$l_i = f + aq_i$$

Krugman model – Love-of-variety

- Preferences feature a **love-of-variety** if consumers value variety. For example, consumers typically value having access to a selection of foods

- We capture this by assuming CES preferences as in the Armington model just now with N instead of two varieties (where N is large)

$$U = \left(\sum_{i=1}^{N} q_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \qquad \sigma > 1$$

- To see that these are indeed love-of-variety preferences, notice that $U = N^{\frac{\sigma}{\sigma-1}} q \Leftrightarrow U = N^{\frac{1}{\sigma-1}} \frac{Y}{p}$ in the special case $q_i = q$ for all i, where Y is income and budget balance requires $Y = Npq$

Krugman model – Monopolistic competition

- The main complication is that IRS are inconsistent with perfect competition. If firms get better when they get bigger, why should an industry then consist of many small price-taking firms?

- While there is only one model of perfect competition in economics, there are many models of imperfect competition including monopoly, Bertrand competition, Cournot competition, and monopolistic competition

- We adopt a framework of **monopolistic competition** which combines elements of monopoly and perfect competition. While each firm is a monopolist for its own variety, there is free entry of firms selling competing varieties

- In equilibrium, the number of firms adjusts so that all firms make zero profits which implies that their monopoly profits exactly equal their fixed costs

Krugman model – Overview

- We start by analyzing the autarky equilibrium in an economy endowed with L workers:
  - Utility maximization
  - Profit maximization
  - Free entry
  - Labor market clearing

Krugman model – Utility maximization

- Just as in the Armington model, utility maximization yields the demands

$$q_i = \frac{p_i^{-\sigma}}{P^{1-\sigma}} wL$$

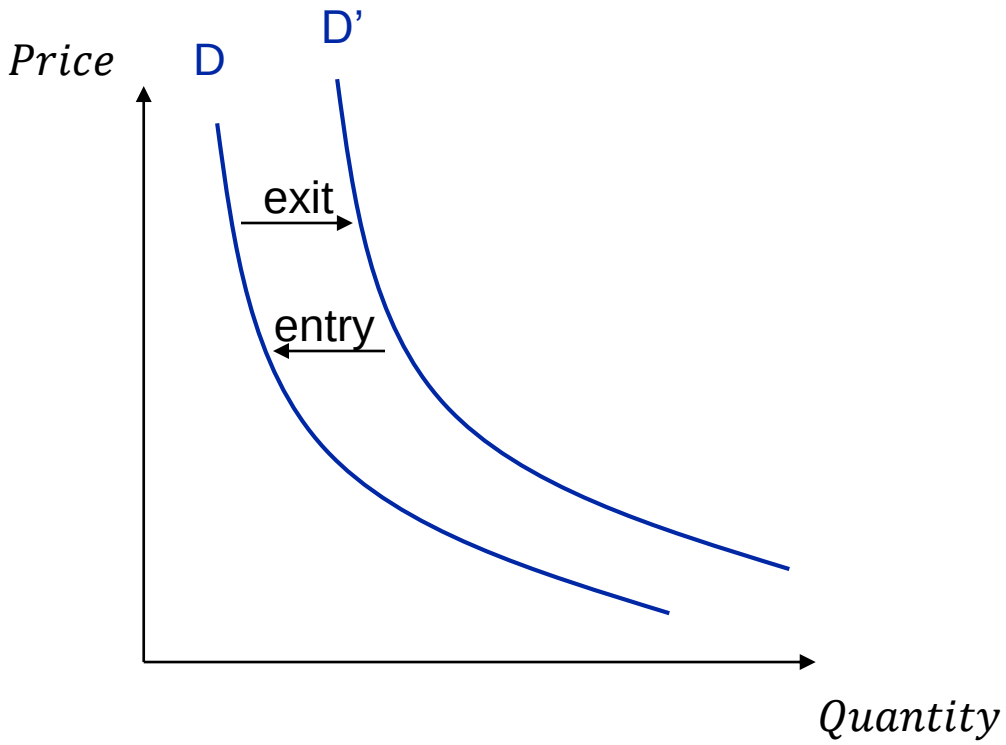
- Also just as in the Armington model, the consumer price index is given by

$$P = \left(\sum_{i=1}^{N} p_i^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$$

<u>Clicker question:</u>

What exactly does this consumer price index capture (hint: it is an example of an ideal price index)?

