Geography, Transparency and Institutions
With a simple two period version of the model

Putting aside the questions of inequality, poverty traps and economic growth we turn to deep rooted factors. Why are some countries so wealthy compared to others? What are the exogenous factors which allow some countries to accumulate technology much faster/ can explain differences in income per capita across countries?

Geographical reasons: tropical climates may mean a disease environment. Different regions of the world have different productivity of farming. Landlocked countries may not have access to a port, which means no trade.

Douglas North/ Acemoglu: Economic Institutions. The rules of the game (democracy/ dictatorship/ etc.)
Emphases on property rights:
Rule of Law: the way the state intervenes to protect peoples' property rights.
Restrictions on the elite: to prevent them from randomly taxing subjects.
Without property rights, the incentives to exert effort and invest are absent.

Institutions can be exogenous too though. Acemoglu: Colonialised countries can have institutions enforced on them.
Alternative view: Geography can have in indirect effect on economic growth by institutions
Endogenous Extractive institutions (stationary bandits): colonisers can extract wealth from natives.
If population is scarcer, more egalitarian institutions may develop - because there is no wealth to extract, colonisers want to help the economy to grow in a successful way.

Outline of our research project

Our main thesis:
Geographical conditions/technology
→ Factors of the tax technology: transparency and storability
→ Appropriability (the ability of the state to obtain revenue from its subjects)
→ Institutions and state's capacity

- 'State capacity' and 'extractive institutions' are related to the ability to tax and expropriate which are affected by geography and technology.
- Extractive states in ancient times lacked these conditions for success according to both theories, but, Ancient Egypt, for example, had a prosperous civilization and was stable over several millennia.

- Both theories presumably believe that extracting resources by the state is beneficial only if the taxes are not excessive, and if the revenue is used for the provision of public goods.
- We argue that geographical conditions and technology determine the state's ability to appropriate revenue from its subjects

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(7:00) Paper: *Geography, Transparency and Institutions* (Moav, Mayshar and Neeman), 2014.
How Geography has an effect on institutions/ property rights/ state capacity (the ability of the state to obtain revenue (tax) and provide public goods)/ state concentration.

Start with differences in geographical conditions or technology. Technology is also related to the geography.
(Tech transition may be change from hunter-gatherer to farming - this is a technological change which has an effect on factors of the tax technology).
We are focussing on how differences in technology and geography have an effect on the tax technology - which is the ability of the elite to tax the subjects. Two main elements:
Transparency: If economic activity is more transparent, it's easier to tax. Hunter-gatherers are not in one place. But farmers you can come and observe what they're doing, since it's in one place - so the technology is more transparent and it's easier to tax.
Storability: Some food produce is storable, others are not. Difference between cereals and tubors.
Most of the main staple food following the transition to farming in the temperate regions were cereals: rice, wheat, barley. With cereals, the harvests are once a year and then farmers have to store the cereals for the year. This makes it easy for the elites to tax the farmers heavily. In contrast, tubers (in tropical regions) like sweet potato are less seasonal, less storable - so when a bandit comes to tax the farmer, there is no surplus to tax.

Differences in geographical conditions - land suitability for different crops has an effect on the tax technology.
Appropriability: the ability of the state to obtain revenue from its subjects.
State capacity: the easier it is to tax, the easier it is to build state capacity.

(13:00)

2. Emergence of the State

2. The emergence of the state

According to the existing literature:
Neolithic Revolution
→Food surplus (income above subsistence)
→An elite that did not produce food (hierarchical societies)
→The emergence of the state

Pascale paper
About the emergence of hierarchy and differences across countries in state capacity.
Then presentation of the model which we have the hand-out for.
Finally: application of the model to understand difference between ancient Egypt and Mesopotamia

Existing Literature: recent summaries

Jared Diamond (1997)
> "In short, plant and animal domestication meant much more food The resulting food ***surpluses*** were a prerequisite for the development of settled, politically centralized, socially stratified, economically complex, technologically innovative societies."

