Development Economics

Lecture 6: Efficiency. Introduction to Labs

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1 Introduction

There are three objectives today:

1. Discuss chapter 10 in Weil (Efficiency)

2. Discuss the following paper: Hall, R. E. and Jones, C. I. "Why do some countries produce so much more output per worker than others?" *Quarterly Journal of Economics*, 1999, 114: 83-116. This paper links very nicely to the material covered in Chapters 7,8 and 10 in Weil, and provides an excellent example of good empirical research on the determinants of economic development.

3. Introduce the two computer exercises.

2 Efficiency

- Last time we discussed how an important driving factor of **productivity** is **technology**. Recall that by technology we mean essentially the manner (how) in which production factors are used to produce output.

- We saw in the first part of the lecture that there are very large differences in productivity across countries in the world. Recall that, for example, Zambia's productivity is only 14% of that in the U.S.*

- Is this really because of technology differences? Probably not.

  – First of all, many pretty advanced technologies are being used in poor countries today - for instance, mobile phones.

*See Table 7.2 in Weil.

– Second, entertain for a moment the thought that Zambia's low level of productivity is due entirely to a technology gap. We saw that the average annual rate of productivity growth in the U.S. over the last 35 years has been 0.67%. If technology is the reason for Zambia's low productivity, how many years (denoted G) behind the U.S. would Zambia have to be for the numbers to make sense?

$$\begin{aligned} 0.14 \times (1 + 0.0067)^{G} &= 1 \\ G &= \frac{\ln \frac{1}{0.14}}{\ln (1 + 0.0067)} \\ G &= 294.4. \end{aligned}$$

That is, if poor technology is the **only** reason Zambia is so much less productive than the U.S., it must be that Zambia is some 294 years behind the U.S. with respect to its technology level. Zambia is certainly not highly developed - but cars, computers, mobile phones etc.

certainly exist in Zambia today. They clearly did not exist anywhere back in 1715.

- So there must be some reason other than technology why the productivity levels of Zambia and other poor countries are so low.

- Define **efficiency** as the *effectiveness with which factor or production* **and technology** *are combined to produce output*.

- In other words, efficiency captures anything that accounts for differences in productivity **other than** differences in technology.

- Using the following formula:

$$A = T \times E,$$

where A is productivity; T is technology; and E is efficiency, Weil shows in Section 10.1 how we can **infer** the difference in efficiency between some country of interest and some baseline country (e.g. the U.S.) if we know:

  - The productivity difference between the two countries (we know how to calculate this - see Chapter 7 in Weil)

  - The rate of technological growth (we know this is 0.67% for the U.S., hence this seems a plausible number for global technological progress - assuming U.S. is the technologically most advanced country in the world).

  - How many years the country of interest is behind the U.S. with regards to the level of technology.

- Weil's example concerns India. The productivity in India is equal to 0.35 times that of the U.S. Assuming that India is 10 years behind the U.S. with regards to technology, what is the implied difference in efficiency?

- Answer:

$$\begin{aligned} \frac{A_{India}}{A_{US}} &= \frac{T_{India}}{T_{US}} \times \frac{E_{India}}{E_{US}} \\ 0.35 &= 1.0067^{-10} \times \frac{E_{India}}{E_{US}}, \end{aligned}$$

hence

$$\frac{E_{India}}{E_{US}} = 0.35 \times 1.0067^{10} = 0.37.$$

The implication is that nearly all of the productivity gap is attributable to an efficiency gap.

- Suppose India is in fact 20 years behind the U.S. with respect to the level of technology. What is the efficiency gap in this case?

- Study Table 10.1 carefully and make sure you understand where the numbers come from.

- [Table 10.1 here]

Table 10.1 Decomposition of Productivity Gap Between India and the US

Years India Lags United States in Technology (*G*)	Level of Technology in India Relative to United States (*T*)	Level of Efficiency in India Relative to United States (*E*)
10	0.94	0.37
20	0.88	0.40
30	0.82	0.42
40	0.77	0.45
50	0.72	0.48
75	0.61	0.57
100	0.52	0.67

$$\frac{E_{India}}{E_{US}} = 0.35 \times 1.0067^{10} = 0.37.$$

- **Key message:** Unless lags in technology are extremely large (i.e. some countries are a very large number of years behind the U.S. with respect to technology), it follows that most of the difference in productivity arises because of efficiency differences.

- You may skip Section 10.2 in Weil (contains case studies of: the Soviet Union; the textiles industry in 1910, industry studies for rich countries; coal mining in the US).

2.1 Types of inefficiency

- Most economists agree that large inefficiencies exist in most countries.

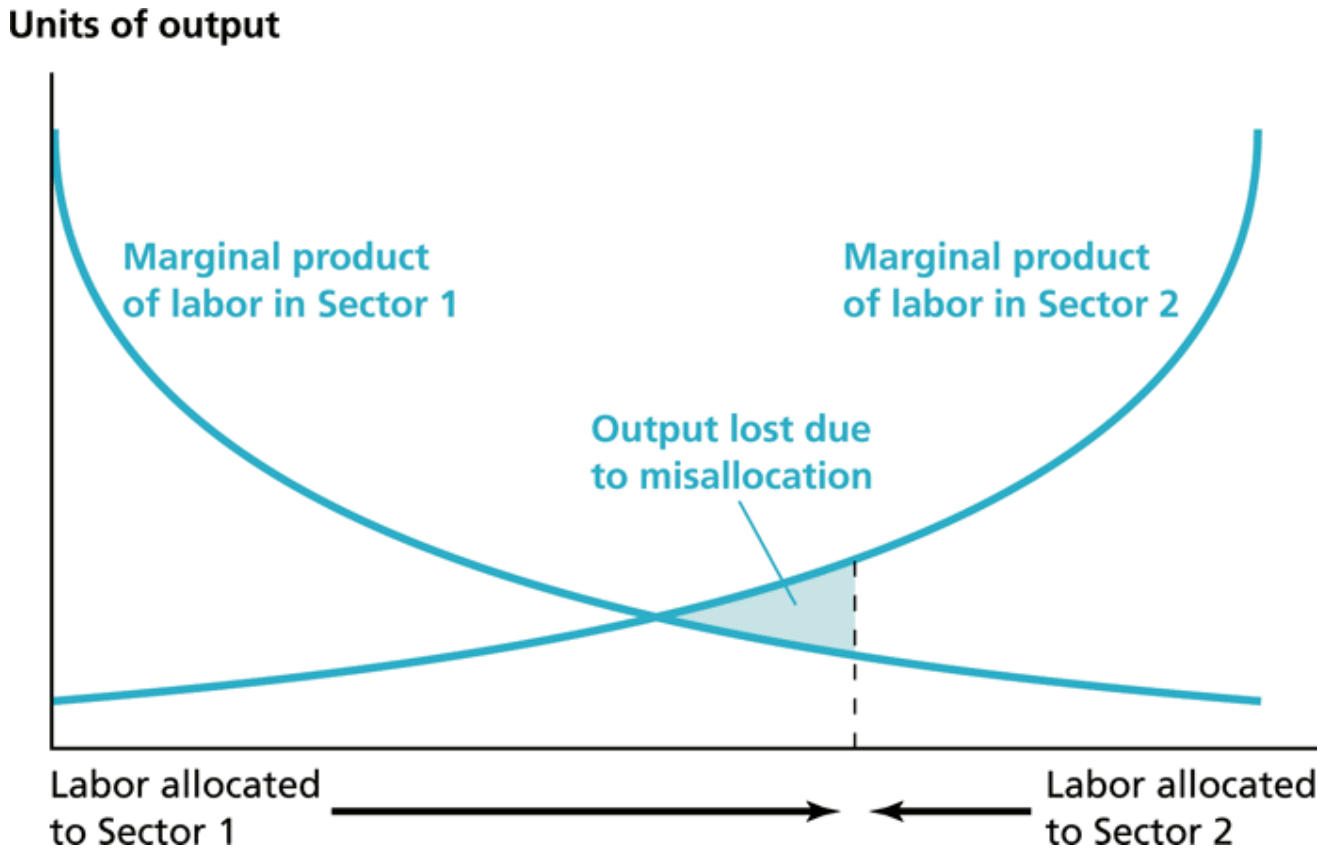
- Weil discusses **five** different ways in which economies can be inefficient.

