Agent Based Computational Model Aided Approach to Improvise the Inequality-Adjusted Human Development Index (IHDI) for Greater Parity in Real Scenario Assessments

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To design, evaluate and tune policies for all-inclusive human development, the primary requisite is to assess the true state of affairs of the society. Statistical indices like GDP, Gini Coefficients have been developed to accomplish the evaluation of the socio-economic systems. They have remained prevalent in the conventional economic theories but little do they have in the offing regarding true well-being and development of humans. Human Development Index (HDI) and thereafter Inequality-adjusted Human Development Index (IHDI) has been the path changing composite-index having the focus on human development. However, even though its fundamental philosophy has an all-inclusive human development focus, the composite-indices appear to be unable to grasp the actual assessment in several scenarios. This happens due to the dynamic non-linearity of social-systems where superposition principle cannot be applied between all of its inputs and outputs of the system as the system’s own attributes get altered upon each input. We would discuss the apparent shortcomings and probable refinement of the existing index using an agent based computational system model approach.

The quest for social system models to establish a harmonious state of affairs and stable egalitarian humane living conditions among all the people of the society has been the most coveted question in societies since the emergence of civilisation. However, it has been observed throughout the passage of time that seemingly unbridgeable gaps exist between the expectations generated from several rational beliefs about the social systems and the actual evolved outcomes in the corresponding systems. These expectation-outcome gaps further expand the disruptions in the social system structures. Thereby the resultant social system scenarios become even more incompatible for being assessed using those existing conventional rational beliefs. This leads to greater divergence of opinions, which merely results in generation of new sets of theorised beliefs that have similar limited capabilities. In more general terms, a mismatch between the driving forces of rapid changes in socio-economic activities of the world and the decision-making structures of most societal institutions gets evident in due course of time. These phenomena happen as these institutions across time, geographic and cultural domains appear to be ill-equipped for managing the subversive emergent processes in the social system. These shortcomings fail to subdue the subversive phenomena, which continue to exert direct/indirect influences on the lives of individuals and their communities in the society resulting in the societal policy expectation-outcome gaps. Thereby assessment of true amount of development becomes even more challenging. In this paper, we would like to highlight the problems in effectively adjudging the amount of human-development through the existing Inequality-Adjusted Human Development Index (IHDI). Subsequently we propose Agent Based Computational methodologies for probable improvisations of the composite-index to overcome its shortcomings.

Related Work

Human Development Index (HDI) developed by Amartya Sen and Mehbul ul Haq in 1990 (1) has been the most significant composite index till now to be credited for credible assessment of human well-being. Amartya Sen has remained concerned about the crudeness of the HDI from the initial phases (2). However he was later on convinced by Mahbub ul Haq’s argument justifying the enormous significance of the index that could bring about a fundamental change in the perspective view of Human Development, competing directly with the artificial statistical measuring metrics like the crude GDP per capita numbers and Gini coefficients that remained predominant in development thinking. The HDI is based upon the geometric mean of Life Expectancy, Education and Income. The composite index was further adjusted for inequality in each of its dimensions to develop the IHDI in 2010 (3, 4). Though it did refine the composite index but the inherent shortcomings in the index rather practically defies the core philosophy behind the Capability Approach as perceived by Amartya Sen (5) and later on by Martha Nussbaum (6). Amartya Sen’s Critiques (8) of Act-Consequentialism, Welfarism, Sum Ranking in Utilitarianism and Resourcism highlight the humanitarian outlook missing in welfare economics. Thereafter Martha Nusbaum developed a very comprehensive systematic, and influential capability theory of justice. She aims to provide a partial theory of justice (one that does not exhaust the requirements of justice) based on dignity, a list of fundamental capabilities, and a threshold (6). Other than

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just individual physical capabilities, life expectancy, health, she
even takes into account, rights for protection of an individual’s
self-respect, to participate in societal processes, to think and feel
freely. In her capability theory, she also considers rights to express
emotions freely, to be attached with other individuals, to be able
to play and have fun. Even capabilities to be able and sensible
to live with concern for and in relation to animals, plants and the
world of nature along with having freedom to control over one’s
own environment, have been taken into account.

