Rent-seeking, Government Size and Economic Growth

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Abstract

We explore the relationship between government size and economic growth in an endogenous growth model with human capital and unproductive social capital. We show that with endogenous discounting, growth outcome is history dependent and is function of initial endowment of human capital. With low endowment, government intervention of any size is growth depressing. With high endowment, government intervention is not associated with any depressing effect. For intermediate levels, there are multiple equilibria. Furthermore, countries with identical endowment and government size can be in different equilibrium, and can have different growth rates within same equilibrium if they differ in institutional quality.

Keywords: Government size, Rent-seeking, Economic Growth, Human capital, Discounting.
JEL codes: O41, H11, D72, D90, J24, O43.

1 Introduction

The relationship between government size and economic growth has traditionally been a well debated topic in economics. Empirical evidence is mixed as a higher government size is associated with accelerated economic growth in some cases and retardation of growth in the case of others (Grossman, 1988; Bairam, 1990; Romero, Avila & Strauch, 2008; and Colombier, 2009). This, in fact, supports both the Pigovian view of a benevolent government and the Public choice view of a distortive government. In the wake of Grossman (1988), the literature is more focused on non-linear relationship between the two where the positive effect of government intervention is prevalent till its size does not exceed some threshold level. Theoretically, the notion of optimal size of government is popularized by Barro (1990) and Armey (1995), which illustrates an inverted U-shaped relationship between government size and economic growth. By its implication, the role of government to correct market failures and to provide public goods is growth enhancing since it is likely to encourage accumulation of productive capitals, whereas beyond a certain threshold, further government intervention is growth depressing since it is likely to encourage unproductive activities such as rent-seeking.

Building on the literature on rent seeking (Ehrlich & Lui 1999; Wadho 2014; and Krueger 1974), we develop an endogenous growth model where the extent of government intervention (size of the government)

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affects accumulation of both productive and unproductive capitals which in turn affect the steady-state as well as the rate of growth of the economy. We model discount factor[1] as endogenous which depends on the level of inherited human capital. We highlight a greater role of initial conditions (inherited human capital) that not only directly, but also indirectly through preferences embedded in the discount factor, affect accumulation of capitals and hence the relationship between the size of government and economic growth.

Literature on corruption and economic growth suggests that corruption is detrimental for growth (Mauro, 1995; Goel & Nelson, 1998; and Ehrlich & Lui, 1999). The Public choice view of government intervention posits that government intervention in market might be a third common factor affecting both corruption and economic growth at the same time. The idea is that government intervention creates opportunities for private individuals, as well as for bureaucrats who work on behalf of the government, to seek private benefits at the expense of social welfare. In this case, along with a benevolent role of government affecting returns to a productive capital, it may also promote accumulation of an unproductive capital which is primarily meant to extract rents resulting from government intervention. This generates an interplay between productive and unproductive facets of government leading to a non-linear relationship between government intervention and economic growth. In this study, we focus on this interplay between productive human capital, which engenders growth, and unproductive social capital, which assures a power to extract rents and has no beneficial effect on productivity.

Human capital and unproductive social capital not only differ in terms of their effect on productivity, these two forms of capital also differ in another important respect—the time it takes to get returns. Human capital is generally believed to be associated with delayed realisation of returns i.e. after certain number of years one can get returns. In comparison to this, unproductive social capital (for rent seeking) is generally associated with relatively immediate realisation. For example, having links with a tax official who can help in tax avoidance/evasion might not need a number of years of accumulation. When capitals differ in this respect, returns to these capitals not only will depend on market factors and the extent of government intervention, but will also depend on individuals' time preference. Recent research on the underinvestment in productive capitals such as human capital directs towards behavioral issues that limit investment decisions by changing the decision making process (Mullainathan, 2005; and Duflo, 2006). Becker and Mulligan (1997) suggest that interaction between time preferences and individual characteristics such as education, wealth, and addictions etc. can partially explain this observation. They argue that a lower rate of time preference enables individuals to discount distant utilities less; making investment in future oriented capitals more attractive.

Incorporating the role of time preferences would necessitate a framework where discount rate is endogenous, i.e. it is a function of individual characteristics. However, as noted by Anderson et al. (2004) we have very little empirical information about the discount rate formation process. From existing literature, for Danish households, Harrison et al. (2002) show the presence of a large difference between the discount rates of skilled and unskilled individuals, with those who have skills having a significantly lower discount rate. Importantly, those with longer investments in education are also those with substantially lower discount rates. This correlation between education and low discount rate is theoretically proposed

[1] Note that discount factor is the inverse of discount rate.

by Becker and Mulligan (1997), and it is also highlighted by Bauer and Chytilova (2010) from Ugandan villages, and by Kirby et al. (2002) from Tsimane' Amerindians of the Bolivian rainforest. In growth models, endogenous discount factor is modelled as a function of physical capital (Haaparanta & Puhakka, 2004), of level of consumption (Sarkar, 2007), of a generic theoretical construct of 'future-oriented' capital (Stern, 2005), of average propensity to consume (Zee, 1997), and of own human capital (Bauer & Chytilova, 2008).

In this paper, we develop an endogenous growth model where individuals face a trade-off between investing in productive human capital with delayed realisation and unproductive social capital with immediate returns in the presence of government intervention, and its impact on economic growth. Building on the recent literature on endogenous discounting, we model a discount factor that is based on two premises highlighted in the empirical literature; there is a positive correlation between education and low discounting, and a positive correlation between parental education and low discounting. However, unlike the Becker and Mulligan (1997) model where causality runs from education to lower discounting, we argue that a higher discount factor affects acquisition of education whereas education affects discount factor with one generational lag, i.e. the discount factor of current generation is a function of human capital it inherited from the previous generation. For example, Perez-Arce (2011) using data on individuals seeking admission in public colleges in Mexico shows that successful applicants were, on average, more patient than those who were denied admission. Similarly, Kirby et al. (2002) find that individual discount rate decreases with parental (father's) education. Bjorklund and Salvanes (2011, ch:3) indicate that agents' incentive to accumulate human capital is influenced by the stock of her parental human capital. On individuals' risk aversion, Hryshko et al. (2011) indicate that agents risk aversion is affected in part by parental education. Bisin and Verdier have written multiple papers on individual traits formation where parents and society's role models play a central role (Bisin & Verdier 1998, 2000, 2001, 2005, and 2010). This literature further highlights the presence of threshold effects; Hryshko et al. (2011) observe that parental education beyond grade 11 has a significant impact on an agent's risk aversion, Haveman, Wolfe and Spaulding (1991) and Manski et al. (1992) show that parental completion of high school and one or two years of post-secondary schooling are typically found to have a larger effect on children's schooling when compared to other levels of parental education.

