The Interplay of Identity and Social Network

An Evolutionary Game Model

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Why Identity?

An everyday scene in an Indian public transport

Why Identity?

An everyday scene in an Indian public transport

Did you make any new friends in your new school?

Connecting Identity with Network

Cultural Capital

Connecting Identity with Network

Cultural Capital

+

Social Capital

Connecting Identity with Network

Cultural Capital

+

Social Capital

+

Evolutionary Stability

Cultural & Social Capital

Pierre Bourdieu

Cultural & Social Capital

Pierre Bourdieu

Capacity due to group membership

Cultural & Social Capital

Pierre Bourdieu

Capacity due to group membership

Non-financial social assets that promote social mobility beyond economic means

Hypotheses

Identity $\Longleftrightarrow$ Group Formation

Hypotheses

Identity $\iff$ Group Formation

Maximization of Cultural Capital drives the dynamics of network formation

Metrics constructed

Openness Index

Metrics constructed

Openness Index

Awareness Index - [not used yet]

Openness Index

Label identity categories caste, income, religion, and gender as 1, 2, 3, and 4.

Qualitative response variables : $I_j^{i=1} = GC, SC, ST, OBC.$
Now, define

$$d_{jl}^{i=1} = \begin{cases} 0 \text{ if } I_j^{i=1} = I_l^{i=1} \\ 1 \text{ otherwise} \end{cases}$$

Then the *unscaled measure of openness* can be put forward as

$$M_j^{i=1} = \sum_l d_{jl}^{i=1}$$

Openness Index

We also get the following variables from the data collected through the survey:

$F_j =$ Total number of friends reported by the person j

$N_j =$ Total number of neighbours reported by the person j

$C_j =$ Total number of colleagues reported by the person j

From these variables, we compute

$$Total_j = F_j + N_j + C_j$$

Now the *openness index* for the person j with respect to caste can be defined as

$$O_j^{i=1} = \frac{M_j^{i=1}}{Total_j}$$

Clearly this ‘openness’ index lies within 0 and 1.

Working with Openness Index

Comparison between the 'openness index' of different groups from the each of the categories Caste, Income, Religion, and Gender can be done using the *Kolmogorov-Smirnov* test.

As the test is a non-parametric test, one does not need a prior assumption about the distribution

Thus the comparisons can be done between $O^{i=1}_{j=GC}$, $O^{i=1}_{j=SC}$ and $O^{i=1}_{j=ST}$ using the test statistic. Log-odds ratio is to be used for constructing the test statistic.

Revealed Preference for Cultural Capital

In the context of social networks built around persons in a society, the revealed preference for cultural capital (CC) can be manifested in two ways:

Similarity flocking or Herd behaviour

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Similarity flocking or Herd behaviour

and

Target difference, which is the urge to mingle in a group with some ‘socially desired’ characteristics.

Revealed Preference for Cultural Capital

Target difference may be *upward* to say that the individual has some preconceived notion of an ordinality with respect to some characteristic and the person wishes to mingle with individuals with higher rank in that characteristic scale, so as to increase its utility.

e.g., an SC person may only want to have SC and GC friends but not ST friends, if there is the respective ordinality of this in its mind. Target difference may be *open* if such behaviour is not revealed.

Revealed Preference for Cultural Capital

The assumption of the model in our analysis can be as follows:-

$$a_j^{caste} > a_j^{religion} \iff \frac{\delta U_j}{\delta(caste)} > \frac{\delta U_j}{\delta(religion)}$$

where the partial derivatives are the notional symbols for marginal utilities in a network.

$$U_j = U(\text{flocking, preferential attachment}) + random$$

Utility Formulation

Social Categories: Income Group, Caste, Gender
Let there are 2 income groups, 2 castes and 2 genders.
$I = \{1, 0\}$, $C = \{1, 0\}$, $G = \{1, 0\}$
Let us assume there is a social prescription that prescribes:

$$I_1 > I_0$$

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$$C_1 > C_0$$

$$G_1 > G_0$$

Utility Formulation

Let us assume the weight proportion between the categories as $I : C : G :: m : n : p, m, n, p > 1$
To formulate the utility when *i* is to connect with *j*:

$$U^{ij} = U_c^{ij} + gU_s^{ij}$$

U_c^{ij} = Utility derived from community strength and U_s^{ij} = Utility derived from social status

$$U_c^{ij} = mI_I + nI_C + pI_G$$

Where I_I, I_C and I_G are indicator variables for matching subscripts in I, C and G respectively, and

$$U_s^{ij} = m^{\alpha_I} \times n^{\alpha_C} \times p^{\alpha_G}$$

Where $\alpha_K = argdifference_K(i_K - j_K)$

Survey Details

Nov 2014 - June 2015

191 Individuals, 2305 connections

Aim to maximize variation

Two tier sampling: Stratified (based on occupation) + convenience/snowball

Analysis: Background

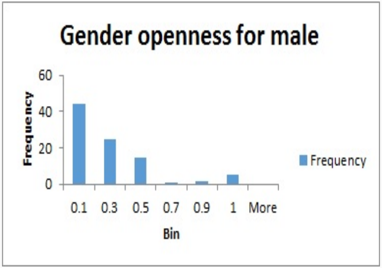
Analyzed identities: Income Group, Gender, & Caste