Krugman model – Utility maximization (contd.)



- The effect of entry and exit on the demand curve is easiest to see in the special case $p_i = p$ for all i
- Then the term $P^{1-\sigma}$ in the denominator simplifies to

$$P^{1-\sigma} = Np^{1-\sigma}$$

Clicker question:

What does the demand curve facing a firm look like in the Ricardian or Heckscher-Ohlin model?

Krugman model – Profit maximization

- Using the earlier expressions for technology and demand, firm profits $\pi_i = p_i q_i - w l_i$ can be written as

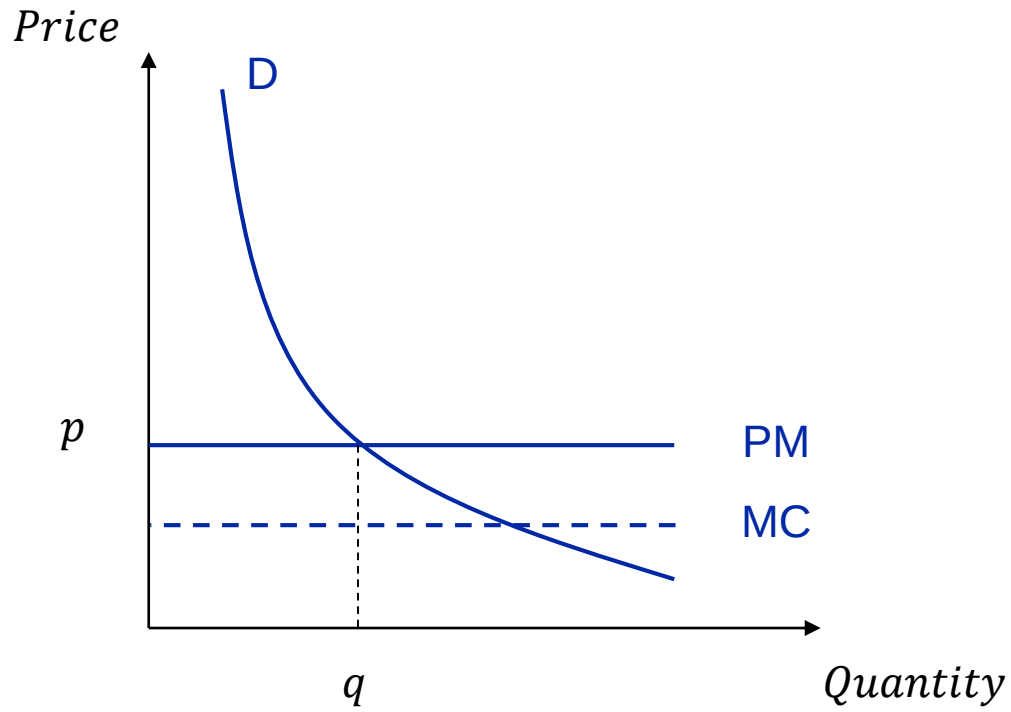
$$\pi_i = \frac{p_i^{1-\sigma}}{P^{1-\sigma}} wL - wa \frac{p_i^{-\sigma}}{P^{1-\sigma}} wL - wf$$

- Maximizing this with respect to p_i taking P as given (we can do this if N is large) yields the pricing formula

$$p = \frac{\sigma}{\sigma - 1} aw \qquad \text{(PM)}$$

- This simply says that firms charge a constant markup $\frac{\sigma}{\sigma-1}$ over marginal costs aw (so that we can also drop the subscript i from now on)

Krugman model – Profit maximization (contd.)



Krugman model – Free entry

- Free entry drives profits down to zero so that prices equal average costs, $p = \frac{wl}{q}$. Using the earlier expression for technology, this can be rewritten as

$$p = aw + \frac{fw}{q} \qquad (FE_1)$$

- Combining this with the optimal pricing formula (PM) reveals that firm size is independent of country size in equilibrium since then

$$q = \frac{(\sigma - 1)f}{a} \quad and \quad l = \sigma f$$

Clicker question:

Intuitively, why is FE_1 decreasing in q?