Our model's settings have features in common with Ehrlich and Lui (1999) and Wadho (2014) where the former looks at the link between accumulation of human capital, political capital (a form of unproductive social capital), and economic growth in the presence of government in an economy that is populated by two classes of agents, namely bureaucrats and workers. Bureaucrats indulge in rent-seeking by appropriation as they appropriate away part of workers' income by making use of their relative political power. And the latter looks at the link between accumulation of human capital, political capital, and economic growth in a setting with (a primitive) natural resource sector. Our setting differs from theirs in number of ways; first and the most important is that we treat discount factor as endogenous. We model discount factor as a positive function of individuals' inherited human capital, and as we show that in equilibrium human capital is a negative function of unproductive social capital, therefore discount factor would also be negative function of previous generations' time investment in unproductive social capital.

This has very important implications for steady-state growth regimes and growth rates as well. Contrary to the conclusions arrived at by Ehrlich and Lui (1999) that a higher size of government is always growth depressing; we do not establish a monotone relationship between government size and growth. In fact, we find that when inherited human capital is sufficiently large, government intervention is not growth depressing, irrespective of its size. Furthermore, endogenous time preferences lead to history dependence emphasizing the importance of investment decisions by previous generations in affecting decisions of subsequent generations. Same is modelled by Azariadis and Drazen (1990), but our settings differ from theirs in two important ways. Most importantly, as we show that in our model the thresholds that demarcate high-growth steady state and the low-growth steady state are endogenous and crucially depend on quality of institutions. Furthermore, we base our model on recent empirical work where inherited capital affects discounting rather than the productivity of human capital technology.

Secondly, in Ehrlich and Lui (1999) settings, there is no public good provision by government which implies that a higher government size always increases the incentive for rent-seeking by appropriation, whereas we model a redistributive government with imperfect administrative controls and institutional checks which creates a trade-off for rent-seekers that generates non-monotone relationship between the size of government and rent-seeking[2]. Thirdly, we model rent-seeking in two different forms, i.e. agents can seek rents by 'evasion' as well as by 'appropriation'. Introduction of rent-seeking by evasion along with rent-seeking by appropriation creates a new trade-off for rent-seekers as a higher extent of evasion implies that a smaller pool of government revenue would be available for appropriation[3].

Since rent-seeking is illegal and rent-seekers run the risk of getting caught, another element that affects individual incentives to invest in these two different forms of capital is the quality of institutions. We model two different forms of rent seeking in this economy. Firstly, government intervention in the economy creates an incentive for agents to spend their time in building unproductive social capital which enables them to reduce the fraction of their income taken away by the government—rent-seeking by evasion. Thus the quality of ex-ante administrative controls, that constrain rent-seeking by evasion, plays a very important role. Secondly, agents have an incentive to invest time in building up unproductive social capital since with the help of it, they can appropriate away part of receipts resulting from government intervention—rent-seeking by appropriation. Hence the ex-post institutional controls that detect and punish rent-seekers play an important role in constraining such rent-seeking. In line with the concept of institutions in Acemoglu et al. (2003), quality of institutions implies how strong/weak the constraints on rent seeking are. We show that returns to rent seeking (and so the human capital) and steady-state level of growth crucially depend on both ex-ante and ex-post institutional controls.

In line with the empirical findings, we show that there is a non-monotone relationship between the size of government and economic growth. When discounting is endogenous and affected by inherited human capital, the growth outcome is history dependent. We suggest that with lower levels of inherited human capital, government intervention of any size is growth depressing as it promotes the accumulation of unproductive capital. And when levels of inherited human capital are large enough, government

[2] Wadho (2014) models redistributive government but the share that corrupt elite gets through appropriation is always greater than the share he could have from government redistribution.

[3] Both Ehrlich and Lui (1999) and Wadho (2014) model rent-seeking by appropriation only.

intervention of any size is not associated with the accumulation of unproductive capital and there is high growth. Whereas for the intermediate levels of inherited human capital, whether government intervention is growth depressing or not depends on the size of intervention and the level of inherited human capital. In this scenario, bigger government size is growth depressing and higher levels of inherited human capital dilute this effect by promoting investment in productive human capital. Thus countries with identical levels of inherited human capital and government size can be in different equilibrium regimes if they differ in quality of institutions. In all our sub-specifications, better institutions imply that lower inherited human capital is needed to be in the high growth equilibrium.

2 Description of the Economy

2.1 Households

There are overlapping generations of two period lived agents with agents being *young* in period 1 and *old* in period 2. There is no population growth and each generation is of size n. Every agent acts as both a producer and a consumer in each period and agents within each generation are identical. Every agent has a unitary time endowment in each period, which when young she allocates among receiving education, working in the unskilled sector, and accumulating unproductive social capital; and when old she spends the entire time working in the skilled sector.

All agents from each generation have identical preferences given by the log utility function of form:

$$U_t = \ln(c_{1t}) + \beta_t \ln(c_{2t}) \tag{1}$$

where c_{1t} and c_{2t} denote consumption in period 1 and 2, respectively, by a representative agent of generation t. $\beta_t > 0$ is the generation-specific discount factor[4]. As we explain in subsequent sections, it depends on the average level of initial/inherited human capital of the generation.

3 Technologies

There are four production technologies involving the production of i) human capital, ii) unproductive social capital, iii) final good by the unskilled sector, and iv) final good by the skilled sector. Accumulation of human capital (knowledge) is the driver of growth in this model. Acquisition of knowledge in the first period enables agents to produce more output in the second period and hence earn more in the latter part of their life. Unproductive social capital on the other hand, enables them to make use of social networks, links and contacts to: i) evade government intervention, and ii) appropriate away the rents that are created as a result of government intervention. Since social capital does not facilitate production, either directly or indirectly, and since it facilitates rent-seeking, we call it 'unproductive'. These two capitals markedly differ with respect to the timing of realisation of returns. Human capital, which involves investment in early period of life, yields returns only in the latter part of life. Whereas returns from unproductive social

[4] β_t is not bounded from above. For further discussion and justification, please refer to Section 7 Patience thresholds and equilibria

capital are immediately realised. Every agent is endowed with one unit of time in every time period. In the first period, it involves three competing uses of this time, i.e. accumulation of human capital, accumulation of unproductive social capital, and working. Let h_{it} and q_{it} be the time spent by agent i of generation t in the accumulation of human capital and unproductive social capital, respectively, then $(1 - h_{it} - q_{it})$ is the time spent working in the unskilled sector. In the second period, each agent spends her entire time working in the skilled sector.