1. **Unproductive activities:** Scarce resources are diverted from productive to unproductive activities - e.g. rent seeking (payment to a factor of production in excess of its normal return) or various forms of crime. That is, the choice of activities is not optimal from the point of view of economic development; yet it may well be optimal from the point of view of the individual. Poor institutions are often the source of the problem - more on this in the discussion below of the paper by Hall & Jones.

2. **Idle resources:** Unemployed workers, underutilized capital stock etc. Below I will briefly discuss an important models of the implications of minimum wages on unemployment (the Harris-Todaro model). This also links to the paper by Kingdon and Knight (2006), which I will discuss below.

3. **Misallocation of factors amongst sectors:** Resources are used in producing the wrong things - arguably the strategy of import substitution, pursued by many African countries in the 1970s and 1980s, belongs to this category. Basically, imports of manufactures was severely restricted, so as to generate a domestic manufacturing sector protected from foreign competition. Good for African manufacturers, probably, but bad for African consumers and likely bad for economic development on the whole. [Figure 10.4 here]

Figure 10.4 Overallocation of Labor to Sector 1



- **Barriers to mobility**:

Closely related to the argument that in a flexible market people will move to the type of activity with the highest return (wage); in equilibrium nobody has an incentive to move, i.e. the wage, and hence the marginal product of labour, is constant across types of activities. Key assumptions:

- – People can move across regions freely (requires good infrastructure, for instance)

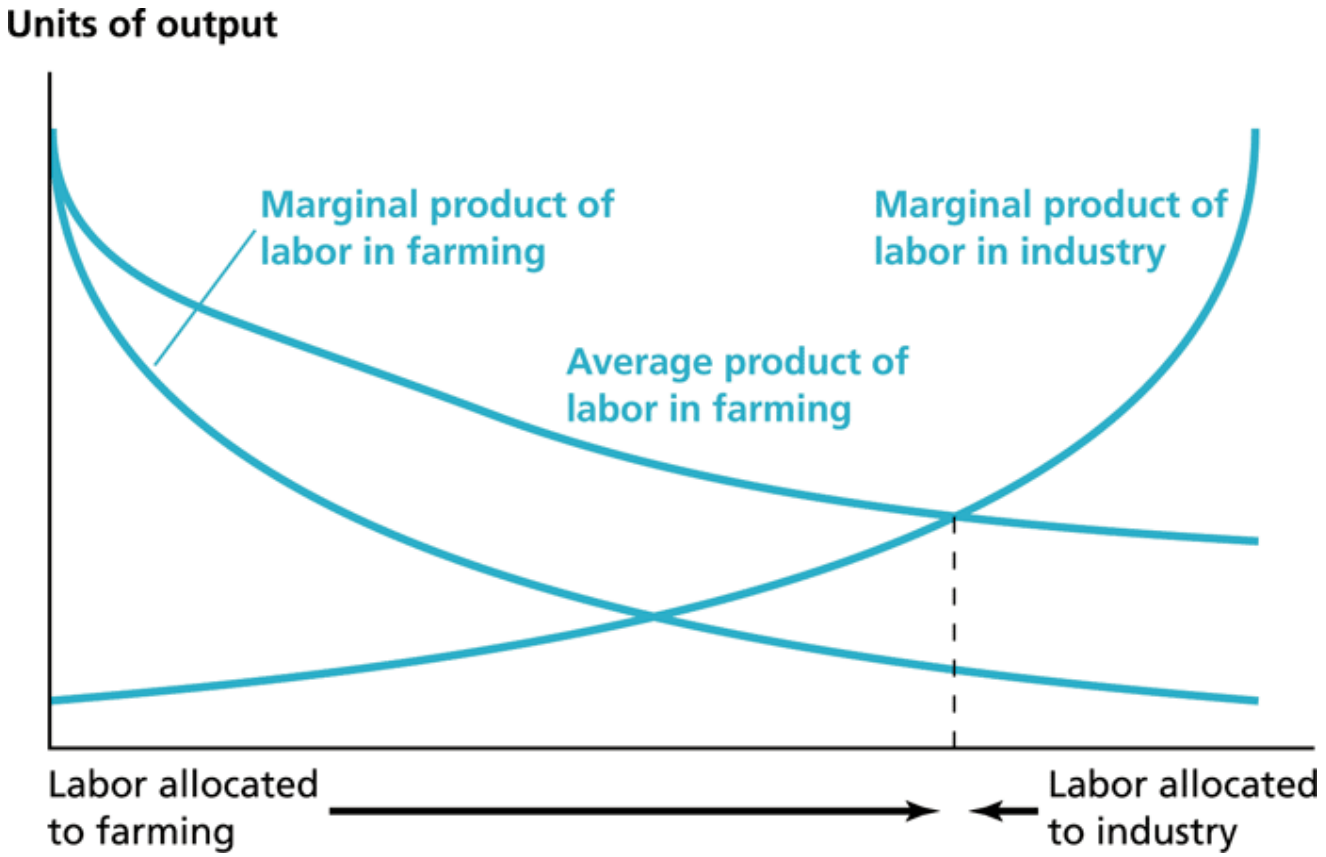
  – Wages adjust freely (no minimum wage, for example)

Of course, both are strong (=possibly unrealistic) assumptions.

- **Wages not equal to marginal product.** Typically for institutional reasons. In development economics, the most common example is based on the idea that, in the rural ("traditional") sector, the productive unit is typically **the family.**

  - It is reasonable to assume that the members of the family **share** the total income (output) generated by the farm between them. The "wage" in the traditional sector is thus given by total output divided by number of people in the household - average product, rather than marginal product. This clearly would **not** be a natural way of modelling a profit maximizing firm. Result: too much labour in agriculture, too little in the "modern" sector. [Figure 10.5 here]

Figure 10.5 Overallocation of Labor to Farming When Farmworkers Are Paid Their Average Product



- How could the distortions illustrated in Figures 10.4 and 10.5 be eliminated?

4. **Misallocation of factors amongst firms:** Same type of argument as for sectoral resource misallocation: in a well-functioning economy, resources will move from less to more productive firms, but market imperfections can prevent this from happening; for example:

- Low productivity firms manage to stay in business (and thus employ scarce resources) because of **government subsidies** (subsidies may be implicit: e.g. if informal firms can stay in business without paying tax, then informal micro firms get an unfair competitive advantage vs. formal firms - not a level playing field).

- **Lack of credit** implies firms with good projects may not be able to implement these unless they have a lot of own savings. Result: foregone output.

- **Poor labour market**: workers are not channelled to the firms where their productivity would be highest.

- The basic idea is thus that the MPL and MPK are not equalized across firms, which is inefficient

5. **Technology blocking:**

- Some influential group in society acts in such a way as to prevent the adoption of new technology. Self-interest. See Weil for examples from history.

I will now turn to a paper by Hall and Jones, entitled "Why do some countries produce so much more output per worker than others?". This paper - which is not discussed in Weil's book - argues that the answer is primarily differences in productivity, caused by differences in **institutions** and **government policies** - which the authors term **social infrastructure**. It links nicely with Chapter 10 in Weil, in the sense that non-technological factors are argued to be very important.

3 Why are some countries so much richer than others?

Reference: Hall, R. E. and Jones, C. I. "Why do some countries produce so much more output per worker than others?" *Quarterly Journal of Economics*, 1999, 114: 83-116.

- Point of departure for this paper: there are large differences in productivity levels across countries. This conclusion is based on levels accounting - essentially the same approach as that discussed in Weil, Chapter 7.

- Main goal of paper: explain **why**.

- Main hypothesis: strong relation between **social infrastructure** and **output per worker**:

Social infrastructure

$\Downarrow$

(Inputs, Productivity)

$\Downarrow$

Output per worker

- Social infrastructure: degree of corruption, barriers to trade, contract enforcement etc.

- Production function:

$$Y = K^{\alpha} (AH)^{1-\alpha},$$

where

$$H = e^{\phi(E_i)} L_i,$$

and $\phi(E_i)$ is the Mincerian earnings equation (example), E_i is education. This model is very similar to that adopted by Weil except human capital is raised to $1-\alpha$ here. Hall and Jones are more explicit about the functional form for human capital - note that $\phi'(E_i)$ is the *return to education* in their model.

