Inequality: An explanation using State-Utility and Information Asymmetry

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Basic Idea

Having a formal understanding of what various institutions represent should be important. There are few economic variables which can accumulate over time (and give us what i call as "state utility"). All these institutions, like education, health, social (like caste system, dowry etc.), do is change the way these state variables evolve.

Government affects these institutions by investing in them which changes the rate of evolvement (via advances in technology or infrastructure or formal laws etc)

There are no "good" or "bad" institutions. There are institutions which are "in-line" with the people's preferences and there are the ones who are "mismatch" with what people want.

As economist, we may think that since caste system etc. are not beneficial in "monetary" terms, they are bad for growth. But comments like "i PREFER being hungry than borrow money from some lower caste person (to start new business)" should make us realize that these institutions are not like some mysterious forces. They represent the aggregate level mechanism by which people let their preferences known and how these preferences evolve.

We should not force the kind of development (i.e. kind of institutions), we (policy makers) want them to have. May be that is not what people want. Hence, having a formal understanding of these institutions and the mechanisms through which government can know about these "preferred" institutions becomes important.

1. Introduction –

There has been much debate about the increasing inequality both across the countries (e.g. Europe vs. Africa) and within a country (e.g. in India Bihar vs. Maharashtra). At both the macro and micro level researchers have tried to explain this unwanted by-product of growth and globalization. Many of the models can be categorized as using production-technology difference approach (including human and physical capital, technological advancements etc.) or more recently, institutions/ social-capital difference approach.

For example, Burgess and Venables (2004) state that spatial inequalities tend to increase during periods of rapid economic development. Datt and Ravallion (2002) find that in India there is considerable diversity in performance across states in the economic growth unleashed by economic reforms in the 1990s.

This paper introduces a new approach for explaining the inequality in development. The model uses the idea of inherent differences in people's preferences for various economic choices. Given economy's current state (i.e. the state of the technology) and the govt. policy (which determines the technology evolution path); different economic choices will have different economic returns.

Moreover, if there is an information gap in the sense that a person does not know the current state of technology (or government's policy for future) or the government does not know its people's preferences for economic choices; few agents may end up at sub-optimal level of utility and hence creating a welfare loss.

As a policy implication, the paper shows that the information plays a vital role in getting the full benefits of the investment in any technology. The government should make sure that its people know what the current state of technology/ economy is and what the government plans to do in future, so that they can make optimal decisions. Similarly, government should use people's actions to infer information about their preferences to make right policy decisions.

I start with detailing the conceptual framework for this paper in section 2. In the next section, a simple model incorporating those ideas is presented. In particular, two special cases are discussed; one with the homogenous preferences (and information asymmetry) and the second one with heterogeneous preferences. Section 4 reports some of the simulation results for few scenarios. In section 5 various empirical applications, possible extensions are suggested. Main conclusions are summarized in Section 6.

2. Conceptual Framework –

The most part in understanding the complexities of people's economic decision making is the realization that mere commodity consumption can not explain everything. Economists have long agreed about introducing non-durable goods as well. More recently services and conspicuous-consumption goods have been added to the list. But in fact even those can not explain many of the oddities we observe. For example people in western (supposedly more individualized) countries have higher trust when compare to many eastern (more society oriented) countries. Economists have started agreeing about existence of some kind of social capital. But even this will not explain many of the current trends like blogging (people writing /reading others' web diaries) etc.

All these can be explained if we move from commodity consumption to information consumption, which is a more general way of defining the utility.

2.1. Information Consumption: State and Flow Utilities –

To move towards the information consumption framework, the first step is to identify that any consumption can give us two types of utilities.

a) Flow Utility –

It is the pleasure one gets from consuming something.

b) State Utility –

It is the pleasure one gets from being in a particular state (of some economic variable).

Any economic activity gives us directly or indirectly either some flow utility or some state utility or both.

Few examples:

- Consumption –
  - *Non-durable:* Eating something gives the flow utility (which is just the usual pleasure of eating), but it can also give the state utility of maintaining/ reducing one's weight (if that is part of your diet).
  - *Durable:* Owning a TV gives the flow utility of consuming it over a time period, and it may also give the state utility (e.g. of being the first in the neighborhood to own a Plasma TV)

- Conspicuous Consumption –

  Owning an exclusive club membership gives one the indirect flow utility (increased business due to networking) and the state utility of being in that club.