Existing Literature: recent summaries

Douglas Price and Ofer Bar-Yosef (2010)
> "Cultivation supported a stable economy with ***surplus*** that resulted in the formation of elite groups "

Hunter-gathering tended to be small groups of people, very egalitarian. Non-hierarchical.
Following the transition to hunter-gathering, there is the emergence of hierarchy, and eventually states.
The standard story concerns food surplus. Farmers are more productive than hunter-gatherers. They could produce excess food above their needs for subsistence. This surplus is taxable by the elite.
Food surplus is a pre-condition for the elite.

Our Criticism

We argue that the surplus explanations are flawed:
- The slow rise in productivity in itself could not have generated surplus since population size adjusts to prevent the creation of such surplus (Malthus)

Malthusian Dynamics: Evidence

Technological improvements before the industrial revolution:
→ positive effect population size
→ no effect on income per capita
(Ashraf and Galor 2011)

Moav and Neeman (2014) claim that these explanations are flawed:
According to Malthusian theory, there is no surplus - because it translates to population growth rather than income per capita. According to Malthus, surplus wouldn't have been created.
They claim that the change (from hunter-gatherer to farmer) is not the increase in income, but the change in the tax technology (the ability of the elite to tax).
This is a reverse causality story: it is not surplus that created an elite; but that **an elite, by taxing created a surplus.**
In a Malthusian economy, where individuals have an income of subsistence. If someone comes after the harvest and takes half their cereals, population would shrink. So with a smaller population and same other factors of production, surplus is created. So the opportunity to tax (the ability for there to be an elite) meant that someone could tax more vulnerable farmers.

Our Explanation

- It is the elite that generated surplus through taxation/expropriation, partly curtailing the increase in population
- Farming requires storage (grain) and is more transparent than foraging
- It was a change in the ability to appropriate that explains the emergence of hierarchy

Farming facilitated expropriation. They are vulnerable to taxation by the state or just bandits.
Formation of hierarchy depends on demand potential:
Farmer would prefer to be taxed by stationary bandits (an elite) rather than roving bandits, because roving bandits have no incentive to cultivate production of farmers for the future, and a state would provide defence (public goods) to protect them.

Formation of hierarchy depends on supply potential:
But if farmers want a small state to provide public goods (protection), the state needs the ability to tax. Even if, as a group these public goods are desirable, everyone individually would like to avoid paying taxes (free-rider problem)
The same things which makes farmers vulnerable to expropriation by bandits also allows the state to tax farmers
Improved tax technology.

The emergence of hierarchy: Storage and Transparency

Farming facilitated expropriation
↙
Roving bandritry
↘
The formation of hierarchy
(Demand for protection)

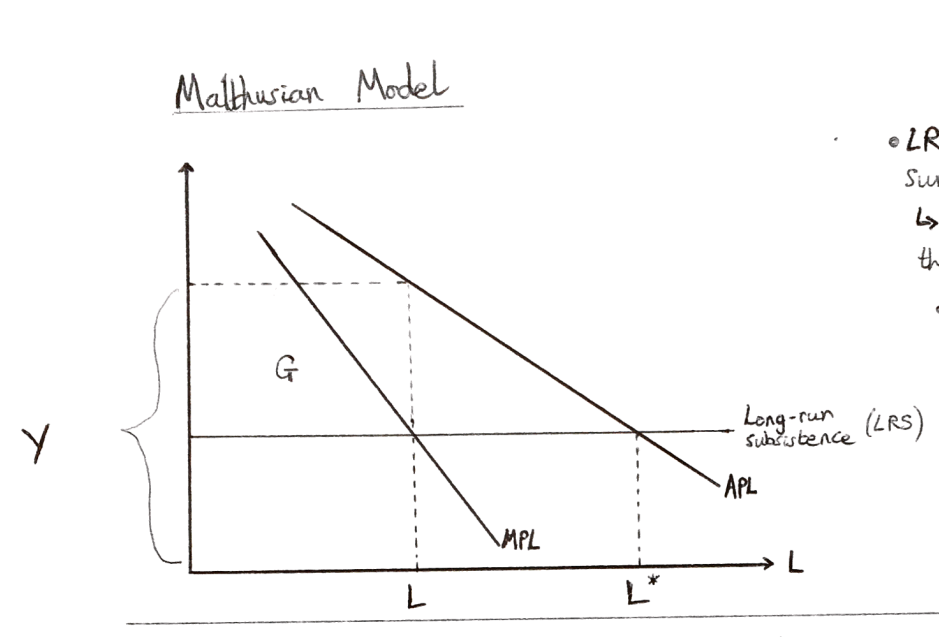
Farming facilitated expropriation
↙ ↘
Roving bandritry | Improved 'tax technology'
↘ ↙
The formation of hierarchy
(Stationary banditry – "supply")