- We begin by manipulating the production function, so as to obtain an equation suitable for a decomposition of per capita income. Given

$$Y = K^{\alpha} (AH)^{1-\alpha},$$

it must be true that

$$\begin{aligned} Y^{\frac{1}{1-\alpha}} &= \left[K^{\alpha}\left(AH\right)^{1-\alpha}\right]^{\frac{1}{1-\alpha}} \\ Y \times Y^{\frac{\alpha}{1-\alpha}} &= K^{\frac{\alpha}{1-\alpha}} AH \\ Y &= \left(\frac{K}{Y}\right)^{\frac{\alpha}{1-\alpha}} AH, \end{aligned}$$

and so in per capita form,

$$\frac{Y}{L} = \left(\frac{K}{Y}\right)^{\frac{\alpha}{1-\alpha}} A\frac{H}{L},$$

or

$$y = \left(\frac{K}{Y}\right)^{\frac{\alpha}{1-\alpha}} Ah,$$

where $y = Y/L, h = H/L$.

- This equation shows how per capita output can be decomposed into three parts:
  - differences in capital-output ratios
  - differences in average human capital (i.e. educational attainments, given the authors' assumptions about the determinants of h)
  - differences in productivity

- Why not use

$$y = \left(\frac{K}{L}\right)^{\alpha} Ah,$$

which also follows from the underlying production function? There is no

theoretical reason why one might prefer

$$y = \left(\frac{K}{L}\right)^{\alpha} Ah$$

to

$$y = \left(\frac{K}{Y}\right)^{\frac{\alpha}{1-\alpha}} Ah,$$

because both are just simple modifications of the same production function. Hall and Jones argue that their formulation is better, but it's hard to make a compelling case either way.

- Given

$$y = \left(\frac{K}{Y}\right)^{\frac{\alpha}{1-\alpha}} Ah,$$

measuring productivity A will require data on per capita output, capital intensity, and human capital. Per capita output and capital intensity are straightforward to measure; for human capital, the authors adopt the Psacharopoulos numbers, i.e.

$$\begin{aligned} h &= e^{\phi(E_i)}, \\ \frac{\partial \phi(E_i)}{\partial E_i} &= \left\{ \begin{array}{c} 13.4\% \text{ if } E_i \leq 4 \\ 10.1\% \text{ if } 4 < E_i \leq 8 \\ 6.8\% \text{ if } E_i > 8 \end{array} \right\} \end{aligned}$$

- Based on the equation

$$y = \left(\frac{K}{Y}\right)^{\frac{\alpha}{1-\alpha}} Ah,$$

it follows that we can measure productivity as

$$\ln A = \ln y - \frac{\alpha}{1-\alpha} \ln \left(\frac{K}{Y}\right) - \ln h,$$

where everything on the right-hand side is observable ($\alpha = 1/3$ is "known"). Figure I in the paper by Hall & Jones shows the association between log productivity, defined according to the previous equation, and log per capita income. Clearly, per capita income is strongly correlated with productivity.

[Figure I in Hall-Jones]

Figure I in Hall & Jones (1999):

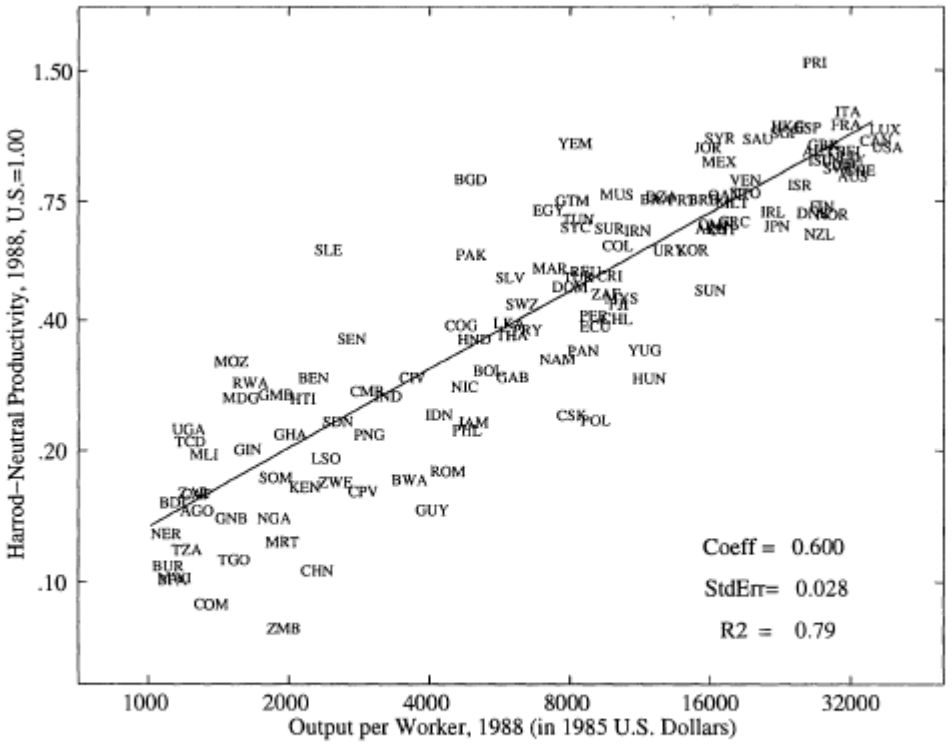


FIGURE I
Productivity and Output per Worker

Output per worker strongly correlated with productivity.

- We can also use the same equation to decompose differences in per capita output into its three components. Using the U.S. as the baseline, per capita output in country i can be expressed as

$$\frac{y_i}{y_{U.S.}} = \frac{\left(\frac{K}{Y}\right)_i^{\frac{\alpha}{1-\alpha}}}{\left(\frac{K}{Y}\right)_{U.S.}^{\frac{\alpha}{1-\alpha}}} \times \frac{A_i}{A_{U.S.}} \times \frac{h_i}{h_{U.S.}}.$$

  Table I in the paper shows the results of decomposing per capita output using this formula.

[Table I here]

TABLE I

PRODUCTIVITY CALCULATIONS: RATIOS TO U. S. VALUES

Country	Y/L	Contribution from $(K/Y)^{\alpha/(1-\alpha)}$	Contribution from H/L	Contribution from A
United States	1.000	1.000	1.000	1.000
Canada	0.941	1.002	0.908	1.034
Italy	0.834	1.063	0.650	1.207
West Germany	0.818	1.118	0.802	0.912
France	0.818	1.091	0.666	1.126
United Kingdom	0.727	0.891	0.808	1.011
Hong Kong	0.608	0.741	0.735	1.115
Singapore	0.606	1.031	0.545	1.078
Japan	0.587	1.119	0.797	0.658
Mexico	0.433	0.868	0.538	0.926
Argentina	0.418	0.953	0.676	0.648
U.S.S.R.	0.417	1.231	0.724	0.468
India	0.086	0.709	0.454	0.267
China	0.060	0.891	0.632	0.106
Kenya	0.056	0.747	0.457	0.165
Zaire	0.033	0.499	0.408	0.160
Average, 127 countries:	0.296	0.853	0.565	0.516
Standard deviation:	0.268	0.234	0.168	0.325
Correlation with Y/L (logs)	1.000	0.624	0.798	0.889
Correlation with A (logs)	0.889	0.248	0.522	1.000

The elements of this table are the empirical counterparts to the components of equation (3), all measured as ratios to the U. S. values. That is, the first column of data is the product of the other three columns.

Key insights:

- Developing countries: differences in productivity are the most important factor in explaining differences in output per worker.
- Differences in productivity across countries are substantial (look at std devs in the table).
- Differences in physical capital and educational attainment explain a fairly small amount of the amount in output per worker across countries.

3.0.1 But WHY these productivity differences? Determinants of economic performance

- Central hypothesis of paper: the primary, fundamental determinant of a country's long-run economic performance is its **social infrastructure**.

- Social infrastructure = institutions & government policies that provide the incentives for individuals and firms in the economy.

- Some incentives encourage productive activities - other incentives encourage theft, rent-seeking, corruption etc.