- Social Capital –

  A person holds door for some old person because it gives them state utility of being generous etc.

- Information Consumption –

  Someone keeps downloading the new software because it gives them indirect flow utility (in terms of extra income due to gained knowledge) and direct state utility of being in touch with technology.

- Institutions –

  People keep marrying their daughters in the same caste paying high dowry because even though they get negative flow utility (money given in dowry) that state utility they get from this exceeds the dowry amount.

With this simple modification of concepts we can easily apply the simple utility maximizing behavior without complicating the analysis with additional concepts.

Till now, state utility has been shown to make the understanding of various concepts very simple. But what is wrong with treating both kinds of utilities as just the utility for mathematical modeling purposes?

The difference is that state utility depends on the current state of economy. While the flow utility a fat person gets from consuming the same amount of McDonald burger remains same, the state utility he gets from it may decrease if now there is an economy wide consensus that obesity is not good/ desirable. The state utility evolves with the time.

2.2. State of Economy: Technology Evolution Paths –

What role does an economy play in the agent's decision making? It is not limited to providing the agent with the effective markets. The relation is two ways. Agent's decisions affect the economy, but more importantly economy affects agent's choices. One of the channels through which it occurs is through state utility (the other one, which is discussed later in the paper, is through expectations).

Assume, $U_f(c_t)$ denotes the flow utility, where c is the flow-consumption-index (e.g. total consumption); and $U_s(\theta_t)$ denotes the state utility, where θ is the vector of state variables.

The mechanism by which this channel operates is through technology. An economy is given by its current state (i.e. economy wide state variables) and their technology evolution paths.

In a given economy,

$$\theta_{t+1} = T_t (\theta_t , \Theta_t)$$

where, Θ_t is the economy wide indices of state variables and T_t is the current technology evolution path.

For example, this technology function can represent –

- The cost to increase one's education from High School to Graduation.
- The return on knowing 5 programming languages.

Notice that one of the state variables can be "money" or any of the state variables can be used as numeraire.

Generally speaking, this technology evolution path will be agent specific and will depend on his skills, talents etc. But since we are already using θ_t in the function, the assumption is that individual's skills will affect this θ_{t+1} only through θ_t.

2.3. Role of Information/ Expectations –

In theory, this technology path is the constraint set over which agents maximize their life time expected utilities, given their information sets (I_t).

Hence the optimization problem can be written as:

$$\max_{\{c_t,\theta_t\}} . \sum_{t=0}^{\infty} \beta^t E_t[U(U_f(c_t), U_s(\theta_t))]$$
$$s.t.\ \theta_{t+1} = T_t(\Theta_t, \theta_t),$$
$$I_t, \qquad \forall t$$

The above expression should emphasize the role information and expectations play in this setup. Since agents can not observe the state of economy (i.e. Θ_t and T_t), they form expectations about it. If their information is not perfect (or expectations are not rational), they may end up at sub-optimal level.

As an example of this information gap, we can think about immigrants in the developed countries. Even though they have similar preferences as citizens, just not knowing enough about the economic opportunities may lead them to inferior outcomes.

2.4. Role of Government: Inducing Technical change –

One important thing is to realize is that the current technology itself is continuously changing (and hence the t subscript in the T_t). Government plays an important role in it by investing in research and development activities.

For discussion purposes let us assume that technical change equation can be modeled as:

$T_{t+1} = \Gamma (T_t , G_t)$

where, G_t is the government spending on R&D and Γ is some probabilistic function. (We can use any of the technology models like Romer, Schumpeter etc. for modeling Γ explicitily).

Just like agents can not observe the state of the economy correctly, government is unable to know the agents' preferences. It must form expectations about the agents' preferences (about the state variables).

$$\max_{\{G_t\}} . \sum_{t=0}^{\infty} \beta^t E_t[\bar{U}(\bar{U}_f(\bar{c}_t), \bar{U}_s(\bar{\theta}_t))]$$
$$s.t.\ \theta_{t+1} = T_t(\Theta_t, \theta_t),$$
$$T_{t+1} = \Gamma(T_t, G_t), \qquad \forall t$$

where, all the upper bar (⁻) variable represent the economy level aggregated indices for utilities and variables.