However, Amartya Sen has not thereof specified any list of all
the capabilities which are important and how they need to be dis-
bursed, as to him these are political decisions for the society itself
to decide. Both capability theorists and external critics expressed
related concerns about the institutional structure of the Capability
Approach. The Rawlsian social justice theorist, Thomas Pogge in
(9) also have raised a few pertinent questions. He accentuated
as how should capabilities be weighted against each other and
non-capability concerns? For example, should some basic capa-
bilities be prioritized as more urgent? What does the Capability
Approach imply for interpersonal equality? How should capability
enhancement be paid for? How much responsibility should indi-
viduals take for the results of their own choices? What should
be done about non-remediable deprivations, such as blindness?
Amartya Sen’s main response (10) to such criticisms has been to
admit that the Capability Approach is not a theory of justice but
rather an approach to the evaluation of effective freedom. Amartya
Sen also acknowledged the fact that it’s easier to gather informa-
tion of some capabilities than others (). Thereby it is evident that
HDI and IHDI too, does not fully reflect the scope or methodology
of the Capability Approach. IHDI does not intrinsically account
for the relative geographic, socio-political, demographic, cultural
differences between regions having same indices. Furthermore,
due the psycho-physiological heterogeneity of human-beings, the
HDI/IHDI assessment appear to be unable to bring-out the real
picture of human development defying the designing philosophy of
the index.

Motivation and Problem Statement

The drawbacks of this composite-index can be elaborated through
the following case scenarios. Saudi Arabia belongs to the very high
human development list having HDI rank 39, as per Human Devel-
opment Report 2018 (11). Still a government sponsored Mobile
App “Absher” is prevalent in the country (12) revealing the grave
scenario of gender inequality. Women of Saudi Arabia and Mid-
dle East countries, many of which belong to the very high human
development group, are also found to have Vitamin D deficiency
(13–16) in general, where one of the key reasons identified for this
phenomenon is their predominant veil regime. Four out of the top
five nations having the maximum number of suicides per year (17),
Lithuania (28) *, Russia (34), South Korea (23) and Belarus (30),
belong to the very high human development group as per IHDI
2018 (11). Lower IHDI ranked countries like India (95), Iraq (83),
Azerbaijan (47) do have much better Inequality-adjusted Income
Index ranks, in spite of having much lower Inequality-adjusted ed-
ucation and life expectancy ranks, than the corresponding much
higher IHDI ranked countries Panama (61), China (56) and Russian
Federation (34) respectively as per Human Development Report
2018 (11). Simply errors due to the quality of obtained statisti-
cal information by the United Nations cannot serve for a justified

*The value inside the braces indicates the IHDI ranking as per Human Development Report 2018.
Pattern of accumulation of private wealth from Pre-World War era in Germany, France and Britain

Pattern of accumulation of private wealth from Pre-World War era in US

Comparison of patterns of accumulation of private wealth from Post-World War era

Comparison of patterns of accumulation of private wealth with China from Post-World War era

Sheer focus on expected life expectancy can be misleading, in the process of giving stress upon artificial support systems and medication for long life but void of expected quality of life. The need should have been to emphasize on a quality of life that would be satisfiable to the all-inclusive society having at least the average life expectancy that encompasses a handsome number of years post the generic universally accepted retirement age. Desirable stable egalitarian equilibrium can only be attained when there is no inflation and there is no deflation too, indicating that commodity or service prices have reached the values beyond which it will be unsalable and below which it would generate inadequate revenue for paying off other input prices. This indicates the optimal strategy selection in classical game theoretic approach for attaining a stable Nash Equilibrium. This can happen only when prices, incomes and the demographic distribution (within specific bounded size limits) as per age-capability are stable and tend to be constant, while considering the available amount of natural resources to be limited. The reason behind this is whatever human or material resources are developed, all correlates to utilisation of naturally available resources in some form or the other, and these utilisation does not
generally relate to restorable exhaustion of resources. This price-income setting can be achieved only when the number of people retiring from income is equal to the number of people starting to earn with the prior condition that the total population is constant. Such scenario demands that the gross loss in the desirable capability of the society due to death-rate should get compensated by the gain in capability due to birth-rate. Further now this desirable setting demands some basic rethinking in the individual choices and underlying societal norms regarding reproduction and familyhood while reforming the mindset towards communityhood. The Population/Age-Sex pyramid needs to be stationary tubular rather than expansive pyramidal or constrictive pyramidal in shape with feasibly narrow width so as to keep natural and physical resources in affluence rather than systematically depleting it. This is crucial because the feelings of insecurities associated with the scarcity principle induces capitalistic behaviour and thereafter the capitalist mentality in return propels the feeling of scarcity principle creating a systemic vicious feedback loop.