- That is, the hypothesis here is that the efficiency of the economy (Weil, Chapter 10) is determined by the social infrastructure.

- Economies with a strong social infrastructure generate incentives that encourage productive activities - whereas if the social infrastructure is weak, non-productive incentives are encourages (e.g. rent-seeking or corruption will be commonplace if court system is weak).

3.0.2 Estimating the effect of social infrastructure

- To test this hypothesis empirically, the authors need a measure of social infrastructure. Obviously, no direct measure of social infrastructure exists. The authors propose the following measure:

$$\text{social infrastructure} = \frac{A + B}{2},$$

where...

  - ...A = an index of government **antidiversion policies**, taking into account law and order, bureaucratic quality, corruption, risk of expropriation & government repudiation (rejection) of contracts

  - ...B = an index measuring the degree to which a country is **open to international trade**.

- **Identification.** The proposed model for per capita income is

$$\ln \frac{Y}{L} = \beta_0 + \beta_1 S + \epsilon,$$

where S is social infrastructure, ϵ is an error term, and β_1 is the (unknown) parameter of interest (to be estimated). Social capital is thus taken to be the fundamental determinant of per capita income.

[Figure II & Table II, Hall & Jones]

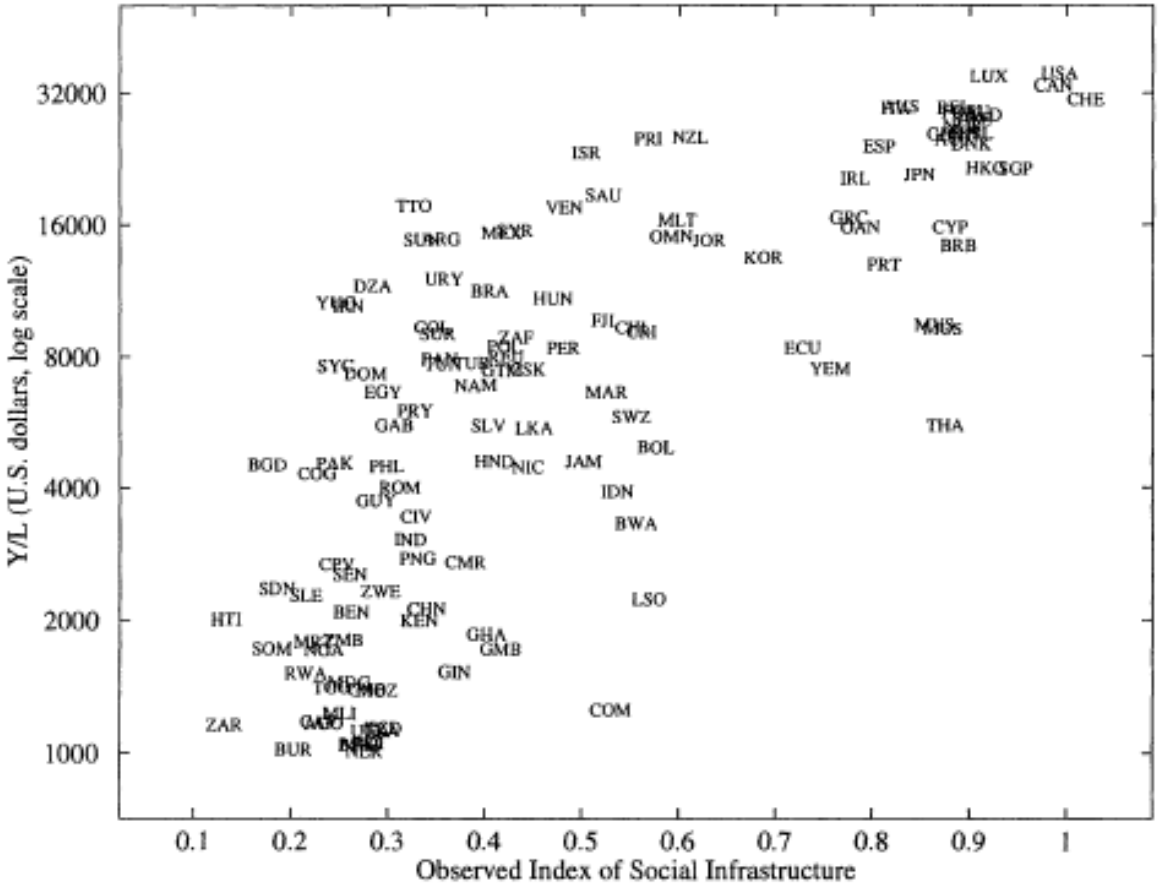


FIGURE II
Social Infrastructure and Output per Worker

TABLE II

BASIC RESULTS FOR OUTPUT PER WORKER

$\log Y/L = \alpha + \beta \tilde{S} + \tilde{\epsilon}$

Specification	Social infrastructure	OverID test p-value test result	Coeff test p-value test result	$\hat{\sigma}_{\tilde{\epsilon}}$
1. Main specification	5.1432	.256	.812	.840
	(.508)	Accept	Accept	
Alternative specifications to check robustness				
2. Instruments:	4.998	.208	.155	.821
Distance, Frankel-Romer	(.567)	Accept	Accept	
3. No imputed data	5.323	.243	.905	.889
79 countries	(.607)	Accept	Accept	
4. OLS	3.289	—	.002	.700
	(.212)		Reject	

The coefficient on Social infrastructure reflects the change in log output per worker associated with a one-unit increase in measured social infrastructure. For example, the coefficient of 5.14 means than a difference of .01 in our measure of social infrastructure is associated with a 5.14 percent difference in output per worker. Standard errors are computed using a bootstrap method, as described in the text. The main specification uses distance from the equator, the Frankel-Romer instrument, the fraction of the population speaking English at birth, and the fraction of the population speaking a Western European language at birth as instruments. The OverID test column reports the result of testing the overidentifying restrictions, and the Coeff test reports the result of testing for the equality of the coefficients on the *GADP* policy index variable and the openness variable. The standard deviation of $\log Y/L$ is 1.078.

Note: Authors focus on instrumental variables (IV) estimates (rows 1-3) but for our purposes, the OLS results in (4) will do just fine (see end of lecture notes for brief description of the IV approach in this paper)

•The estimated coefficient on social infrastructure is equal to 3.29 and highly statistically significant (IV estimation gives qualitatively similar results).

•Point estimate of 3.29 implies that a 0.1 increase in the index of social infrastructure is associated with an increase in output per worker of about 0.329 log points – i.e. by about exp(0.329)-1 = 39%.

- Main conclusion: Differences in social infrastructure across countries cause large differences in per capita income across countries.

On "instrumental variables" (optional):

- It is acknowledged that social infrastructure may depend on the level of economic development, i.e. that social infrastructure may be **endogenous**. More precisely, social infrastructure is assumed to be determined by the following equation:

$$S = \gamma + \delta \log (Y/L) + \mathbf{X}\boldsymbol{\theta} + \eta,$$

where $\mathbf{X}$ is a set of exogenous variables (and $\boldsymbol{\theta}$ is a vector of parameters).

- Why might social infrastructure be "endogenous"?

- If, in the equation

$$\ln \frac{Y}{L} = \beta_0 + \beta_1 S + \epsilon,$$

S is endogenous, how can we obtain a reliable estimate of the parameter β_1? In theory, this parameter is supposed to measure the **causal** effect of social infrastructure on per capita output. The OLS estimator will estimate this parameter reliably (consistently) provided social infrastructure is uncorrelated with the residual ϵ - however, if per capita income affects social infrastructure ($\delta \neq 0$) this will not be the case.

- What to do? Answer: instrumental variables - use as an instrument for social infrastructure a variable that is i) correlated with social infrastructure; and ii) uncorrelated with the residual ϵ in the per capita output equation.

- **Choice of instruments:**
  - Geographical factors - e.g. distance from **equator.**
  - Extent to which the primary **languages** of Western Europe (English, French, German, Portuguese, Spanish) are spoken as first languages today.

- Hall and Jones discuss why these are useful instruments, i.e. why assumptions (i) and (ii) are realistic ones. They argue for example that these instruments are correlated with social infrastructure because the ideas of Adam Smith, the importance of property rights, and the system of checks & balances in government, were developed in Western Europe. Hence countries that were strongly influenced by Western Europe were more likely to adopt favourable social infrastructure.