Assume that agents have heterogeneous preferences. Majority of the agents preferring state variable θ_i to θ_j (there is a small minority of agents who instead like θ_j more than θ_i). If the government weighs their preferences in such a way, that as a result of R&D activity T_{t+1} increasing return θ_i on while reducing the returns on θ_j is optimal policy; then minority will lose from such a policy while majority will gain. This will create an inequality.

Whether there is a tradeoff between different state variables in technical-change terms will depend on the functional form of Γ. As an extreme example, we can think of θ_i as agriculture and θ_j as manufacturing. If there are number of people who have training for a particular (say car manufacturing), government's optimal growth policy may invest a lot in setting up a car-plant in the cultivatable land reducing income opportunity for other type of people.

2.5. Policy Implications –

Now, consider the case of homogenous preferences, with all the agents preferring state variable θ_i to θ_j. But suppose that government has wrong information (expectation) and hence the indices created are putting more weight on θ_j instead. Ideally, the government should have invested in a R&D activity which increases the return on θ_i ; but in this case it may happen that R&D activity actually decreases the return on θ_i (if finally it increases the total utility). Notice that in this case government investment will lower the actual total/ average welfare rather than increasing it.

This highlights the importance of ensuring the information accuracy.

3. A Simple Model –

Let us consider a case with 2 state variables:

- Computer Education (*E*)
- Physical Strength (*H*).

Endowment – Each individual is born with E_0 and H_0.

Each individual lives for two periods $t = 1,2$.

In each period he gets exogenous income *Y*.

The discount factor β = 1.

3.1. Homogenous Preferences and Different Returns on skills (Role of Information dissemination) –

Utility function is Cobb-Douglas, given by:

$$U = C^{\alpha_1} E^{\alpha_2} H^{1-\alpha_1-\alpha_2}$$

where C is the flow-consumption index.

Period 1:
Individual decides how much to spend on his flow consumption and how much to acquire the state variables, which may give some return also in next period.

Period 2:
Just spend all the income on flow consumption.

This setup is consistent with the view that most of the people study and acquire skills in the first half of their lives and get the benefits of those in the later period of life in terms of higher pay etc.

Technology is such that –

1. Both *E* and *H* cost 1consumption good for each additional unit:

$$E_1 = E_0 + I_E$$
$$H_1 = H_0 + I_H$$

where,

I_E and I_H are the investments in each variable.

2. Difference in the returns –

The return on *E* is R_E consumption good for each unit and return on *H* is R_H.

where,

$$R_E > R_H$$

For simplicity also assume that $R_H = 0$. All we need for the results is that $R_E - R_H$ is positive and only one kind of agent knows it.

There are two types of agents.

- Informed – He knows that $R_E > 0$ and uses this information to get the proper returns on his Computer Education.
- Un-Informed – He thinks that $R_E = 0$ and hence gets no return.

The reason for taking this kind of approach is to emphasize the importance of information in today's economy. An uninformed agent does not know that his skills are useful and hence fails to get the returns on those. For example, Indian government started a policy of giving low interest loans to university graduates if they wanted to start a business. But since the scheme was not properly publicized, only few people who knew about it gained this return from their college degree.

The budget constraints –

Period 1:

$$Y = C_1 + I_E + I_H$$

Period 2:

$$C_2 = Y + R_E E_1 + R_H H_1$$

Informed Agent –

After substituting the budget constraints, in each period's utility and using $R_H = 0$, we can reduce the optimization problem to:

$$\max_{C_1, I_E} [\, C_1^{\alpha_1} E_0^{\alpha_2} H_0^{1-\alpha_1-\alpha_2} + (Y + R_E\, I_E + R_E\, E_0)^{\alpha_1} \, (E_0 + I_E)^{\alpha_2} \, (H_0 + Y - C_1 - I_E\,)^{\,1-\alpha_1-\alpha_2}$$

Taking FOCs, we get:

(i) w.r.t. C_1 :

$$\alpha_1 C_1^{\alpha_1 - 1} E_0^{\alpha_2} H_0^{1-\alpha_1-\alpha_2} - (Y + R_E I_E + R_E E_0)^{\alpha_1} (E_0 + I_E)^{\alpha_2} (1 - \alpha_1 - \alpha_2)(H_0 + Y - C_1 - I_E)^{-\alpha_1-\alpha_2} = 0$$

