# Development Economics

## Slides 2

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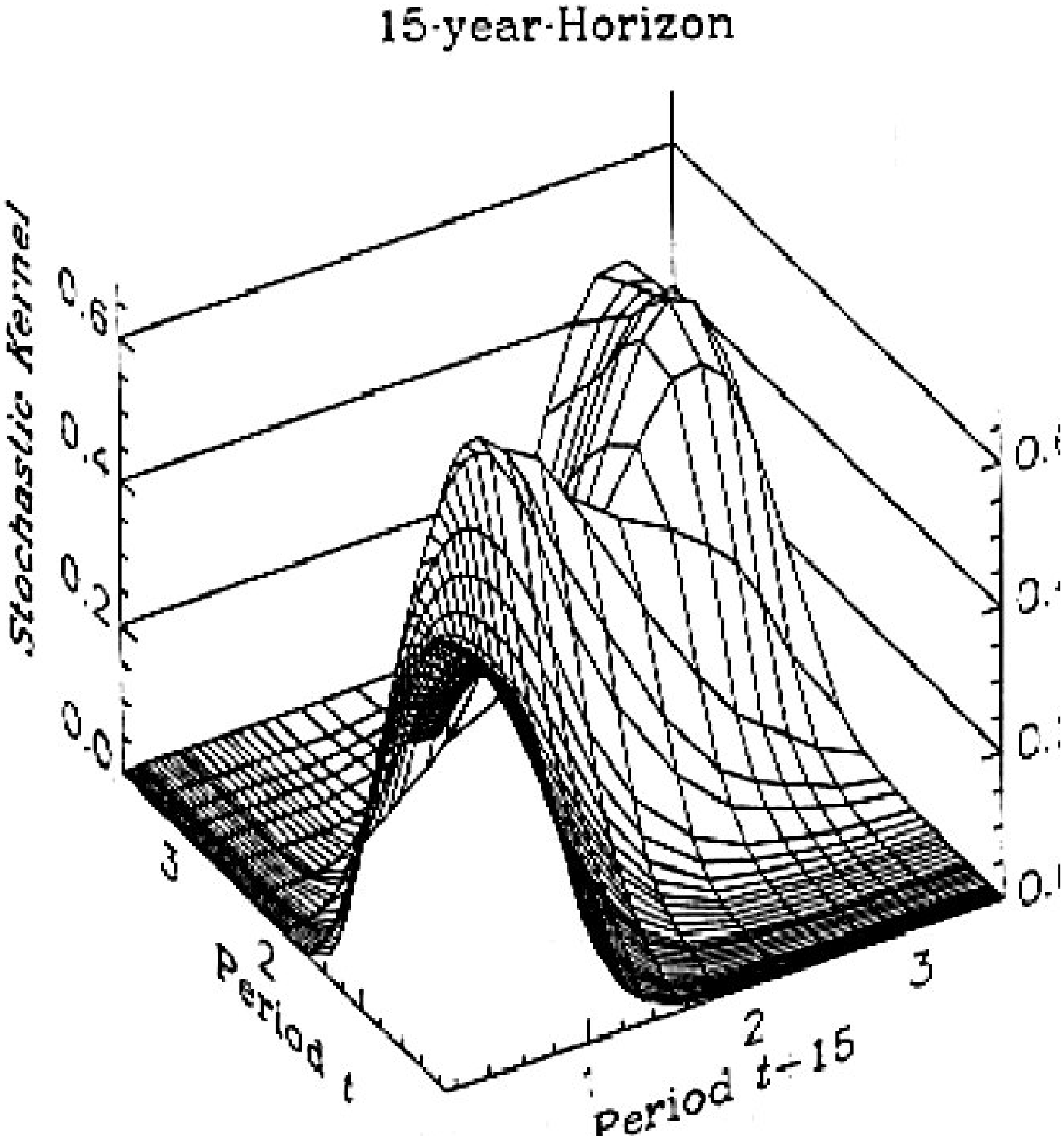
Warwick, Summer 2014

- Development traps

- [1] Self-fulfilling failure of expectations.

- [2] History-dependence

- Underdevelopment as a trap (diagram from Quah 1993)



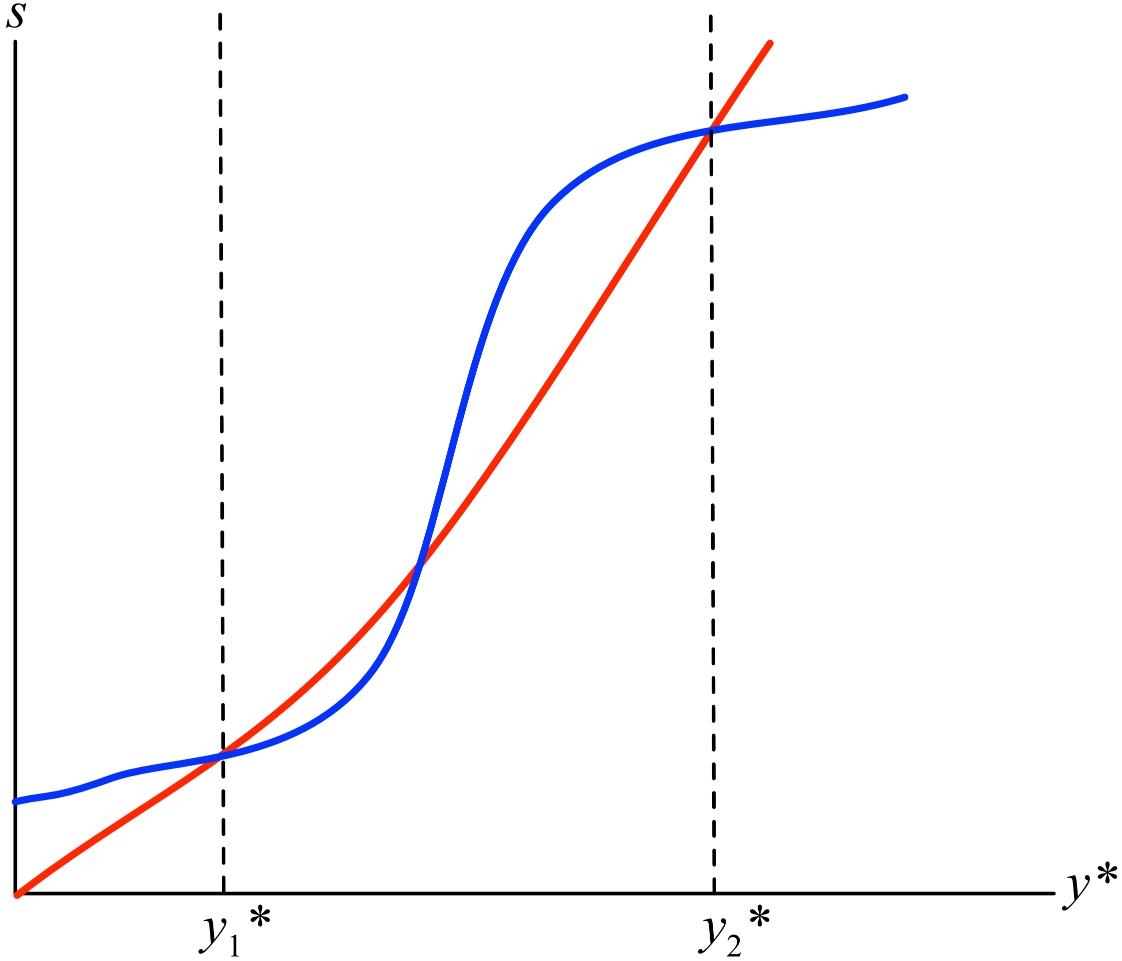
## Mobility matrix, 1982–2009

Cat 1: income $<$ 1/4 world av; Cat 2: between 1/4 and 1/2 world av; Cat 3: between 1/2 world av and world av; Cat 4: between world av and twice world av; Cat 5: income $>$ twice world av.

| Obs | Cat | ① | ② | ③ | ④ | ⑤ |
|---|---|---|---|---|---|---|
| *32* | ① | **84** | **13** | **3** | **0** | **0** |
| *21* | ② | **43** | **43** | **14** | **0** | **0** |
| *26* | ③ | **0** | **27** | **50** | **23** | **0** |
| *20* | ④ | **0** | **0** | **20** | **70** | **10** |
| *29* | ⑤ | **0** | **0** | **0** | **3** | **97** |

- The general problem: there is “too little” convergence.
- Of course we can keep conditioning; e.g.:
- one country is more corrupt than another,
- or less democratic,
- or is imbued with a horrible work ethic,
- or is prone to reproducing like rabbits,
- or is intrinsically predisposed not to save,
- but then what is the point of “conditional convergence”?
- Too little emphasis on the *process*
- endogenous variable $\longrightarrow$ economics $\longrightarrow$ endogenous variable