These facts also justify that any constituent principal-subsystem of the composite socio-economic system can adversely affect and even negate the positive utilities of another principal-subsystem resulting in overall failure of the socio-economic system. Only a stable setting for securing individual expectations and aspirations, where all the individuals in the social system have low variance in the upper and lower bounds of individualistic expectations and aspirations, can lead to stable and egalitarian setting for the society. The individual capabilities does not only rely on their physical abilities but also on their behavioural and cognitive aspects. These behavioural and cognitive abilities are completely heterogeneous having several dependencies on their individual genetic structures with some directly inherited and some being randomly evolved. As observed they also correlate to mental and cognitive disorders, posing more sets of capability deficiencies that cannot be compensated by merely providing direct physical resource incentives which on the other-hand may just turn out to be futile exercises resulting in disproportionate wastage of resources. As per general observations individual brain structures are infinitesimally different, due the varied genetic structures but even the slightest change can result in exhibition of grossly different characteristics. Therefore each human being (the individual social-agent) relates to a scenario having different intrinsic neural networks where same inputs to each of the networks would result in varied outputs through each of the different networks correspondingly. So we have to modulate the inputs such that the self adaptive neural networks slowly evolve in such manner that same inputs confer to similar outputs. Oded Galor and Quamrul H. Ashraf in and their joint research with Cemal Eren Arbatli, Marc Klemp too highlighted that the varying degrees of genetic diversity in the population of a place is responsible to a great extent for the quality and amount of that particular place’s socio-economic development. The cultural paradigms of different places too evolve from such diversity.

Amartya Sen raised his concerns regarding ‘act-consequentialism’ where he emphasized that not only the outcome is important but the process through which that outcome is achieved needs to be accounted for in the comprehensive analysis of social systems. Thus it is quite apparent from the above observations that in addition to this concern, the non-uniformly varying quality and feedback aspects of such processes, which are changing the initially expected behaviour and outcome patterns, restructuring the social system scenario, are of prime importance. Quantification of the qualitative aspects of social actors and a framework to correlate the quantitative analysis with empirical economic analysis remains a challenge. To the best of our knowledge even if the theoretical aspects were analysed, the analyses were not well equipped to predict the future real outcomes with precision for any given policy. Moreover, these analytical studies in general have been limited to single level of exogenous influences in the social system. They do not account for the multilevel convoluted structure of influences across the time domain amongst contextually related social agents/agent-groups, which results in the expectation-outcome gaps of socio-economic policies. This happens because, in reality, a constituent (individual or collective institution of social agents) of the social structure, not only does receive/gather some input from related social-subsystems for delivering some output, but it also undergoes self-structural changes wherein the same input to it in future would produce some different output compared to the one yielded now. Thus these factors poses serious challenges in designing realistically analogous composite assessment indices for human development.

**Proposed Approach**

In this paper we would propose an approach to improvise the introspection of the macro aspects arising from the micro behaviour with greater realistic analogy. For this purpose we view all individuals, collective groups of individuals, institutions as social-agents. We consider all social-agents having heterogenous capability, expectation attributes. The interplay between these social-agents result in a dynamic composite macro behaviour. This macro behaviour has different dimensions having varying effects upon different activities in the society. Traditionally the socio-economic systems were studied in isolation as shown in one of the general conventional diagrammatic representation of socio-economic systems in Fig. 2.

![Fig. 2. An Example of Conventional Macro Economic Model](51)

We view the entire society as the composite socio-economic system comprising of the underlying principal-subsystems of basic activity processes in the society. We have conceptualised the socio-economic system modelling approach by concurrently incorporating the principal inter-related subsystems deriving realistic analogy of the actual society. All social-agents including individuals (human-beings) or groups in collective form, do (need
to, expect to and wish to) consume some of the natural and social resources irrespective of the fact whether they produce or contribute something to the society and thereby they do have a considerable effect upon the society and it’s resources. Hereby we consider all the constituent agents of the society as consumers. The diagrammatic representation of the complete society as The Consumer Set Model is illustrated in Fig. 3 elaborates the sectional classification of the agents based on their social existence. At present we would restrict our discussion to the macro behaviour of the principal-subsystems, which is actually the aggregate influence outcome of the micro-constituents (social-agents) of the subsystems. These principal-subsystems too influence each other thereby making the complete dynamic nature of the socio-economic activities inherently evident.