3.1 Human Capital

We envisage human capital accumulation technology similar to Lucas (1988), Ehrlich and Lui (1999), and Wadho (2014). Human capital is generated by:

$$H_{i2t} = AH_{i1t}h_{it} \tag{2}$$

where H_{i1t} denotes the inherited human capital by agent i of generation t. It is equivalent to her ancestor's second period stock of human capital, H_{i2t-1}. h_{it} denotes time invested by agent i in the accumulation of human capital, and $A > 1$, which represents the productivity of human capital production technology.

3.2 Unproductive Social Capital

Investing time in building up social networks, links, and contacts enables individuals to achieve two ends, i.e. i) to escape from government intervention, and ii) to appropriate part of the rents created in the economy due to government intervention. Although it might be tempting to think that the sort of social networks and contacts modelled here are those specifically involving government officials and bureaucrats as is the case, for instance, in Ehrlich and Lui (1999). We envisage a rather broader context where apart from government officials, private agents can also develop these links to achieve the same ends of escaping government intervention and appropriating away government revenue. These links can take various forms, for instance, media and journalistic organisations, religious groups, political parties, and other such organised groups and collective bargaining organisations which can influence government affairs by means of consent, manipulation, force, and coercion.

The concept of unproductive social capital is similar to the concept of rent-seeking in Krueger (1974). By indulging in this particular form of social networking, an agent: i) spends less time working for the production of the final good in period 1, and also ii) spends less time receiving education when young, and therefore as a result, produces less of the final good in the second period due to smaller second period skill set.

Unproductive social capital for rent-seeking differs from human capital in one important respect that unlike human capital, which is realised in the second time period, social capital is accumulated and realised in the same time period. The reason for formation of social capital in the period of investment is that developing acquaintances[5] and building links is a relatively quick process when compared to acquiring education, which, at best, takes more than a decade to reach a particular level of attainment (i.e. high

[5] Such 'friendships' are purely transactional in nature in which individuals develop contacts only for the purpose of extracting certain benefits, exhibiting opportunist behaviour.

school, undergraduate, graduate, post-graduate, etc.). Secondly, rewards to human capital accumulation are realised only in the latter half of life, whereas the returns to unproductive social capital accumulation are realised instantaneously.

The production technology of unproductive social capital is symmetric to that of human capital. Every young agent can access social networks developed by her parent and can build on these contacts and links by taking away time from production and education. The production function for unproductive social capital is as follows:

$$Q_{i2t} = Q_{i1t} = BQ_{i0t}q_{it} \tag{3}$$

where Q_{i0t} denotes the inherited stock of unproductive social capital of agent i of generation t, q_{it} denotes her time investment in the accumulation of unproductive social capital, $B > 1$ is the productivity parameter. Since returns to this capital are realised in the period of investment, therefore, Q_{i1t} denotes the first period stock of unproductive social capital. Agents may accumulate this capital only once in their lifetime, therefore, in the absence of depreciation, the second period stock of this capital, Q_{i2t}, will remain at its first period level[6].

3.3 Final Goods Production

The final good is produced using two different technologies. Every agent works as an entrepreneur in both unskilled and skilled sectors using her own labour to produce the final good. A one-for-one relationship is assumed between hours worked by an unskilled agent and the amount of final good she produces.

3.3.1 Unskilled sector

Output produced by the unskilled sector is given by:

$$Y_t^u = \sum_{i=1}^{n} y_{it}^u = \sum_{i=1}^{n} (1 - h_{it} - q_{it}) \tag{4}$$

where Y_t^u denotes the aggregate output of the unskilled sector produced by agents from generation t. It is sum of the output produced by each of the n young agents working in the unskilled sector, where output produced by the i^{th} agent is given by y_{it}^u.

3.3.2 Skilled Sector

Output produced by the skilled sector is given by:

$$Y_t^s = \sum_{i=1}^{n} y_{it}^s = \sum_{i=1}^{n} \gamma H_{i2t} \tag{5}$$

where Y_t^s denotes aggregate output of the skilled sector produced by agents belonging to generation t. It is sum of the output produced by each of the n old agents working in the skilled sector, where output produced by the i^{th} agent is given by y_{it}^s. Where $\gamma > 1$ denotes the productivity of the skilled sector and

[6] This setting will remain the same if we allow social capital to depreciate and assume that new investment in it is equal to depreciated capital, i.e. break-even investment.

H_{i2t} is the effective labour supplied by the i^{th} agent in period 2. Since γ is greater than unity, the wage (per unit of effective labour) paid by the skilled sector is strictly greater than the unitary wage paid by the unskilled sector.

Total output of the economy at time τ is thus the sum of aggregate skilled sector output produced by old agents and aggregate unskilled sector output produced by young agents living at time τ.

$$Y_\tau = Y^s_{\tau,t-1} + Y^u_{\tau,t}$$

4 Government Intervention and Rent-seeking

We model government along the lines of Ehrlich and Lui (1999) as all transactions in the economy are subject to government intervention, or alternatively, government takes away a certain fraction, θ of agents' income in each period. It then redistributes all receipts from intervention as a public consumption good[7] and runs a balanced budget. Receipts from each sector are distributed equally among the agents working in that particular sector[8].