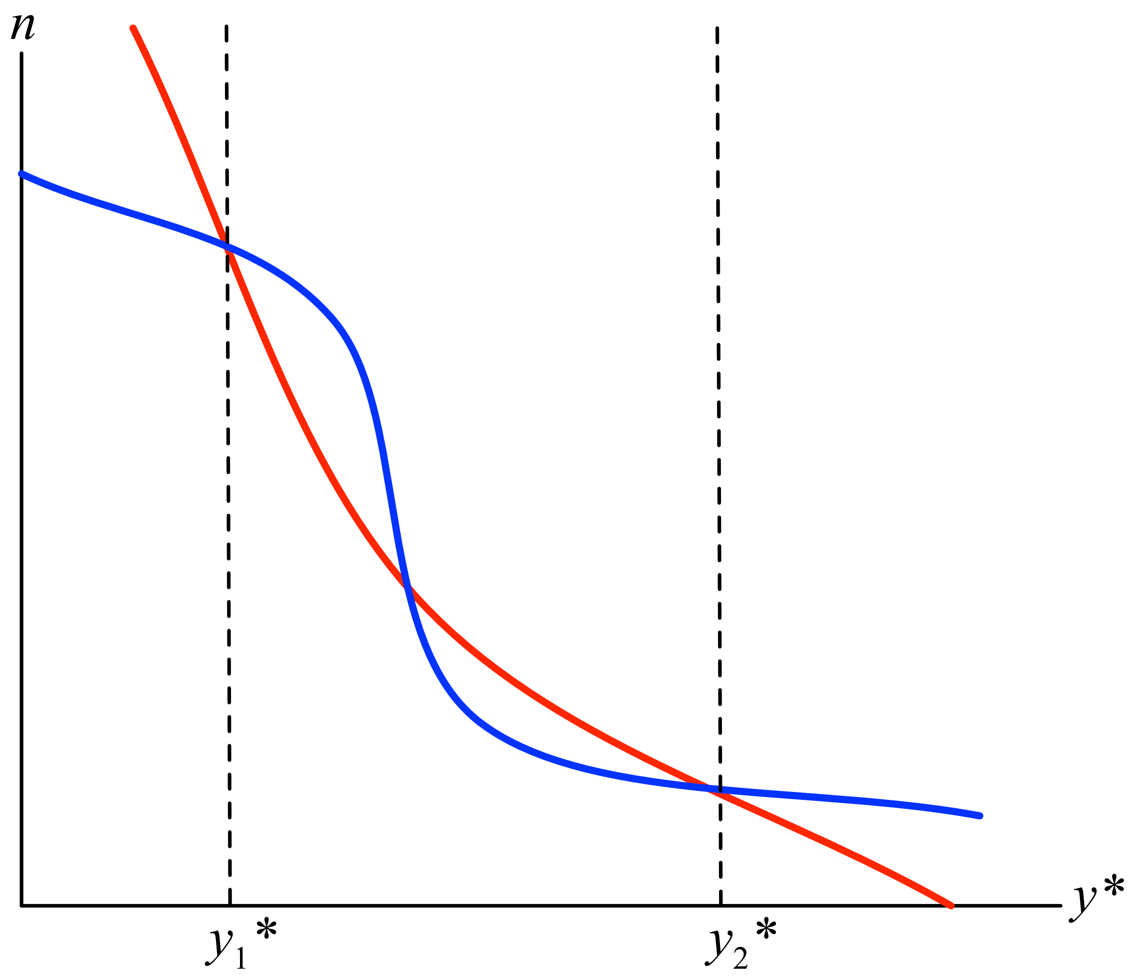
# Example: The Endogeneity of $s$




Blue line: How $s$ is affected by steady state income $y^*$.

Red line: How $y^*$ is determined by $s$ (as in Solow model).

# Example: The Endogeneity of $n$




Blue line: How $n$ is affected by steady state income $y^*$.

Red line: How $y^*$ is determined by $n$ (as in Solow model).

# Development Traps I: Self-Fulfilling Prophecies

- Origins: Rosenstein-Rodan (1943), Myrdal (1944, 1957) and Albert Hirschman (1958).

- Later: Murphy, Shleifer and Vishny (1991), Krugman (1991), Matsuyama (1991, 1996), Ciccone and Matsuyama (1996), Rodriguez (1996), *Journal of Development Economics* (1996) . . .

- Can express as game with strategic complementarities.

- Such games *may* exhibit Pareto-ordered multiple equilibria.

# Complementarities

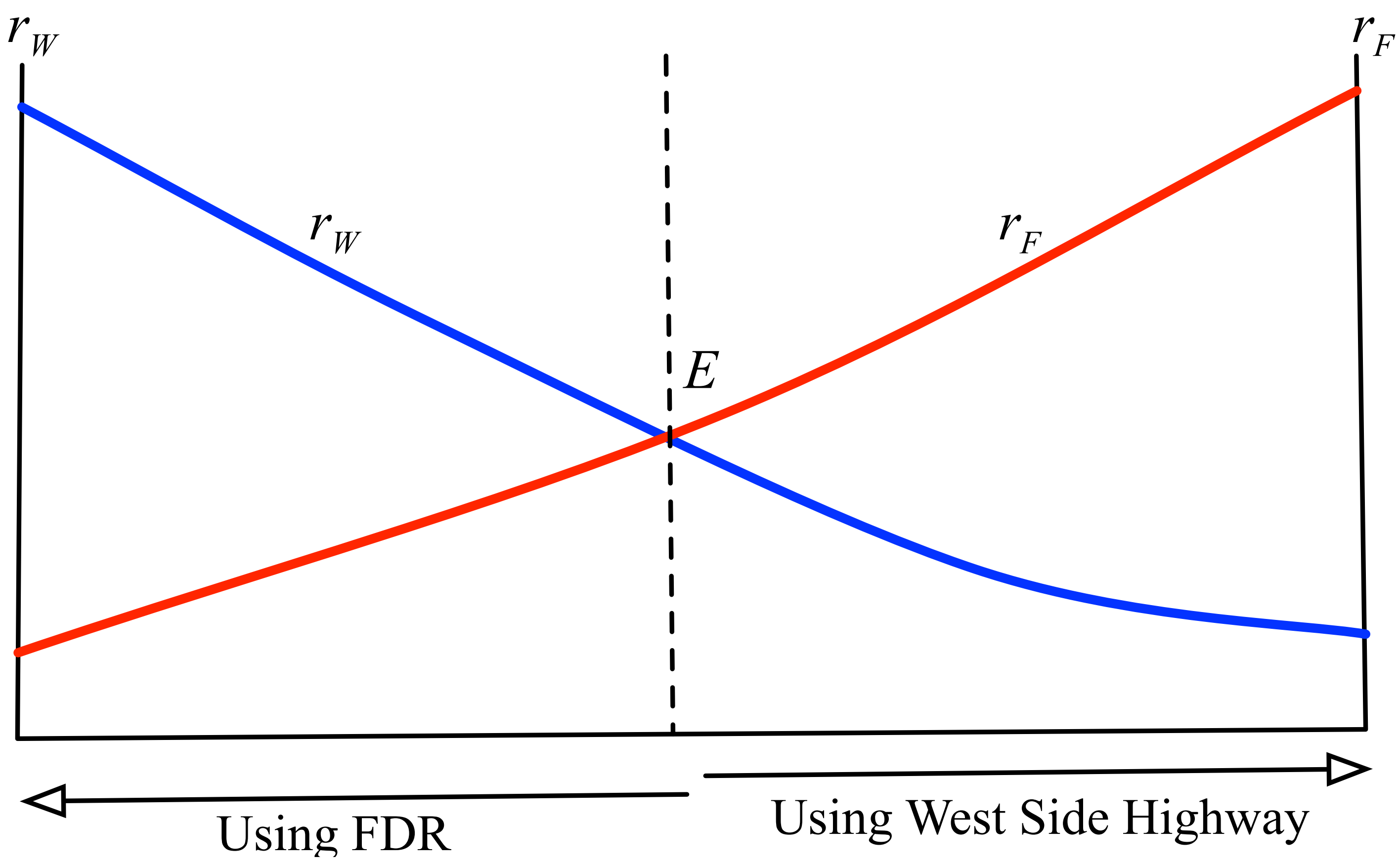
- players 1, . . . , n; action sets $A_1, \ldots, A_n$, each ordered.
- For each $i$, payoff function $\pi_i : \bigtimes_i A_i \to \mathbb{R}$.
- Game exhibits complementarities if whenever $a_{-i} \geq a'_{-i}$, then

$$\arg\max_{a_i} \pi(a_i, a_{-i}) \geq \arg\max_{a_i} \pi(a_i, a'_{-i}).$$

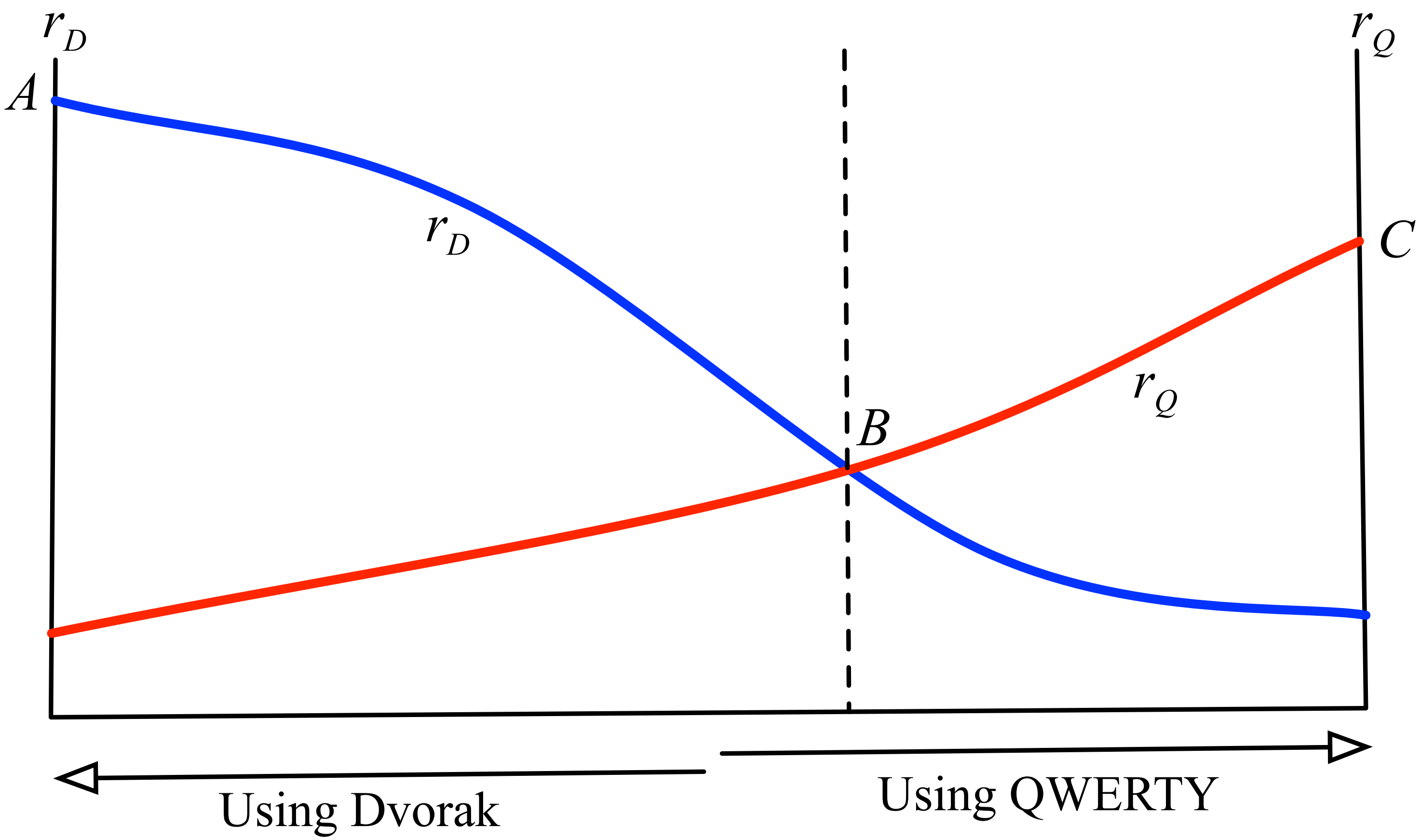
- Special case: everyone has action set $A \subseteq \mathbb{R}$.
- $m_i$ is average of all actions other than $i$'s.
- Payoff function given by $\pi_i(a, m)$.
- Then complementarities if

$$\pi_i(a, m) - \pi_i(a', m) \text{ is increasing in } m$$

- whenever $a > a'$ are two actions in the set $A$.



