Post-Midterm Topics

Oct 09: Human Capital Demand Intervention

- Education requires public intervention
  - Sub-optimal consumption (demand for education)
    - Social externality, imperfect credit market, different utility function between parents and child, high discount rates, imperfect information on returns
  - Sub-optimal production (under-provisioning of education by private sector)
- Dubois et al., 2012: Progresa, conditional cash transfer program
- RCT to evaluate program
  - Both arms identical in all other covariates except for assignment to treatment
- $Y_i = \alpha + \beta T_i + u_i$
  - Y_i: outcome of interest e.g. continuation rate (%)
  - T_i: indicator for treatment group
  - u_i: error term
  - $\hat{\beta}$: estimator for causal effect of treatment
- External validity: generalising conclusion of experiment to universe eligible population i.e. those samples not selected into RCT (i.e. into either treatment or control group)
- Internal validity: within the eligible sample population
- Conditional cash transfer: cash given to family if their children are enrolled in school and they regularly visit health clinics
  - Targeted at poor households; participants have to be below some income threshold to be eligible
  - Most significant for school continuation rate percentage at entry into secondary school
  - Positive program effect on enrolment rates, impact is larger among groups with lowest baseline probability of enrolment (help reduces inequality of opportunities)

Oct 11: Human Capital Supply Intervention

- Duflo, 2001: Large scale school construction program in Indonesia, want to evaluate this program on individual's years of education
- $Y_{it} = \alpha + \beta_1 T_i + \beta_2 P_t + \beta_3 (P_t \times T_i) + u_i$
  - Y_{it}: years of education
  - P_t: indicator variable, 1 if t is post-treatment, 0 if t is pre-treatment
  - T_i: indicator for treatment group
  - $\hat{\beta}_3$: difference-in-difference estimator of effect of program

Oct 16: Health Products Demand

- Cohen and Dupas, 2010: Randomised malaria prevention experiment on free-distribution or cost-sharing for health products
- Free distribution: good's effectiveness is independent of recipients' behaviour
- Cost-sharing: good's effectiveness depends on recipients' adherence/usage; price has selection, psychological sunk cost effect, signals quality of good; but may dampen demand and restrict usage by the poor
- Elasticity of demand to price, elasticity of usage to price, impact of price on vulnerability of the marginal consumer, size of externality
- $U(h,n) = u(h) + v(n) - (C - T)(h + n) + kH$
  - U: household utility given h bednets for health usages, n bednets for non-health usages
  - C: production cost = unsubsidised cost of bednet
  - T: subsidy
  - k: health externality from other families using bednets
  - H: usage of bednets in other families in the community

- Conclusion: cost-sharing reduces demand substantially; did not seem to select sicker individuals to getting ITN; reduces community health versus 100% subsidy