Fig. 3. The Consumer Set Model Representing the Entire Society

We have analysed that there are 5 principal-subsystems (based on analytical studies (46–50)) of the society which actually determines all the parameters of the socio-economic activities. These are - 1) Comprehensive Education System 2) Health-care and Nutrition Access Platform 3) Public Insurance and Micro-financing Frameworks 4) Human Security and Legal Systems 5) Income Avenues, Technological Growth and Demographic Transition Management. These principal-subsystems are interrelated and influencing each other simultaneously evolving the society which is represented in Fig. 4.

Let us consider S to be the set comprising of all the 5 principal-subsystems in the composite socio-economic system such that $S = \{S_1, S_2, S_3, S_4, S_5\}$. Here $S_1, S_2, S_3, S_4, S_5$ represent the principal-subsystems - 1) Comprehensive Education System 2) Health-care and Nutrition Access Platform 3) Income Avenues, Public Insurance and Micro-financing Framework, 4) Human Security and Legal Systems 5) Technological and Demographic Growth/Transition Management respectively. Each principal-subsystem is interrelated with each other such that the fixed utility weight factor of $S_i$ resulted by $S_j$ is $U_{ij}$ and the dynamic relationship strength of $S_i$ incident on $S_i$ is $R_{ij}(t)$ at a time instance $t$. Here $t$ represents the timestamp in the concerned timeseries for analysis. Each $S_i$ has a total utility weight parameter, $W_{S_i(t)}$, relates to the performance metrics of the principal-subsystem $S_i$ at time $(t)$, for example Learning Rate may be considered as the performance evaluation metric for the Comprehensive Education System. It can be represented as -

$$W_{S_i(t)} = \sum_{j=1}^{S} R_{ij(t)} \times U_{ij}, \text{ where } |S| \text{ is the cardinality of the set } S$$

$R_{ij(t)}$, dynamic relationship strength, is the measure of the ratio of change total utility weight parameter of the principal-subsystem $S_i$ with respect to the change in that of $S_j$ in the previous cycle. The values of dynamic relationship strength, $R_{ij(t)}$, of $S_j$ incident on $S_i$ at time $(t+1)$ is calculated as -

$$R_{ij(t)} = \begin{cases} 0, & \text{if } (W_{S_i(t)} - W_{S_i(t-1)}) \neq (W_{S_j(t)} - W_{S_j(t-1)}) = 0 \\ R_{ij(t)}, & \text{if } (W_{S_i(t)} - W_{S_i(t-1)}) = (W_{S_j(t)} - W_{S_j(t-1)}) \\ \left|\frac{(W_{S_j(t)} - W_{S_j(t-1)})}{(W_{S_i(t)} - W_{S_i(t-1)}) \times R_{ij(t)}}\right| + \sum_{ij}^{S} (W_{S_j(t)} - W_{S_j(t-1)}) \times R_{ij(t)}, & \text{otherwise} \end{cases}$$

We need to derive $W_{S_i(t)}$ and $W_{S_j(t)}$ from statistical data for a given time. Initial $R_{ij(t)}$ values for all the principal-subsystems need to be adjusted/tuned and set in the normalized scale of 0 (no relation) to 1 (directly proportional influence) based on analytical studies. This needs trial and error tuning to check which initial settings, upon applying the known policy function $P(t)$ during that specific time instance, that yields closer to known real values for the subsequent time instance during the simulation of the system model. This approach is in consonance with the concerns for the precarious results that may arise, while working with social systems, due to the gaps between moderately accurate simulation results and the actual events, as detailed by Wallach in (S2). From
### Table 1. Influence Matrix of Dynamic Relationship Strengths $R_{ij(t)}$ between the principal-subsystems at time $t$

| $S_1$ | $S_2$ | $S_3$ | $S_4$ | $S_5$ |
|-------|-------|-------|-------|-------|
| $S_1$ | 1.0 | 0.9 | 0.1 | 0.3 | 0.2 |
| $S_2$ | 0.3 | 1.0 | 0.2 | 0.4 | 0.1 |
| $S_3$ | 0.4 | 0.6 | 1.0 | 0.1 | 0.5 |
| $S_4$ | 0.0 | 0.5 | 0.2 | 1.0 | 0.0 |
| $S_5$ | 0.7 | 0.6 | 0.2 | 0.0 | 1.0 |

Equation 1 we have a set of equations in this scenario where the values of $W_{S_i(t)}$ and $R_{ij(t)}$ are known and the corresponding fixed utility weight factors $U_{ij}$ are the unknowns as shown in Equ. 3.