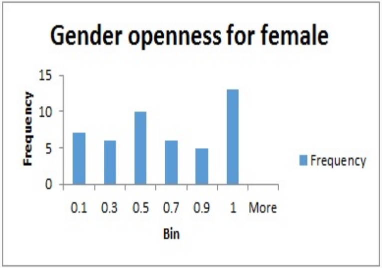
Analyzed metric: Openness index

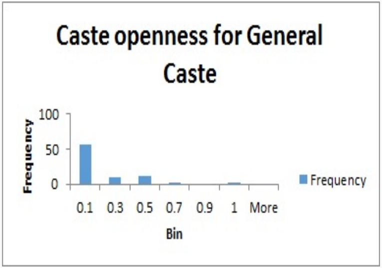
Kolmogorov-Smirnov Test

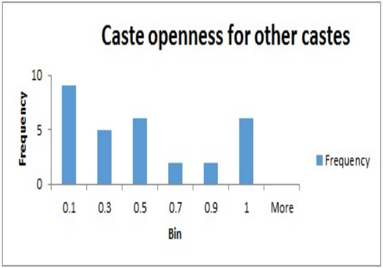
Regression Analysis

Analysis: Kolmogorov-Smirnov

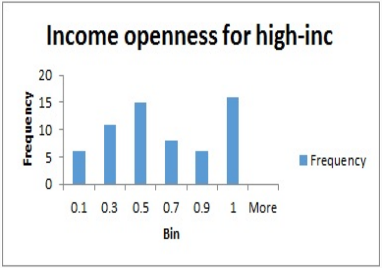


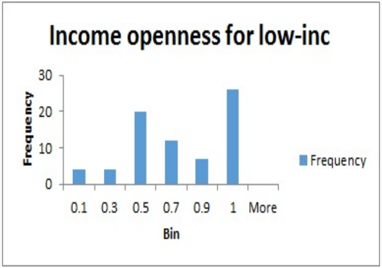






Analysis: Kolmogorov-Smirnov (cont.)





Analysis: Regression

For regression analysis, we worked with two categories within each identity of Income, Gender, & Caste.
We denote

$$I^{income=high} = 1, I^{income=low} = 0,$$
$$I^{gender=male} = 1, I^{gender=female} = 0,$$
$$I^{caste=general} = 1, I^{caste=other} = 0$$

Analysis: Regression

Dep Var () openness	Coefficient (s.e.)						
	Religion	Gender	Income	Caste	Intercept	R^{sq}	F (df)
Religion	-0.2533	-0.1569	-0.2473	-3.1861	1.2319	0.4718	20.7742
	0.2492	0.1080	0.2393	0.3866	0.4325		93
Gender	-0.2658	0.2223	-1.7604	-0.0781	0.3961	0.1701	4.7679
	0.4327	0.1875	0.4155	0.6712	0.7510		93
Income	0.0476	-0.0508	0.1611	0.1661	0.5227	0.0026	0.0611
	0.3943	0.1708	0.3786	0.6116	0.6843		93
Caste	-0.7175	0.0120	-0.64	-0.0939	-1.203	0.065	1.6163
	0.3629	0.1572	0.3485	0.5629	0.6298		93

Table: Regression Table

Estimation of parameters: Utility Recap

$$U^{ij} = U_c^{ij} + gU_s^{ij}$$

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Estimation of parameters

Identity (vector) of a person is member from the set $I = \{\{1,0\} \times \{1,0\} \times \{1,0\}\}$