In the absence of rent-seeking, government revenue at time τ from its intervention in the skilled sector results in total receipts of θY^s_τ. Assuming that old agents from generation $t-1$ work in the skilled sector at time τ, this then becomes θY^s_{t-1}. Similarly, government revenue at time τ from its intervention in the unskilled sector is θY^u_τ. It is equivalent to θY^u_t since young agents from generation t work in the unskilled sector at time τ. The total government revenue at time τ, in the absence of rent-seeking, thus becomes:

$$\theta Y_\tau = \theta\left(Y^s_{\tau,t-1} + Y^u_{\tau,t}\right) = \theta Y^s_{\tau,t-1} + \theta Y^u_{\tau,t}$$

where $0 \leq \theta \leq 1$. Since government redistributes receipts collected from each sector equally among all agents working in that sector, the total amount of public consumption good provided by the government thus becomes:

$$R_\tau = n\left(\frac{\theta Y^s_{\tau,t-1}}{n}\right) + n\left(\frac{\theta Y^u_{\tau,t}}{n}\right) = \theta Y^s_{\tau,t-1} + \theta Y^u_{\tau,t} = G_\tau$$

It is important to note that in the absence of rent-seeking, the presence of a 'redistributive' government does not affect incentives and optimal allocations of agents. The reason being that agents within each generation are homogenous coupled with government's policy of sector-specific redistribution ensures that agents receive the same fraction of their income as public consumption good that is initially taken away by government. Therefore government intervention and subsequent redistribution along these lines leaves agents' payoffs unaffected.

We model rent-seeking in two different forms, i.e. rent-seeking by 'evasion' and rent-seeking by

[7] We abstain from the use of term 'taxation' in our discourse throughout and instead rely on much broader notion of 'government intervention'. This distinction is necessitated by the fact that we have modelled government intervention in a way that seems remarkably similar to the treatment of taxes in most theoretic economic models. However, in this model, the role of government is neither that of facilitating final goods production, a là Barro (1990) nor is that of ensuring provision of education, as modelled by Glomm and Ravikumar (1992). It is equivalent to assuming that the government takes away some fraction of agents' income in order to provide them with a public consumption good which is produced on a one-for-one basis using receipts from government intervention as the only input.

[8] Two different generations work in the unskilled and the skilled sector at any time τ. We assume that the government does not carry-out intergenerational redistribution of income.

'appropriation'. We assume that an agent who opts to indulge in rent-seeking would commit to both forms of rent-seeking activities. Furthermore, it is interesting to note that despite there being redistribution by the government, agents still may prefer appropriation over it in the hope of commanding a greater share of government revenue than they would if they remain honest. This will particularly be true if agents fear dishonesty on part of their peers, which may result in them being deprived of their due share of government redistribution, and hence leading to the particular form of 'coordination failure' exhibited in this setting.

Rent-seeking is illegal and rent-seekers run the risk of getting caught. Every rent-seeker faces a probability, z, of being caught. When caught, her entire second period earnings are confiscated by the government[9]. z reflects the quality of institutions, where better institutions (higher z) would imply stronger constraints on rent-seeking. These law enforcement institutions reflect the 'ex-post' institutional constraints which may take the form of policing and legislative organs of the state which spring into action after the illegal/criminal activity of rent-seeking is carried out. For simplicity, we assume that the confiscated earnings of rent-seekers are not subject to redistribution (and therefore to appropriation), i.e. these are dissipated.

4.1 Rent-seeking by evasion

When an agent opts for evasion, she may be able to escape government intervention, either partly, or completely, depending on three different factors; the relative strength of her unproductive social capital, the strength of administrative controls put in place by government, represented by α, and the proportion of dishonest agents in the society, d_t. These administrative controls by the government are a form of 'ex-ante' institutional constraints. α in the present context may refer to the competence of civil servants, their independence from being swayed by pressure groups, lobbies, and political parties[10]. Therefore α acts as a deterrent to rent-seeking 'before' an agent indulges in such an activity.

The fraction of income that is subject to government intervention varies from one agent to another and this is true for agents working in the skilled as well as the unskilled sector. The expression for the extent of government intervention, which an i^{th} agent's income will be subject to is given by:

$$\theta_{i\tau t} = \left\{ \begin{array}{ll} \theta & \text{if } q_{it} = 0 \\ \theta\left[1 - d_t\left(\frac{Q_{i\tau t}}{\bar{Q}_{\tau t}} - \alpha\right)\right] & \text{if } q_{it} > 0 \end{array} \right\} \tag{6}$$

where $\tau = 1, 2$ and $0 \leq \alpha \leq 1$, and $0 \leq d_t \leq 1$ is the proportion of dishonest agents in the economy. Equation (6) implies that if an agent opts to be honest (i.e. $q_{it} = 0$) then the fraction of her income that will be subject to government intervention is equal to the size of government. However, if she opts to

[9] The reason why the entire second period income may be taken away from a rent-seeker is that the government may impose a fine or a penalty as large as agents' entire second period income to deter agents from rent-seeking. Also, when caught, an agent may be imprisoned for a considerable amount of time, disabling her from work. Furthermore, once an agent is identified as a rent-seeker, then she may lose her job not to be employed any further.

[10] It may also refer to "the credibility of the government's commitment to policies". In our case θ is the policy variable which entails the government taking away a pre-defined proportion of agents' income for the purpose of provision of public consumption good. α in this case can be interpreted as a measure of credibility of government's commitment to its policy since a higher α would imply higher administrative controls by the government preventing leakages in the form of rent-seeking and therefore keeping government's credibility in tact to provide the public consumption good in return for its receipts from market intervention (see Glaeser et al., 2004).

invest in unproductive social capital for rent-seeking (i.e. $q_{it} > 0$), and uses her social capital to evade government intervention, then, the fraction of her income subject to government intervention will vary. She will be successful in preventing the government from taking away some part of the fraction θ of her income if the relative strength of her social capital to that of the average of agents from her generation $\left(\text{i.e.}\frac{Q_{i\tau t}}{\bar{Q}_{\tau t}}\right)$ is greater than the strength of government's administrative controls (i.e. α). However, if the converse is true, then she may relinquish a higher fraction of her income than she would have in the case of being honest. This indicates that if government administrative controls are adequate enough, then this particular form of rent-seeking can be discouraged since the government will punish rent-seekers by taking away a larger fraction of their income than θ.[11] Furthermore, the effect of either of these cases is accentuated by the proportion of dishonest agents in the economy. An agent with relatively strong social networks (strong enough to render government administrative controls ineffective) will be benefited by the strategic complementarity stemming from d_t. However, if her social networks are not strong enough, then a higher proportion of dishonest agents in the economy will be detrimental for her, and the fraction of her income subject to government intervention will increase. Thus, the relative 'social' standing of an agent amidst her peers and the strength of government administrative controls mutually determine, as to whether or not rent-seeking by an agent will be profitable.

4.2 Rent-seeking by appropriation

Rent-seeking by appropriation takes place when agents use their unproductive social capital to appropriate away part of receipts accrued due to government intervention. The size of share that rent-seekers can appropriate depends on two factors.