Oct 18: Health Externalities

- Health interventions tend to have large externalities, need to evaluate impact of an intervention when it has positive externality
- Miguel and Kremer (2004): Deworming
  - Schools randomly assigned into 3 groups and treatment was phased in at different periods.
  - Direct treatment effect ($G1 - G2$)
  - Within-school externality impact ($G1_t - G1_u$)
    - Those untreated are due to noncompliance, can compare with $G2_u$ since randomisation guarantees similarity in all covariates except treatment
  - Cross-school externality impact
    - Some schools close to other treatment schools
    - $Y_{ijt} = \alpha + \beta_1 T_{1it} + X_{ijt}\delta + \sum_d N_{dit}^T \gamma_d + \sum_d N_{dit}\phi_d + u_i + e_{ijt}$
      - d is "within 3 km", "within 3 – 6 km"
      - i: school, j: student, $t \in \{1, 2\}$: group
      - Y_{ijt}: health or education outcome
      - T_{1jt}: indicator for treatment
      - X_{ijt}: school and student covariates as control
      - N_{idt}: number of students at distance d from school i in year t
      - N_{idt}^T: number of students in treatment schools at distance d from school i in year t
      - $\hat{\beta}_1$: estimator for effect of deworming
      - $\hat{\gamma}_d$: estimator for cross-school externality impact
      - $\hat{\beta}_1 + \sum_d \overline{N}_{dit}^T \hat{\gamma}_d$: average effect of deworming treatment on overall infection prevalence in treatment schools
- Ozier, 2018: Deworming on education outcomes
  - Significant cognitive gains for those living in treatment schools; effect larger if older sibling attended treatment school
- Eliminating a person's infection reduce transmission to others → control group benefits from the same intervention: spillover effect
- Standard RCT: treatment group may have effect on control group → estimated effect of intervention is less optimistic than it should be
- Change the unit of randomisation – Cluster RCT. Randomise at higher levels. Either:
  - Ensure clusters are far enough apart
  - Use methods or research design to estimate externality effect
- $Y_{ij} = \alpha + \beta T_j + e_{ij}$
  - Y_{ij}: moderate-to-severe infection for individual i in cluster j
  - T_j: indicator for whether cluster j is assigned to treatment
  - e_{ij}: error term (has both individual and cluster components)
- This reduces statistical power (smaller effective sample), increases treatment cost, but can ascertain spillover effects.
- Also worry about compliance

Oct 23: Healthcare Access and Supply

- Okeke, 2023: Effect of access to a trained physician on infant mortality
- RCT, randomisation done at the health center level
- Three arms: doctor, mid-level provider, control
- Intent-to-treat estimator: reduces selection effect, but if compliance low, ITT effects might be small

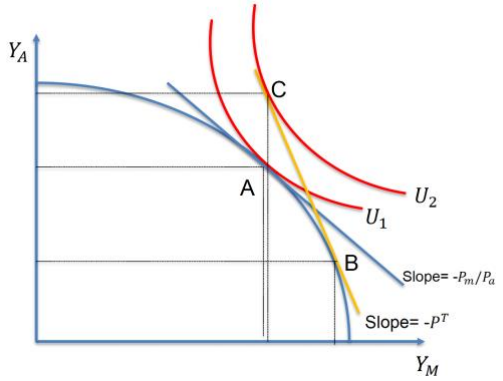
- $Y_{iks} = \alpha + \beta_1 M_{ks} + \beta_2 D_{ks} + \gamma X_{iks} + \theta_s + \epsilon_{iks}$
  - Y_{iks}: outcome of interest for patient i attending centre k in strata s
  - M_{ks}: indicator for centre being assigned a mid-level provider
  - D_{ks}: indicator for centre being assigned a doctor
  - β_1: effect of being assigned a mid-level provider versus control
  - β_2: effect of being assigned a doctor versus control
- Nearly perfect compliance
- Immediate reduction in neonatal mortality, whereas an additional MLP does not significantly affect mortality
- Mechanism: better quality treatment – doctors more likely to follow clinical guidelines, carry out physical exams, better clinical knowledge, provide diagnosis, better communication, workplace spillover → improvement in clinic care and processes
- Quality of training and skill-level of health providers have an important impact on patient outcomes