$r_W$
$r_F$
$r_W$
$r_F$
$E$
Using FDR
Using West Side Highway


$r_D$
$r_Q$
A
B
C
$r_D$
$r_Q$
Using Dvorak
Using QWERTY

- Basic recipe: Look for monotone "equilibrium map".

- Technology. MacOS vs Android.

  - Network externalities (Katz and Shapiro 1985, Arthur 1989)

- Growth with Externalities (Romer 1986).

  - Economy-wide investment raises return to individual investment.

- Infrastructure (Murphy-Shleifer-Vishny 1989)

  - Need to cover fixed and variable cost $p(n) = v + (F/n)$.

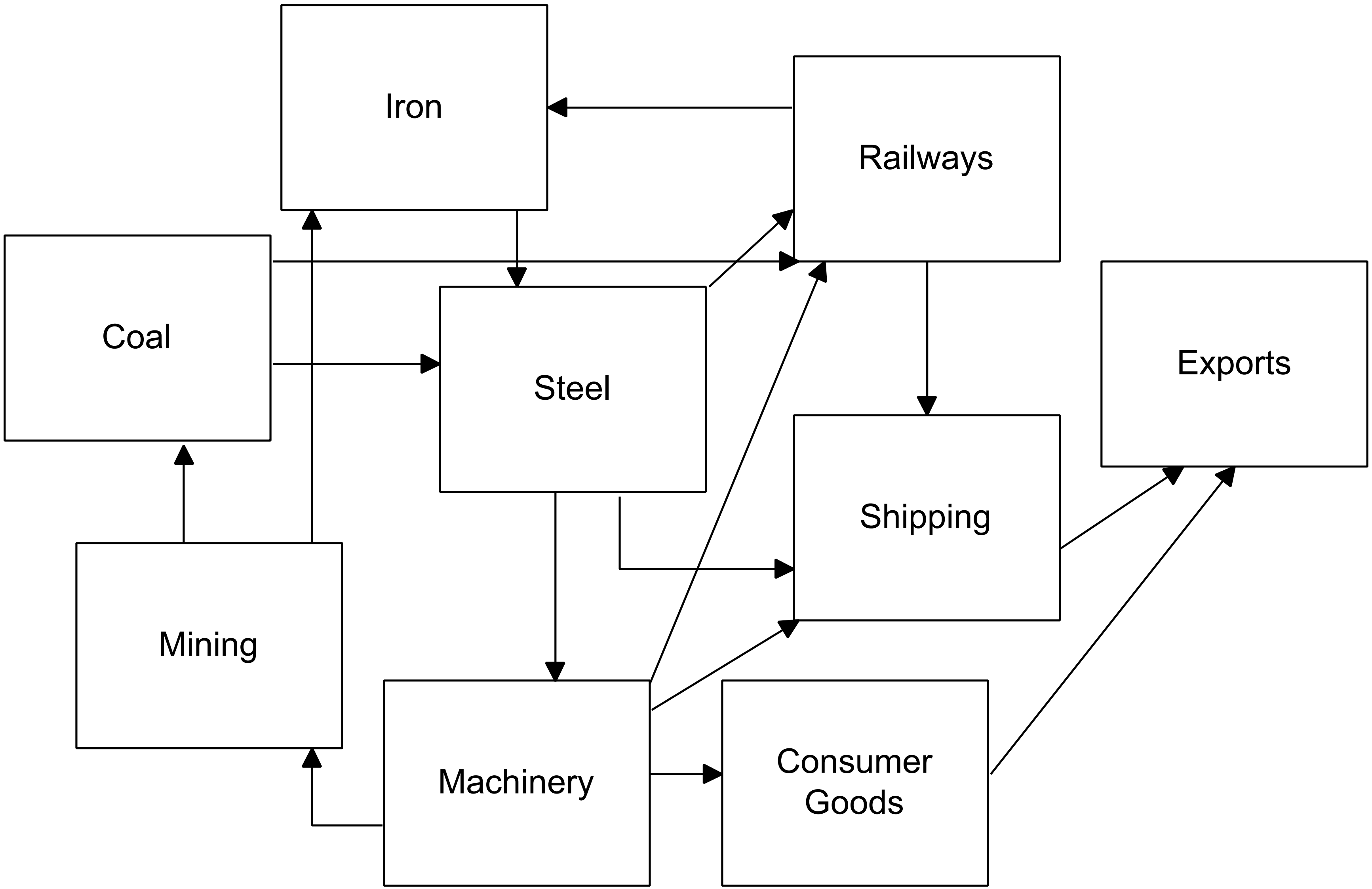
- Finance (Acemoglu and Zilibotti [1997]).

  - Thicker financial market $\Rightarrow$ diversification $\Rightarrow$ more investment $\Rightarrow$ thicker market.

- Corruption. Economy with limited auditing capacity
  - Only a fraction of "corrupt" people can be investigated.
- Capital Deepening (Ciccone and Matsuyama 1996).
  - $X = \left[\int_0^n x(i)^{(\sigma-1)/\sigma} di\right]^{\sigma/(\sigma-1)}$, where $\sigma > 1$ and $n$ is endogenous.
- Norms (Hardin 1997, Ray 1998, Munshi-Myaux 2003).
  - Crop adoption, using contraceptives, joining the revolution...
- Currency Crises (Obstfeldt 1994, Morris and Shin 1998).
  - Herding versus the fundamentals.
- Discrimination (Myrdal 1944, Arrow 1972, Tirole 1996).
  - Groups discriminated against fail to "invest" $\Rightarrow$ discrimination.

# Two Economy-Wide Coordination Failures

- Inter-Industry Links (Hirschman [1958])



# Two Economy-Wide Coordination Failures, contd.

- Demand Complementarities (Rosenstein-Rodan [1943])
  - Industrial expansion raises income, generates demand for *other* industries.
  - Complementarity across producers of non-inferior goods.
  - The parable of the shoe factory.
- These models lay a (limited) foundation for policy debates
  - Balanced versus unbalanced growth
  - Rosenstein-Rodan (1943, 1961), Nurkse (1952, 1953), Hirschman (1958), Streeten (1956, 1963)
- At the heart of this view: pecuniary externalities.

# Murphy-Shleifer-Vishny formalization of RR 1943

- A model of demand-side externalities.
  - Continuum of sectors, $i \in [0, 1]$.
  - Identical individuals with labor endowment $L$ and utility function

$$\int_0^1 \ln x(i) dq.$$

  - Note: if income is $y$, then $y$ spent on every good $q$.
  - Normalize wage to 1; then $y = \pi + L$ (profits + labor income).
- Each sector has two technologies, cottage, and industrialized.
  - Cottage: $x = \ell$, no setup cost.
  - Industrialized: $x = \alpha\ell$, $\alpha > 1$; setup cost $F(i)$ for sector $i$.

- Competitive cottage and unit demand elasticity imply $p = 1$.
- So profit from industrialization in sector $i$ is given by

$$py - \frac{y}{\alpha} - F(i) = \frac{\alpha - 1}{\alpha} y - F(i) \equiv ay - F(i)$$

- $\Rightarrow$ Note: Larger $y$ is conducive to industrialization.
- Arrange sectors in increasing order of $F(i)$.
- End-point conditions: $F(0) = 0$, $F(1) = \infty$.
- WLOG sectors in $[0, n]$ industrialize.
- If $n$ sectors invest, at aggregate income $y(n)$, zero-profit at $n$:

$$ay(n) - F(n) = 0.$$

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$$ay(n) - F(n) = 0.$$

- and national income $y(n)$ is given by

$$y(n) = \int_0^n \pi(i)di + L = \int_0^n [ay(n) - F(i)]di + L = any(n) - nA(n) + L,$$

- where $A(n)$ is average of all the fixed costs on $[0, n]$. So:

$$y(n) = \frac{L - nA(n)}{1 - an}.$$

- Use this information in zero-profit condition:

$$[1 - an]F(n) + anA(n) = aL.$$

- Derivative of LHS is $[1 - an]F'(n) > 0$, so unique solution.

- Complementarities but no multiplicity! Why?

- Externality generated via payoffs alone.
  - Firm's payoff positive, so is the externality, firm invests.
  - It does not internalize the externality but does not need to.
  - Likewise for the case in which profits are negative.
- Lesson: Rosenstein-Rodan intuition needs careful examination.
  - The source of the complementarity must be something other than private profit alone.
- What's the difference between:
  - Profits tax with proceeds redistributed?
  - Output tax with proceeds redistributed?

# The Wage Externality

- Assume: wage premium in industrial sector: $w = 1 + v$.

  - $F(i) = F$ for all $i$ (easy to generalize).