Krugman model – Labor market clearing

- Labor market clearing requires $L = Nl$. Together with the earlier expression for technology, this can be used to rewrite the free entry condition (FE_1) as

$$p = \frac{aw}{1 - \frac{f}{L}N} \qquad (FE_2)$$

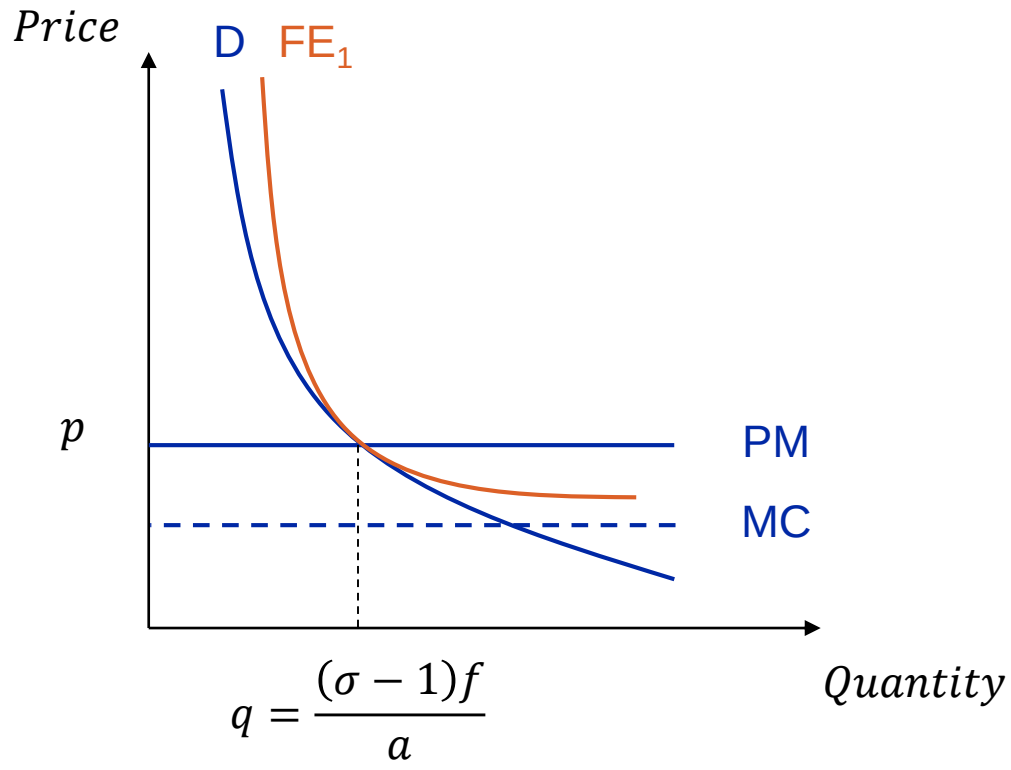
- Combining this with the optimal pricing formula (PM) reveals that the number of firms is proportional to country size in equilibrium since then

$$N = \frac{L}{\sigma f}$$

Clicker question:

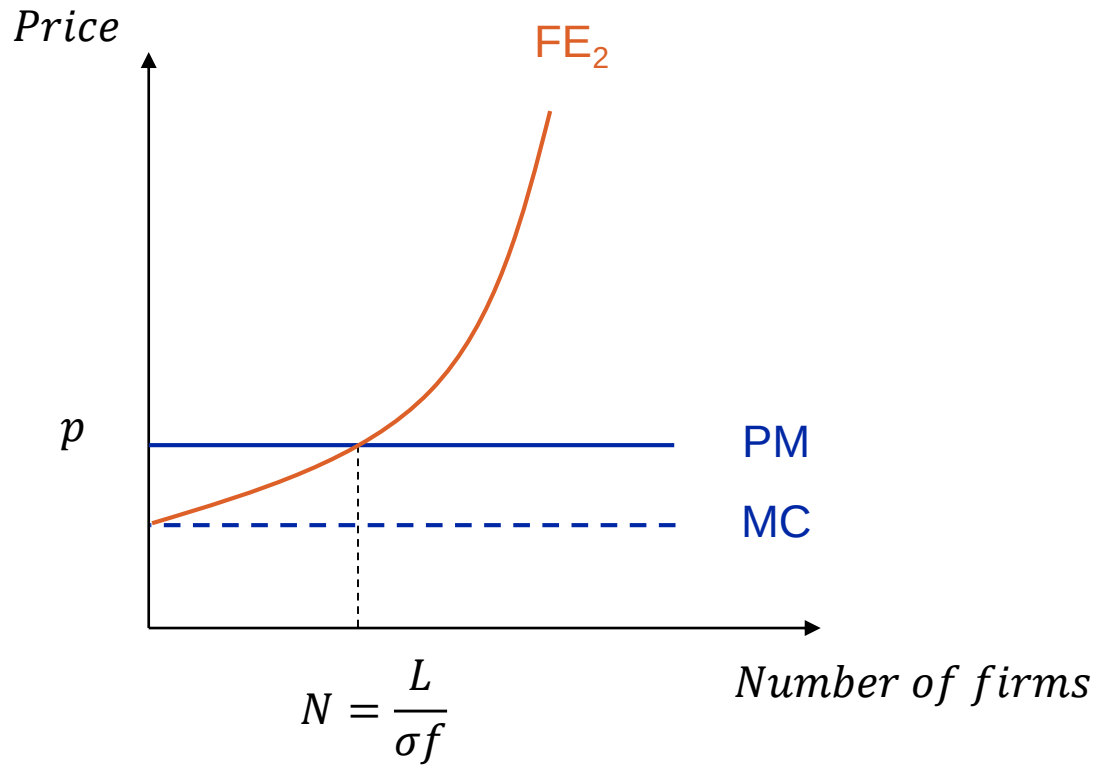
Intuitively, why is FE_2 increasing in N?

Krugman model – Autarky equilibrium



- In equilibrium, firms maximize profits and make zero profits
- If the demand curve was further to the right, $p > AC$ so that there would be entry which would then shift it back to the left
- If the demand curve was further to the left, $p < AC$ so that there would be exit which would then shift it back to the right

Krugman model – Autarky equilibrium (contd.)



- This graph illustrates exactly the same equilibrium as the previous graph, just at the industry-level instead of the firm-level
- Notice that p is only determined relative to w in both graphs since all curves are proportional to w. We could normalize $w = 1$

Krugman model – Trade liberalization

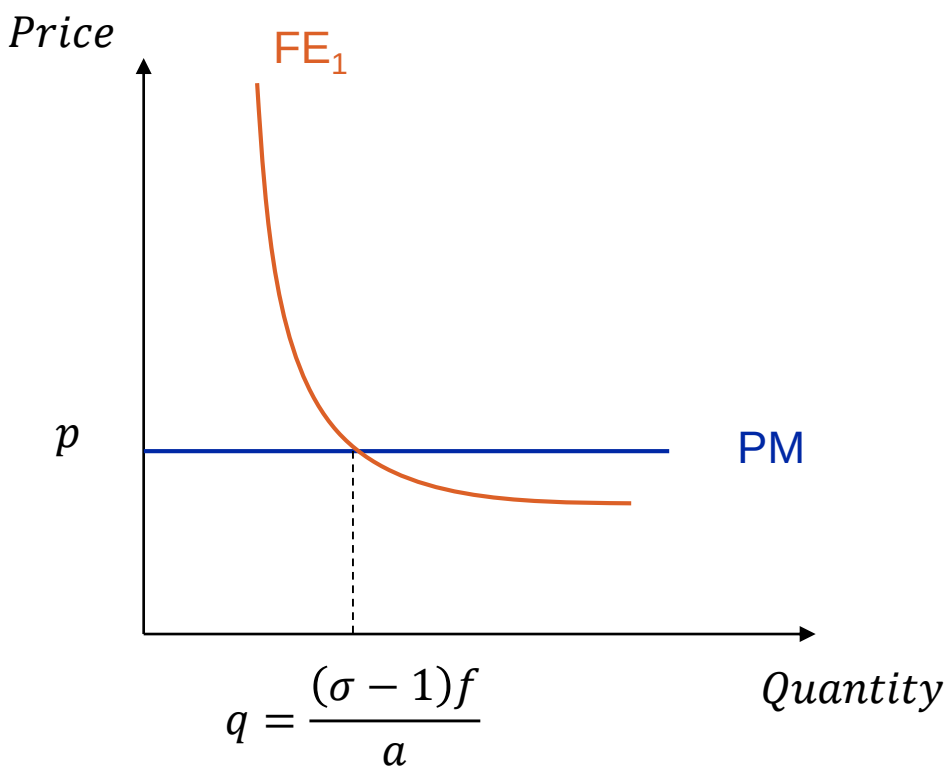
- In order to illustrate that the Krugman model can explain intra-industry trade, we now consider trade between two identical countries (called “Home” and “Foreign” as usual)