Mancer (1993): Roving bandits and stationary bandits.
An early state is just bandits turning stationary
The difference between roving and stationary bandits:
Roving bandits, given the opportunity, will take everything.
Stationary bandits/ state only wants to tax part of income, because they have on monopoly on power/ force/ taxation in a repeated game situation - and so want to maximise their payoff discounted into the future. They want to keep incentives in place, and therefore not impose a 100% tax rate.

> Adam Smith: "Among nations of hunters where there is no property civil government is not so ***necessary"***

> Robert Allen (1997): Following the surplus approach argues that the perishability of the food produced by foragers rendered them non-exploitable. Agriculture made it ***possible*** *for the* state to exploit its inhabitants as food was much more storable

(21:00)
In terms of a model: **A simple Malthusian model**

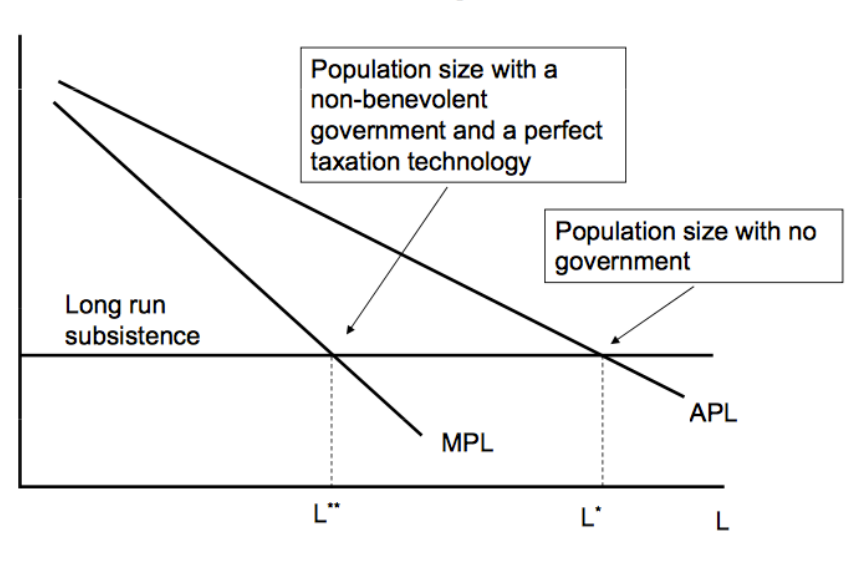


- LRS = income required for LR survival of society
  ↳ enables us to calculate the Malthusian equilibrium
- Where APL > LRS, surplus would translate to LR population growth
- Population would grow until income per capita equals subsistence & pop. growth stops.