  - Profit from industrializing in any sector (when demand is $y$) is

$$\pi = y - \frac{1+v}{\alpha} y - F(1+v).$$

  - No-industrialization equilibrium: $y(0) = L$. Works if

$$L\left(1 - \frac{1+v}{\alpha}\right) - F(1+v) \leq 0.$$

  - Industrialization equilibrium: $y(1) = \alpha(L - F)$. Works if

$$L\left(1 - \frac{1+v}{\alpha}\right) - F \geq 0.$$

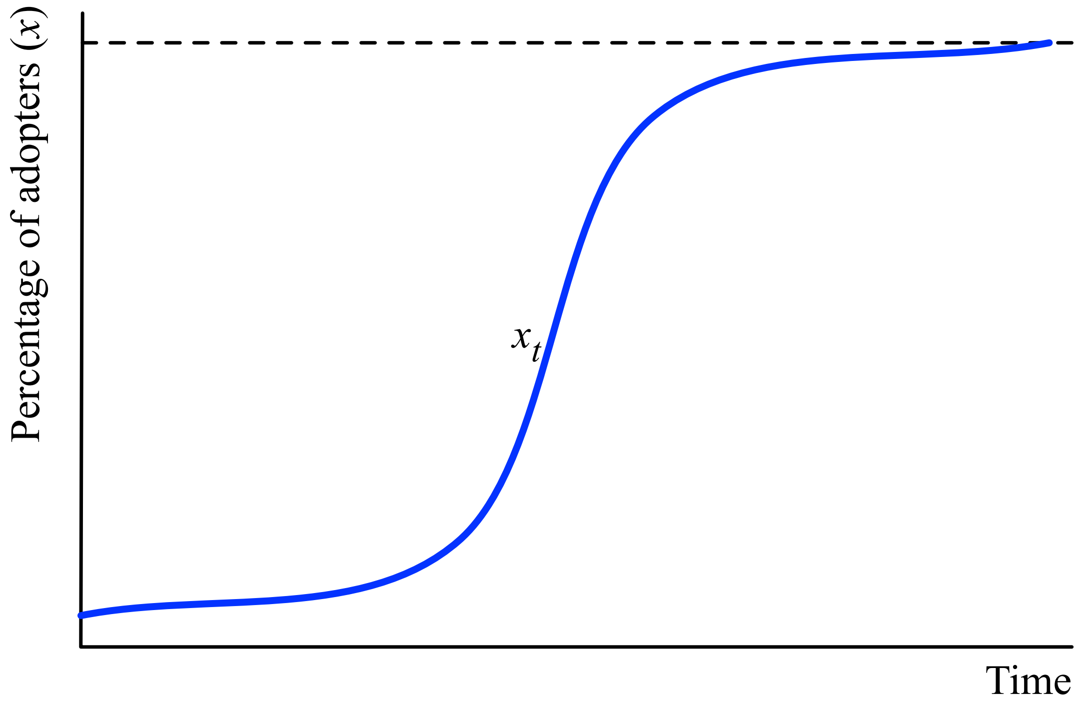
- Compare. Multiplicity possible!

## Implications

- Complementarities may result in multiple equilibria.
  - When they do, the equilibria are typically Pareto-ranked.
  - Two fundamentally identical societies can behave differently.
- Complementarities change the way we think about policy.
  - Temporary versus permanent interventions.
  - amnesties, minimum wage legislation, temporary fines, family planning programs, affirmative action program . . .
- Warning: Implementing equilibrium-tipping policies may be a delicate task.

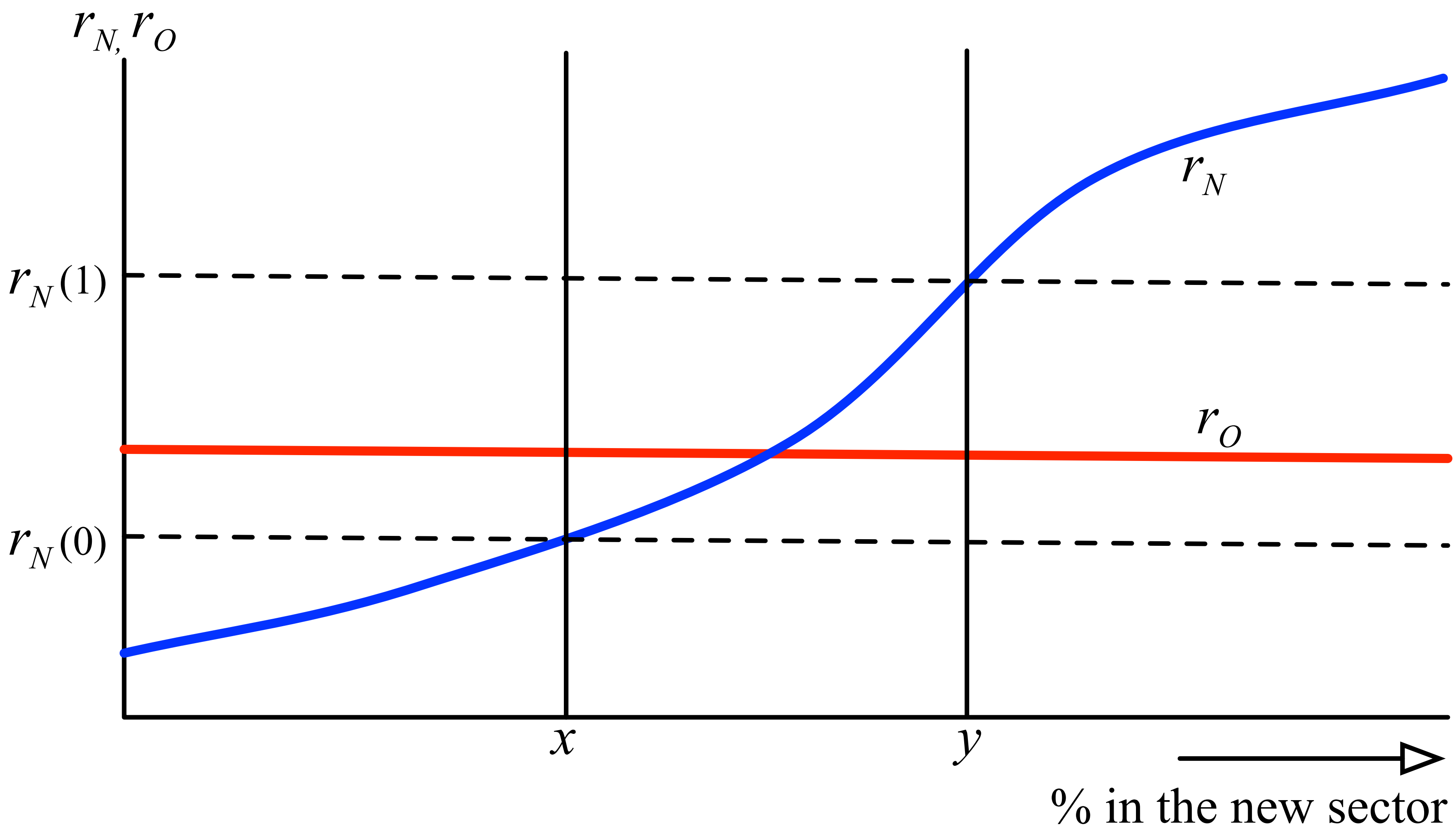
# Questions of Transition

- Problem: these theories are way too nondeterministic.
- Why does "yesterday's state" affect "today's state"?
- Why is QWERTY stickier than fashion?
- Why does a transition follow a logistic path?



# Canonical Multiple Equilibrium Model

- Two regions or sectors, $A$ and $B$.
- Total endowment of $\bar{K}$ split between the regions:
  - $K_A$ in $A$, $K_B = \bar{K} - K_A$ in $A$.
- Each person has one unit of endowment:
  - Deliberately chooses sector $A$ or $B$.
- Capital in $A$ has fixed rate of return, say 0.
- In $B$, $r = f(K)$, continuous, increasing, and $f(0) < 0 < f(\bar{K})$.




- Alternative initial conditions: $K_B = x$, $K_B = y$.
- Most of our examples fit this canonical model well.

## History Versus Expectations

- Myopic adjustment: history matters completely
- Farsighted adjustment: history doesn't matter at all.
- Can one allow for expectations, but retain the weight of history?

# Analysis of the Canonical Model

- Capital free to move but there is a switching cost:
  - From $B$ to $A$: $\hat{c}_A(K_A)$.
  - From $A$ to $B$ and $\hat{c}_B(K_B)$.
  - Congestion in sector $j$ if $\hat{c}_j$ is increasing.
- Path of prices $\gamma \equiv \{r(t), c_A(t), c_B(t)\}_{t=0}^{\infty}$ given for the individual.
  - Discount rate $\rho$.
  - Value function $V(\gamma, i, t)$.
  - Switch sectors at time $t$ if $V(\gamma, i, t) < V(\gamma, j, t) - c_j(t)$.
- Equilibrium price path: $\gamma$ generated by optimal decisions of agents in response to $\gamma$.

- Generating $\gamma$.

- Fix a path of capital allocation $\{K_A(t), K_B(t)\}_{t=0}^{\infty}$.

- Assume that at date 0, $r(0)$ is precisely $f(K_B(0))$.

- Thereafter: increasing function $g$, with $g(0) = 0$, such that

$$\dot{r}(t) = g(f(K_B(t)) - r(t)).$$

- That is, $r(t)$ "chases" the "appropriate" rate at every date.

- The steeper is $g$, the faster the adjustment.

- Finally, $c_A(t) = \hat{c}_A(K_A(t))$ and $c_B(t) = \hat{c}_B(K(t))$ for all $t$.

- This is how $\{K_A(t), K_B(t)\}$ generates $\gamma(t) = \{r(t), c_A(t), c_B(t)\}$.

■ If $g$ is "infinitely steep," then multiplicity of equilibrium paths.

▪ In contrast, an equilibrium is exclusively history dependent there is migration only to the sector that is initially profitable.

■ Theorem. Assume $f(K(0)) \neq 0$. Barring congestion, every equilibrium must be exclusively history dependent.

■ Outline of proof. Assume (wlog) $f(K(0)) < 0$.

■ Claim. $K(t) \leq K(s)$ for all $(s, t)$ with $t \geq s$.

▪ Suppose not, then there are $t$ and $s$ with $t > s$, such that:

a. $K(t) > K(s)$.

b. $r(\tau) < 0$ for all $\tau \in [s, t]$.

c. Some agent moves to sector $B$ at date $s$.

■ That agent should postpone her move, unless congestion.