- It turns out that it doesn't much matter whether you use the instrumental variables estimator or OLS in this application - I focus on the OLS estimator since this is easier to interpret.

4 Background Material for Labs 1 & 2

LAB 2

- In Lab 1 we use cross-country macro data to analyze the effects of aid on growth.

LAB 1

- In Lab 2 we use micro data from South Africa to analyze the determinants of wages.

- Note: Everything in these notes is **examinable** - i.e. you may be asked about it in the final exam. This also applies for the labs themselves. However, you will not be expected to learn all details in the articles underlying the two labs; for the exam, it is enough to focus on the points that I raise in the notes and in the labs.

4.1 Lab 1: Human capital, labour market flexibility and wages in South Africa

Reference: Kingdon, G. and J. Knight "How flexible are wages in response to local unemployment in South Africa" Industrial & Labor Relations Review, Apr 2006, Vol. 59 Issue 3, p471-495.

In the first lab we will use household data from South Africa to investigate the determinants of wages. Kingdon and Knight (2006) used these data in their analysis.

4.1.1 Background and main research question

- High unemployment in South Africa (>30% at the time of the survey, 1993)

- Common claim: South Africa's labour market is **inflexible**, because of the strength of the unions and the centralized collective bargaining.

- Various theories exist predicting a relationship between unemployment and wages.

- Drawing on such theories (I will briefly discuss these below), this paper investigates the relationship between wages and unemployment.

4.1.2 Other questions that can be answered with this dataset

- Very rich dataset - recall from Lecture 5 that there is cross-section data on 8,848 households with regards to labor force participation, employment status, earnings, education, hours worked in the past week, job-search activity, occupation, industry, and employer type.

- So we can investigate the role of education in driving wage differences. We will focus on mostly this, and the wage-unemployment relationship, in the lab.

- We will also look at the role of gender, and consider the striking differences between Black and White South Africans.

4.1.3 Unemployment and wages: Theory

- Simplifying a bit, the paper contrasts two classes of models of the relationship between wages and unemployment:
  - Models predicting a causal effect of unemployment on wages. This effect is predicted to be **negative**.
  - Models predicting a causal effect of wages on unemployment. This effect is predicted to be **positive**.

Unemployment impacts on wages:

- Principal-agent problem. The owner of the firm cannot monitor the worker perfectly. The worker dislikes effort and so has an incentive to **shirk**. In

response, the firm will raise the wage as a way of motivating workers to work hard and not shirk.

- However, if unemployment is high, then this acts as a "disciplining device" - if the worker is found out shirking he or she will be sacked which will be a severe punishment if unemployment is high; the firm understands this, and so does not have to offer quite as high a wage under high unemployment as under low unemployment to ensure that the worker works hard.

- So: High unemployment $\longrightarrow$ low wages.

- A similar argument in models based on union bargaining: high unemployment frightens workers and weakens their bargaining power over wages.

Wage impacts on unemployment: The basic Harris-Todaro model.

- The **Harris-Todaro** (HT) model is not described at great length in the paper. However it's an important model in development economics, and we do need to understand the intuition of this model for the lab to be interesting.

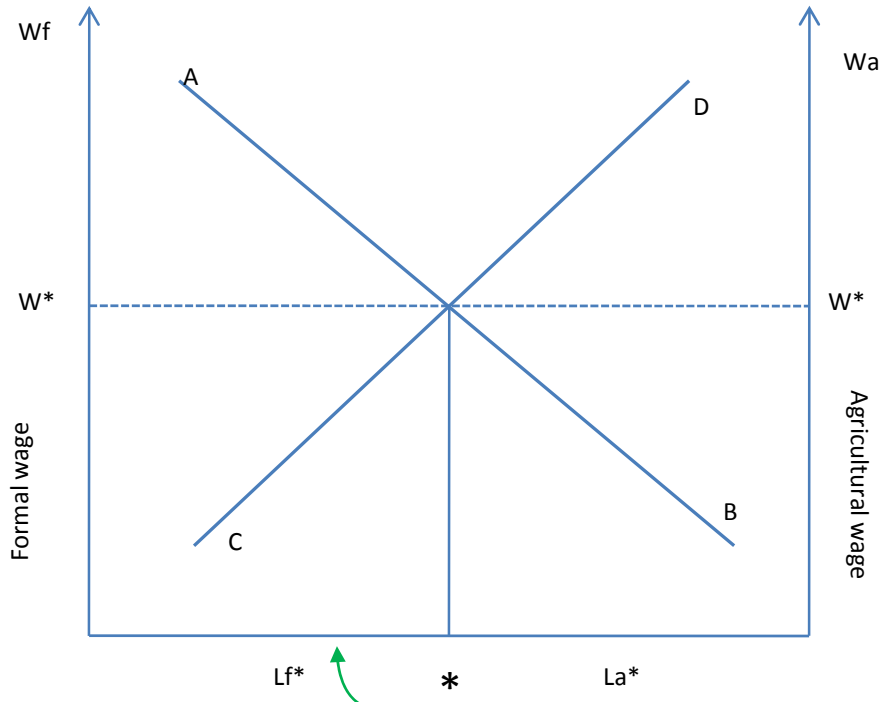
- Drawing on Section 10.3 in Debraj Ray's book "Development Economics", here is a brief overview of the HT model. You are not required to read Ray's exposition, but you are expected to know the following.

- Starting point: Only two sectors in the economy, namely formal urban sector and rural sector.

- Initially, suppose that wages in both sectors are fully flexible (we will relax this soon - indeed, the whole point of the HT model is to illustrate what happens if the wage in the formal sector is too high).

- SEE SEPARATE GRAPHS

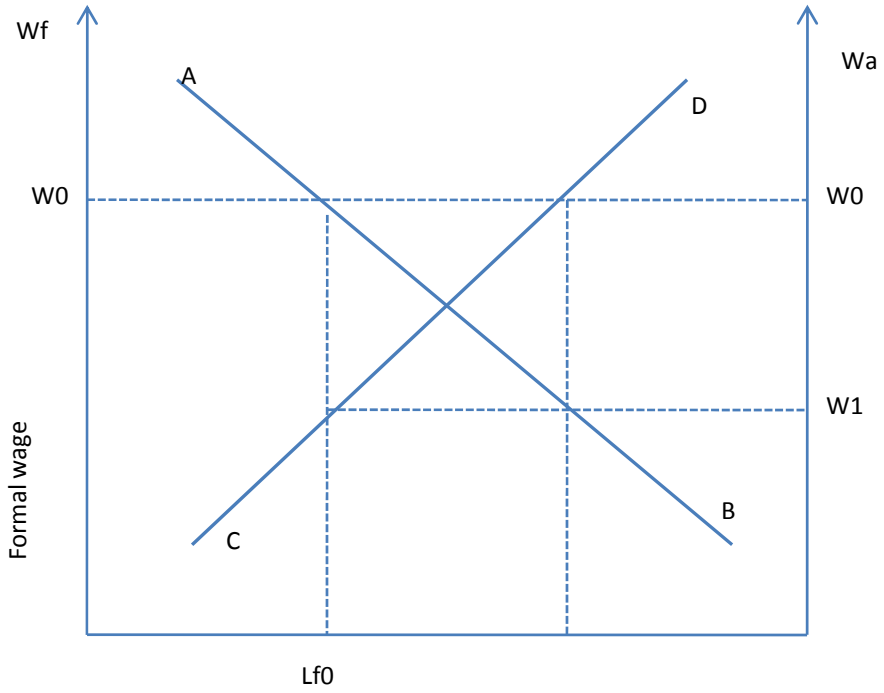
MARKET EQUILIBRIUM WITH FLEXIBLE WAGES



Horizontal axis: entire labour force
AB: demand for labour in formal sector
CD: demand for labour in rural sector
Equilibrium in *. Wages in the 2 sectors are equalized.
If you're to the left of * => migration to urban sector, reducing urban wages and increasing rural wages.