Oct 25: Ricardo Trade Model

- Autarky: independent, without influences from other countries i.e. just consider local demand and supply
- Openness to trade for country i at time period t: $O_{it} = \frac{X_{it}+M_{it}}{Y_{it}}$
  - X_{it}: exports, M_{it}: imports, Y_{it}: total GDP
- Set up: two countries e and p, two products C and W, labour is fixed in both countries and perfectly mobile across sectors
- Opportunity cost of 1 unit of $C = w_e$ unit of W
- Assume production linear in labour i.e. $F_{we}(L) = a_{we}L$
  - Compare a_{we} and a_{wp} to ascertain absolute advantage
  - Compare $\frac{a_{we}}{a_{ce}}$ and $\frac{a_{wp}}{a_{cp}}$ (equivalently $\frac{P_{ce}}{P_{we}}$ and $\frac{P_{cp}}{P_{wp}}$) to ascertain comparative advantage
- Assume wage is 1 per unit of labour.
- Cost of producing x units of a good $C_{we}(x) = \frac{x}{a_{we}}$
- Assume competition, price = marginal cost
- $P_{we} = \frac{\partial C_{we}}{\partial x} = \frac{1}{a_{we}}$
- Production possibility frontier is linear
- Technology tradeoff of a country is the slope of PPF = $-\frac{a_{we}}{a_{ce}}$
- Preferences $U(C, W) = C^{\alpha}W^{1-\alpha}$
- Short term analysis
  - Production is fixed at the autarky production level (C^*, W^*).
  - Consider the convex hull of the other country emanating from (C^*, W^*)
  - Solve the new utility maximisation problem with constraint to obtain (C^s, W^s). Import and export are determined by the differences between (C^*, W^*) and (C^s, W^s)
- Long term analysis
  - Production can specialise. For linear PPF, this results in full specialisation. Again, consider the convex hull and solve the optimisation problem.
- World production possibility frontier
  - Combine the individual PPFs such that the resulting PPF is convex w.r.t. the origin
  - Small countries tend to specialise completely (i.e. when they are not the segment that contains the maxima)
- Ricardo's theory emphasises comparative advantage (differences in technology, resources): saves resources by concentrating on what it is relatively better at, allows for gains from trade for countries which can make a representative individual better off

Oct 30: Specific Factors Trade Model

- Terms of trade: $\frac{P_{\text{export}}}{P_{\text{import}}}$ i.e. ratio of export good price to import good price
- Improving TOT makes a country better off
- Set up: sectors are manufacturing and agriculture. Labour is mobile across sectors, but capital is only used in manufacturing and land is only used in agriculture.
  - Diminishing returns to labour in each industry (i.e. marginal product of labour declines)
  - Example: $Y_M(K,L) = K^{\frac{1}{3}}L^{\frac{2}{3}}$ and $Y_A(T,L) = T^{\frac{1}{3}}L^{\frac{2}{3}}$, $\frac{\partial^2 Y_M}{\partial L^2} < 0$
- Production possibility fronter is a curve, with tangent $= -\frac{\text{MPL}_A}{\text{MPL}_M}$
- Competitive market: $\text{wage}_A = P_A \cdot \text{MPL}_A$, $\text{wage}_M = P_M \cdot \text{MPL}_M$
- Equality of wages across sectors: $\frac{P_M}{P_A} = \frac{\text{MPL}_A}{\text{MPL}_M}$
- With a foreign country with $\left(\frac{P_M}{P_A}\right)_F$, the final relative price will be between $\left(\frac{P_M}{P_A}\right)_H$ and $\left(\frac{P_M}{P_A}\right)_F$. Overall, the average person can consume more in both products.



- Trade affects spending (consumption) channel and earnings (wage) channel
- Increase in relative price of an industry's output will increase real rental earned by factors specific to that industry, but decrease real rental of factors specific to other industries
- Rental to capital: $R_K = P_M \cdot \text{MPK}_M$
- Rental to land: $R_T = P_A \cdot \text{MPT}_A$
- $P_M \uparrow$, P_A no change
- Labour shift into manufacturing → $\text{MPK}_M \uparrow$, $\text{MPT}_A \downarrow$ → $R_K \uparrow$, $R_T \downarrow$
- An increase in relative price of an industry's output will increase the real rental earned by factors specific to that industry, but will decrease the real rental of factors specific to other industries (mobile factors have ambiguous effects)