Implications of the lagged externalities model:

- Independent of the magnitude of discounting
- Independent of how quickly returns adjust, as long as not instantaneous.
- Why congestion matters.
- Back to question: why is QWERTY different from fashion?
- Economic mavericks: those who don't mind making losses.

# Global Games and Equilibrium Transition

- Carlsson and Van Damme (1993), Morris and Shin (1998)
- Coordination game indexed by a state variable.
- Sometimes multiple equilibrium, and sometimes not.
- State variable observed publicly but with a bit of individual noise.
- Example: Pegged exchange rate $e$ (overvalued)
- Fundamentals: $f(\theta)$, with $e > f(\theta)$.
- $\theta$ is the state (interest rate, oil price).
- Arrange so that $f(\theta)$ increasing. High $\theta$ is good state.

- Speculators (of total measure 1).
  - Each can sell one unit of the currency; transactions cost $t$.
  - If peg holds, payoff is $-t$.
  - If peg abandoned, payoff is $e - f(\theta) - t$.
- Government has only one decision: abandon or retain peg.
  - Abandons if attacks exceed $a(\theta) < 1$, increasing function.
- End-points.
  - There is $\underline{\theta}$ such that $a(\theta) = 0$ for $\theta \in [0, \underline{\theta}]$.
  - Then $a(\theta)$ rises but always stays less than one by assumption.
  - There is $\bar{\theta}$ s.t. $e - f(\bar{\theta}) - t = 0$ (no one wants to sell at $\theta > \bar{\theta}$).
  - $\underline{\theta} < \bar{\theta}$.

- Benchmark: assume that $\theta$ perfectly observed.

- Case 1. $\theta \leq \underline{\theta}$. Abandon. Everyone sells; currency crisis.

- Case 2. $\theta \geq \bar{\theta}$. No speculator attacks; peg holds.

- Case 3. $\underline{\theta} < \theta < \bar{\theta}$. Multiple equilibria.

  - One equilibrium: no one attacks, peg holds.

  - One equilibrium: everyone attacks, peg abandoned.

  - Prototype of the second-generation financial crises model, in which expectations — over and above fundamentals — play an important role (see Obstfeld (1994, 1996)).

- Now we drop common knowledge of realizations of $\theta$.

## How to model higher-order beliefs

- Say $\theta$ uniform on $[0,1]$ (with $0 < \underline{\theta} < \bar{\theta} < 1$).

- Each individual sees $x$ uniform on $[\theta - \epsilon, \theta + \epsilon]$.

- This additional noise is iid across agents.

**Theorem**. There is a unique value of the signal $x$ such that an agent attacks the currency if $x < x^*$ and does not attack if $x > x^*$.

- Extraordinary result: a tiny amount of noise refines the equilibrium map considerably.

- As $\epsilon \to 0$, we're practically at common knowledge limit, yet no multiplicity zone.

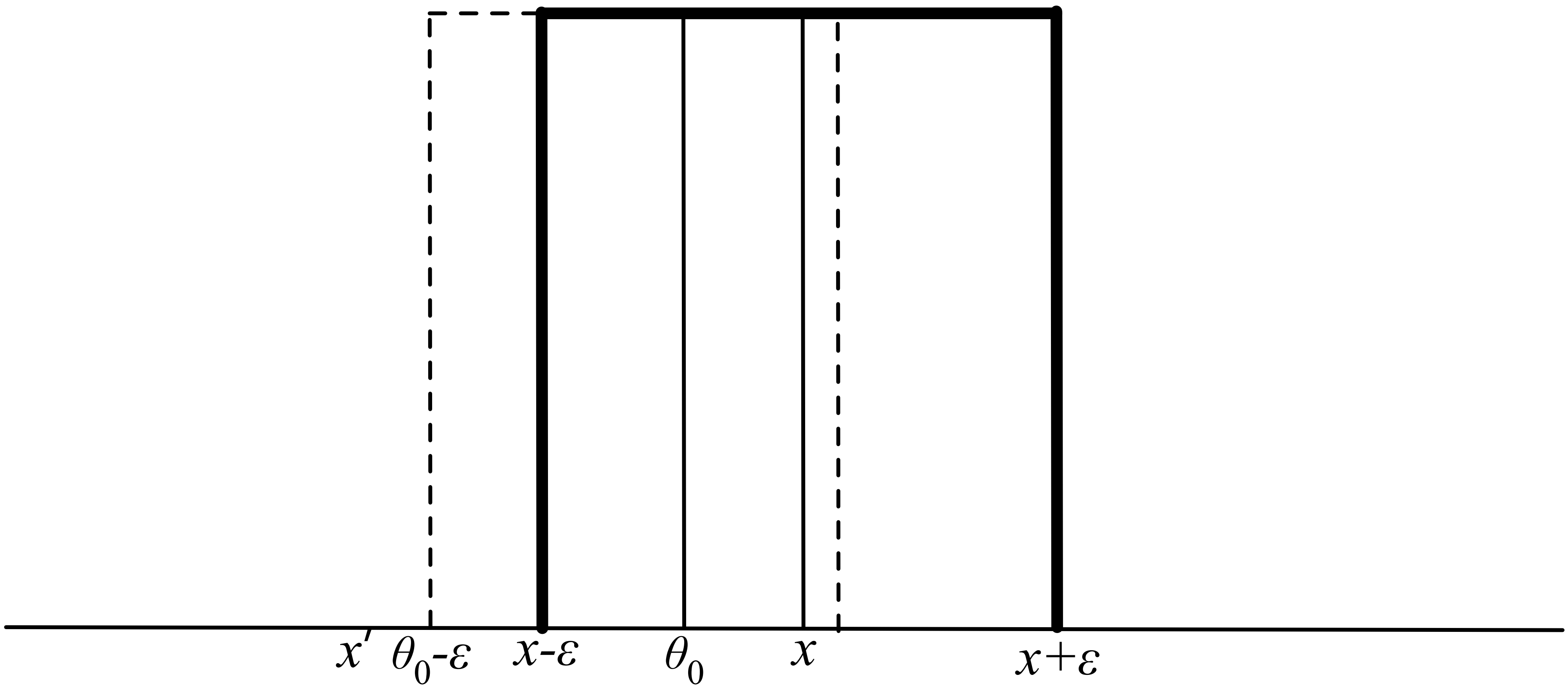
- An "infection argument" central to the proof.

- Proof of the theorem.

- Suppose that someone receives a signal $x \leq x_0 \equiv \underline{\theta} - \epsilon$.

- $\Rightarrow$ true state *cannot* exceed $\underline{\theta}$. Therefore sell.

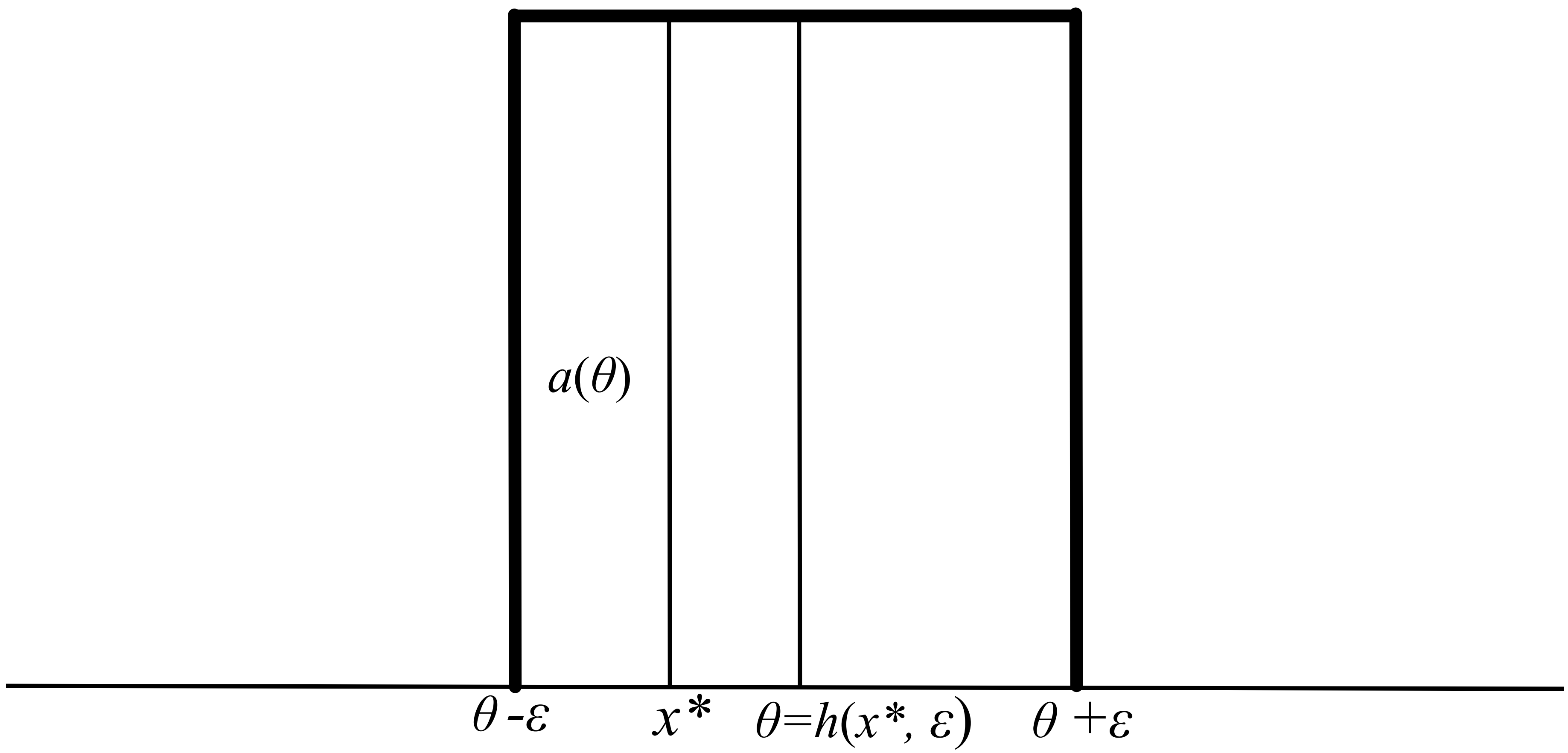
- Now $x$ slightly bigger than $x_0$. Higher-order infection starts.