- Home and Foreign have identical preferences, identical technologies, and identical labor endowments but produce differentiated varieties

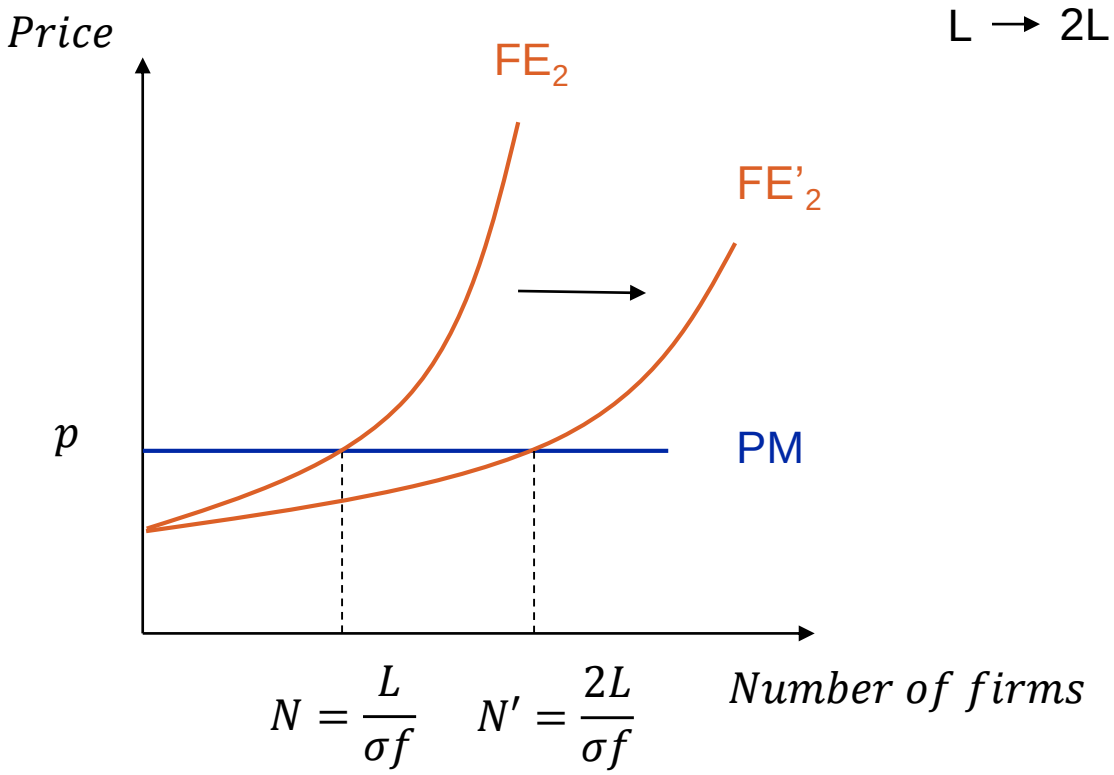
- One can show (but we won’t) that the effects of trade liberalization are the same as if these two countries became one

- This means that the effects of trade liberalization can be illustrated by considering a doubling of the labor force

Krugman model – Trade liberalization (contd.)