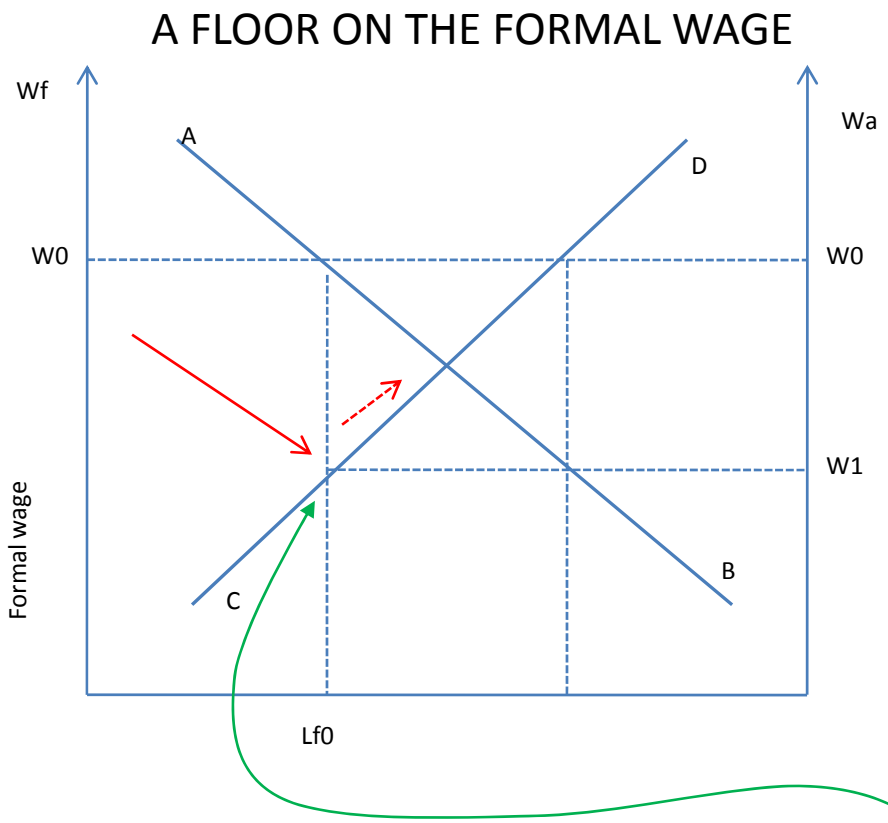
-Now consider the case where the formal wage is set above its market clearing level (so that it is ”too high”)
- Employment in formal sector is now equal to Lf0, which is lower than under flexible formal wages (above).

A FLOOR ON THE FORMAL WAGE



What happens to rural wages and employment? There are a few possibilities….

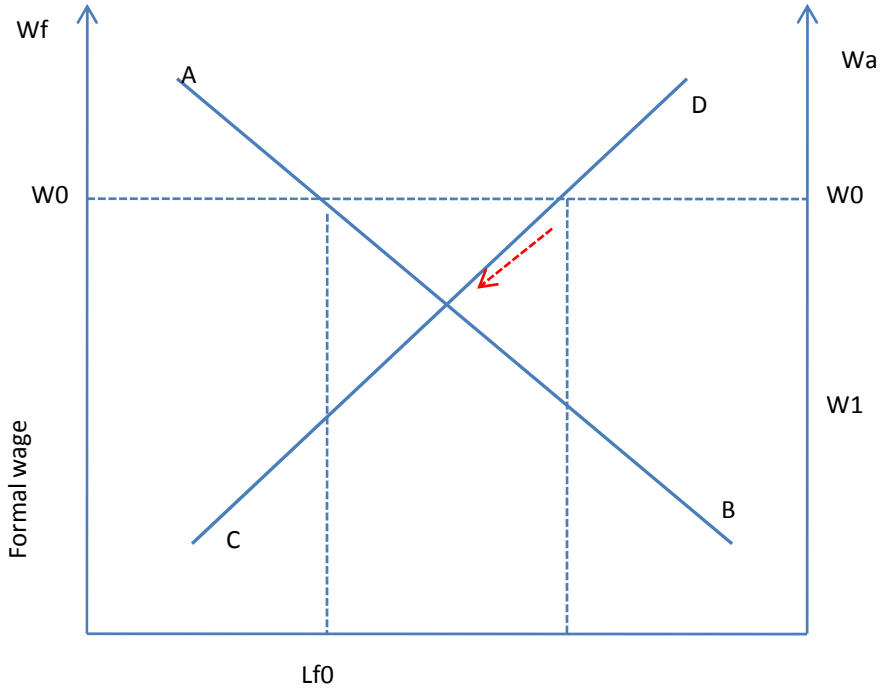
a) Everyone not employed in formal sector ends up in rural sector:



No unemployment, but very low wages in agriculture. For this reason, people in rural sector will want to migrate. So the point here cannot be an equilibrium.

b) Wages in the 2 sectors can't be equal (at W0) in equilibrium, since wages in agriculture are flexible…

A FLOOR ON THE FORMAL WAGE



In other words, there can't be unemployment in the rural sector.
But there may be unemployment in the urban sector (since wages are not flexible).

- Taking stock: A floor on the urban wage means the urban sector will hire fewer people than it would if wages were flexible. That is pretty clear. It is less clear what will happen to employment and wages in the rural sector. We have not yet arrived at an equilibrium.

- Now let's try to establish what the equilibrium might look like, drawing on the insights established so far.

- The formal wage is "too high". Rural workers therefore have an incentive to migrate to the urban sector. However, because formal jobs are limited, chances are that a migrant might end up unemployed.

- So we can view the migration decision as one made under uncertainty. The potential migrant assesses her options:

- Stay in the rural sector and earn a low but certain wage

- Migrate to the urban sector, in which case she either gets a formal (=good) job that is well paid (with probability p, conditional on migration; following Ray I denote the formal wage by $\bar{w}$); or not, in which case she gets an informal job that pays her the wage w_I (with probability $1-p$, conditional on migration).

- The expected value associated with migration is thus simply

$$p \times \bar{w} + (1-p)\, w_I$$

Now, if this expected value of migration is higher than the agricultural wage, and the individual is risk neutral, she might decide to migrate; otherwise she will stay in the rural sector.

- Now, at last, we can proceed towards the equilibrium outcome. At the equilibrium, where no person wants to migrate from sector to another, it must be that

$$p \times \bar{w} + (1 - p)\, w_I = w_A$$

- What can we say about the likelihood of getting a formal job, p? Consider the proportion

$$\frac{\bar{L}_F}{\bar{L}_F + L_I},$$

i.e. the share of formal jobs in all urban jobs. The **Harris-Todaro equilibrium condition** can now be written as

$$\frac{\bar{L}_F}{\bar{L}_F + L_I} \times \bar{w} + \frac{L_I}{\bar{L}_F + L_I} w_I = w_A$$

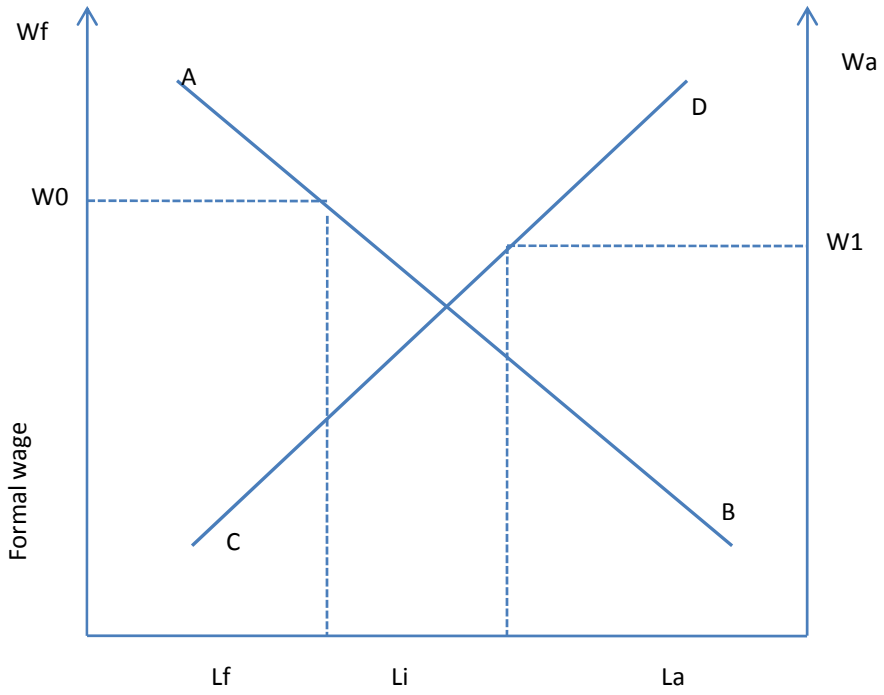
- For sure, in equilibrium, it must be that

$$\bar{w} \geq w_A \geq w_I.$$

  Hence, landing a formal job is the best case scenario and ending up in the urban informal sector is the worst case scenario.

