

Uneven Development

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- ① Uneven development.
- ② Reinforcement and reversals.
- ③ Rational underdevelopment.
- ④ Other applications of dynamic external economies.

Setup: simple Ricardian model

- 2 regions: North and South ('*')
- 1 factor of production: $L = L^*$.
- 2 sectors: food and manufacturing
- Preferences:

$$U(C_M, C_F) = C_M^\mu C_F^{1-\mu}$$

where $\mu > 1/2$.

Setup: simple Ricardian model

- Technologies:

$$\begin{aligned} Q_F &= L_F & Q_F^* &= L_F^* \\ Q_M(t) &= A(E(t))L_M & Q_M^*(t) &= A(E^*(t))L_M^* \end{aligned}$$

- A region's productivity in manufacturing depends on both direct experience producing manufactures (*dynamic localized external economies*) and possible spillovers from other technologies:

$$\begin{aligned} E(t) &= \int_0^t Q_M(s) ds + S(t) \\ E^*(t) &= \int_0^t Q_M^*(s) ds + S^*(t) \end{aligned}$$

- Manufacturing learning curve is increasing and concave, so that $A' > 0$ and $A'' < 0$.

Specialization patterns

- Utility maximization gives inverse demand function ($p_F = 1$):

$$\frac{C_M}{C_F} = \frac{\mu}{1 - \mu} \frac{1}{p_M}$$

- Technology differences: $A > A^*$.
- $\mu > 1/2$ implies that North is always fully specialized in manufacturing.
- South is either fully specialized in food or produces both goods.
- South will be fully specialized in food if

$$1 > \frac{\mu}{1 - \mu} \frac{A^*}{A} p_M = \frac{\mu}{1 - \mu} \frac{1}{A} \quad (1)$$

- If (1) does not hold, South produces both food and manufactured goods.

- Starting point: at time $t = 0$ assume that

$$\begin{aligned}A[E(0)] &= \underline{A} \\ A[E^*(0)] &= \underline{A} - \varepsilon\end{aligned}$$

- Initially the TFP difference is small, so that (1) does not hold: North is fully specialized in manufacturing, and South produces both goods.
- Wages in North relative to South:

$$\frac{w}{w^*} = \frac{A(E(0))}{A(E^*(0))}$$

so that initially the wage advantage of North is negligible.

Dynamics of uneven development

- Although North and South have virtually identical initial conditions, the small productivity advantage of North determines the patterns of specialization.
- Over time the North's specialization in manufacturing allows it to accumulate manufacturing experience faster than the South, so that the productivity differences get reinforced and grow:

$$\frac{A[\dot{E}(t)]}{A[E(t)]} > \frac{A[\dot{E}^*(t)]}{A[E^*(t)]} \quad \text{for all finite } t$$

- As a result, (i) wage differences increase over time, and (ii) the South deindustrializes. Eventually, condition (1) holds, and the South stops producing manufactured goods.
- At that point, relative wage of North compared to South has become:

$$\frac{w}{w^*} = \frac{\mu}{1 - \mu}$$

- The two regions, in spite of their virtually identical initial conditions, diverge into a rich industrial North and a poor agricultural South.
- This is discussed in **Krugman (1981)**.

- Assume a new technology to produce manufacturing is exogenously introduced.
- For a given level of accumulated production (experience), the new technology is more productive than the old technology.
- In spite of this, the North does not necessarily adopt the new technology: given its experience with the old technology, its productivity may be higher in the old technology (with lots of experience) than in the new technology (given the absence of experience).
- The new technology may, however, locate in the low-wage South.

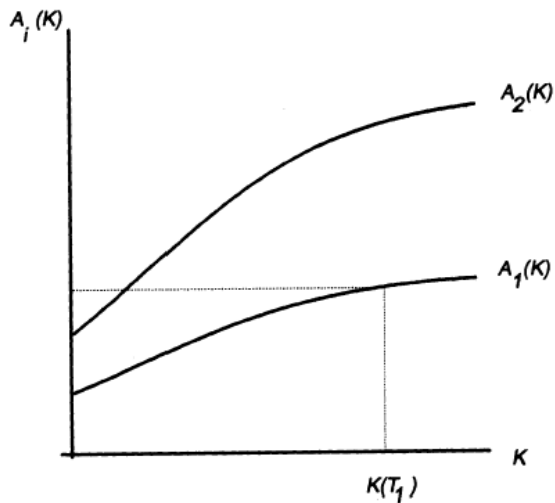


FIGURE 1. ASSUMPTIONS ABOUT THE NEW AND OLD TECHNOLOGIES

- If the South adopts and the North does not, the South starts growing faster than the North.
- At some point, the South's productivity in the new technology is greater than the North's productivity in the old technology.
- At that point, the South overtakes the North, and the pattern of specialization reverses.
- This is discussed in **Brezis, Krugman and Tsiddon (1993)**.