- Suppose everyone sells if $x \leq x^*$. Find best response $\Psi(x^*, \epsilon)$.

- For any $\theta$, government will yield if

$$\frac{1}{2\epsilon}[x^* - (\theta - \epsilon)] \geq a(\theta), \text{ or } \theta \leq h(x^*, \epsilon).$$



- So if signal is $x$ and our person attacks, expected payoff is

$$\frac{1}{2\epsilon}\int_{x-\epsilon}^{h(x^*,\epsilon)}[e-f(\theta)]d\theta - t.$$

- $\Psi(x^*,\epsilon)$ defined by value of $x$ such that above expression is 0.

- Claim. $\Psi(x^*,\epsilon)$ is nondecreasing in $x^*$, but slope $<1$:

$$\Psi(x_2^*,\epsilon)-\Psi(x_1^*,\epsilon) < x_2^* - x_1^* \text{ when } x_2^* > x_1^*.$$

- Proof. $\Psi$ nondecreasing is obvious. Now pick $x_2^* > x_1^*$.

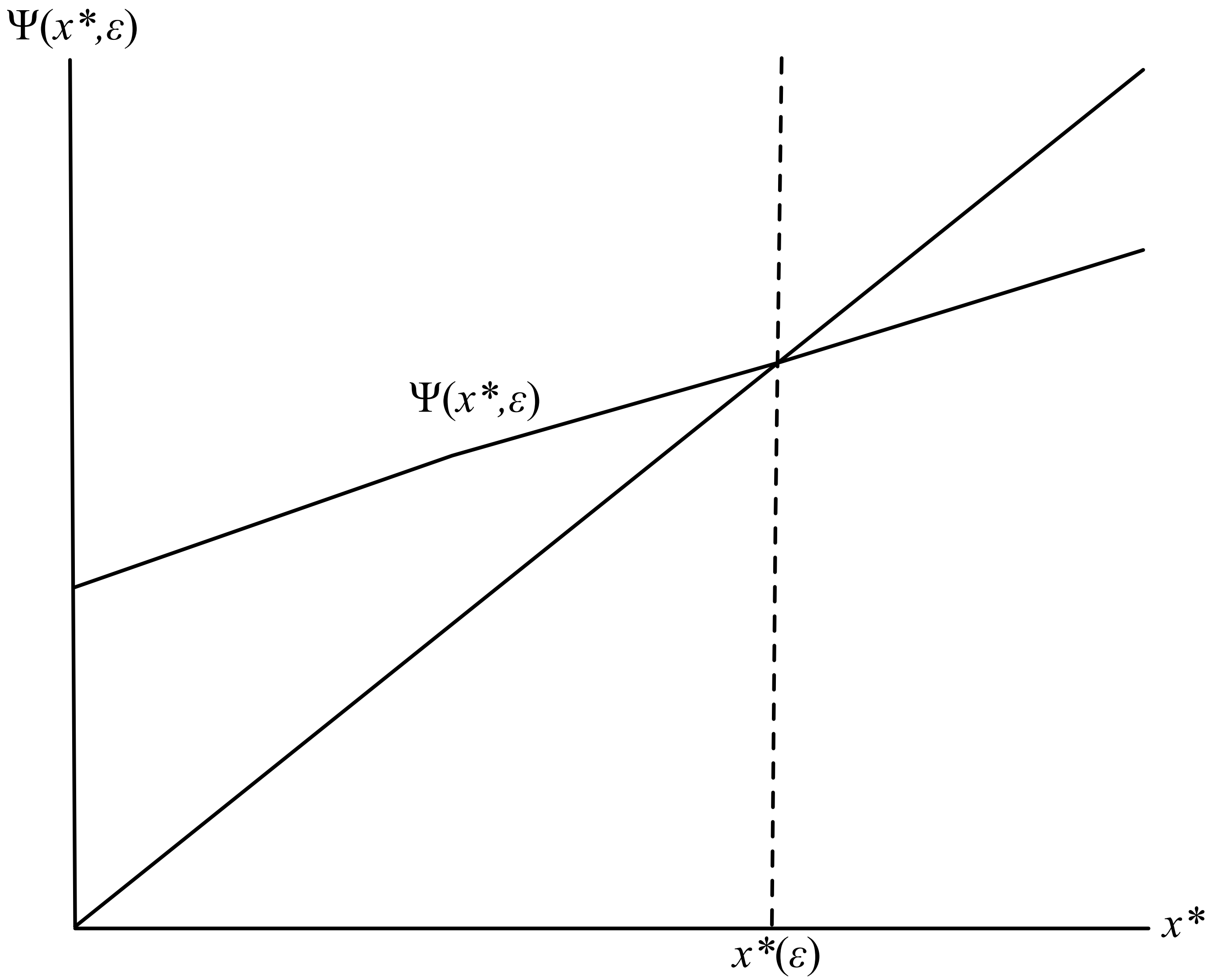
- Then two things happen: first:

$$h(x_2^*,\epsilon)-x_2^* < h(x_1^*,\epsilon)-x_1^*,$$

- so that the support over integral above narrows.

- In addition, the stuff inside the integral is also smaller when we move from $x_1^*$ to $x_2^*$, because $f(\theta)$ is increasing. Claim proved.

■ Summary. There is a unique equilibrium in the "perturbed" game, in which a speculative attack is carried out by an individual if and only if $x \leq x^*(\epsilon)$, where $x^*(\epsilon)$ is the unique intersection of $\Psi$ with the 45 degree line.



- Take $\epsilon \to 0$ and calculate limit $x^*$:

$$
\begin{aligned}
[e - f(h(x^*,\epsilon))][1 - a(h(x^*,\epsilon)] &\leq \frac{1}{2\epsilon}\int_{x^*-\epsilon}^{h(x^*,\epsilon)} [e - f(\theta)]d\theta \\
&\leq [e - f(x^* - \epsilon))][1 - a(h(x^*,\epsilon)]
\end{aligned}
$$

- noting that $f(x^* - \epsilon) \leq f(\theta) \leq f(h(x^*,\epsilon))$ for all $\theta \in [x^* - \epsilon, h(x^*,\epsilon)]$.

- $x^*$ and $h(x^*,\epsilon)$ go to a common limit, call it $\theta^*$. This solves:

$$[e - f(\theta^*)][1 - a(\theta^*)] = t.$$

- Note: Careful when reading Morris-Shin; error in Theorem 2.

- See Heinemann (AER 2000).

# Equilibrium Transition? Fertility Decline in Bangladesh

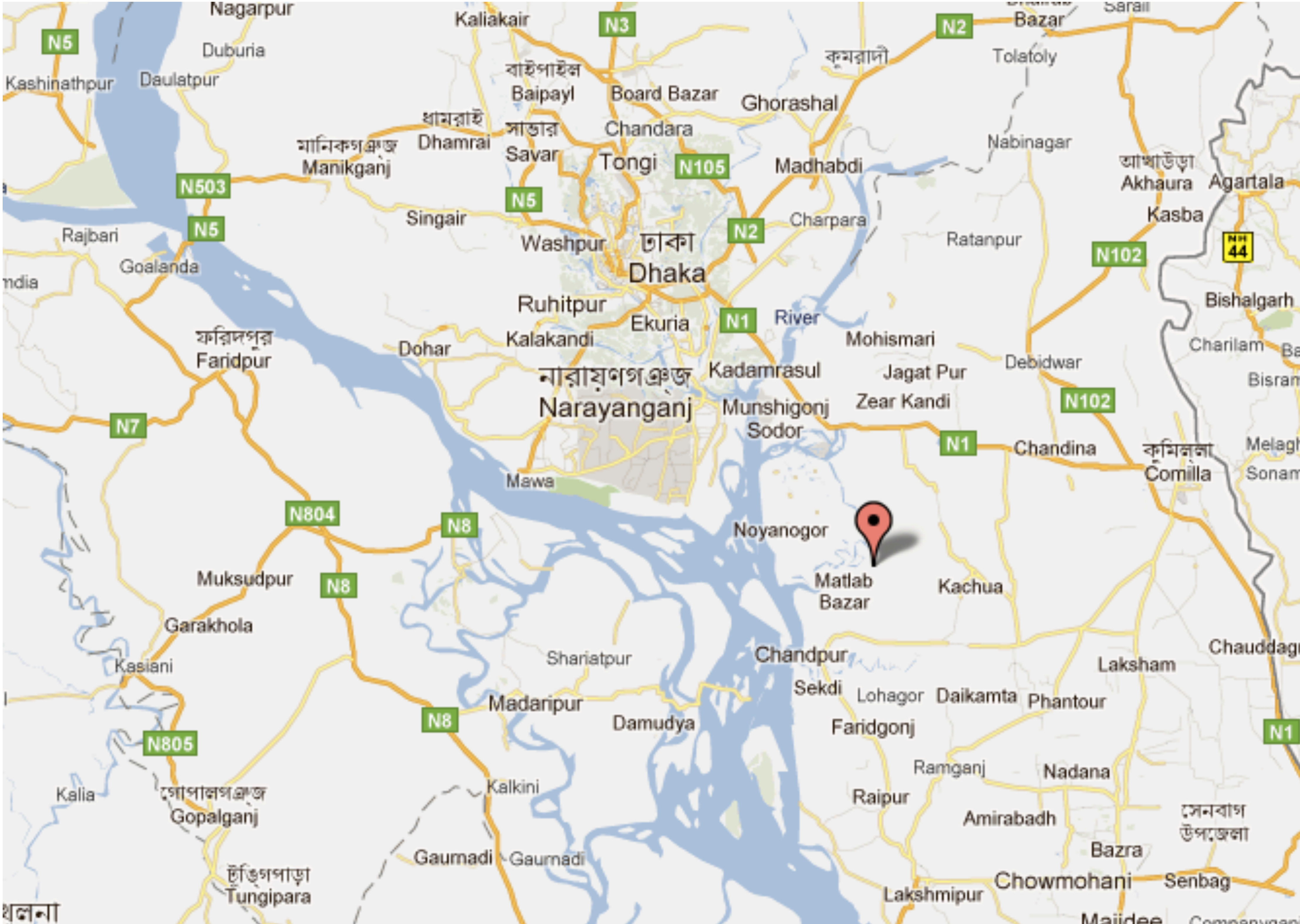
- Munshi and Myaux (JDE 2006)
- 1983–1993: Total fertility rate goes from 4.5 to 2.9.
- This is a huge drop.
- Norms governing fertility use and contraception.
- Contraception went from 40% in 1983 to 63% in 1993.
- "This paper provides a norm-based explanation for two features of the fertility transition that have been observed in many different settings: the slow response to external interventions and the wide variation in the response to the same intervention."