- [GRAPH: HT EQUILIBRIUM; Figure 4 in Kingdon-Knight]

Harris-Todaro equilibrium



Lf individuals have a formal urban sector job
Li individuals have a job in the informal urban sector
La individuals have a farm job

Empirical relationship between local unemployment & wages in South Africa

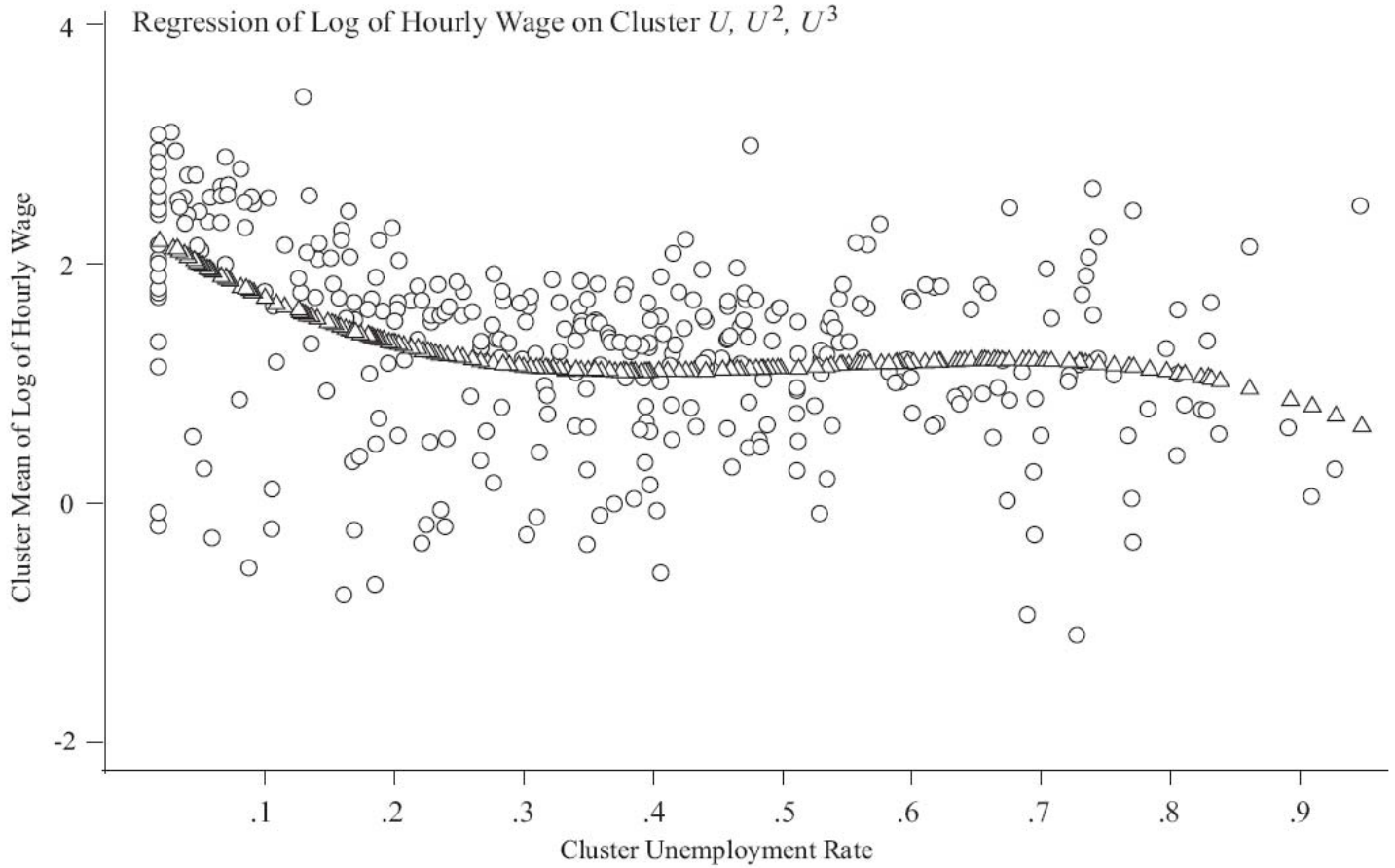


Figure 4. Unconstrained Cluster Data.

4.2 Lab 2: Aid & Growth

This note provides a brief summary of the following two papers

Burnside, Craig and David Dollar (2000). "Aid, Policies, and Growth." American Economic Review 90(4), pp. 847-68.

Easterly, William, Ross Levine, David Roodman (2004). "Aid, Policies, and Growth: Comment," American Economic Review 94(3), pp. 774-780.

Both papers can be downloaded from the course webpage. You need to have read these papers before working on lab 2.

4.2.1 Overview

- Empirical research in the mid 1990s found that aid has not raised growth rates in the typical poor country (see the papers by Boone, referenced by Burnside and Dollar; henceforth BD).

- Main hypothesis in BD is that *the effect of aid on economic growth depends on the policies in the recipient country*

- The idea is that in countries with sound economic policies, aid will accelerate growth; in countries with bad economic policies, aid is dissipated in unproductive government expenditure.

- To investigate if this hypothesis is supported by the data, BD construct a **policy index**, which is based on a measure of openness, inflation and the budget surplus divided by GDP. They then run regressions in which growth is modelled as a function of aid, policy and other explanatory variables.

- BD also analyze the determinants of aid. Although important, we will not focus on this aspect of their work.

- BD reported evidence confirming their hypothesis: aid works in good policy environments, but not in bad policy environments.

- The BD paper became very influential, primarily amongst policy makers, and was frequently cited in the media (see Footnote 1 Easterly, Levine &

Roodman). Donors now had research to fall back on, when arguing that aid should be conditional on improved governance in developing countries. Solid, robust research.

- Or maybe not. A few years later, Easterly, Levine and Roodman (henceforth ELR) wrote a comment on the BD paper. ELR had made some seemingly minor updates of the BD data (extending the time series over which the data were collected by a few years; plus making some other minor revisions of the data), and found that the above result reported in BD was not robust, in the sense that the original empirical finding was completely overturned. In fact, ELR couldn't find any direct effects of aid on growth at all.

- ELR concluded that "...economists and policy makers should be much less sanguine about concluding that foreign aid will boost growth in countries with good policies" (p.780).

4.2.2 Summary of Burnside-Dollar (2000) analysis

- Empirical framework: a 'modified' neoclassical growth model. Data on 56 countries, six 4-year periods 1970-93.

Growth equation (p. 848 in paper):

$$g_{it} = y_{it}\beta_y + a_{it}\beta_a + P_{it}\beta_P + (a_{it} \times P_{it})\,\beta_1 + z_{it}\beta_z + g_t + \varepsilon^g_{it}, \qquad (1)$$

where y_{it} is initial income, P_{it} is a policy variable, a_{it} is the aid to gdp ratio, z_{it} is a vector of exogenous control variables, g_t and a_t are time effects, $\beta_y, \beta_a, \beta_P, \beta_1, \beta_z$ are parameters to be estimated, and ε^g_{it} is a residual (unobserved error term). The term $(a_{it} \times P_{it})$ is an **interaction term,** constructed simply by multiplying two variables.

- Why is this interaction term of interest here? Think about what specification (1) implies. In particular, think about the **effect of aid**. As you can see, the marginal effect of aid on growth is

$$\frac{\partial g_{it}}{\partial a_{it}} = \beta_a + P_{it}\beta_1.$$

  Now observe the following:

  - If β_1, the coefficient on the product $a_{it} \times P_{it}$, is equal to zero, then the marginal effect of aid is straightforward - the effect is equal to β_a, which is the coefficient on the aid variable in (1). Thus, if $\beta_1 = 0$ and $\beta_a > 0$, for example, then the aid effect on growth is positive.