- If spillovers between the old and the new technology are strong enough, the North adopts the new technology and stays in the lead.
- The pattern of uneven development is reinforced.
- This is discussed in [Desmet \(2000\)](#) and [Desmet \(2002\)](#).

- Inter-regional transfers reduces the possibility of take-off by the South.
- Raises the question of why the South would want to accept those transfers, and why the North would be willing to pay them.
- To address these issues, we discuss [Desmet and Ortuño \(2006\)](#).

Inter-regional transfers may contribute to permanent underdevelopment

Examples

- Italy's *Mezzogiorno* (Boltho, Carlin and Scaramazzino, 1997)
- Germany's *Mezzogiorno* (Sinn and Westermann, 2001)

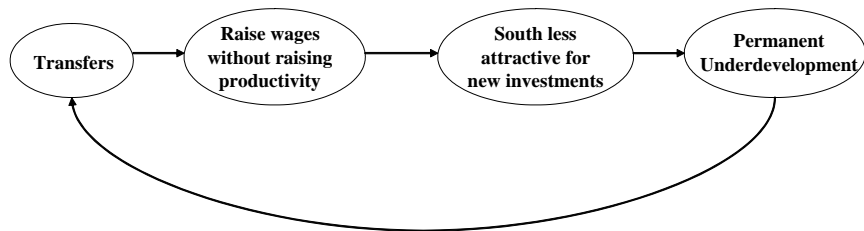
- Beginning 1970s: public policy shifted from investment incentives to income support (Paci and Sabo, 1998)
- Between 1971 and 1990 unit labor costs in the South rose 23% more than in the North.
- Over same period, GDP per capita of South relative to North declined from 0.65 to 0.57.

- Wages in East, relative to West, jumped from 7% in 1991 to 70% in 1998.
- Over same period, relative labor productivity only went from 35% to 55% (Sinn, 2000).

Examples: peripheral countries vs peripheral regions

- Peripheral countries (Spain, Ireland, Finland) have been catching up faster than peripheral regions (Southern Italy, Eastern Germany).
- National unions constrain wages to be the same across regions *within* countries. The same is not true *across* countries (Padoa Schioppa et al., 2002).

Mechanism is easy



Rationalization is more difficult

- Why would the North want to pump money into a bottomless well?
- Why would the South be willing to accept transfers that keep them trapped into underdevelopment?

- Transfers can arise in equilibrium:
 - As a risk sharing device against asymmetric shocks (Alesina and Perotti, 1995; Persson and Tabellini, 1996a, 1996b).
 - As a way of limiting the effect of distortionary public policy (Wildasin, 1994).
- Transfers can keep the lagging region backward:
 - Transfer problem (Leontieff, 1936).
- Our paper tackles both problems simultaneously: shows how transfers can be sustained, and how they can keep the lagging region backward.

- World divided into rich industrial North and poor agricultural South.
- A new technology can either locate in the lagging South (attracted by its low wages) or in the advanced North (if spillovers from the previous technology are sufficiently strong).
- Inter-regional transfers raise wages in backward region, without raising its productivity, thus making it less likely for the new technology to locate in the South.
- With high enough transfers, that probability goes to zero: the backward region *never* adopts new technologies, and is doomed to remain backward.

Levels of transfers that condemn the backward region to underdevelopment may Pareto dominate (lower) levels of transfers where the backward region still has a chance to take off.

This is what we call **rational underdevelopment**.

- Rationale of the advanced region: gives transfers to keep the backward region from taking off (“limiting low wage competition”).
- Rationale of the backward region: prefers the certainty of transfers (and thus of backwardness) to the uncertainty of taking off.