Firm-level



Industry-level

Krugman model – Trade equilibrium

- The firm-level graph reveals that the price charged by each firm and the quantity produced by each firm is the same in the autarky equilibrium and the trade equilibrium

- The industry-level graph adds that the number of firms doubles from the autarky equilibrium to the trade equilibrium

- But, in the autarky equilibrium, this shows the number of firms in Home or Foreign while, in the trade equilibrium, it shows the number of firms in Home and Foreign combined

- Since each firm still produces the same amount of output and thus hires the same amount of workers, the number of firms operating in each country actually remains unchanged

Krugman model – Trade equilibrium (contd.)

- The key difference is that consumers spend half of their income on foreign varieties and firms sell half of their output to foreign consumers in the trade equilibrium

- Essentially, consumers then have access to twice as many varieties and spread their income equally across all of them

- Because of the IRS technology, each firm specializes in a unique variety because it is not profitable to replicate what another firm already does

- Because of love-of-variety preferences, consumers then demand all these varieties thus giving rise to intra-industry trade

Krugman model – Gains from trade

- Welfare is again given by real income in this model, that is the nominal wage deflated by the consumer price index

- Mathematically, the price index measures the minimum costs of obtaining one unit of utility so that a lower price index implies a higher utility for a given wage

- Here, the price index is given by $P = N^{\frac{1}{1-\sigma}} p$ under autarky and by $P = (N + N^*)^{\frac{1}{1-\sigma}} p$ under free trade so that it falls upon trade liberalization

- This captures that there are **import variety gains** in the Krugman model in the sense that consumers benefit from having access to import varieties

Import variety gains

- In the extreme case of going from autarky to free trade, these import variety gains look entirely distinct from the earlier comparative advantage gains

- Comparative advantage gains are about getting access to existing goods at lower prices whereas import variety gains are about getting access to new goods

- However, this stark difference disappears when one interprets trade liberalization as a gradual reduction in trade costs (which can be modeled as “iceberg trade barriers”)

- Then, all consumers always consume all goods unless trade costs are infinitely large and trade liberalization is again about falling import prices

Import variety gains (contd.)

- In any case, the empirical literature has picked up on the idea and tried to estimate the magnitude of the import variety gains

- The best known paper on this is by Broda and Weinstein (2006) who extend and apply a methodology from Feenstra (1994)

- Broda and Weinstein (2006) calculate the import variety gains reaped by the US between 1972 and 2001

- They (i) define varieties as product-country pairs such as “French red wine”, (ii) estimate σ for many industries, and (iii) calculate the effect new import varieties had on the US price index

Import variety gains (contd.)

- They first show that the number of imported varieties more than tripled between 1972 and 2001 (from 74,420 to 259,215)

- They then estimate that the real income gains associated with this increased import variety amount to 2.6%

- An important limitation of the Broda and Weinstein (2006) calculation is that they focus entirely on import variety gains

- We will see later that there tend to be contemporaneous domestic variety losses which a comprehensive calculation should also take into account

Home market effect

- In the basic Krugman model, the number of firms does not adjust following trade liberalization since zero profits imply $l = \sigma f$ and labor market clearing requires $N = \frac{L}{l}$

- This changes if we add a second industry to the model so that firms enter and exit as workers move between sectors

- Suppose, for concreteness, that we are considering the countries Germany and Italy and the industries cars and fashion

- Suppose also that cars and fashion trade is subject to trade costs and that Germans have a relatively stronger preference for cars

Home market effect (contd.)

- One can show (but we won't) that firms then have a tendency to locate in the country which offers them a larger home market which is known as the **home market effect**

- In our example, disproportionately many car firms locate in Germany and disproportionately many fashion firms locate in Italy

- The logic is simply that firms save on trade costs by locating in the country with the larger home market because less of their goods then need to be shipped internationally

- The idea that countries with larger demand for some products at home also have larger sales of the same product abroad is also known as the **Linder (1961) hypothesis**

Home market effect (contd.)

- In a recent contribution, Costinot et al (2016) provide compelling evidence for the home market effect by looking at the global pharmaceutical industry

- They exploit the fact that a country's demographic composition can be used as a predictor of the drugs that are most likely to be high in demand

- They show that countries indeed tend to be net sellers of the drugs that they demand the most, just as predicted by Krugman (1980)

Home market effect (contd.)