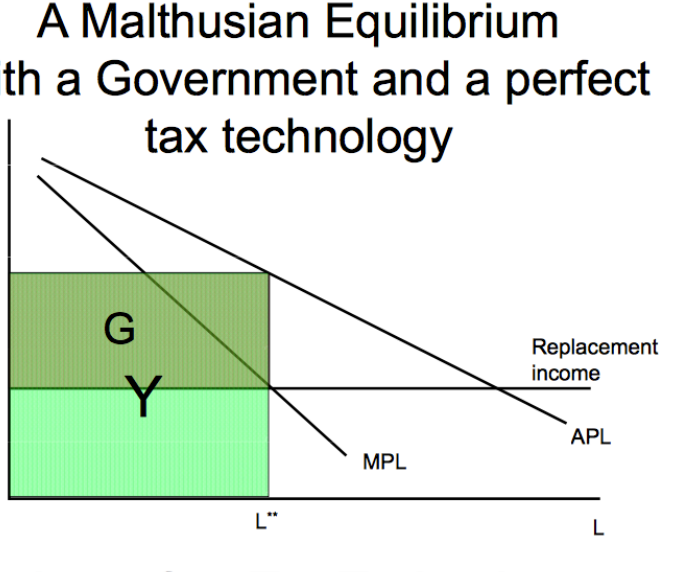
- According to Malthus, improved technology would translate to a larger pop. and would not ↑ income per capita.
- Now suppose we have a government (stationary bandits) - all they care about is max. revenue
  ↳ they supply public good of defence (but this only serves elite, as without providing this they cannot extract the max. revenue).
- In this model there is no surplus, so when the state starts taxing, population will shrink - up to point where MPL = LRS = (L).
  * assumes state has a perfect tax technology
- Y = overall surplus G = govt. surplus (G/Y) is ratio
- If productivity increases, ↑G ↑Y but (G/Y) stays same
  ↳ this goes against surplus theory that more productivity increases the scale of the government
- Improvement in tax technology meas (G/Y) ↑

An improvement in the tax technology means the state taxes more. Y may grow, but (G/Y) increases.

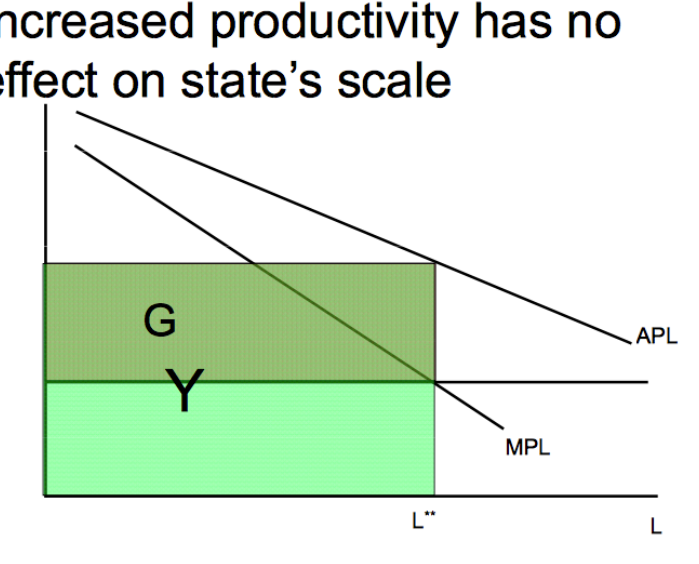
A Malthusian Equilibrium



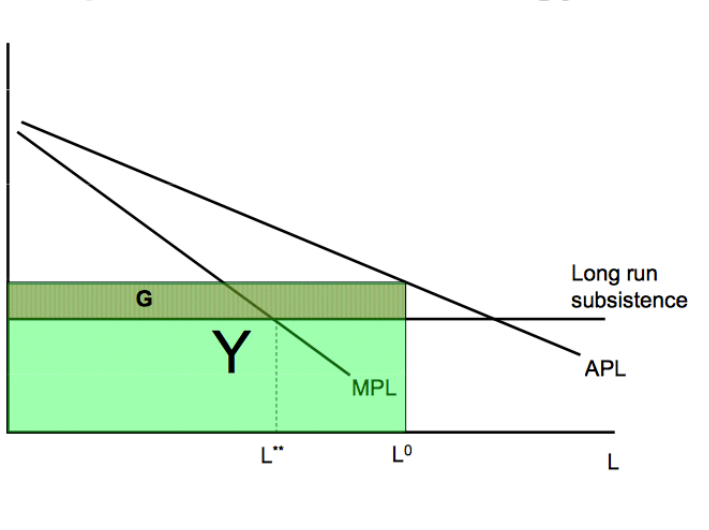
A Malthusian Equilibrium With a Government and a perfect tax technology