Period 1: rich North and poor South

- In this paper, take as starting point a rich North and a poor South.
- In other words, technology differences are large ($A \gg \gg A^*$), the North is fully specialized in manufacturing, and the South in food.

Relative wage of North compared to South:

$$\frac{w}{w^*} = \frac{\mu}{1 - \mu}$$

- Only difference with previous model: risk aversion.

$$U(C_M, C_F) = v(C_M^\mu C_F^{1-\mu})$$

where v is a strictly increasing and strictly concave function.

- Central government reduces relative wages to α , where $1 \leq \alpha \leq \frac{\mu}{1-\mu}$.
- **The smaller α , the greater the degree of redistribution!**
- The value of α is decided at the beginning of period 1, and lasts for both periods.
- Inter-regional redistribution is implemented by taxing manufacturing workers in the rich region, and subsidizing food workers in the poor region.
- The redistribution policy does not give an incentive to anyone to switch sectors, so that production is unaffected.
- Given homothetic preferences, the relative manufacturing price does not change either. Only wages are affected by redistribution.

- Wages drop in North and rise in South:

$$w = p_M A - t \qquad w^* = 1 + t^*$$

where $w/w^* = \alpha$, and $t = t^*$.

- Using the price expression, this gives us the following wages:

$$w = \frac{1}{1 - \mu} \frac{\alpha}{1 + \alpha}$$
$$w^* = \frac{1}{1 - \mu} \frac{1}{1 + \alpha}$$

- Utilities are then:

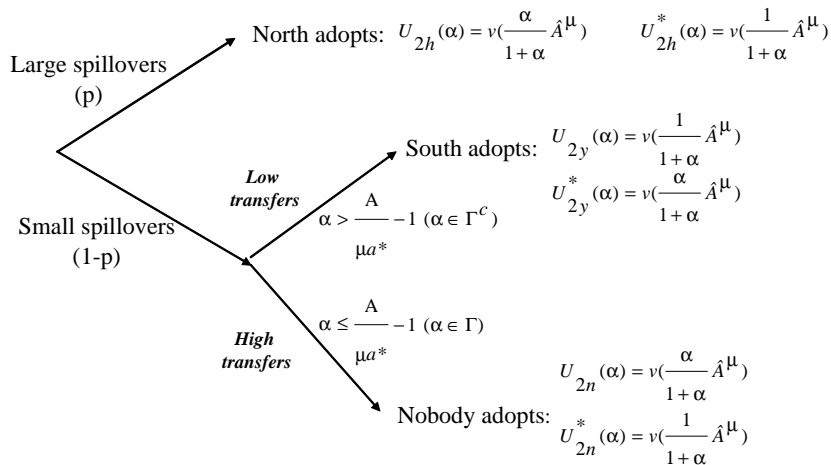
$$U_1(\alpha) = v\left(\frac{\alpha}{1 + \alpha} A^\mu\right)$$

$$U_1^*(\alpha) = v\left(\frac{1}{1 + \alpha} A^\mu\right)$$

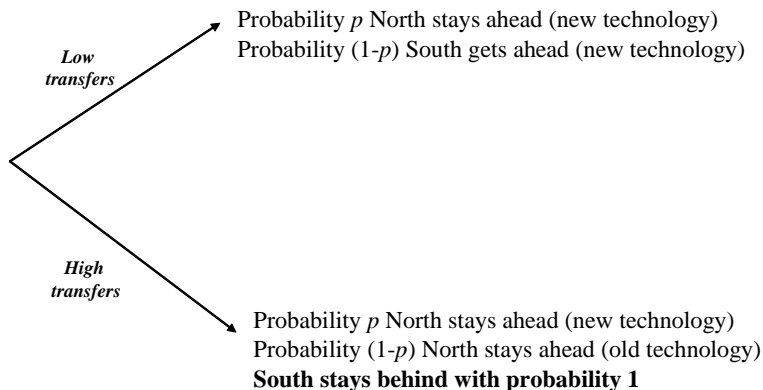
Period 2: technological change

- New manufacturing technology is exogenously introduced.
- Although neither region has any experience with the new technology, the North benefits from learning spillovers coming from the old technology.
 - With probability p spillovers are large, and the North's productivity in the new technology is high: $a_h > A$.
 - With probability $1 - p$ spillovers are small, and the North's productivity in the new technology is low: $a_l < A$.
 - The South does not benefit from learning spillovers, so that its productivity is always below that of the North: $a^* < a_l < a_h$.
- Once a region adopts the new technology, it starts accumulating experience until reaching a maximum $\hat{A} > A$.