Nov 01: Trade Policies

- Consumer surplus and producer surplus analysis
- Net gain from trade: benchmark is autarky
- Tariff: a tax placed on goods when crossing national borders e.g. import tariff
  - Rationale: consumer safety, protect domestic producers/jobs, geopolitical reasons
- Assumptions: imported product perfectly substitutable with domestic product; home country is small relative to world market → world supply perfectly elastic
- $P_T = P_W(1+t)$, t can be positive or negative depending on policy
  - P_W: world price
  - P_T: price after tariff
  - Deadweight loss is with respect to no tariff (i.e. include gains from trade)
    - One side is due to distortion in production (compare marginal cost of domestic production and cost of importing)
    - One side is due to consumer's ability/inability to consume more due to price

- Production subsidies for imported goods
  - Results in a downward shift of supply curve
  - No loss of consumer surplus
  - Producer captured higher surplus (increase by trapezoidal area)
  - Deadweight loss is due to government financing the relatively inefficient domestic production, but smaller than the deadweight loss in the case of tariff
- Political economy: tariffs concentrate benefits on producers and diffuse the cost over many consumers. Lobbying is expensive, so only producers have the incentive to lobby.
  - Collective action problem

Nov 04: Trade and Environment

- Tanaka, 2022: investigated battery recycling and infant health
  - Revised air quality standard reduced lead concentration around US battery-recycling plants, but increased exports of those used batteries to Mexico.
    - Pollution was displaced from rich to poor country with weaker environmental regulations
  - Mexico's battery-recycling industry grew, resulting in negative health effects, including increased incidence of low birth weight
  - Binding area means areas above the air quality lead concentration threshold
  - $Y_{ijmht} = \alpha + \beta(N_j \times P_t) + \rho X_{it} + \phi(Z_{j,2005} \times P_t) + \mu_{mt} + \gamma_j + \lambda_{ht} + \epsilon_{ijmht}$
    - Mother i, locality j, municipality m, hospital h, time t
    - Y_{ijmht}: birth outcome of mothers
    - N_j: indicator for mother's locality within 2km of recycling plant
    - P_t: indicator for $t \geq 2009$
    - X_{it}: mother's characteristics
    - $Z_{j,2005}$: locality characteristics
    - $\mu_{mt}, \gamma_j, \lambda_{ht}$: fixed effects
- Negative production externalities: production inflicts harm on people but are not taken into account by private firms e.g. water and air pollution
- Private costs of production are lower than social costs of production, which factors in the negative externalities
- Deadweight loss: the benchmark is w.r.t. the intersection between S^{social} and D
  - Think of S^{private} as an ill-guided supply curve
- Solutions: directly tax pollution, cap total pollution and allow trade in pollution permits and gradually reduce cap, legislation
- Pollution out-sourcing
- Pollution haven hypothesis: No pollution control can lead to comparative advantage
  - A country with no pollution control will export pollution-intensive product, with world price higher than domestic price
- New generation free trade agreements require LMIC to strengthen their environmental protections
- Trade as a substitute for environmental regulation: if a good's production generates negative externalities, importing it can reduce local pollution (e.g. planes)

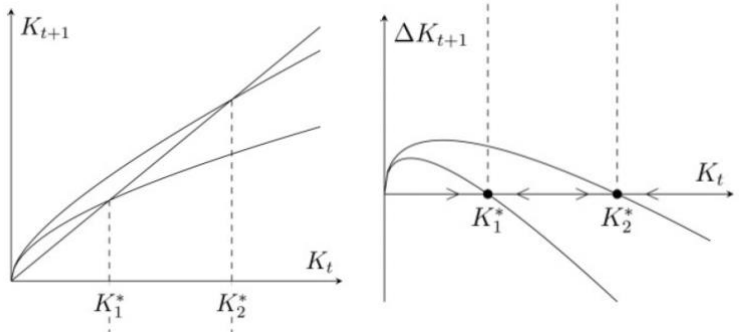
Nov 06: Payments for Ecosystem Services

- Jayachandran et al., 2017: Cash for carbon, randomised trial of payments for ecosystem services to reduce deforestation
  - Offer private home owners monetary payments if they refrain from cutting trees
  - Randomly select 60 out of 121 villages i.e. randomisation is at village level
  - Participation requires all of participant's forested lands to be enrolled (no spillover)
  - Enforcement done by satellite images
  - $\Delta TC_j = \alpha + \beta\, T_j + X_{1j}\delta + X_{2j}\mu + \epsilon_j$
    - TC_j: tree cover in village j

