Transformation via Formalisation: An Evolutionary Game Approach

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Received: January 16, 2019 Accepted: February 24, 2019

ABSTRACT: *Growing informalization exists as market equilibria which need to be shifted to formal establishment with added payoff in a game-theoretic framework. We model the transition from informal to formal system of production; the latter appears as an evolutionary stable strategy. The relative magnitudes of the pay-offs matter for transformation from pre-capitalist to pro-capitalist order. Our model is based on existing literatures related with this subject.*

I Introduction

Formalisation of informal sector is often discussed in favour of strengthening economic institutions through transformation of "dead" capital into "active"[1] capital. It brings efficiency in the production and distribution of resources in a market based economy. Plethora of literatures have discussed at length that how ill-defined and deficient government capacity to enforce laws and regulations have established informality as a rule and lead to the emergence of huge informal sector in developing nations. Formalisation through provision of private property rights might lead to informal-formal integration to foster entrepreneurship, the most crucial issue in developing countries today. Formalisation provides legal shelter to business, makes exchange credible, remove risk of expropriation, endows with access to formal credit and ultimately cultivate trust, the most important factor to run businesses smoothly. Hayek (1944), Sen (2000), De soto (2000), Granovetter (1985), Williamson (1991, p. 271) Dixit (2004) Demsetz (1967), Kumar, Hatekar and Mathur (2012) have emphasized the role of formal institution in asset creation in the economy. Urban informal markets are primarily regulated by relation-based governance as opposed to rule based governance. In a different context, Li (1999) offers an explanation based on differences in the costs of the two types of systems. Self-enforcing "relation-based" groups face rising marginal costs: members added at the margin are almost by definition less well connected, making it harder to communicate information with them and to ensure their participation in any punishments. Formal "rule-based governance" has high fixed costs of setting up the legal system and the information mechanism, but once these costs have been incurred, the marginal costs of dealing with strangers are low.

Contract enforcement must be analyzed within the wider context of prevailing economic, social, cultural and political institutions (Greif, 1993). A society is dictated by institutions. Persistently, there is a clash between formal and informal institutions, as informal rules resist changing. A game with many rules and less strategy makes the game complicated, thus one should be very cautious while implementing the rules, even though that seems feasible or viable. A game may result in to multiple equilibria which enhances complexities. Apart from these, to decide the rules of the game is itself challenging. Possibility of desirable outcome as an equilibrium depends on whether formal institutions are effective or not i.e. in other way, whether informal institutions responses are apt or not.

In a pro-capitalistic system, provision of private property rights is the fundamental rule of the game. Firms under this system have two choices; either accept the rule or function in disguise or become evasive. The matter turns out to be worse when firms intend to become formal but the government's bureaucratic processes have been operational in such a way that informality appears as the outcome of the game. In other words, informal construct replaces the formal construct. In this situation, doing business becomes very difficult and coercive character of the government dominates. Sundaram (2008) comments: "Vendors in urban cities very often face the threat of being dislocated and their articles confiscated by the city administration in most part of the country, while earning their livelihood on the urban road." He also raised the issue of extortion, bribery and harassment of street vendors in urban cities in India. Bhowmik (2003) observes that,

[1] For extensive discussion on dead vs. Active capital refer, De soto (2000).

"the unlicensed street vendor is vulnerable to all sorts of extortion from various quarters. The police and municipal authorities extract rents for allowing them to operate. Studies on street vendors indicate that around 20 per cent of the meager earnings of these people are paid as rents. The underworld too steps in many places, ostensibly to provide'protection'. Vendors become victims of these corrupt practices and also dependent on them for their survival."De Soto (2000) adds, "Because extralegal entrepreneurs live in constant fear of government detection and extortion from corrupt officials, they are forced to split and compartmentalize their production facilities between many locations, thereby rarely achieving important economies of scale. In Peru 15% of gross income from manufacturing in the extralegal sector is paid out in bribes, ranging from 'free samples' and special 'gifts' of merchandise to outright cash." Above research findings lead us to state that "Every market system aspires to function in a rule based formal set-up where "market" would preserve its essence. supremacy of formality is associated with higher payoff than informally dominant market. The former case is a "win-win" situation for the Government as well as for firms but the latter case is a "lose-lose" situation for both where the government loses the most not only in monetary terms but in terms of trust deficit which is very difficult to bridge." With this reference, we can argue that Formality is the evolutionary stable strategy.