Period 2: technological change



Period 2: technological change



Definition 1. For a given μ , a^* and A , we define Γ as the set of α for which the South never adopts the new technology; and we define Γ^c as the set of α for which the South has a chance of adopting the new technology.

Putting the two periods together

- Utility in North:

$$U_y(\alpha) = U_1(\alpha) + \beta[pU_{2h}(\alpha) + (1-p)U_{2y}(\alpha)]$$

$$U_n(\alpha) = U_1(\alpha) + \beta[pU_{2h}(\alpha) + (1-p)U_{2n}(\alpha)]$$

- Utility in South:

$$U_y^*(\alpha) = U_1^*(\alpha) + \beta[pU_{2h}^*(\alpha) + (1-p)U_{2y}^*(\alpha)]$$

$$U_n^*(\alpha) = U_1^*(\alpha) + \beta[pU_{2h}^*(\alpha) + (1-p)U_{2n}^*(\alpha)]$$

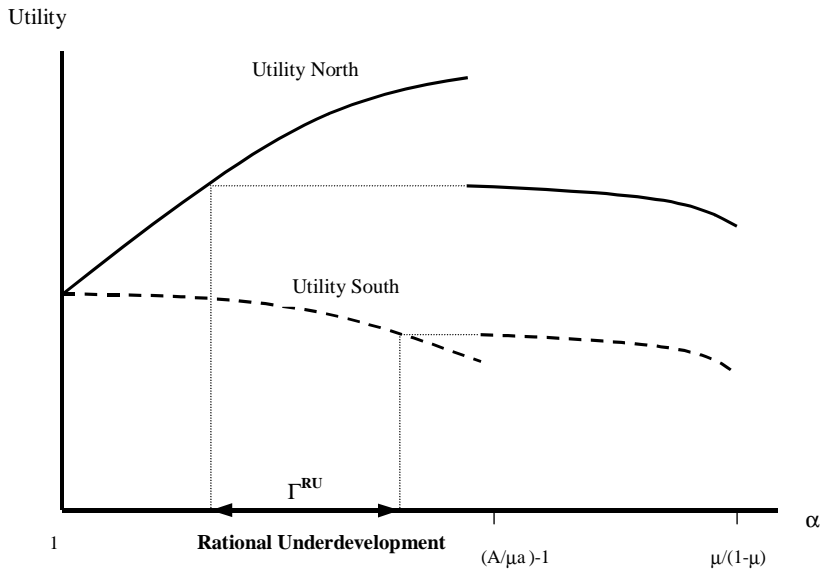
- Total expected utility in North and South is then:

$$U(\alpha) = \begin{cases} U_y(\alpha) & \text{if } \alpha \in \Gamma^c \\ U_n(\alpha) & \text{if } \alpha \in \Gamma \end{cases}$$

$$U^*(\alpha) = \begin{cases} U_y^*(\alpha) & \text{if } \alpha \in \Gamma^c \\ U_n^*(\alpha) & \text{if } \alpha \in \Gamma \end{cases}$$

Definition 2. A redistribution policy $\alpha \in \Gamma$ leads to rational underdevelopment if $U(\alpha) \geq U(\alpha')$ and $U^*(\alpha) \geq U^*(\alpha')$ for all $\alpha' \in \Gamma^c$. We denote by Γ^{RU} the set of such redistribution policies.

Example of rational underdevelopment



- **Condition 1.** $p < 1$ and $\beta > 0$

For the North to have any interest in paying transfers, it should be uncertain to attract the new technology, and it should care about this second period uncertainty:

- **Condition 2.** $\left(\frac{\hat{A}}{A}\right)^\mu < \frac{\mu}{1-\mu}$

The North should not experience welfare gains from the South switching to the new technology, so that new technology's productivity gain should not be too large.

- **Condition 3.** $\hat{\alpha} < \hat{\alpha}^*$

In the range of redistribution policies for which neither region adopts the new technology, the maximum level of redistribution in the North (above which it prefers zero redistribution) should be higher than the minimum level of redistribution in the South (below which it prefers zero redistribution). In other words, risk aversion should be high enough.