        - T_j: indicator for whether village j is in treatment or control arm
        - β: coefficient of interest ($\beta > 0$ if program is effective)
        - X_{1j}: subcounty fixed effects
        - X_{2j}: additional controls for pre-trends in deforestation
    - Program had other secondary outcomes e.g. increased patrolling, increased non-food expenditure among treatment groups
- PES: payment for specific **voluntary** pro-environmental behaviours e.g. reducing deforestation (participation not required, so that no one is worse off)
    - Environmental version of CCT
- Payments = compensation for the cost of changing behaviour + remaining amount
- Risks: low take-up rate (not interested), inframarginality/additionality (only those who had no plans to deforest anyways partake), leakage/spillover (may shift deforestation elsewhere)
- PES is one way to put a price on environmental degradation, some incidental poverty reduction, high cost-benefit analysis

Nov 08: Social Protection (Graduation Programs)

- Balboni, 2022: suggests two views (1) equal opportunities but different fundamentals (2) unequal opportunities due to poverty traps; shows existence of poverty trap for ultra-poor
    - Poverty trap: need to reach a certain level of assets (threshold) in order to escape poverty, else wind up at the same steady state e.g. inability to borrow, nutrition
    - If (1), a large cash transfer will not be effective. If (2), a large cash transfer to get over the threshold helps in graduating from poverty
    - $Y_i = A_{i,v} f(K_i)$, $K_{i,t+1} = s_i A_{i,v} f(K_{i,t}) + (1-\delta) K_{i,t}$, assume no credit market
        - Y_i: individual i's earnings
        - $A_{i,v}$: individual i and village v traits that determine productivity
        - $f(\cdot)$: production function, takes in capital as input
            - If concave, then 1 stationary point → supports (1)
            - If S-shaped e.g. increasing returns to scale, then likely many stationary points → supports (2), large asset transfers can shift equilibrium
            - If discontinuous e.g. change of occupation on certain threshold, similar to S-shaped case → supports (2)
        - s_i: individual i's saving rate
        - δ: rate of depreciation of capital, common to all
    - K_i^*: steady state where savings of individual i offsets capital depreciation



    - Goal: relax credit and skill constraint, help ultra-poor women develop source of regular income (livestock rearing rather than irregular labour)
    - Implementation: one-time transfer of productive assets (livestock), training, consumption support for the first year, health support and rights training
    - Treatment in phases → control group exists
    - Limitation: pre-transfer baseline asset values are not random (a design to combat this is to randomise transfer amount)
    - Interpretation: minimum scale needed to be profitable in lifestock rearing

- Social protection: policies concerned with preventing, managing and overcoming situations that adversely affect people's well-being e.g. social insurance, assistance
- Enhance their capacity to earn more income (skills) or provide them directly with resources (cash)
- Policy depends on whether poverty is transitory or permanent

Nov 13: Social Protection (Cash Transfers)