Firstly, it depends on the total fraction of government revenue which is subject to appropriation. This fraction varies with the proportion of rent-seekers in the economy, d_t and the strength of government administrative controls, α. The expression for total pool of government revenue which is subject to appropriation is as follows:

$$P_t = d_t m_t = d_t \left[1 - \alpha \left(1 - d_t\right)\right] \tag{7}$$

where $0 \leq P_t \leq 1$. Equation (7) implies that the fraction of government receipts that can be appropriated positively depends on the proportion of rent-seekers, d_t. Firstly, there is a direct positive effect as an economy with higher proportion of rent-seekers would be subject to bigger appropriation. The second effect is indirect, coming through m_t, which is in line with the literature on the theory of deterrence suggesting that when the proportion of dishonest individuals is high, it makes administrative controls less effective. Lui (1986) reports that a fundamental observation on corruption is that it becomes very difficult to audit effectively if many are corrupt.

We also model another complementarity among the rent-seekers which arises from the way appropriated receipts are shared. Similar to Tullock (1980)[12], the share $\upsilon_{i\tau t}$ that an individual gets depends on

[11] It seems plausible as when agents are caught, they will not only be asked to pay equal to what they were legally supposed to, but some penalty on top of that as well.

[12] This sharing technology is also incorporated by Wadho (2014).

her relative power, specifically:

$$\upsilon_{i\tau t} = \frac{Q_{i\tau t}}{\sum_{j=1}^{n} Q_{j\tau t}} \tag{8}$$

where $\tau = 1, 2$. Equation (8) implies that the share that an individual gets increases with her investment in unproductive social capital and decreases with the aggregate unproductive social capital as bigger aggregate capital would imply a smaller relative capital of an individual.

5 Agents' Income and Consumption

In each period, an individual's income comprises of three components; the wage income, the share of consumption subsidy received from the government, and the share of appropriated receipts received. We assume that income of each period is entirely consumed in that period. The expression for the lifetime income of, and henceforth consumption by agents is as follows:

$$\begin{aligned} c_{it} &= c_{i1t} + c_{i2t} = (1-\theta_{i1t})y^u_{it} + (1-P_t)\frac{\sum_{j=1}^{n}\theta_{j1t}y^u_{jt}}{n} + \phi_{it}P_t\upsilon_{i1t}\sum_{j=1}^{n}\theta_{j1t}y^u_{jt} + \\ & (1-\phi_{it}z)\left[(1-\theta_{i2t})y^s_{it} + (1-P_t)\frac{\sum_{j=1}^{n}\theta_{j2t}y^s_{jt}}{n} + \phi_{it}P_t\upsilon_{i2t}\sum_{j=1}^{n}\theta_{j2t}y^s_{jt}\right] \end{aligned} \tag{9}$$

where $\phi_{it} = 0$ if $q_{it} = 0$ and $\phi_{it} = 1$ if $q_{it} > 0$, y^u_{it} and y^s_{it} represent an agent's period 1 and period 2 income, respectively. θ_{i1t} and θ_{i2t}, respectively, are the fraction of an agent's period 1 and period 2 income subject to government intervention, P_t is the fraction of government revenue subject to appropriation, υ_{i1t} is the share of appropriated rents that i^{th} agent will receive if she opts to be a rent-seeker. The term $(1-\phi_{it}z)$ represents the probability of a rent-seeker escaping accountability. We assume that if an agent is caught seeking rent then her entire second period income is confiscated.

6 Agents' Decision Problem

We have a two-dimensional problem; first an individual decides to be a rent-seeker or remains honest depending on the behavior of others, second, how much time to be allocated to each activity (when she is young), i.e. human capital accumulation, unproductive social capital accumulation, and working.

The solution to agents' decision problem is obtained through backwards induction. We first determine agents' optimal time allocation in scenarios when all are honest and when all of them are rent-seekers. We find agents' optimal time allocation between acquiring education, h_t, in the accumulation of unproductive social capital, q_t, and working, $(1-h_t-q_t)$.

The second stage involves individual decision to be a rent-seeker or not depending on the utility comparison under two different scenarios when others do not invest in unproductive social capital, $q_{it} = 0$, and when others invest in unproductive social capital, $q_{it} > 0$.

6.1 High Growth ($q_{it} = 0$) Equilibrium

To begin with, we find the optimal time allocation by agents between acquiring education and working in the unskilled sector in period 1, assuming that all of them have opted to remain honest, i.e. $d_t = 0$. We call this the 'high growth equilibrium' since none of the agents is indulging in the unproductive activity of rent-seeking, implying that $\phi_{it} = 0$, $q_{it} = 0 \ \forall \ i$. In addition to that, the government takes away a fraction θ of each agent's income. The fraction of government revenue available for provision of public consumption good , $1 - P_t$, becomes $1 - P_t = 1$.

The individuals' maximization problem is:

$$\max_{c_{i1t},\ c_{i2t},\ h_{it}} U_{it} = \ln(c_{i1t}) + \beta_t \ln(c_{i2t})$$

subject to:

$$c_{i1t} = (1-\theta)y^u_{it} + \frac{\sum_{j=1}^{n} \theta_{j1t} y^u_{jt}}{n}$$

$$c_{i2t} = (1-\theta)y^s_{it} + \frac{\sum_{j=1}^{n} \theta_{j2t} y^s_{jt}}{n}$$

$$y^u_{it} = (1 - h_{it})$$

$$y^s_{it} = \gamma H_{i2t}$$

$$H_{i2t} = A H_{i1t} h_{it}$$

$$0 \leq h_{it} \leq 1$$

where each agent takes the total unskilled(skilled) sector output when young(old) and therefore the total amount of public consumption good to be provided by the government in both periods as given. The first-order condition of this maximization problem for h_{it} is:

$$\frac{c_{i2t}}{c_{i1t}} = \gamma \beta_t A H_{i1t}$$

Using the expressions for c_{i1t} and c_{i2t} and by using the condition that all agents are homogeneous in equilibrium (implying that $h_{it} = h_t$, $H_{i2t} = H_{2t}$) , time investment in human capital is:

$$h^{HG}_t = \frac{\beta_t}{1 + \beta_t} \tag{10}$$

Using equation (2), it can be observed that in a high growth equilibrium, the growth rate of human capital, and therefore of output is:

$$1 + g^{HG}_t = \frac{\beta_t A}{1 + \beta_t}$$

The rate of growth in 'high growth' case depends on the productivity of education technology and the discount factor (patience), β_t. This is in line with Lucas (1988) where productivity of education technology and patience positively affect economic growth. As we will see in subsequent sections that

β_t is endogenous and it depends on the educational investment of the previous generation, the level of human capital, therefore the rate of growth is going to be history dependent as in Azariadis and Drazen (1990). Although here it is β_t that is endogenous as compared to theirs where A was endogenous.