- The home market effect has also received renewed attention in the recent literature on quality specialization which tries to explain why richer countries tend to specialize in higher quality goods

- In particular, Fajgelbaum et al (2011) argue that this is because richer countries demand higher quality goods which then triggers home market effects

- But one could also give a Heckscher-Ohlin explanation saying that rich countries are capital abundant and high quality goods are capital intensive

- Dingel (2016) finds that both these explanations are equally important for understanding the quality specialization across US cities

Home market effect (contd.)

- The home market effect is also the foundation of the “new” economic geography literature which revisits the causes and consequences of economic agglomeration

- For example, Krugman and Venables (1995) show that in a multi-sector Krugman model with intermediate goods having a large home market can become a self-fulfilling prophecy

- In particular, consider agriculture and manufacturing and suppose that manufacturing firms use other manufacturing varieties as intermediate inputs

- In the presence of trade costs, manufacturing firms then want to be close to other manufacturing firms simply because this reduces their input costs

Home market effect (contd.)

- A large home market can then become a self fulfilling prophecy in the sense that more manufacturing firms want to locate in countries which already have many manufacturing firms

- One can show that this happens if the share of intermediate inputs in gross production is high so that manufacturing firms care strongly about being close to other manufacturing firms

- One country then becomes the manufacturing “core” while the other becomes the manufacturing “periphery” potentially having no manufacturing firms at all

- But which country becomes the core and which becomes the periphery depends on initial conditions so that there are multiple equilibria

Home market effect (contd.)

- Importantly, Krugman and Venables (1995) show that in such situations countries may actually lose from trade

- Most intuitively, countries that become the manufacturing periphery upon trade liberalization experience a decline in real incomes

- Similar results can be obtained in models featuring external increasing returns to scale in the sense that firm productivity is increasing in industry output (for example as a result of technological spillovers)

- Indeed, Kucheryavvy et al (2017) have recently shown that such models are isomorphic to multi-sector Krugman models in a mathematical sense

Home market effect (contd.)

- Kucherayavvy et al (2017) also show that countries may lose from trade only in cases in which there are multiple equilibria

- But this seems unlikely to be the empirically relevant case since we rarely observe drastic shifts between equilibria

- For example, Davis and Weinstein (2002) show that even the nuclear bombing of Hiroshima and Nagasaki did not really change their economic geography

- In any case, these analyses provide a useful benchmark for understanding under which conditions countries may lose from trade

Extensions – Endogenous markups

- One stark feature of the Krugman (1980) model is that markups are constant which rules out any pro-competitive effects of trade

- Krugman (1979) actually allows for endogenous markups and a simplified version of this earlier paper is discussed in the textbook chapter on increasing returns

- However, Arkolakis et al (forthcoming) point out that such pro-competitive effects are largely elusive in more realistic models

- Essentially, markups tend to fall for import-competing firms but rise for export-oriented firms so that the net welfare effect is small