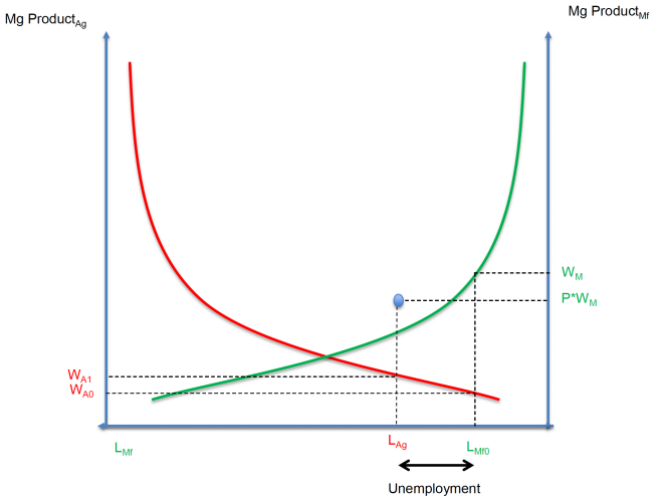
- Egger et al., 2022: General equilibrium effects of cash transfer i.e. aggregate effects of unconditional cash transfer, trace out pattern of transaction in an integrated economy
  - Large influx of cash, distributed in 3 phases over 8 months
  - Randomisation across large units, generates spatial variations
  - Extensive measurement of outcomes for both recipients and non-recipients, enterprises, markets, local government, consumer good prices
  - Reduced form (ITT) treatment effect on treated household (benchmark; assumes no neighbourhood effects)
    - $Y_{ivs} = \alpha_1 T_v + \alpha_2 H_s + \delta_1 Y_{ivs,t=0} + \delta_2 M_{ivs} + \epsilon_{ivs}$
    - Y_{ivs} can be recipient household expenditure, income, enterprise profits, non-recipient household expenditure
    - α_1: benchmark effect (direct effect + within-village indirect effects)
  - Average total effect of outcomes for treated and control households (direct effect, neighbourhood effect)
    - Cumulative amount of cash going into own village
    - Cumulative amount of cash going into other villages 0 to 2km away
    - Use IV: indicator for treatment village, the share of eligible households in other villages 0 to 2km away assigned to treatment
    - Average total effect is $\hat{\beta}\bar{X}$, where $\bar{X}$ = mean amount of cash distributed to a village
  - Transfer multiplier: $\mathbb{M} = \frac{1}{T}\int_0^{\bar{t}} \Delta GDP_t$, result shows $\mathbb{M} \approx 2.5$
    - $GDP_t = C_t + I_t + G_t + (X_t - M_t)$
    - $GDP_t = W_t + R_t + \Pi_t + T_t - NFI_t$
    - $\widehat{\mathbb{M}} = \frac{\text{MPC}}{1-\text{MPC}}$, MPC: marginal propensity to spend locally
  - Transfer may affect welfare by (1) changing the optimisation problem that households face and (2) effects on non-market outcomes that affect well-being (e.g. inequality)
  - Offers factor under-utilisation (on demand capital
- Conditional cash transfer: payment made if individuals/households engage in certain behaviours considered desirable by provider
- Unconditional cash transfer: money provided with no strings attached; households are free to do with whatever they want
  - Allow household to use as they see fit – not paternalistic, poverty escape strategy varies per household; evidence that recipients generally spend money well
  - Saves on monitoring and administrative costs
  - Cash as a benchmark
- Design: lump-sum or continuous, magnitude of transfer size

Nov 18: Internal Migration

- Harris Todaro Model: deals with internal migration between rural and urban places
- Formal labour: higher wage (e.g. enforced by unions)
- Informal labour, unemployed, semi-employed
- Model assumption: fixed labour units; individuals make decision based on expected wage
  - p: probability of being employed in urban; $p = \frac{L_M}{L - L_A}$
  - W_M: urban wage, W_A: rural wage

- At equilibrium, $W_A = pW_M$
- Loss of output from individuals who could be productive in rural area instead

- Policies:
  - $\uparrow W_M$: does not work, will worsen unemployment
  - Subsidise agriculture: higher curve for agriculture, $\uparrow W_A$
  - Restrict migration to cities: can achieve full employment
  - Restrict migration to cities, subsidise manufacturing: can achieve full employment