(ii) w.r.t. I_E :

$$\begin{aligned}
&\alpha_1 R_E (Y + R_E I_E + R_E E_0)^{\alpha_1 - 1} (E_0 + I_E)^{\alpha_2} (H_0 + Y - C_1 - I_E)^{1-\alpha_1-\alpha_2} \\
&+ (Y + R_E I_E + R_E E_0)^{\alpha_1} \alpha_2 (E_0 + I_E)^{\alpha_2 - 1} (H_0 + Y - C_1 - I_E)^{1-\alpha_1-\alpha_2} \\
&- (Y + R_E I_E + R_E E_0)^{\alpha_1} (E_0 + I_E)^{\alpha_2} (1 - \alpha_1 - \alpha_2)(H_0 + Y - C_1 - I_E)^{-\alpha_1-\alpha_2} = 0
\end{aligned}$$

These two (equation (i) and (ii)) give optimal C_1 and I_E for an informed agent

Un-Informed Agent –

For uninformed agent, R_E is also zero. Substituting this we get the objective function as:

$$\max_{C_1, I_E} [C_1^{\alpha_1} E_0^{\alpha_2} H_0^{1-\alpha_1-\alpha_2} + Y^{\alpha_1} (E_0 + I_E)^{\alpha_2} (H_0 + Y - C_1 - I_E)^{1-\alpha_1-\alpha_2}$$

And the FOCs become:

(iii) w.r.t. C_1 :

$$\alpha_1 C_1^{\alpha_1 - 1} E_0 H_0^{1-\alpha_1-\alpha_2} - Y^{\alpha_1} (E_0 + I_E)^{\alpha_2} (1 - \alpha_1 - \alpha_2)(H_0 + Y - C_1 - I_E)^{-\alpha_1-\alpha_2} = 0$$

(iv) w.r.t. I_E :

$$\begin{aligned}
&Y^{\alpha_1} \alpha_2 (E_0 + I_E)^{\alpha_2 - 1} (H_0 + Y - C_1 - I_E)^{1-\alpha_1-\alpha_2} \\
&- Y^{\alpha_1} (E_0 + I_E)^{\alpha_2} (1 - \alpha_1 - \alpha_2)(H_0 + Y - C_1 - I_E)^{-\alpha_1-\alpha_2} = 0
\end{aligned}$$

Equation (iii) and (iv) solve for the optimal allocations for un-informed agent.

In section 4, I have shown some of the simulation results for this model.

This shows that how the same government policy can benefit two persons differently, not because they are different but just because one has more information even though they had exactly the same endowment.

Now extend this reasoning to two similar regions (with similar kind of economic conditions). A growth policy can create inequality between those regions, if there is a difference in information dissemination.

We can easily apply this model to two most talked about cases of inequality.

1) Uneven growth within a developing country.

2) Immigrants in developed countries.

These are discussed later in section 5.

3.2. Heterogeneous Agents and Different costs of skill acquisition (Role of lobbying) –

Let us consider a more realistic case, where agents have different preference for various states.

Unlike previous model, in this case agents have perfect information.

There are two types of agents:

- Type A likes Computer Education more than type B.
- Type B likes Physical Health more than type A.

This is the most intuitive and general way of modeling the real world heterogeneity. Since our definition of state variables is very broad. For example this approach could explain why some minorities stick-to few particular activities (e.g. blacks kids mostly going to music or sports career), even though there are many other better opportunities available or even though those activities are relatively costly (e.g. muslim women wearing veils in US). This is because they get more state utility from these.

The utility function for agent of type i (A or B) is given by:

$$U = C^{\alpha_1} E^{\alpha_i} H^{1-\alpha_1-\alpha_i}$$

with,

$$\alpha_A > \alpha_B$$

Technology is such that:

1. The returns on both state variables (E, H) are equal. For simplicity assume that both are equal to zero.

2. The costs of skill acquisition are different:

$$E_1 = E_0 + \gamma_E I_E$$
$$H_1 = H_0 + \gamma_H I_H$$

where, $(1/\gamma_E)$ and $(1/\gamma_H)$ are costs and

$$\gamma_E > \gamma_H$$

This setup is also very pertinent to real economic situations. The reason for this difference in cost may be the current state of technology being more advanced in one sector.
As discussed earlier, we know that current state of technology is the result of technical change induced by government investment in R&D. So, why is technology more advanced in this particular sector?