Theorem 1. *Let Conditions 1, 2 and 3 hold. Let all parameters but a^* be fixed. Then, there exists $k \leq A$, such that for all $a^* \leq k$ we have rational underdevelopment, i.e. the set Γ^{RU} is not empty.*

Rational underdevelopment tends to happen when the productivity gains from the new technology are modest (Condition 2), risk aversion is high (Condition 3), and the new technology's initial productivity in the new technology is low (Theorem 1).

Baseline case

- CRRA utility function: $v = \frac{x^{1-\rho}}{1-\rho}$, with $\rho = 5$ (Mehra and Prescott, 1985)
- $\mu = 0.6$, so that GDP per capita in the rich region is 50% higher than in the poor region.

In Italy GDP per capita in the North was 79% higher than in the South; in Spain the East had an advantage of 53% over the South; and in Belgium the difference was of 29% between the North and the South.

- Normalize $A = 1$ and set $\hat{A} = 1.1$.

If South adopts, instead of North, TFP growth will be 1.6 percentage points higher in South over a period of 25 years. Consistent with differences in TFP growth rates across countries (Young, 1995).

- Technology's initial productivity in the South: $a^* = 0.7$.

Annual TFP growth in South of 2% if adopts.

- Annual discount rate of 0.96, so $\beta = 0.375$ (1 period = 25 years)
- Probability of the North adopting the new technology: $p = 0.5$.

Numerical examples

(1) Risk aversion ρ	(2) Discount factor β	(3) New techn. \hat{A}	(4) North adopts p	(5) Productivity South a^*	(6) Rational underdev't $\Gamma^{RU}[\alpha_1, \alpha_2]$	(7) Tax rate North $[\frac{t}{w}(\alpha_1), \frac{t}{w}(\alpha_2)]$
1. Baseline case						
5	0.375	1.10	0.5	0.7	1.218, 1.312	0.085, 0.054
2. Risk aversion						
9	0.375	1.10	0.5	0.7	1.128, 1.338	0.117, 0.046
3	0.375	1.10	0.5	0.7	1.284, 1.292	0.063, 0.061
3. Productivity of new technology						
5	0.375	1.2	0.5	0.7	1.269, 1.307	0.068, 0.056
5	0.375	1.4	0.5	0.7	--	--
4. Initial productivity in South						
5	0.375	1.10	0.5	0.67	1.218, 1.411	0.085, 0.025
5	0.375	1.10	0.5	0.73	1.218, 1.224	0.085, 0.083

Is model reasonable?

Model focuses on wage (or income) subsidies.

- Other policies (publicly provided goods, unemployment benefits, and public employment) would all have same effect, as they would either reduce the labor supply, or increase the reservation wage.
- Bottomline: we need policies that increase wages without increasing productivity.
- Of course, subsidies to infrastructure or subsidies to investment would not have this feature. But in that case: where is the gain for the North?

Advanced region is willing to pay transfers, because it is worried about low-wage competition.

- Western German unions pushed for wage equality, because they were worried about firms moving East, and workers moving West (Akerlof et al., 1991).
- Absence of wage parity would drive down Western wages (German trade union journal *Die Quelle*.)
- Western German capital owners were often in favor of wage parity, to protect the value of past investments in the West. The chairman of the Metal Trades Employers Association, “vigorously” defended Eastern wage increases (Sinn and Sinn, 1992).

Lagging region is willing to accept transfers, because it prefers the certainty of transfers, to the uncertainty of take-off.

- Eastern German workers understood what was going on.
 - 80 percent of Eastern Germans understood that their wages were increasing faster than their productivity (Akerlof et al., 1991).
 - In a poll conducted by the Allensbach Institut in 1990, only 45 percent of East Germans thought their firm would survive.
- In spite of this dismal outlook, this deal was accepted, possibly because of the promise of transfers in the form of unemployment benefits (Akerlof et al., 1991; Sinn and Sinn, 1992).
- Unemployment benefits depend on terminal wages, so that workers may have preferred a significant, though brief, wage increase, before becoming unemployed.

- Dutch disease and infant industry.
- This is discussed in This is discussed in **Krugman (1987)**.