II The Model

In a game an individual player makes decisions, but the payoff to each player depends on the decisions made by all. This basic idea of game theory can be applied even to situations in which no individuals are overtly reasoning. The idea can also be applied to settings in which different forms of behaviour have the ability to persist in the population and which forms of behaviour have a tendency to be driven out by others.

The game being modelled here has two players: The Government and The firm. The government has the exclusive right to ensure formalisation of a firm.The firm too has same strategy in different way i.e. whether the firm wish to remain informal or be formal via the ways government suggests. We have presented the interaction between two players "the government" and "the firm" in context of adopting an informal or a formal strategy in the form of an evolutionary model.

This approach has been applied most widely in the area of evolutionary biology, which was first articulated by Darwin. Evolutionary biology is based on the idea that an organism's genes largely determine its observable characteristics, and hence its *fitness* in a given environment. Organisms that are more fit will tend to produce more offspring, causing genes that provide greater fitness to increase their representation in the population. In this way, fitter genes tend to win over time, because they provide higher rates of reproduction.

An organism's genetically-determined characteristics and behaviour are like its strategy in a game, its fitness is like its payoff, and this payoff depends on the strategies (characteristics) of the organisms with which it interacts. An *evolutionarily stable strategy* in biology is a genetically-determined strategy that tends to persist once it is prevalent in a population a given strategy is *evolutionarily stable* if, when the whole population is using this strategy, any small group of invaders using a different strategy will eventually die off over multiple generations.

Our model assumes formality as underlying rule which needs to be ensured by the government. Ensurance of formality can be considered as strategy of the government to push the market to reap the optimum benefit of exchange in a fearless environment. Ensurance of formality ensures revenue to the government in the form of license fee, taxation etc. Although formality is the set rules of the game across all economiesfailing in this ensurance, the government can be blamed as ensurer of informality and can be said that 'establishment of informality as a rule' is a strategic decision of the government. The latter is not satirical as the responsibility to ensure formality is the sole responsibility of the government. The other participant of the market, "the firm" can be either formal or informal. Formal firms follow the fundamental rule set by the government while informal do not. The strategies chosen by "the firm" is 'formality' and 'informality'[2]. Payoff structures has been constructed with all the possible strategies. In an arbitrary symmetric two-player strategic game consisting of the Government and the Firm, we define the circumstances under which the action ***f**** representing the formal strategy as an evolutionary stable strategy.

Suppose a group, adopting the informal strategy choosing an action ***Inf*** enters the population. The notion of evolutionary stability requires that each player adopting the informal strategy obtain an expected payoff

[2] It is to be noted here that informal firm is not informal only because she has adopted informality as first rule but it could be the failure of the government to ensure formality. This is the common phenomena in developing nations because of cumbersome beaurocratic processes as well as to earn political mileage.

less than that of the player adopting the formal strategy, ***f****. Then they would become less dominant in the population and eventually die off.

We denote the fraction adopting the formality as strategy in the population as ***(1-ϵ)***.Consider that each player in the formal group adopts an action ***f****.In a random encounter, the probability of its facing an informal unit that adopts an action ***inf*** is approximately ***ϵ***,and the probability of its facing a formal, which adopts ***f**** is approximately ***1- ϵ***.

Thus the expected payoff for the player which adopts the formal strategy is

$$(1-\epsilon)\, u(f^*,f^*) + \epsilon\, u(f^*,inf)$$

The expected payoff for the player which adopts the informal strategy is

$$(1-\epsilon)\, u(inf,f^*) + \epsilon\, u(inf,inf)$$

For the formal strategy to be established in the population, we need the expected payoff from formal strategy to be greater than the expected payoff from an informal strategy:

$$(1-\epsilon)\, u(f^*,f^*) + \epsilon\, u(f^*,Inf) > (1-\epsilon)\, u(inf,f^*) + \epsilon\, u(inf,inf) \quad .....(1)$$

To capture the idea that informal strategy ***inf***, if chosen by any of the players will not evolve, the notion of evolutionary stability requires that there be some fraction $\bar{\epsilon}$ such that inequality holds whenever $\epsilon < \bar{\epsilon}$.

Thus, the action ***f**** is evolutionary stable if there exists $\bar{\epsilon} > 0$ such that equation (1) is satisfied for all ***ϵ*** with $0 < \epsilon < \bar{\epsilon}$.The larger is $\bar{\epsilon}$, the more stable will be the action ***f**** because the growth of the informal sector will be resisted.