# Bangladesh

| *Period* | *Birth rate* | *Death rate* |
|---|---:|---:|
| 1881-91 | - | 41.3 |
| 1891-01 | - | 44.4 |
| 1901-11 | 53.8 | 45.6 |
| 1911-21 | 52.9 | 47.3 |
| 1921-31 | 50.4 | 41.7 |
| 1931-41 | 52.7 | 37.8 |
| 1941-51 | 49.4 | 40.7 |
| 1951-61 | 51.3 | 29.7 |
| 1961-74 | 48.3 | 19.4 |
| 1976 | 45.4 | 19.7 |
| 1980 | 43.8 | 13.6 |
| 1986 | 38.9 | 11.9 |
| 1989 | 36.7 | 10.7 |
| 1994 | 27.8 | 8.6 |
| 2000 | 27.2 | 7.4 |
| 2010 | 20.8 | 6.1 |

Taken from Cleland and Streathfield, BBS, World Bank

Charikar
Kabul
Jalalabad
Peshawar
پشاور
Jammu and
Kashmir
fghanistan
Gardēz
Khowst
راولپنڈی
Rawalpindi
فیصل آباد
Faisalabad
لاہور
Lahore
Himachal
Pradesh
Kandahar
西藏自治区
Quetta
ملتان
Multan
اوکاڑہ
Okāra
Punjab
Chandigarh
Lhasa
拉萨
Pakistan
Uttarakhand
Sibbi
Baitadi
दिपायल
Dipayal
بہاولپور
Bahāwalpur
Haryana
Meerut
New Delhi
Nepalganj
Nepal
Uttar
Pradesh
Kathmandu
Khairpur
Khuzdar
Aligarh
Agra
Sikkim
Bhutan
हरिवन
भरतपुर
Bharatpur
Birganj
Rajasthan
Jaipur
Barabanki
Kanpur
Assam
Shaheed
Benazir Abad
Jodhpur
Gwalior
बिराटनगर
Biratnagar
Meghalaya
کراچی
Karachi
Kota
Allahabad
Patna
Bihar
حیدرآباد
Hyderabad
Varanasi
Bihar Sharif
Udaipur
Bhawani
Mandi
राजशाही
Rajshahi
Bangladesh
Manip
Madhya
Pradesh
Jharkhand
Ahmedabad
Gujarat
West
Bengal
Ujjain
India
যশোর
Jessore
Rajkot
Vadodara
Indore
Chhattisgarh
Bagasara
Surat
Amravati
Nagpur
Bhilai
Baleshwar
Tripura
Tumbru
Valsad
Bhadrakh
Akola
Wardha
Dakhinpar
Nashik
Orissa
Bhubaneswar
Boisar
Chandanpur
Mizoram
Sittwe
Maharastra
Mumbai
Umbraj
Damanjodi
Pune
Hanamkonda
Vishakhapatnam
Solapur
Hyderabad
Bijapur



Nagarpur
Kaliakair
N3
N2
Bazar
Sarail
N5
Duburia
বাইপাইল
Baipayl
Board Bazar
Ghorashal
Tolatoly
Kashinathpur
Daulatpur
ধামরাই
Dhamrai
সাভার
Savar
Chandara
Tongi
N105
Madhabdi
Nabinagar
মানিকগঞ্জ
Manikganj
N503
N5
Singair
Charpara
আখাউড়া
Akhaura
Agartala
Kasba
Rajbari
N5
Washpur
ঢাকা
Dhaka
N2
Ratanpur
N102
44
Goalanda
Ruhitpur
Ekuria
N1
River
Bishalgarh
ফরিদপুর
Faridpur
Dohar
Kalakandi
Mohismari
Charilam
Kadamrasul
Jagat Pur
Debidwar
Bisram
নারায়ণগঞ্জ
Narayanganj
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N102
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Chauddagr
Kasiani
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Faridgonj
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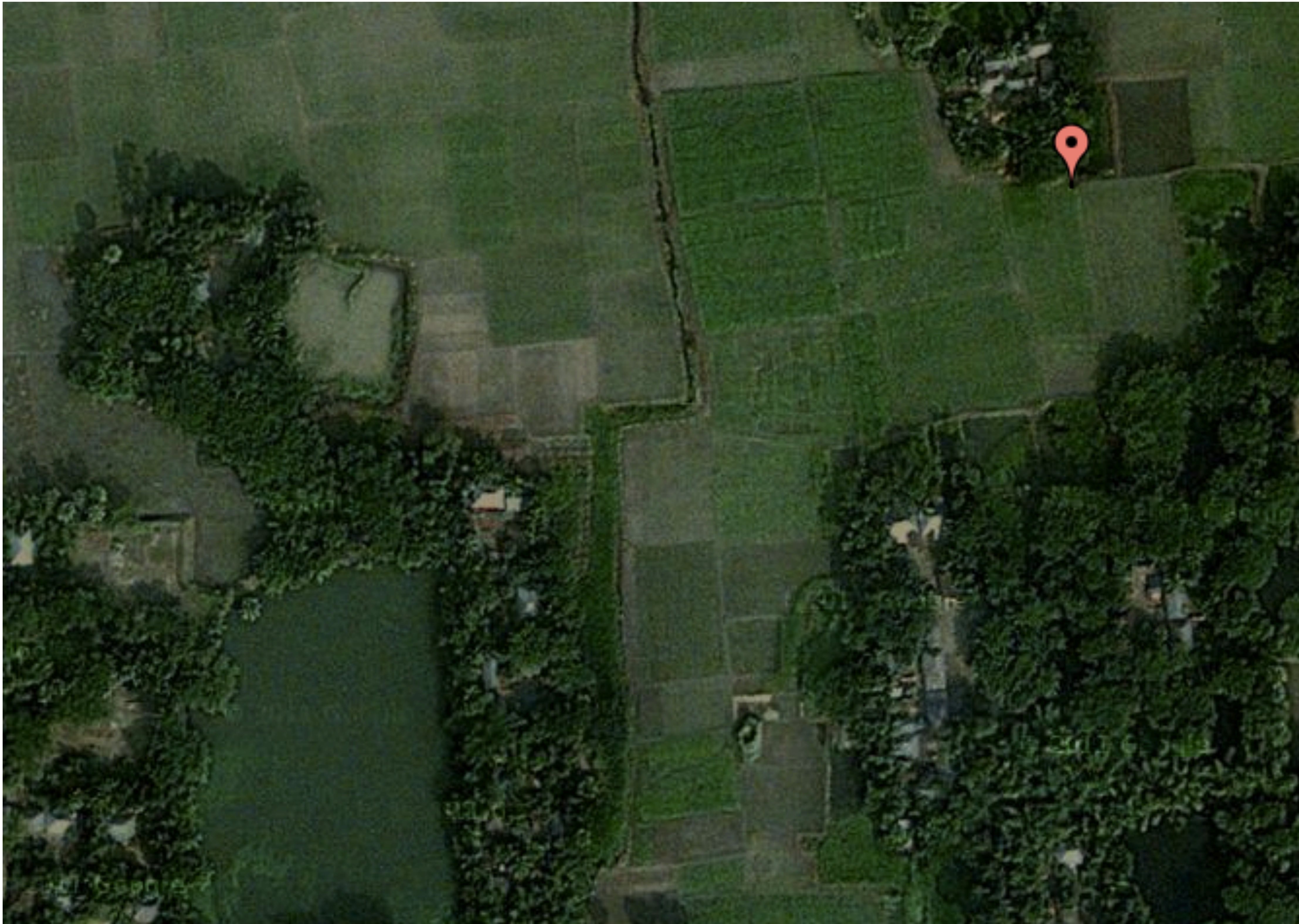
Ramganj
Nadana
Kalia
গোপালগঞ্জ
Gopalganj
Kalkini
Raipur
Amirabadh
সেনবাগ
উপজেলা
Bazra
Gaumadi
Gaurnadi
টুঙ্গিপাড়া
Tungipara
Chowmohani
Senbag
Lakshmipur
Majidee



- Maternal Child Health - Family Planning (MCH-FP) project
- Launched in 1978, 70 villages in Matlab thana, Comilla district.
- Intensive family planning program
- Community Health Worker (CHW) visited each family once every 2 weeks since start of the project in 1978.
- Contraceptives are provided to them free of cost.
- Use goes from from 40% in 1983 to 63% in 1993
- TFR from 4.5 to 2.9 children over that period.