This can be because of three reasons (each of which is important in understanding the inequality and how to deal with it):

a) One sector is inherently more suitable for technical innovation.

b) The majority of the country's population prefers that sector, and hence government's optimal policy invests more in that sector's technical change.

c) There is strong lobbying for that sector.

If it is case a), then that means inherently some agents have slight disadvantage compared to others. The government should identify those agents and should device schemes (subsidies, handouts etc.) to compensate for that disadvantage. Few examples of cases like this may be government giving subsidies to native people or people with disability getting benefits etc.

In case of minority being a mismatch with the majority, the government can do one of the two things. First is to publicize the fact that economy is going to do better in one kind of sector compared to other (i.e. to let people know about the economy; Φ_t and T_t).
The second (more important and more difficult) approach is to find a balance between the development of both the sectors (which is to reallocate G_t for use in Γ). The example of development and eco-system maintenance falls into this category.

Returning to the optimization problem of the agent of type i (A or B), the budget constraint in each period is –

$Y = C_1 + I_E + I_H$
$C_2 = Y$ (assuming that returns on both sectors are equal and zero)

The agent of type i solves:

$$\max_{C_1, I_E} [\, C_1^{\alpha_1} E_0^{\alpha_i} H_0^{1-\alpha_1-\alpha_i} + Y^{\alpha_1} (E_0 + \gamma_E I_E)^{\alpha_i} [H_0 + \gamma_H (Y - C_1 - I_E)]^{1-\alpha_i-\alpha_2}$$

The first order conditions are –

(v) w.r.t. C_1 :

$$\alpha_1 C_1^{\alpha_1 - 1} E_0^{\alpha_i} H_0^{1-\alpha_1-\alpha_i} - (1-\alpha_i-\alpha_2)\gamma_H Y^{\alpha_1} (E_0 + \gamma_E I_E)^{\alpha_i} [H_0 + \gamma_H (Y - C_1 - I_E)]^{-\alpha_i-\alpha_2} = 0$$

(vi) w.r.t. I_E :

$$\alpha_i \gamma_E Y^{\alpha_1} (E_0 + \gamma_E I_E)^{\alpha_i - 1} [H_0 + \gamma_H (Y - C_1 - I_E)]^{1-\alpha_i-\alpha_2}$$
$$- (1 - \alpha_1 - \alpha_i) \gamma_H Y^{\alpha_1} (E_0 + \gamma_E I_E)^{\alpha_i} [H_0 + \gamma_H (Y - C_1 - I_E)]^{-\alpha_i-\alpha_2} = 0$$

Solving these two for $i = A, B$; gives the optimal allocations for each type of agent.

The model results are simulated in section 4.

It becomes very easy to explain the inequality in this case. Since these agents have different preferences, their optimal allocations will be different. The technology makes one kind of agents (in this case, the agents who prefer Computer Education) to acquire their skills at lower cost. So their optimal allocations take them to a higher welfare point compared to the welfare of Physical Strength type of agents.

If we generalize the model to allow for the returns to be different as well (just like model in section 3.1), then Computer Education person will not only have a higher state utility but they will also have a higher flow utility as well.

4. Simulation Results –

The matlab code for solving the models in section 3.1 and section 3.2 is given in the appendix.

Unfortunately, I couldn't find a set of parameter values and starting values for which the solution converges. So, I am going to explain how the simulation would work.

The idea is to take different values for:

- Preference parameters – alphas
- Initial Endowments.
- Technology parameters –
    - Cost : gamas
    - Return : Rs

For both the models, then we solve the non-linear equations for finding the optimal allocations for each kind of agent.

- Homogenous Preferences – Informed (eq. i, ii) and Un-informed (eq. iii, iv)

- Heterogeneous Preferences – E Type and H Type (eq. v, vi with different alphas)

Once we obtain the solution, we can get the optimal welfare of each agent.

Using this, we show that these parameter values may generate the inequality between agents.