An action ***f**** of a player in a symmetric two-player strategic game consisting of the government and the firm, in which the payoff of each player is ***u(a, a')*** where the player's action is ***a*** and her opponents action is ***a'*** is evolutionary stable with respect to action ***inf*** if

- ***u(f*, f*)*** is a Nash equilibrium, and
- ***u(inf, inf) < u(f*, inf)***

If ***u(f*, f*)*** is a strict Nash equilibrium the second condition will be automatically satisfied.

In table 1.1 we consider the payoff matrix of the Government and the Firm, the government has the choice of ensuring formality in the economy or letting the economy run in an informal manner. The government's strategy depends on various aspects other than the payoff considerations. Government will have to ensure ownership rights, right to engage in business with other economic units, wages and good conditions of work for the employees.

The firms' strategy towards formalizing itself will include payoff considerations and inclusive benefits such as improved access to credit, fearlessness in dealing with corrupt public officials, benefits of economies of scale.

Table1.1

		GOVERNMENT			
		f*		***inf***	
FIRM	***f****	**P*-t**	**t**	**p-B**	**-t**
	Inf	**p-B**	**-t**	**p-B**	**-t**

Changes undertaken by the government can play an important role in the removal of inefficient conventions and bring about an evolutionary change in the economic structure of the society. Payoff of the firms when the government ensures formality in the economy is ***P*-t. P**** represents the firms' earnings when both the firm adopts formality and the government is ensuing formality (i.e.***f*f*)***. The amount that the firm has to pay as taxes to the government for ensuring formality is represented by ***t***. Payoff of the firms when the government fails to ensure formality is given by ***p-b.*** Firms' earnings in an informal infrastructure are less than in a formal environment. Therefore, ***P* > p. p-b*** represents the role of the state as a predatory organisation in the absence legal infrastructure.

Table1.2

		GOVERNMENT	
		*f**	*inf*
FIRM	*f**	P*-t t (120-20) (20) 100 20	p-B -t (50-30) (-20) 20 -20
	Inf	p-B - t (50-30) (-20) 20 -20	p-B -t (50-30) (-20) 20 -20

When a firm's strategy is formal its expected payoff is:
Let the share of players adopting the informal strategy(by choice or under compulsion) be 90%.Therefore, the value of ϵ be .90
$100 (1-\epsilon) + 20 \epsilon = 100*0.10 + 20*0.90 = 28$.

When a firm's strategy is informal its expected payoff for $\epsilon = 0.90$ is:
$20 (1-\epsilon) + 20 \epsilon = 20*0.10 + 20*0.90 = 20$.

Therefore,
$100 (1-\epsilon) + 20 \epsilon > 20 (1-\epsilon) + 20 \epsilon$ at $\epsilon = 0.90$
The expected payoff of the firm's formal strategy exceeds the expected payoff of the firm's informal strategy.

When the government's strategy is to ensure formality, given the firm's strategies, its expected payoff for $\epsilon = 0.90$ is:
$20 (1-\epsilon) + (-20) \epsilon = 20*0.10 - 20*0.90 = -16$.
When the government's strategy is informal its expected payoff for $\epsilon = 0.90$ is:
$-20 (1-\epsilon) + (-20) \epsilon = -20*0.10 + (-20)*0.90 = -20$.

Therefore,
$20 (1-\epsilon) + (-20) \epsilon > -20 (1-\epsilon) + (-20) \epsilon$ at $\epsilon = 0.90$

The formal strategy yields a greater payoff for players, the firm and the government. Even when the share of players adopting the informal strategy is as high as 99% of the population, the formal strategy appears as an evolutionary stable strategy.

III Conclusion

Formalization of the huge informal sector existing in developing economies by the government can play an important role in the removal of inefficient conventions and bring about an evolutionary change in the economic structure of the society. The firms will be able to take advantage of a series of benefits provided due to formalization, which will lead to an increase in their earnings. The government's revenue receipts will also be enhanced due to the new source of taxation. It is reflected in the increased payoff of both the players when they adopt the formal strategy. The mutual benefits created for the firms and the government due to the integration of firms into the formal sector will bring about a renewed relationship among these economic units. These economic units will now be able to coordinate production and distribution in the economy in a more efficient manner.

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