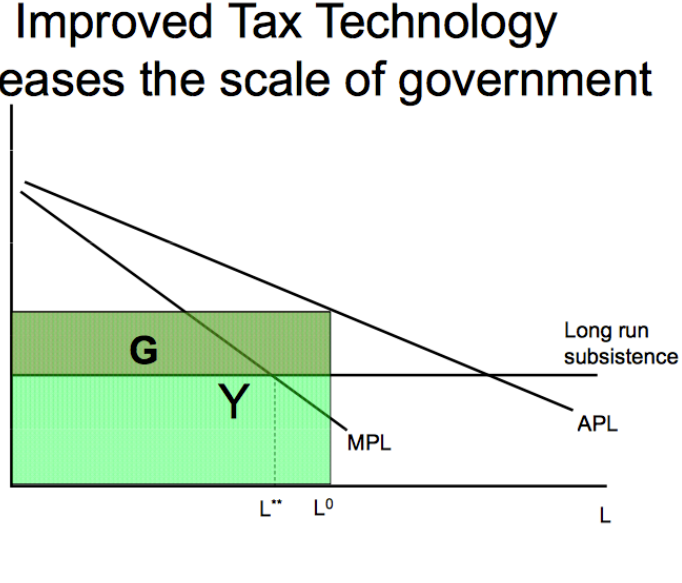
Increased productivity has no effect on state's scale



Imperfect Tax Technology



Improved Tax Technology increases the scale of government



The view of increased transparency, or shifting from non-storable to storable food improves the tax technology and increase state capacity; unlike the standard surplus theories.

Luigi Pascale: empirical work
Cereals vs tubors predictions:
A: Farmers would raise **tubors instead of cereals**. Even if tubors are less productive than cereals, farmers would prefer to raise tubors **because it provides them some immunity from roving bandits (taxation and theft).**
Looking at land suitability (0-8) for cereals and tubors (separately).
Find that the more suitable the land is for cereals, the more likely farmers would raise cereals, unless tubors are very suitable. If farmers have to opportunity to raise tubors, they will do it.
THEN, when farmers raise cereals, this is highly correlated with state capacity and strength of state.

How does this explain why the temperate zones are more successful economically than tropical areas?
In the tropics, the opportunity to raise tubors is what kills state capacity. And without a state that could provide and produce public goods, there is no economic development.

This is an explanation of why some regions are more successful than others that goes through state capacity and institutions. The ability to raise stuff which is not cereals, and doesn't require storage leads to poor institutions.

Summary of our contribution to the emergence of hierarchy

Mainstream theory: productivity
→ surplus → hierarchy & institutions

Acemoglu & Robinson: hierarchy & institutions
→ surplus & increased productivity

Our approach: transparency/storability
→ hierarchy & institutions → surplus & state

(30:00)

3. Transparency and Institution

The role of transparency in explaining regional differences in institutions:

1. Land ownership (private vs. elite)
2. State capacity
3. State concentration (center vs. periphery)

3. Transparency and Institutions Paper (Moav & Neeman, 2014)
We look at the role of transparency in explaining regional differences in the following institutions:
Property Rights over land: whether farmers or tenants own the land they cultivate
State Capacity: capacity to tax and provide public goods
State Concentration: power of the centre versus the periphery (how independent is the periphery)
Two measures for power of the state

This is a simplified version of the model that is in the paper:
The model is based on the Moav Neeman (2012) paper.

Endogenous Property Rights

(Based on Mayshar, Moav & Neeman 2013)

The principal-agent problem
- The principal designs the contract to maximize its expected income
- Agents are risk neutral and choose their effort level to maximize their expected welfare
- The economy exists for two periods

Principle Agent Model:
In cases of asymmetry of information, when the principle needs to incentivise the agent towards some behaviour, but there are problems of information.
We have the principle agent problem. The principle is the state, and the agents are the farmers.
We assume agents are risk-neutral and choose their effort level to maximise their expected welfare.
TO SIMPLIFY:
The economy only exists for two periods. In paper, it is a repeated game.