5. Empirical Applications and possible extensions –

Where can we apply this framework and these models? The conceptual framework can be used to generate a large variety of models depending on the requirement and the complexity of the economic issue it is trying to deal with. I have mentioned few of them as example during the discussion through out the paper.

Here I will talk about implementing this model to two very specific cases I discussed earlier. One to explain the uneven regional growth within a nation and the second one is to address the inequality between immigrant and citizens in developed countries.

5.1. Uneven Development –

India is often cited as a classic example of studying the development issues. Hence, I will also discuss the application of this model in the context of development in India. But the analysis should be valid for many other cases as well.

It is a well known fact that development in India has been uneven. Few states like Maharashtra, Punjab have done really well, while others like Bihar and Uttar Pradesh are still struggling to deal with poverty.

We can model it as heterogeneous agents approach assuming that the regions were geographically and culturally different, and hence due to technology (i.e. government policy) some region were in advantageous position than others. This approach will fall in line with others who have already tried to model this by studying the effect of Green Revolution (or land reform etc) on different region or using the difference in the institutions between regions.

I will model this as a result of informational frictions. This way one can explain the inequality at a more granular level. For example few studies have shown that even in poor states, there are pockets of rich villages. Hence, inherent regional differences (economic or institutional) are not responsible for the inequality.

Assume that two states (say Punjab and Bihar) are similar. If people in Punjab knows that Green Revolution has created increased the returns on investing in acquisition of some agricultural know-how, while people in Bihar do not; then it will be similar to our model in section 3.1

The major empirical issue is how to identify this information gap and more importantly how to measure this.

Here is one suggestion for the case of India. Caste system is very prevalent everywhere in India, especially in the villages. Most of the government schemes are executed at the village level. The only source of information people have about these opportunities (i.e. return R_A in our model) is through the village council or chairman / "pradhan".

One would expect that a person of same caste would be willing to share and discuss this kind of information more easily compared to with someone of other caste. Hence, in the villages/ areas with this kind of caste-conflicts (council and other members are of different castes), the transmission of information about government policy will not be as effective as the areas without these conflicts.

Hence, in areas with conflicts will lack the information about the government policies. This in turn will make them end up at a lower level of welfare.

This will be true at all level of aggregation, i.e. if there is some conflict between state government and central government; the information about the policies and their benefits will be scarcely available. In practical terms, we can think about it as central government officials not responding to the queries of state officials (it seems this is exactly what happened during Hurricane Katrina).

Data Set Required –

For various regions, we need panel data on:

- Information about the households (income etc.)

- Their economics decisions (which crop, what methods etc.)
- Village characteristics (caste distribution, village council etc)
- Government Data (which party is in state govt. vs. central govt. etc)
- Policy data (what percentage of people participated in a particular policy from a village etc.)

Estimation Strategy –

The model would suggest that if:

- The degree of conflict (same party/ friendly parties/ opposition parties etc.) between state and central government will be related to the degree of policy implementation.
- At the village level, if the village council is of different caste; then the policies will not be implemented.
- On macroeconomic level, areas with conflicts (representing hindrance to free flow on information) will be doing badly in terms of reaping benefits of a government policy/ technological breakthrough.

If the results show that this channel exists in India, it will have huge policy implications. The government should spend more on policy publicity. Similarly, it will highlight the importance of separating the executive body of government from the governing body (i.e. ruling parties).

5.2 Inequality between citizens and Immigrants –

Inequality is not limited to developing countries. It is a known fact that even in developed countries; inequality exists between immigrants and citizens. The recent riots in Paris emphasize the pervasiveness and seriousness of the issue.
We can apply the homogenous agents model like the previous case and attribute this inequality to information differences between immigrants and citizens. It seems logical to assume that due to language or other social barriers in the new country, immigrants will not be able to have the same kind of information about opportunities in the country as citizens have.

Moreover, one can also think about this issue in heterogeneous agents framework. Immigrants come to developed country with different social and economic background and have different preferences. As discussed in section 3.2, the difference in the agents' preferences may make one type at disadvantage in the economy given its technology.

Data Set –

Since this is more of an issue in developed countries, the data should be relatively easy to gather. Here are the broad categories of panel data required (both for citizens and immigrants):

- Household characteristic data (background, religion etc.)