6.2 Low Growth ($q_{it} > 0$) Equilibrium

Now, consider the case when all agents opt to be rent-seekers, i.e. $d_t = 1$. This implies that $\phi_{it} = 1$ and $q_{it} > 0 \; \forall \; i$. The fraction of government revenue subject to appropriation, as given by equation (7), thus becomes $P_t = 1\left[1 - \alpha\left(1 - 1\right)\right] = 1$.

This implies that the entire government revenue is going to be appropriated and therefore there is no provision of public consumption good.

The individuals' maximization problem is:

$$\max_{c_{i1t},\, c_{i2t},\, h_{it},\, q_{it}} U_{it} = \ln(c_{i1t}) + \beta_t \ln(c_{i2t})$$

subject to:

$$c_{i1t} = (1 - \theta_{i1t}) y^u_{it} + \upsilon_{i1t} \sum_{j=1}^{n} \theta_{j1t} y^u_{jt}$$

$$c_{i2t} = (1 - z)\left[(1 - \theta_{i2t}) y^s_{it} + \upsilon_{i2t} \sum_{j=1}^{n} \theta_{j2t} y^s_{jt}\right]$$

$$y^u_{it} = (1 - h_{it} - q_{it})$$

$$y^s_{it} = \gamma H_{i2t}$$

$$H_{i2t} = A H_{i1t} h_{it}$$

$$Q_{it} = Q_{i2t} = Q_{i1t} = B Q_{i0t} q_{it}$$

$$\theta_{it} = \theta_{i2t} = \theta_{i1t} = \theta\left[1 - \left(\frac{Q_{i1t}}{\bar{Q}_{1t}} - \alpha\right)\right]$$

$$\upsilon_{it} = \upsilon_{i2t} = \upsilon_{i1t} = \frac{Q_{i1t}}{\sum_{i=1}^{n} Q_{i1t}}$$

$$0 \leq h_{it} \leq 1$$

$$0 \leq q_{it} \leq 1$$

where each agent takes the total unskilled(skilled) sector output when young(old) and therefore the total amount of public consumption good to be provided by the government in both periods, and the levels of aggregate and average social capital of the society in both periods as given. The first-order conditions of this maximization problem for h_{it} and q_{it}, respectively, are as follows:

$$h_{it} = \frac{\beta_t}{1 + \beta_t}\left[(1 - q_{it}) + \frac{\sum_{j=1}^{n} \theta_{jt}\left(1 - h_{jt} - q_{jt}\right)}{1 - \theta_{it}}\left(\frac{Q_{it}}{\sum_{i=1}^{n} Q_{it}}\right)\right] - \frac{1}{1 + \beta_t}\frac{\sum_{j=1}^{n} \theta_{jt} H_{j1t} h_{jt}}{\left(1 - \theta_{it}\right) H_{i1t}}\left(\frac{Q_{it}}{\sum_{i=1}^{n} Q_{it}}\right)$$

$$q_{it} = \beta_t(1-z)\frac{c_{i1t}}{c_{i2t}}\left[\gamma H_{i2t} + \frac{\bar{Q}_t}{\theta\sum_{i=1}^{n} Q_{it}}\sum_{j=1}^{n}\theta_{jt}y_{jt}^{s}\right] + (1-h_{it}) + \frac{\bar{Q}_t}{\theta\sum_{i=1}^{n} Q_{it}}\sum_{j=1}^{n}\theta_{jt}y_{jt}^{u} - \frac{\bar{Q}_t}{\theta B Q_{i0t}}(1-\theta_{it})$$

From the first-order condition for h_{it} given above, the time investment in human capital is a negative function of time investment in unproductive social capital, highlighting the trade-off that more time invested in unproductive social capital reduces the investment in human capital. Thus, an agent's decision to indulge in rent-seeking reduces her incentive to accumulate human capital by lowering her returns to acquisition of education.

By using first-order conditions and expressions for c_{i1t},c_{i2t}, θ_{it} and equilibrium conditions (implying that $h_{it} = h_t$, $q_{it} = q_t$, $H_{i2t} = H_{2t}$, $Q_{i1t} = Q_{1t}$, and so forth), we obtain:

$$q_t^{LG} = \frac{\theta(1+\alpha)}{1+\theta} \tag{11}$$

$$h_t^{LG} = \frac{\beta_t}{1+\beta_t}\left(\frac{1-\alpha\theta}{1+\theta}\right) \tag{12}$$

As was the case without rent-seeking, investment in human capital increases with the discount factor. Whereas investment in unproductive social capital does not depend on the discount factor because returns to it are realised in the same time period. Since bigger size of the government implies a bigger amount of receipts and hence greater appropriation, the investment in unproductive social capital increases with the size of government. Our first-order conditions show that investment in human capital decreases with investment in unproductive social capital. Thus the size of government indirectly depresses investment in human capital by promoting investment in unproductive social capital.

Ex-ante institutional controls, α, increase investment in unproductive social capital resulting in depressing investment in human capital. α affects incentives to invest in unproductive social capital through two different channels with opposing effects. It reduces returns to rent-seeking by evasion whereas it increase returns to rent-seeking by appropriation as it increases the amount of appropriable receipts. In this case with $d_t = 1$ the latter effect is dominant over the former. Furthermore, since $\alpha\theta < 1$, equation (11) implies that $q_t^{LG} < 1$ and there is no corner solution where individuals invest their entire time in accumulating unproductive social capital.

Using equation (3), it can be observed that in the low growth equilibrium, the growth rate of human capital and therefore of output will be:

$$1 + g_t^{LG} = \frac{\beta_t A}{1+\beta_t}\left(\frac{1-\alpha\theta}{1+\theta}\right)$$

First observation is that since $\frac{1-\alpha\theta}{1+\theta} < 1 \Longrightarrow g_t^{LG} < g_t^{HG}$, higher level of patience (higher β_t) and higher productivity of education technology, A, create an incentive for agents to accumulate the 'future oriented' human capital and it therefore results in an increase in the rate of economic growth. However, in the presence of rent-seeking, growth rate decreases with the size of government. Interestingly, a higher size of government coupled with better ex-ante institutional controls increases the pool of receipts that can be appropriated thus increasing incentives to invest in unproductive social capital and depressing investment

in human capital and the rate of growth.