Here is the model:
Suppose each agent has a block of land, and output can be high or low
State of nature (theta) can be good or bad
b = prob that the state of nature is good
Output is only high if the effort of the agent is high (H), and the state of nature is good (G).
Effort is fully controlled by the agent. The agent knows what the state of nature is, but the principle doesn't observe the state of nature or the effort level (information asymmetry).
The principle needs to design an incentive scheme to cajole the agent to exert high effort

Output (per agent in each period):

$$Y = \begin{cases} H & \text{if } e = h \text{ and } \theta = G \\ L & \text{otherwise} \end{cases}$$

- $e \in \{h, l\}$ - effort (unobserved by the principal)
- $\theta \in \{G, B\}$ - state of nature (observed by the agent before exerting effort)
- $p \in (0,1)$ - the probability that $\theta = G$

Information:
There is a signal (sigma) about the state of nature, but this may be wrong
q is the probability that the signal is correct. (1-q) is prob that signal is misleading.
THIS IS THE KEY VARIABLE WHICH DISTINGUISHES BETWEEN DIFFERENT REGIONS OF THE WORLD

Information

$\sigma \in \{\tilde{G}, \tilde{B}\}$ - a public signal about the state of nature

Signal accuracy $q \geq 1/2$

$$q = \Pr(\tilde{G}|G) = \Pr(\tilde{B}|B)$$

$$1 - q = \Pr(\tilde{G}|B) = \Pr(\tilde{B}|G)$$

σ - observed after the effort decision

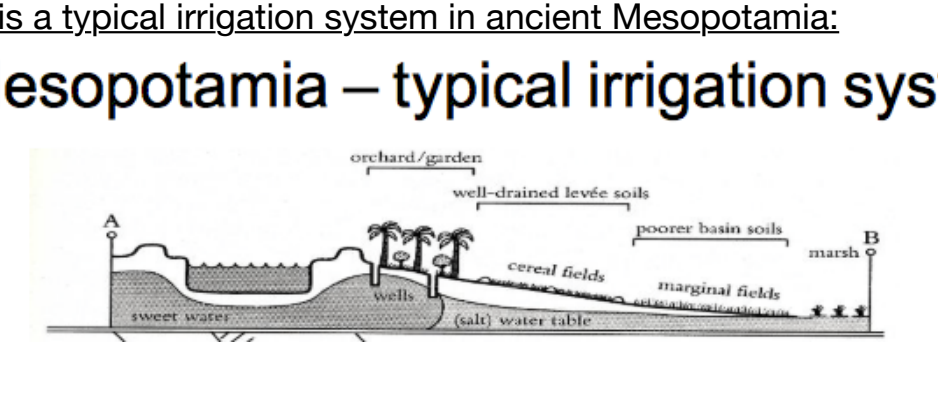
The interpretation of the signal:
In a given area, there is correlation across different plots of land. Suppose the state knows land is flat/ uniform and homogenous: if output is high in all plots except one, state may infer that the state of nature was good, but agent was shirking. By observing neighbouring plots of land, the state learns something about the state of nature in this specific plot of land.
If land is flat and uniform, there is no differences in micro-climates/ less variance in same region - so information is more accurate (higher q)
But if land in a certain part of the world is hilly and rigid, then you would see more variance within the same region, so information is less accurate.

Interpretation of the signal

a. Observation of output in other plots provides information about the state of nature at a specific plot depending on the correlation across plots.