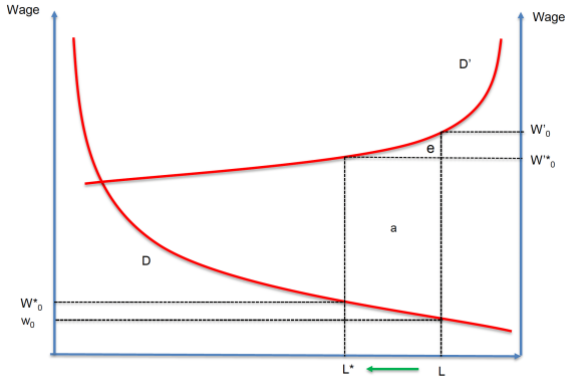


Nov 20: Seasonal Migration

- Chowdhury, 2014: underinvestment
- Randomise villages into 4 treatment arms: (1) Cash (info + cash); (2) Credit (info + cash but needs to be repaid); (3) Information (info); (4) Control (nothing)
- [ITT] $Y_{ivj} = \alpha + \beta_1 Cash_{ivj} + \beta_2 Credit_{ivj} + \beta_3 Info_{ivj} + \phi_j + \nu_{ivj}$
  - Household i, village v, subdistrict j
  - Y_{ivj}: consumption per capita and calorie intake per capita among remaining household members
- [IV] $Y_{ivj} = \alpha + \beta_1 Migrant_{ivj} + \theta X_{ivj} + \phi_j + \nu_{ivj}$
  - $Migrant_{ivj} = \lambda + \rho Z_v + \gamma X_{ivj} + \phi_j + \epsilon_{ivj}$
  - β_1: local average treatment effect i.e. consumption effect of migration for households that were induced to migrate by the program
- Conclusion: even temporary unskilled job opportunities in cities can have a big impact on the welfare of rural region residents; could be good for seasonal fluctuations

Nov 22: International Migration

- Clemens, 2011: argues that global welfare will be much higher if developed countries allow less restricted international migration
- International migration growingly important due to climate change and aging population
- Eliminating migration barriers can lead to around 50% - 150% increase in global GDP; price gap of labour can be up to 1000%



- Model assumption: fixed total labour
- Analysis: gain for migrants, gain for workers in the poor country, loss for producers in poor country (integral), loss for workers in the rich country, gain for producers in the rich country (integral)
- Poor country net gain of a, rich country net gain of e → total gain $= a + e$
- Welfare analysis:
  - Externality of migrants on non-migrates: might shift labour demand down, remittances, brain drain, return migration
  - Elasticity of labour at origin and destination
  - Productivity of worker on self and location (evidence that it is mostly location)
  - Future levels of emigration: sustainability of policy, political favourableness, protection and rights of migrants

Dec 02: Political Economy in Autocracies and Democracies

- Burgess et al., 2015
  - Identified Kenya as a country which experienced both autocracy and democracy and where the same president governed under both regimes (avoids the need to account for inter-country differences)
  - Democracy and autocracy defined by polity scores
  - Y: share of road expenditure received by a district (out of total national development budget) divided by population share of the district
    - $Y = 1$ → district received road spending proportional to its population
  - $\text{road}_{dt} = \gamma_d + \alpha_t + \beta(\text{coethnic district}_{dt}) + \delta(\text{coethnic district}_{dt} \times \text{democracy}_t) + \theta\left(X_{d,1963} \times (t - 1963)\right) + u_{dt}$
    - road_{dt}: road spending for district d in year t
    - $\text{coethnic district}_{dt}$: indicator for whether district d is more than 50% coethnic with president in year t
    - democracy_t: indicator for whether time period t is a democratic regime
    - γ_d, α_t: fixed effects
    - $X_{d,1963} \times (t - 1963)$: linear time trends and other controls
  - Result: coethnic district gets approximately twice as much as non-coethnic district
  - Conclusion: Democracy tends to lessen ethnic favouritism in government spending
- Resources, culture, environment → {state, market, society} → welfare, development
- Selection of politicians who can act in public's interest and tendencies for government agents not to act in society's interest
- Ideally, elections fulfil representation, selection, incentives
  - Representing citizens' voices in public policy making processes
  - Selecting good leaders
  - Incentive to act in the public interest
- Resource allocation
  - Democratic leaders need to get elected (support of majority) versus autocratic leaders