  - However, if the coefficient on the product $a_{it} \times P_{it}$, i.e. β_1, is **not** equal to zero, then the marginal effect of aid on growth **depends** on the policy variable. Suppose that, as is the case in BD, the policy

variable is such that a high value of P_{it} corresponds to good policies. Then, if $\beta_1 > 0$, we would conclude that the effect of aid on growth becomes **higher** in environments with good policies. This is thus what BD are looking for, given their basic hypothesis that the effect of aid on economic growth depends on the policies in the recipient country.

- Of course, "policy" as such is not a well defined variable. To be able to do their empirical analysis, BD construct a policy variable based on the Sachs-Warner trade openness dummy, inflation and the budget surplus divided by GDP:

  policy $= 1.28 + 6.85 \times$ budget surplus / GDP $- 1.40 \times$ inflation $+ 2.16 \times$ openness.

- The aid variable is defined as the percentage of aid received of GDP.

- Their key results are shown in Table 4 in the paper. This table shows OLS and two-stage least squares (2SLS) results - we focus on the OLS results only.* Key OLS estimates, shown in column 5 in the table, are as follows:

  Estimate of β_a = -0.021 (not significantly different from zero)
  Estimate of β_1 = 0.19 (significantly different from zero at 5% level)

  Thus BD argue that their main hypothesis is supported by the data.

- There are other results of interest in the paper too. For instance, in a growth equation in which the aid variable enters only with a linear term (i.e. the interaction term ($a_{it} \times P_{it}$) is omitted), the estimated aid effect is very small and statistically insignificant (Table 3). This is consistent with

*Using 2SLS we can treat aid as an endogenous variable, e.g. potentially dependent on growth. It turns out OLS and 2SLS results are pretty similar, and so we might as well focus on the simpler OLS estimator.

earlier findings (see papers by Boone): aid appears not to affect growth. BD would argue this is because such a regression is incorrectly specified: if indeed the effect of aid depends on policy, then that needs to be taken into account when running the regression (e.g. in the way done by BD). The authors also report results from a sensitivity analysis, focussing on the effects of dropping the middle income countries (why would you want to do this?). And so on. Read if you are interested. We will concentrate on the key result however, which is the one discussed above.

4.2.3 Summary of Easterly-Levine-Roodman (2004) analysis

- Recognizing that the key BD result has "enormous policy implications" (ELR, p. 774), ELR ask how robust this result is.

- Robustness: if you make minor changes to the data or the specification (the set of explanatory variables) and you find that this overturns the result, you would conclude that the result is not robust.

- ELR do not investigate the effects of changing the specification, they only focus on the effects of updating the data. Specifically, what they do is to extend the data from 1993 to 1997, add a few more countries to the sample, and some other minor updates. Certainly, if the BD finding that the effect of aid depends on policy is "the truth", then you wouldn't expect the result to vanish as a consequence of such extensions of the data.

- So the model in ELR is the same as in BD:

$$g_{it} = y_{it}\beta_y + a_{it}\beta_a + P_{it}\beta_P + (a_{it} \times P_{it})\,\beta_1 + z_{it}\beta_z + g_t + \varepsilon_{it}^g.$$

- Main insight: "The BD results do not hold when we use new data that includes additional countries and extends the coverage through 1997. The aid*policy interaction term enters insignificantly when using data from 1970-1997" (ELR, P. 775).

[Table 1 in ELR].

TABLE 1—TESTING THE ROBUSTNESS OF BURNSIDE AND DOLLAR PANEL REGRESSIONS 5 AND 8 TO MORE DATA (DEPENDENT VARIABLE: GROWTH OF GDP/CAPITA)

	(1)	(2)	(3)	(4)
Sampling universe:	All developing countries, outliers omitted		Only low-income countries, outliers omitted	
Burnside-Dollar regression:	Regression 5, OLS		Regression 8, 2SLS	
Right-hand-side variable:	BD data, BD sample, 1970–1993	New data set, full sample, 1970–1997	BD data, BD sample, 1970–1993	New data set, full sample, 1970–1997
Aid	−0.02	0.20	−0.24	−0.16
	(0.13)	(0.75)	(−0.89)	(−0.26)
Aid*policy	0.19**	−0.15	0.25*	−0.20
	(2.61)	(−1.09)	(1.99)	(−0.65)
Log initial GDP per capita	−0.60	−0.40	−0.83	−1.21*
	(−1.02)	(−1.06)	(−1.02)	(−2.02)
Ethnic	−0.42	−0.01	−0.67	−0.74
	(−0.57)	(−0.02)	(−0.76)	(−0.82)
Assassinations	−0.45	−0.37	−0.76	−0.69
	(−1.68)	(−1.43)	(−1.63)	(−1.68)
Ethnic*Assassinations	0.79	0.18	0.63	0.69
	(1.74)	(0.29)	(0.67)	(0.78)
Sub-Saharan Africa	−1.87*	−1.68**	−2.11**	−1.20
	(−2.41)	(−3.07)	(−2.77)	(−1.79)
Fast-growing E. Asia	1.31*	1.18*	1.46	1.01
	(2.19)	(2.33)	(1.95)	(1.40)
Institutional quality	0.69**	0.31*	0.85**	10.38*
	(3.90)	(2.53)	(4.17)	(2.46)
M2/GDP lagged	0.01	0.00	0.03	10.02
	(0.84)	(0.16)	(1.39)	(1.00)
Policy	0.71**	1.22**	0.59	1.61**
	(3.63)	(5.51)	(1.49)	(2.93)
Observations	270	345	184	236
R^2	0.39	0.33	0.47	0.35

Notes: *T*-statistics are given in parentheses. The regressions omit outliers, either as described in Burnside and Dollar (2000) or using the Hadi method as discussed in the text. Variable definitions: Aid is Development Assistance/real GDP; Policy is a regression-weighted average of macroeconomic policies described in BD; Ethnic is ethnic fractionalization from Easterly and Levine, 1997; Assassinations is per million population; Sub-Saharan Africa and Fast-growing E. Asia are dummy variables; Institutional quality is from Stephen Knack and Philip Keefer (1995). Other data sources are described in the Data Appendix available at www.cgdev.org.

* Significant at the 5-percent level.

** Significant at 1-percent level.

variable enters insignificantly (we will show these results below).

We perform the same exercise with BD regression 8 for the sample of low-income countries (also following them in omitting outliers). BD note that low-income countries might be a preferred sample to detect the effects of aid, and indeed their aid*policy interaction term is significant in both OLS and two-stage least squares (2SLS) in their regression 8. In order to check the robustness of the estimates of the instrumental variables estimates, we do the exercise in two-stage least squares as shown in columns (3) and (4) of Table 1. We use the same set of instruments as BD. We are again able to reproduce their results with our data set (see Table 2 below).

The aid*policy term is insignificant in their regression 8 when we simply add all the data for low-income countries that we can collect for 1970–1993 and the data for 1994–1997 [column (4)]. The coefficient not only becomes insignificant, but changes sign. Our sample is 52 observations larger than the BD sample for regression 8.

SOLUTION: ”Light-hearted quiz”:

Calculate the **implied productivity** of Ghana relative to that of the US.

Formula:

$$\frac{A_1}{A_2} = \frac{y_1/y_2}{k_1^{\alpha} h_1^{1-\alpha} / k_2^{\alpha} h_2^{1-\alpha}}.$$

Numbers:

1. What is Ghana’s **per capita income** relative to that of the US?
   a) 18%
   b) 11%
   c) 4%

2. What is Ghana’s **human capital** relative to that of the US?
   a) 60%
   b) 45%
   c) 10%

3. What is Ghana’s **physical capital** (machinery etc.) relative to that of the US?
   a) 6%
   b) 2%
   c) 0.1%

$$\frac{A_1}{A_2} = \frac{y_1/y_2}{(k_1/k_2)^{\alpha} \times (h_1/h_2)^{1-\alpha}}$$

$$\frac{A_1}{A_2} = \frac{0.04}{0.02^{0.3} \times 0.6^{0.7}} = 0.18$$