**Table 1: Percent distribution of couples using each contraceptive method, Matlab 1998**

| Method | n | Percent of total |
|---|---|---|
| A. Users | | |
| Pill | 2,396 | 19.4 |
| Intra-Uterine Device | 171 | 1.6 |
| Injectibles | 4,015 | 32.6 |
| Condom | 605 | 4.9 |
| Tubal ligation | 634 | 5.1 |
| Vasectomy | 16 | 0.1 |
| Others | 287 | 2.4 |
| B. Non-users | 4,186 | 33.9 |
| **All** | **12,342** | **100** |

Khan-Bairagi (1998)

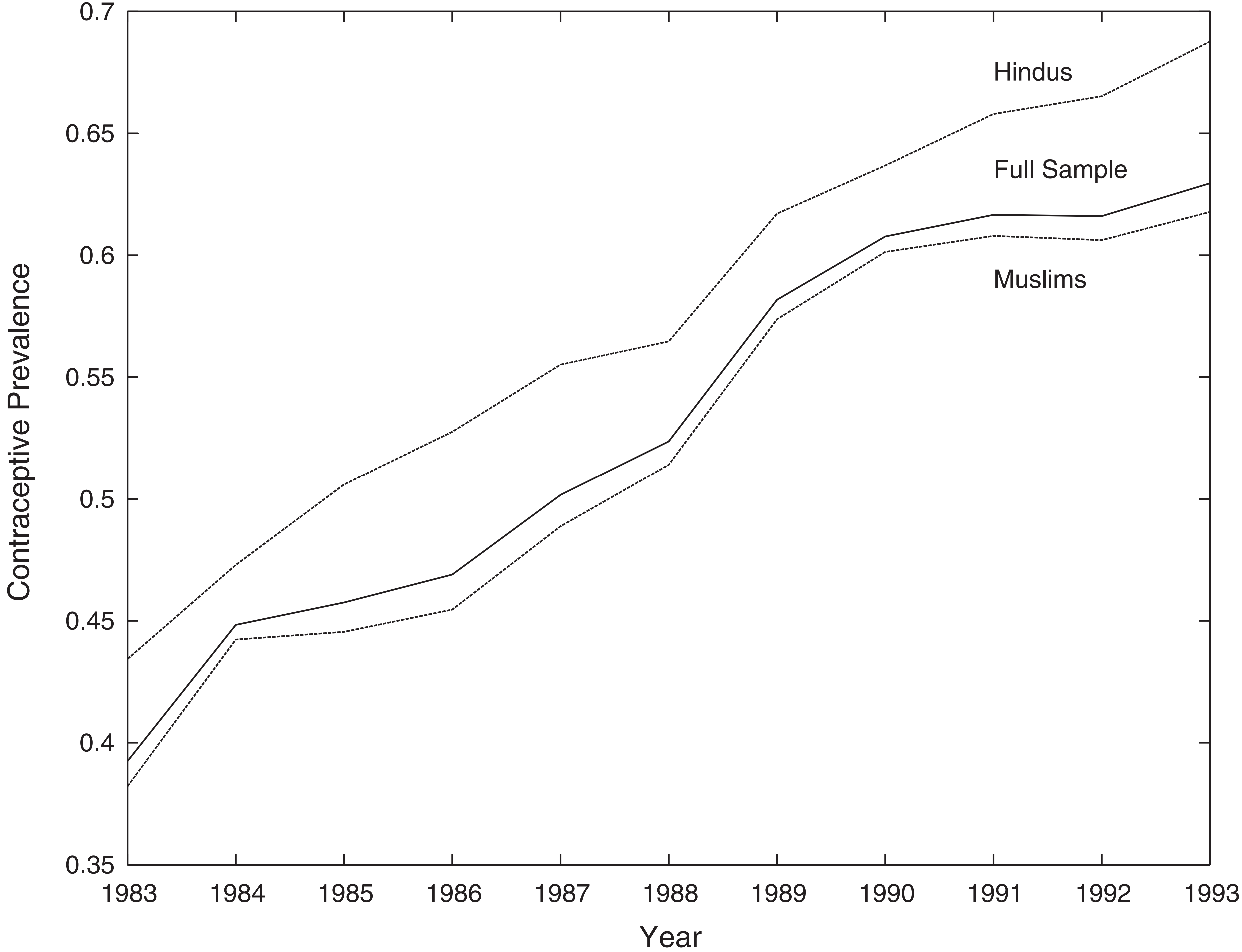



Fig. 1. Contraceptive prevalence over time.

- Strong initial hostility to MCH-FP, especially from religious leaders.

  - Especially hostile reaction against community health workers (violating *purdah*)

  - Also, pressure against contraceptive use (linked to perceived promiscuity)

- Women in village limited in their mobility:

  - Schuler et al. (1997) survey of 1300 married women under 50, 1992.

  - Ever been to market, a medical facility, the movies, and outside the village.

  - One point for accompanied visit, 2 points for solo visit.

  - Mean score 2.1 (out of a maximum of 8).

- Sample: all married women 15–49 in MCH-FP area, 1983–93.

Table 2
Descriptive statistics

| | Full sample | Hindus | Muslims | Illiterate | Literate |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| *Panel A: Individual characteristics* | | | | | |
| Age | 29.44 (8.01) | 29.91 (8.00) | 29.34 (8.01) | 30.49 (8.18) | 27.75 (7.44) |
| Number of children | 2.41 (1.99) | 2.18 (1.79) | 2.45 (2.03) | 2.57 (2.05) | 2.14 (1.86) |
| Education | 2.12 (3.12) | 1.48 (2.68) | 2.26 (3.19) | 0.00– | 5.53 (2.55) |
| Husband's education | 3.21 (4.00) | 3.07 (3.81) | 3.24 (4.04) | 1.53 (2.62) | 5.91 (4.34) |
| *Panel B: Occupation of household head (%)* | | | | | |
| Farming | 34.48 | 23.45 | 36.88 | 30.32 | 41.16 |
| Fishing | 5.80 | 26.18 | 1.37 | 8.07 | 2.15 |
| Business | 6.75 | 8.37 | 6.40 | 6.30 | 7.47 |
| Housework | 10.46 | 6.81 | 11.26 | 10.00 | 11.21 |
| Other | 42.51 | 35.20 | 44.10 | 45.31 | 38.01 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| *Panel C: Asset ownership* | | | | | |
| Land (hectares) | 1.00 (2.55) | 0.72 (1.39) | 1.06 (2.74) | 0.82 (2.41) | 1.29 (2.74) |
| Cows | 1.06 (1.57) | 0.81 (1.42) | 1.11 (1.59) | 0.91 (1.46) | 1.28 (1.70) |
| Boats | 0.55 (0.61) | 0.63 (0.76) | 0.54 (0.57) | 0.55 (0.61) | 0.56 (0.60) |
| No. of Observations | 21,570 | 3847 | 17,723 | 13,288 | 8282 |
| *Panel D: Contraceptive prevalence* | | | | | |
| Probability of using contraceptives | 0.55 (0.50) | 0.59 (0.49) | 0.54 (0.50) | 0.53 (0.50) | 0.57 (0.50) |
| No. of Observations | 144,186 | 26,414 | 117,772 | 91,727 | 52,459 |

Means (standard deviations) in panel A, panel C and panel D.
The individual is the unit of observation in panels A–C. The individual-year is the unit of observation in panel D.
All statistics in this table are computed over the full 1983–93 sample period.

# A Conceptual Problem

- Linear probability model (also tried logit):

$$y_{it} = A + \gamma y_{i,t-1} + \beta x_{t-1}^{v(i)} + \eta Z_{it} + C_t^{v(i)} + \epsilon_{ivt}$$

- $y_i$ is 0-1 for contraceptive use by couple $i$, $t$ is time, $x$ is aggregate village-level use, $v(i)$ is the village of person $i$, $Z$ a vector of individual characteristics (such as age) including individual and time fixed effects in some specifications.

- $C_t^v$ is unobserved omitted variable for village $v$ at date $t$.

- At the heart of identification problem (Manski critique)

- $\beta$ can pick up the effects of unobserved $C_t^v$ ...

- E.g., economic growth

- Village-level success of the MCH-FP program.

## $C_t^v$

- $C_t^v$ can be decomposed into three parts.
  - First component only depends on the village: $C_1^v$.
  - Second component only depends on time: $C_{t2}$.
  - Third varies in a village-specific way over time.
- Components 1 and 2 dealt with by village and time fixed effects.
  - The last one screws everything up: identification problem.

# Main Idea in Munshi-Myaux Paper

- Inter-religion communication low.

- So include own-group and cross-group use separately.

- If own-effect strong, then pushes back the Manski critique:

- For critique to work, there has to be an omitted variable which is village-, time- and group-specific.

$$y_{it} = A + \gamma_m y_{i,t-1} + \beta_{mm} x_{t-1}^{v(i),m} + + \beta_{mh} x_{t-1}^{v(i),h} + \eta_m Z_{it} + C_t^{v(i),m} + \epsilon_{ivt}$$

- where $i$ is $m$-household, and $m$ and $h$ labels self-explanatory.

- Can get spurious effects only if $C_t^{v(i),m}$ and $C_t^{v(i),h}$ orthogonal.

Table 3
Partitioning the village by religion

| | Dependent variable: contraception | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | All villages | | More than 5% Hindus/Muslims | | More than 15% Hindus/Muslims | | Annual data | |
| | Muslims | Hindus | Muslims | Hindus | Muslims | Hindus | Muslims | Hindus |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Lagged contraceptive prevalence (own group) | 0.217 | 0.161 | 0.193 | 0.169 | 0.207 | 0.168 | 0.312 | 0.246 |
| | (0.013) | (0.014) | (0.016) | (0.017) | (0.018) | (0.020) | (0.023) | (0.023) |
| Lagged contraceptive prevalence (other group) | 0.008 | 0.009 | 0.007 | 0.024 | − 0.001 | 0.019 | 0.009 | 0.006 |
| | (0.006) | (0.007) | (0.011) | (0.016) | (0.013) | (0.024) | (0.011) | (0.012) |
| Lagged contraception | 0.698 | 0.712 | 0.704 | 0.710 | 0.706 | 0.717 | 0.498 | 0.517 |
| | (0.003) | (0.005) | (0.004) | (0.005) | (0.004) | (0.006) | (0.005) | (0.008) |
| $R^2$ | 0.513 | 0.559 | 0.520 | 0.558 | 0.521 | 0.565 | 0.281 | 0.338 |
| Number of observations | 139,875 | 43,101 | 79,927 | 29,771 | 49,730 | 20,756 | 70,787 | 21,419 |
| Box–Pearson $Q$ statistic | 0.000 | 0.003 | 0.001 | 0.002 | 0.002 | 0.006 | 0.003 | 0.008 |

Standard errors in parentheses.
Standard errors are robust to heteroskedasticity and correlated residuals within each village-period.

- All data 6-monthly except last two columns
- See paper for other robustness checks: no fisherman, *bari*-level effects

## Alternative Explanations

- Program effects:
  - Cross-sectional variation: individual fixed effects.
  - Secular changes: time effects.
  - But village-specific time effects pose a problem. The CHW varies from village to village, after all.
  - That is where the own-religion cross-religion trick plays a role.
- Economic growth
  - Religion and occupation largely uncorrelated except for fishermen.
- Learning about a new technology
  - Possible, with injectibles. But authors argue against it.