Estimate m, n, p, g for each identity vector

g varies from 1 to 10, m, n, p varies from 2 to 10

7290 possible utility for each identity vector

Variance minimization leads to estimation

Estimation: Results

(0, 1, 0) : m=3 n=3 p=10 g=6

(0, 0, 0) : m=2 n=2 p=2 g=1

(0, 0, 1) : m=2 n=2 p=2 g=1

(1,0,1) : m=3 n=2 p=2 g=1

(0, 1, 1) : m=2 n=4 p=2 g=1

(1, 1, 1) : m=2 n=2 p=2 g=1

Evolutionary Game Model

Identity vs Society

Evolutionary Game Model

Identity vs Society

No hyper-rationality

Evolutionary Game Model

Identity vs Society

No hyper-rationality

Identity's strategy: Preference

Evolutionary Game Model

Identity vs Society

No hyper-rationality

Identity's strategy: Preference

Society's strategy: Hierarchy

Evolutionary Game Model

Identity vs Society

No hyper-rationality

Identity's strategy: Preference

Society's strategy: Hierarchy

Identity's payoff achieved through U_{ij}

Evolutionary Game Model

Identity vs Society

No hyper-rationality

Identity’s strategy: Preference

Society’s strategy: Hierarchy

Identity’s payoff achieved through U_{ij}

Society’s payoff = sum of payoffs of all identity vector

Strategy of player: Identity

Each identity have a ’best preferred’ identity to connect with

6 possible identity vectors $\Rightarrow 6^6$ possible ’best preference vectors’

P = Set of all best preference vectors

Strategy set of the player Identity
$S_I = \{x : x \in P\}$

Strategy of player: Society

Society can have various hierarchy schemes between identities

8 possible hierarchy schemes $([I^1 \succ I^0, G^1 \succ G^0, C^1 \succ C^0], [I^0 \succ I^1, G^1 \succ G^0, C^0 \succ C^1], \ldots)$

H = Set of all hierarchy schemes

Strategy set of the player Society
$S_S = \{y : y \in H\}$

Payoff of player: Identity

	111	101	011	001	010	000
111	$m+n+p+g$	$m+p+\frac{g}{n}$	$n+p+\frac{g}{m}$	$p+\frac{g}{mn}$	$n+\frac{g}{mp}$	$\frac{g}{mnp}$
101	$m+p+gn$	$m+n+p+g$	$p+\frac{gn}{m}$	$n+p+\frac{g}{m}$	$\frac{gn}{mp}$	$n+\frac{g}{mp}$
011	$n+p+mg$	$p+\frac{gm}{n}$	$m+n+p+g$	$m+p+\frac{\{}{g}\}\{n\}$	$m+n+\frac{g}{p}$	$m+\frac{g}{np}$
001	$p+gmn$	$n+p+gm$	$m+p+gn$	$m+n+p+g$	$m+\frac{gn}{p}$	$m+n+\frac{g}{p}$
010	$n+gmp$	$\frac{gmp}{n}$	$m+n+gp$	$m+\frac{gp}{n}$	$m+n+p+g$	$m+p+\frac{g}{n}$
000	$gmnp$	$n+gmp$	$m+gnp$	$m+n+gp$	$m+p+gn$	$m+n+p+g$

Table: Preference Payoff

Actual Payoff: Identity

	111	101	011	001	010	000	m, n, p, g
111	7	4.5	4.5	2.25	2.25	0.125	2,2,2,1
101	7	8	2.67	4.33	0.33	2.33	3,2,2,1
011	8	2.5	9	4.25	6.5	2.125	2,4,2,1
001	6	6	6	7	3	4.5	2,2,2,1
010	183	60	66	23	22	15	3,3,10,6
000	8	6	6	6	6	7	2,2,2,1

Table: Actual Payoff

Best Preference

	111	**101**	**011**	**001**	**010**	**000**	m, n, p, g
111	7	4.5	4.5	2.25	2.25	0.125	2,2,2,1
101	7	8	2.67	4.33	0.33	2.33	3,2,2,1
011	8	2.5	9	4.25	6.5	2.125	2,4,2,1
001	6	6	6	7	3	4.5	2,2,2,1
010	183	60	66	23	22	15	3,3,10,6
000	8	6	6	6	6	7	2,2,2,1

Table: Best Preference

Best preference vector- P_{best}

111-111
101-101
011-011
001-001
010-111
000-111

Payoff of player Society

For the best preference vector, Society's payoff is $(m+n+p+g)+(m+n+p+g)+(m+n+p+g)+(m+n+p+g)+(n+gmp)+(gmnp)$

It is easy to see that this term is highest among all the payoffs obtained from all possible hierarchies in the set H

Insights: From Survey

Males are less ’open’ than females

General Caste is less ’open’ then Other Caste

Insights: From Game Model

All 3 male instance connected to male. 2 of 3 females connected to female, 1 connected to male

All 4 General Caste connected to General Caste. All of 2 Other caste connected to General Caste.

Comparison between Survey and Game

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All 4 General Caste connected to General Caste. All of 2 Other caste connected to General Caste.

Finding an Equilibrium

Can we say that the strategy couple $\{P_{best}, H_{1 \succ 0}\}$ is an Evolutionary Stable Strategy (ESS)?

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$\{P_{best}, H_{1 \succ 0}\}$ is a Strict Nash Equilibrium, hence, ESS for the estimated values of m, n, p, g

THANK YOU