Extensions – Comparative advantage

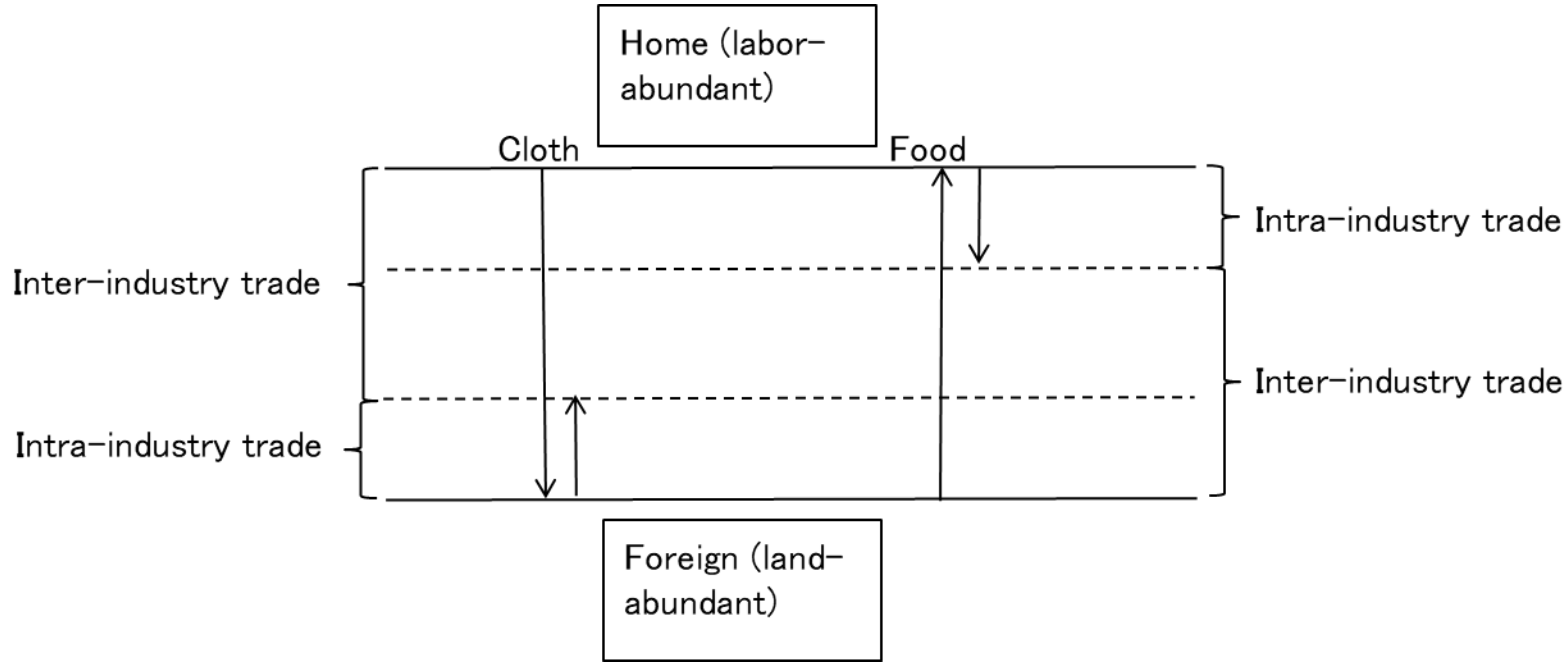
- Another stark feature of the Krugman (1980) model is that countries are completely identical and there is no inter-industry trade

- Helpman and Krugman (1985) have shown that it can be integrated with a standard Heckscher-Ohlin model

- In this extended model, there is still two-way trade within all industries but countries are net exporters in the industries in which they have a comparative advantage

- Indeed, the main models we discuss in this class are all mutually compatible so it is also possible to add Ricardian elements

Extensions – Comparative advantage (contd.)



Source: KMO textbook

Extensions – Comparative advantage (contd.)

- The relative importance of intra-industry trade in a given industry between a given country pair (say Home's cloth trade with Foreign) is typically measured by the **Grubel-Lloyd index**

$$GLI_{cloth} = 1 - \frac{|EXP_{cloth} - IMP_{cloth}|}{EXP_{cloth} + IMP_{cloth}}$$

- Without intra-industry trade, $IMP_{cloth} = 0$ so that $GLI_{cloth} = 0$. Without inter-industry trade, $EXP_{cloth} = IMP_{cloth}$ so that $GLI_{cloth} = 1$.

- Notice that this index is sensitive to our definition of an industry. The more disaggregated our definition, the lower the measured importance of intra-industry trade

Extensions – Comparative advantage (contd.)

- The KMO textbook reports GLIs for some US industries summing US exports and imports over all US trading partners

Inorganic chemicals	0.99
Power-generating machinery	0.97
Electrical machinery	0.96
Organic chemicals	0.91
Medical and pharmaceutical	0.86
Office machinery	0.81
Telecommunications equipment	0.69
Road vehicles	0.65
Iron and steel	0.43
Clothing and apparel	0.27
Footwear	0.00

Source: KMO textbook

Conclusions

- We introduced the Krugman (1980) model which explains intra-industry trade by combining increasing returns to scale technologies and love-of-variety preferences

- The main idea is that increasing returns to scale technologies imply specialization while love-of-variety preferences bring about trade

- Besides explaining intra-industry trade, the Krugman model delivers two main results: (i) trade can generate import variety gains and (ii) having a large home market for a good can result in becoming a net exporter of that good

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