- Economic activities data (education skills, kind of jobs etc.)
- Government policy data

Empirical Strategy –

The framework suggests that we should be able to find below mentioned relationships:

- Immigrants will be less likely to make use of government technological/ policy initiatives.
- Citizens and Immigrants will have different affinity for different activities (showing different preferences).
- Returns on and acquisition costs of skills/ attributes preferred by citizens and immigrants will be different (skills popular among citizens getting higher return, and lower acquisition cost),

Policy Implications –

The government should identify this issue and spend on educational programs for immigrants informing them about the skills advantageous in the economy. Other thing government can do is to develop a customized policy/ technology to increase returns on skills preferred by immigrants.

5.3 Possible Extension: Two way signaling –

Here I have just developed a framework outlining the basic building blocks for the models. Many possible extensions of this can be designed.

One such extension will be combining both ideas, i.e. heterogeneous preferences and information gap, and introduce the government.

Then extend the signaling game (like Spence's Education model) .

1) Agents signaling their types –

If government suspects that there can be two types of agents, then government should use the fact that their choices in previous periods indicate which types they are. It should then use their signaled types to construct the true economy wide indices.

2) Government signaling its indices/ state of economy –

Moreover, if the government knows that some of the agents are mismatch (i.e. going to lose under optimal policy given current economic indices and technology); then it should signal this fact (by making appropriate policy choices) so that the agents can change their expectations about economy.

6. Conclusions –

There is a difference between concepts of flow and state utility. Each of these state variables has a technology evolution path. Government plays a role in the economy by investing to change the technical state of the economy. These concepts can be used to provide simple explanation of various complex economic issues.

A model with information gap or heterogeneous agents can explain the inequalities. In a country two regions may experience different results of a development policy, if the benefits of it are unequally publicized or if there are informational frictions. Immigrants may have different preferences (as compared to citizens) and hence may be at disadvantage in an economy (technology). Government can increase the information access to reduce these inequalities.

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Appendix

A. Matlab code for Homogenous Agent model (section 3.1) –

```
function F = homogenousAgents(x)
alpha1;
alpha2;
ENot;
HNot;
Y;
Re;

F = [

   (alpha1*(x(1)^(alpha1-1))*(ENot^alpha2)*(HNot^(1-alpha1-alpha2))) -
   (((Y+Re*x(2)+Re*ENot)^alpha1) * (ENot+x(2)^alpha2)
      *((1-alpha1-alpha2) ((HNot + Y - x(1) - x(2))^(-alpha1 -alpha2)))) ;


    (alpha1*Re*((Y+Re*x(2)+Re*ENot)^(alpha1-1))((ENot+x(2))^(alpha2))
    ((HNot+Y-x(1)-x(2))^(1-alpha1-alpha2)) ) +
    (alpha2*((Y+Re*x(2)+Re*ENot)^alpha1)((ENot+x(2))^(alpha2-1))
    ((HNot+Y-x(1)-x(2))^(1-alpha1-alpha2)) )  -
    ((1-alpha1-alpha2)*((Y+Re*x(2)+Re*ENot)^(alpha1-1))((ENot+x(2))^(alpha2))
    ((HNot+Y-x(1)-x(2))^(-alpha1-alpha2)) )

    ];
```

B. Matlab code for Heterogeneous Agent model (section 3.2) –

```
function F = hetrogenousAgents(x)
alpha1;
alphaI;
ENot;
HNot;
Y;
GammaE;
GammaH

F = [
   (alpha1*(x(1)^(alpha1-1))*(ENot^alphaI)*(HNot^(1-alpha1-alphaI))) -
   ((Y^alpha1) * (ENot+GammaE*x(2)^alphaI) * GammaH
      *((1-alpha1-alphaI) ((HNot + GammaH*(Y - x(1) - x(2)))^(-alpha1 -alphaI)))) ;


    (alphaI*GammaE*(Y^alpha1)((ENot+GammaE*x(2))^(alphaI-1))
    ((HNot+Y-x(1)-x(2))^(1-alpha1-alphaI)) )  -
    ((1-alpha1-alphaI)*GammaH*(Y^alpha1)((ENot+GammaE*x(2))^(alphaI))
    ((HNot+ GammaH*(Y-x(1)-x(2)))^(-alpha1-alphaI)) )

    ];
```