6.3 Agents' decision to seek rents

In the previous section, we solved for agents' optimal time allocation decision between human capital, unproductive social capital, and working. In this section, we use the backward induction approach, and by using agents' optimal choices from the previous section, determine whether or not she becomes a rent-seeker. In doing so, we compare the utility of an agent when she acts like the rest of her peers in either of the two cases discussed above with the case when her optimal choices differ from that of the rest of her peers. Given the equilibria in the previous section, there are two possible scenarios depending on whether others invest time $q_t = 0$ or $q_t > 0$ in the accumulation of unproductive social capital. Moreover, since rents are generated due to government intervention, an individual's decision to be a rent-seeker would crucially depend on the extent of government intervention in the economy, θ. For further analysis, we assume that the size of population of each generation is large enough implying that $\frac{1}{n} \approx 0$.

6.3.1 When all others opt to remain honest (i.e. $q_t = 0$ and $h_t = h^{HG}$)

When all others are honest and individual i also opts to be honest, then $q_{it} = 0$ and $h_{it} = h^{HG}$. The utility of the i^{th} agent when she opts to remain honest is given by:

$$U^h_{iht} = \ln(1 - h^{HG}_t) + \beta_t \ln(\gamma A H_{1t} h^{HG}_t) \tag{13}$$

Throughout the rest of this paper, we use a sub-script to represent the behavior of an individual agent and a super-script to represent the behavior of others. We use (r) for rent-seeking and (h) is used to denote honest behavior. When all others are honest and individual i opts to be a rent-seeker then since she is the only one to be a rent-seeker, our diversion technology implies that $d_t = \frac{1}{n}$and $P_t = \frac{n-(1-\alpha)}{n}$.

The first-order conditions yield the following optimal values of time-investment in human and unproductive social capital, respectively:

$$h^h_{rt} = \frac{\beta_t}{1 + \beta_t} \left(\frac{1 - \theta\,(1 - \alpha)}{1 + \theta} \right) \tag{14}$$

$$q^h_{rt} = \frac{\theta(2 - \alpha)}{1 + \theta} \tag{15}$$

The utility of the i^{th} agent who is a rent-seeker while all others are honest is therefore given by:

$$U^h_{irt} = \ln\left[\left(1 - h^h_{rt} - q^h_{rt}\right) + (2 - \alpha)\theta(1 - h^{HG})\right] + \beta_t \ln\left[(1 - z)\left(\gamma A H_{1t} h^h_{rt} + (2 - \alpha)\theta\gamma A H_{1t} h^{HG}_t\right)\right] \tag{16}$$

By comparing her utilities in equation (13) and equation (16), the individual decides whether to be a rent-seeker or not.

Proposition 1 *$\forall\theta \leq \bar{\theta}$, there exists a high growth equilibrium such that no one is a rent-seeker.*

Proof. See Appendix A. ■

When the extent of government intervention in the economy is $\bar{\theta}$ or lower, then returns to rent-seeking are small enough that it does not pay individuals to be rent-seekers and to invest in unproductive social capital. As a result, when $\theta \leq \bar{\theta}$, the economy is in a high-growth equilibrium which is characterized by no rent-seeking and a higher stock of equilibrium human capital, where:

$$\bar{\theta} = \frac{1 - \mu + \sqrt{(1-\mu)^2 + 4(2-\alpha)\mu(1-\mu)}}{2(2-\alpha)\mu} \tag{17}$$

where $\mu = (1-z)^{\frac{\beta_t}{1+\beta_t}}$

Whereas, when $\theta > \bar{\theta}$, then it always pays to become a rent-seeker, irrespective of whether others are honest or not. The threshold level of government intervention that determines high-growth equilibrium, $\bar{\theta}$, is endogenous and it depends on discount factor (patience), β_t, and strength of government ex-ante (α), and ex-post (z) institutional controls. This implies that the extent of government intervention compatible with high growth depends on patience embedded in discount factor (β_t) and the institutional quality represented by α and z. Comparative statics can be obtained by differentiating the threshold $\bar{\theta}$ with β_t, z, and α. Interestingly, $\frac{\partial \bar{\theta}}{\partial \beta_t}$, $\frac{\partial \bar{\theta}}{\partial z}$, and $\frac{\partial \bar{\theta}}{\partial \alpha}$ are all positive[13]. It is also interesting to note that when there are no ex-post constraints, i.e. $z = 0$, then $\bar{\theta} = 0$ and high growth equilibrium does not exist. This is very intuitive as with bad institutions, such that there is no cost of rent-seeking, returns of being a rent-seeker would always exceed returns of being honest. And in the other extreme when the agent is certain of being caught in the second period, the quality of ex-post institutions is good, i.e. $z = 1$, then $\bar{\theta} = \infty$ and high-growth equilibrium exists for all values of $\bar{\theta}$.

6.3.2 When all others opt to seek rent (i.e. $q_t = q^{LG}$ and $h_t = h^{LG}$)

The utility of an agent when she opts to be a rent-seeker when all others are also rent-seekers is given by:

$$U^r_{irt} = \ln(1 - h^{LG}_t - q^{LG}_t) + \beta_t \ln((1-z)\gamma A H_{1t} h^{LG}_t) \tag{18}$$

When all others are corrupt and individual i decides to deviate and stay honest, in this case a share $d_t = \frac{n-1}{n}$ is appropriated by other corrupt members. Individual i will invest $h_{it} = h^{HG} = \frac{\beta_t}{1+\beta_t}$ and her utility is:

$$U^r_{iht} = \ln((1-\theta)(1 - h^{HG}_t)) + \beta_t \ln((1-\theta)\gamma A H_{1t} h^{HG}_t) \tag{19}$$

$\forall \theta \geq \underline{\theta}$, there exists a low growth equilibrium such that everyone is a rent-seeker.