Here is a typical irrigation system in ancient Mesopotamia:

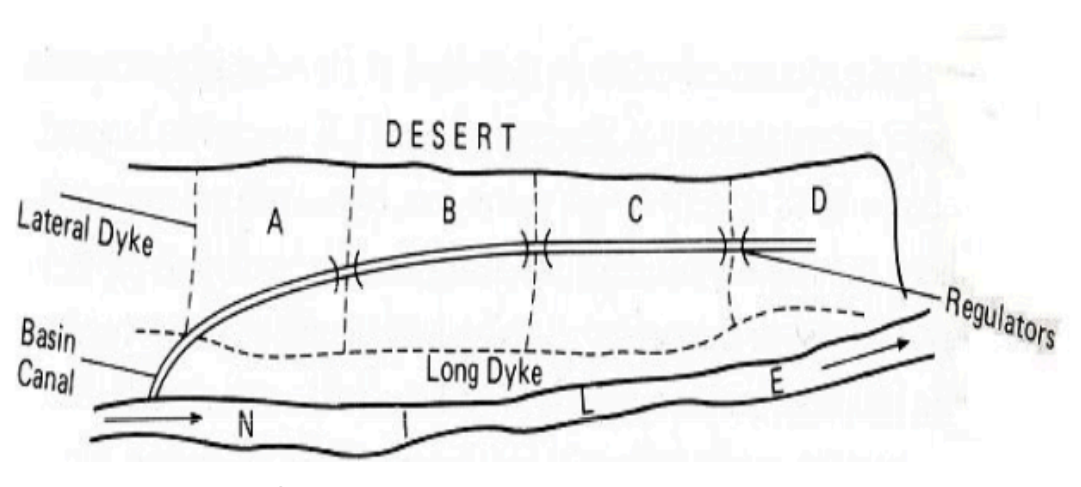
Mesopotamia – typical irrigation system



There are rivers and flood areas. Main point is that there are large differences within a small area, because of the irrigation system - meaning large differences in land productivity within a small area. So it is harder to infer what output should be in one plot by looking at another plot, (one region is subject to flooding, another isn't).
There is a shortage of water further away from the river.
Local elite had full control over supply of water and therefore had a lot of control over farmers, and information.
Information is a key factor in obtaining revenue.

Here is a typical irrigation system in ancient Egypt:

Egypt – typical irrigation system



Large successful state. Could control farmers, extracting revenue which was diverted into large pyramids and other public goods. The irrigation system surrounded the Nile River in the Valley of the Nile River. The river floods in august, which is then diverted into basins. After allowing the water to stand for 40 days they drain it back into the river.
It is very uniform within a given year. Huge flat fields. There are difference across years - as the level of the river differs across years. **The height of the Nile provided a useful signal, which was measured using the Nilometer.**
Based on the Nilometer, the govt knew in advance what revenue to anticipate.
This was a public signal on the STATE OF NATURE

Interpretation of the signal

b. An observable signal, such as the 'Nilometer' that measures the amount of water in the Nile.

Nilometer

- The Nilometer: indicator for the inundation height of the Nile
- Cooper (1976:366): "On the basis of the Nile flood recorded by the Nilometer, the government knew in advance what revenue to anticipate."

The agent needs to survive. Crucial: the survival of the agent depends on effort, and there is a cost of exerting effort (gamma > 0) (calorie exertion). Even if output is low, it is sufficient for the survival of the agent.
Effort is efficient: the gap between high and low output is more than the cost of effort. (H-L > gamma)

The cost of maintaining the agent

0 if effort is low ($e = l$)

$\gamma > 0$ if effort is high ($e = h$)

Assumptions:

$L \geq \gamma$
(low output is larger than the maintenance cost)

$H - L > \gamma$
(effort is efficient)

The agent's income and utility
Income and utility = I.
Utility, U = I - gamma
In equilibrium, the contract is such that the agent will exert effort when the state of nature is good.
Agent only cares about U (income - cost of effort).
Important because, by shirking, the agent makes the extra income of gamma.
Delta = agent's discount factor
Necessary because the contract includes the threat of dismissing the agent. So the agent works hard not just to obtain higher revenue now, but also to keep his job.
V = Value of agent's employment in the next period.
0 = Agent's alternative (being dismissed) is zero.