$$W_{S_i(t)} = \sum_{j=1}^{S} \sum_{k=1}^{S} R_{jk(t)} \times U_{jk}; \quad \forall i = 1 \text{ to } |S| \quad [3]$$

We can solve the set of these equations, each of which here represents an underdetermined system, using the method of Lagrange multipliers to derive the values of $U_{ij}$. Conjunctly using these initial values with the performance metrics derived for each principal-subsystem in future cycles, we can evaluate as to the level of sensitivity each principal-subsystem is having towards its corresponding influencer principal-subsystems in a certain scenario. For this we construct a matrix having the principal-subsystems and their corresponding principal-systems as influencers. A toy example with random values has been shown in Table 1. From this example table we can infer that the normalized value of the relationship strength of influence of Comprehensive Education System ($S_4$) incident upon the Human Security and Legal Systems ($S_3$) is 0.3 whereas Human Security and Legal Systems ($S_3$) has no influence relation upon Comprehensive Education System ($S_4$) as the corresponding value is 0 at time $t$.

The basic algorithm for the generation of these matrices at any time instance $t$ is shown in Algorithm 1. This would further enable us to design policies with specific quantitative emphasis on principal-subsystems for achieving the desired state of the composite socio-economic system at time $(t + 1)$.

#### Algorithm 1 Formation of Influence Matrix

```plaintext
for i = 1 to |S| do
    initialize: $W_{S_i(t-1)}$, $W_{S_i(t)}$; // Fetch from performance analysis metric statistics of $S_i$ at time $(t - 1)$ and $(t)$ respectively
    for j = 1 to |S| do
        Assume $R_{ij(t-1)}$ value between 0 to 1; // Based on statistical analysis
        Approximate $U_{ij}$; // $P_{t-1} = 1$ is the known policy function adopted at time $(t - 1)$
        while $P_{t-1}(R_{ij(t-1)}, U_{ij}) \neq W_{S_i(t)}$ do
            Tune $R_{ij(t-1)}$
        end
        Calculate $R_{ij(t)}$ using $R_{ij(t-1)}$
    end
end
Form the Influence Matrix;
```

Cumulative super-positioning effects of inter and intra principal-subsystems in the prior steps are embedded in the performance metric of each principal-subsystem in the present step. From this matrix we can further use feature extraction tools, like Principal Component Analysis, to find out the most influential principal-subsystems in the composite socio-economic system at a given time $t$ to design requisite policies for the particular scenario at that time. We can further analyse how the inter-relational strengths and total utility weight parameters of principal-subsystems self-adjust under the influence of it’s own performance and impact of other principal-subsystems. From these observations we can further infer while designing policies, given certain initial scenarios, what would be the right proportionate emphasis on specific principal-subsystems to fetch the desired outcomes by overcoming the undesired impacts of the underlying influences in the composite socio-economic system.

#### A. Incorporating the proposed approach with IHDI and its analysis

IHDI serves to be the foundational human development composite-index available and to the best of our knowledge, is the most reliable and widely accepted index projecting human development growth of regions. We improvise it using it as the comparative reference to formally describe the level of actual Human Development and also project the variation between the qualitative amount of principal-subsystems’ development and same ranked IHDI regions. For this purpose, the macro indicator can be related with the aggregate analysis of the performance metrics of the considered principal-subsystems. We introduce the concept of a quality proportioning coefficient $Q_{c(t)}$ in Equ. 4. $Q_{c(t)}$ accounts for the geographic, socio-political, demographic, cultural differences which are the underlying factors affecting the performance parameters of the constituent principal-subsystems of the society.