Dec 04: Political Selection in Democracies

- Ferraz and Finan, 2008: effect of publicly released anti-corruption audits on electoral outcomes for incumbent mayors in Brazil
  - Lottery for selecting municipalities to be audited (due to manpower limitation) e.g. schools were indeed built, health services were indeed provided, no overbilling…
    - Random assignment
  - Temporal variation allows comparison of places with audits before and after 2004 election; audits disseminated to local media sources
  - $E_{ms} = \alpha + \beta A_{ms} + X_{ms}\gamma + \phi v_s + \epsilon_{ms}$
    - E_{ms}: electoral performance of mayor in municipality m and state s e.g. re-election rate

        - A_{ms}: indicator for whether municipality m is audited before 2004 election
        - X_{ms}: municipality and mayor characteristics
        - v_s: state fixed effect
        - ϵ_{ms}: error term
        - Average effect is negative, statistically insignificant, possibly because it did not take into account the result of the audit
    - $E_{ms} = \alpha + \beta_0 C_{ms} + \beta_1 A_{ms} + \beta_2 (C_{ms} \times A_{ms}) + X_{ms}\gamma + \phi v_s + \epsilon_{ms}$
        - C_{ms}: number of corrupt irregularities found in municipality
        - β_2: causal effect of the policy, conditional on municipality's level of corruption
    - $E_{ms} = \alpha + \beta_0 C_{ms} + \beta_1 A_{ms} + \beta_2 M_{ms} + \beta_3 (A_{ms} \times M_{ms}) + \beta_4 (A_{ms} \times C_{ms}) + \beta_5 (M_{ms} \times C_{ms}) + \beta_6 (A_{ms} \times C_{ms} \times M_{mx}) + X_{ms}\gamma + \phi v_s + \epsilon_{ms}$
        - M_{ms}: number of local radio stations in municipality
        - Triple difference to find out if dissemination to media sources ensure voters get the information
        - β_6: find negative and statistically significant effect
- Result: election is a selection device to weed out corrupt politicians, but imperfect (requires media dissemination). Can also conduct random audits to reduce vote-buying and clientelism in citizen-politician interaction.

Dec 06: Political Representation in Democracies

- Fujiwara, 2015: electronic voting technology to enfranchise illiterate voters in Brazil
    - Electronic voting in 1998 only introduced for municipalities with > 40500 registered voters → regression discontinuity → estimate local effect of EV on enfranchisement of illiterate population
    - $Y_m = \alpha + \beta \mathbb{1}\{V_m > 40500\} + \gamma V_m + \delta V_m \mathbb{1}\{V_m > 40500\} + \epsilon_m$
        - m: municipality
        - Y_m: outcome - number of valid votes or which party wins
        - V_m: number of registered voters in municipality m
        - $V_m \mathbb{1}\{V_m > 40500\}$: allows slope above the discontinuity to vary as well
    - IKBW: optimal bandwidth
    - Result: $\hat{\beta}$ significant for valid votes; no discontinuity in other characteristics; significant shift leftward in voting (party ideology)
    - Policy analysis: whether EV results in higher state health expenditure
        - S_i: share of population in state i living in municipalities with > 40500 registered voters
        - Comparing states with large S_i and states with small S_i, due to the temporal variation, state with large S_i should have larger increases in health expenditure in 1998-2002 versus states with small S_i in 2002-2006
            - States with large S_i see sign of effect flip in later period
    - Conclusion: technology enfranchise citizens, representation is key to policy-making
- Increased representation for a particular group can lead to better policy outcome for that group → increased participation of poor voters may result in more resources for them
- Residual votes: votes that cannot be counted