Agent's Income and Utility

I - agent's expected income

$U = I - \gamma$ - agent's periodic utility when exerting effort

δ - the agent's discount factor

δV - the value of the agent's employment in the next period

zero - agent's value of unemployment

Incentive scheme we have a stick and a carrot
Carrot is bonus payment, b, if output is high. In addition, the principle allows the agent to keep atleast a basic wage (w) which is at least as large as gamma to cover the cost of survival of the agent.

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In addition, there is the stick.
Two possible strategies - to use the stick, or to not use the stick:
d=0 means the probability that the agent is dismissed, is 0. The stick is out of the equation.
d=1 means the probability that the agent is dismissed, is 1 in the following case:
Output is low, but the signal on the state of nature is good.
If output is high the principal could understand that state of nature was good.
But the interesting case, whether to punish the agent, or not is in the case of low output. When output is low the principal doesn't know if this was because the agent was shirking, or because of a bad state of nature. **But the principal could condition punishment on the signal on the state of nature.**
If the strategy is to use the stick, this is the probability that agent is dismissed.
However, this costs the principal, as they have to find a different agent, who may be less efficient.
x = cost of replacing the agent

Incentive scheme - the carrot:

The principal pays the agent:

a bonus $b \geq 0$ if output is high ($Y = H$)

a basic wage $\omega \geq \gamma$ regardless of output

Incentive scheme - the stick:

$d \in \{0,1\}$ - the probability the agent is dismissed after the first period if:

$Y = L$ and $\sigma = \tilde{G}$

(otherwise the agent is retained)

x - the cost of replacing the agent

Two types of contract:
Pure carrot (no dismissal) - the only way the principle can incentive the agent is with a bonus payment.
Stick and carrot - a combination of the stick and the carrot. I will pay you a bonus if output is high, but if output is low and the signal on the state of nature is good, then punishment by dismissal with cost x to the principle.

→ Two types of contracts are possible in the first period:
$d = 0$ *"Pure Carrot"*
and
$d = 1$ *"Stick and Carrot"*

Optimisation: we want to find the optimal contract.
The minimum wage is equal to the cost of effort (w=y).
An employment contract is fully described by the bonus (b) and the probability of dismissal (d).

The optimization implies that

$$\omega = \gamma$$

→ An employment contract is fully described by b and d
(a carrot and a stick)

Solve it by starting in the second period:
In the second period, the stick is not relevant, as that's the end of the world. Threatening the agent to dismiss them at the end of the second period is meaningless.

The second period solution is:
that the principal could only incentive the agent by providing a bonus.
The principal would like to minimise the cost of incentivising the agent (+ gamma is just min wage)
pb is the expected cost of the bonus. Principle needs to promise the agent a sufficiently high bonus in case of high output. Cost = prob. of good state of nature * bonus.
If agent exerts high effort, output will be high (when state of nature is good).
This is subject to the agent's incentive compatibility constraint, IC.

Second period optimization

The principal's objective function, OF_2, is to minimize the cost of incentivizing the agent:

$$\min_{b \geq 0} pb_2 + \gamma$$

subject to the agent's incentive compatibility constraint, IC_2, for $\theta = G$ (If $\theta = B$ the agent doesn't exert high effort):

$$b_2 + \omega - \gamma \geq \omega \text{ and } \omega = \gamma$$

$$\rightarrow b_2 = \gamma$$

Agent knows state of nature, so
if state of nature is bad, agent doesn't work and nothing is relevant
if state of nature is good, agent can exert high effort or shirk.
the advantage of exerting high effort is obtaining the bonus payment [b+w-y] = b (because w-y=0)
the advantage of shirking is that the agent may obtain w anyway = y
Which means b > y
Or that the bonus payment must be greater than the minimum wage
If agent's utility is indifferent between working hard and shirking, then agent will work hard and principle can set b = y

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The value of being employed is w. The agent's income would be b + w. But the agent's utility is b + w - y.
The agent makes an income which is more than subsistence, which gives them utility.
The value of being employed is y V = y

The agent's welfare is independent of the state of nature in the second period since the IC is binding

→ The value of employment at the second period

$$V = \gamma$$

Going to the first period the calculations are a bit more complicated

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