$$Q_{c(t)} \times IHDI_{t} = \sum_{i=1}^{S} W_{S_i(t)}$$

Herein we would also highlight the fact that a particular policy for a region is not proportionately appropriate for another region even if they share the same IHDI unless their $Q_{c(t)}$ values tend to be same. Human species like all other species too have variance in their breeds accounting from their places of origin based on their natural surroundings, habitual and eventually cultural differences. These differences also sum up to enormous impacts onto the policy designs. Consideration of such impacts, which has been lacking in the quantitative analyses of conventional socio-economic theories, has been accounted for through this approach. Every crisis scenario has to be treated individually taking into account the current status and the known data of preceding scenarios for that specific region. It is also evident that a policy pattern cannot be static for a specific region under the impact of networks of underlying influences between the principal-subsystems of the society and needs to be restructured periodically based on the evolved scenario observations over feasibly short intervals of time to overcome the evolving undesirable impacts of the intangible influence networks. IHDI is considered here because it serves as the comparative composite index which expresses the levels of income, education and life expectancy. And we try to relate these levels with the actual quality of life therein. In the ideal case both should be homologous but as we have observed, that due
to the sheer heterogeneity amongst the social-agents (individuals/groups) having time varying nature and interactive adaptive influences upon one another, the levels of IHDI values does not represent the actual quality of life. Through this approach we try to relate these two different attributes, that is, the observed levels to the actual quality yielded considering the underlying complex network of influences. We introduce the concept of the quality proportioning coefficient, $Q_{c(t)}$, to account for the proportionality of the index of a region to the quality of life there. $Q_{c(t)}$ reflects the actual quality of the functional status of the principal-subsystems and the micro constituents, the social agents, therein relaying the true picture of the composite socio-economic system there. Ideal objective values for $Q_{c(t)}$ and IHDI should be 1, but any value, for both $Q_{c(t)}$ and IHDI, above 0.9 having a stationary or increasing trend can be considered as indicator of a realistically satisfiable quality of life. This can be achieved via evolutionarily cultivating epigenetic transformations (inducing behavioural changes through external envirmont stimuli, through adaptive policies, on an epigenetic level) (53) for achieving expected functionality bounded by desired upper and lower behavioural thresholds. This would result, with much high probability, in the expected external behavioural manifestation after rounds of biological evolution through the intrinsic attributes (natural genetic behaviour) of social-agents. Another important aspect apparently emerges out whilst considering this probable improvisation to IHDI is that if we deal with IHDI attributes of smaller regions such as districts, states in place of counties as a whole, we would achieve better accuracy in observing and designing required policy frameworks. This is because consideration of larger regions often under-mines the varying inter-regional cultural, demographic, geographic, socio-political fall-outs. The proposed system model approach provides the platform for establishing greater correlation between the macro and micro views of the social system. Thereby this has the potential to enable us for designing and tuning truly adaptive synchronised polices for any existing scenario at a specific time instance. This approach for improvising the existing IHDI composite human development index may fetch desired outcomes overcoming the non-desirable arbitrary impacts of the underlying influence networks in the society.

Conclusion and Future Works

Our approach towards reducing the expectation - outcome gap is by analysing the interplay between social-agents using Agent Based Computational approach. Through this proposed approach we tried to bring the insight about the convoluted influence of influences between the principal-subsystems of the society which takes shape as a complex time folded network of influences. The structural approach outline for the functioning of the micro constituents of the composite socio-economic system, the social agents, for designing the individual principal-subsystem models can be conceived from the similar pattern of the proposed approach. The primary requisite for this is the true assessment of the parameters of a crisis scenario. The analysis should account for the convoluted multiple degrees of influences (influence of influences) of adaptive social-agents in the composite socio-economic systems, to correlate the observed deviations of macro level data from estimated values. We have tried to analyse and modularize the social system into perceivable self restructurable principal-subsystems, which can be aptly interlinked in a comprehensive manner to represent the realistic scenario. Such models should also encompass the time dependent multi-layered influence of the social-agents. This would enable us to aptly analyse the dynamic adaptive complex networks with multi-level influences of social-agents, which actually outweigh their embedded impacts in long runs. Such an approach is in contrast to the classical game theoretic approach that accounts for single level of influences with binary choices of co-operate and defect. Designing models based on this approach would enable us to maintain analogy with the real socio-economic system having unconstrained dynamic sized adaptive strategy sets accounting for the varying gradients of co-operate/defect, heterogeneity and size of agent population. Constructing such models for the individual principal-subsystems remains the future scope of work in this context. The task once accomplished would enable us to represent the all-inclusive society provisioning the platform for both top-down and bottom-up views for observing the evolutionary socio-economic system. This would account for the macro-micro, reverse macro-micro linkages and the embedded networks of influences formed therein. Such frameworks would let us prevent deprivation of any deserved from the requisite human and physical resources and at the same time put a check on the misutilization and under-utilisation of such resources. Thereby such frameworks would facilitate us to design and tune realistically adaptive synchronised polices for varying scenarios at specific time instances to fetch desired outcomes overcoming the non-desirable arbitrary impacts of the underlying influence networks.

Acknowledgments

Please include your acknowledgments here, set in a single paragraph. Please do not include any acknowledgments in the Supporting Information, or anywhere else in the manuscript.

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