Proof. See Appendix B. ■

When the extent of government intervention is greater than or equal to the threshold of $\underline{\theta}$, then irrespective of the probability of detection (quality of institutions) and whether other members are rent-seekers or not, it will always pay to be a rent-seeker. Thus, when $\theta \geq \underline{\theta}$ then the economy is in a

[13] For proof, see Appendix A.

low-growth equilibrium in which everyone is a rent-seeker and where:

$$\underline{\theta} = \frac{\alpha\mu + \sqrt{(\alpha\mu)^2 + 4(1-\mu)}}{2} \tag{20}$$

recall that $\mu = (1-z)^{\frac{\beta_t}{1+\beta_t}}$

Whereas when $\theta < \underline{\theta}$, then it always pays an agent to remain honest. Since there is a cost of losing second period income if detected, when the extent of government intervention is less than $\underline{\theta}$, pay-off from rent-seeking is not sufficient to offset expected costs and in such a situation agents remain honest. Therefore, the low-growth equilibrium does not exist when the size of government is below $\underline{\theta}$. Moreover, the threshold $\underline{\theta}$ is endogenous and it depends on discount factor (patience), β_t, and strength of government ex-ante (α), and ex-post (z) institutional controls. Partial derivatives, $\frac{\partial\underline{\theta}}{\partial\beta_t}$, $\frac{\partial\underline{\theta}}{\partial\alpha}$, and $\frac{\partial\underline{\theta}}{\partial z}$, all are positive[14]. This implies that the range of government intervention where low growth equilibrium exists decreases with patience that allows less discounting of returns to human capital, and with both ex-ante and ex-post institutional constraints that make rent-seeking less profitable. Interestingly, when $z = 0$ (no ex-post institutional controls), then $\underline{\theta} = \alpha$ and low growth equilibrium exists for $\theta \geq \alpha$. Intuitively, in the case when there is no ex-post cost of rent-seeking, then rent-seeking is profitable only if extent of government intervention is large enough to cover the ex-ante cost of rent-seeking, α. Range of the extent of government intervention where there is low-growth equilibrium decreases with the quality of ex-post institutional constraints, and in a extreme case when $z = 1$, low-growth equilibrium does not exist even when the entire economy is run by the government, i.e. $\theta = 1$.

7 Patience thresholds and equilibria

In the pervious section, we demonstrated that the steady-state levels of growth are influenced by the extent of government intervention. More importantly, the thresholds of size of government which demarcate high and low growth steady-states are endogenous and crucially depend on the extent of individuals' discounting of the future. Both thresholds ($\bar{\theta}$ and $\underline{\theta}$) are positive functions of the discount factor, β_t, which generates the most important result of our model that the relationship between the size of government and growth is non-monotone. This implies that two countries with identical size of government can be in different equilibria if they differ in discounting. A more patient society can be in a high-growth equilibrium even with a larger extent of government intervention. In this section we go one step ahead and model the discount factor, β_t, as endogenous. Anderson et al. (2004) noted that we have very little empirical evidence when it comes to the discount rate formation. We model discount rate based on two premises highlighted by the recent research. Firstly, there is a positive correlation between education and discount factor (patience). Secondly, discounting is affected by parents and their education (Kirby et al., 2002; Bjorklund & Salvanes, 2011).

The level of patience of agents belonging to generation t is a function of their average initial stock of

[14] For proof, see Appendix B.

human capital, H_{1t}, as follows:

$$\beta_t = \beta\left(\frac{\sum_{i=1}^{n} H_{i1t}}{n}\right) = \beta\left(H_{1t}\right) = \max\left[\underline{\beta}_0\ ,\ \beta_0 H_{1t}^{\lambda}\right] \tag{21}$$

where $\beta_t = \beta_0 H_{1t}^{\lambda}$ for any $H_{1t} > 0$, $\beta_t = \underline{\beta}_0$ when $H_{1t} = 0$ and $0 \leq \lambda \leq 1$[15].

Before proceeding further, for the rest of the paper we assume that θ cannot be equal to 0 or 1, specifically, $\varepsilon \leq \theta \leq \omega$ where $\varepsilon \to 0$ and $\omega \to 1$.

Proposition 2 *$\forall H_{1t} \geq \overline{\overline{H}} \Longrightarrow \beta_t \geq \overline{\overline{\beta}}$, there is a unique high growth equilibrium$\forall\ \theta \leq \omega \to 1$. $\forall H_{1t} \leq \underline{\underline{H}} \Longrightarrow \beta_t \leq \underline{\underline{\beta}}$, there is a unique low growth equilibrium $\forall\ \theta \geq \varepsilon \to 0$. And $\forall \underline{\underline{H}} < H_{1t} < \overline{\overline{H}}$ there are multiple equilibria*

Proof. See Appendix C. ■

where:

$$\underline{\underline{H}} = \left(\frac{\ln\left(\frac{1+\varepsilon+(2-\alpha)\varepsilon^2}{1+\varepsilon}\right)}{\beta_0 \ln\left[\frac{1+\varepsilon}{(1-z)[1+\varepsilon+(2-\alpha)\varepsilon^2]}\right]}\right)^{\frac{1}{\lambda}}$$

$$\overline{\overline{H}} = \left(\frac{\ln\left(\frac{1-\alpha\omega}{1-\omega^2}\right)}{\beta_0 \ln\left[\frac{1-\omega^2}{(1-z)(1-\alpha\omega)}\right]}\right)^{\frac{1}{\lambda}} \tag{22}$$

Results in Proposition 3 reinforce the role of history dependence of steady-states on human capital proposed in the seminal paper by Azariadis and Drazen (1990). Our results though differ from theirs in two important respects. First, thresholds in their paper are exogenous, whereas we model thresholds as endogenous, and crucially, these depend on the quality of institutions. Second, in our setting, rather than affecting the productivity of human capital technology, inherited human capital affects the discount factor, which makes investment in productive human capital with delayed realisation more valuable. This is in line with threshold effects highlighted by the recent literature, for instance, Haveman, Wolfe and Spaulding (1991) and Manski et al. (1992) show that parental completion of high school and one or two years of post-secondary schooling typically have a larger effect on children's schooling when compared to other levels of parental education. Hryshko et al. (2011) find that individuals' risk aversion is affected by their parents' education and by the society. They find that parental education beyond grade 11 has a significant impact on an individual's risk aversion, indicating that risk aversion exhibits threshold effects in levels of parental education. Moreover, Dohmen et al. (2010) find that there is a significant and a robust relationship between individuals' risk aversion and impatience.

Our results indicate that societies with high inherited human capital are considerably patient and discount future less, which results in high investment in human capital by the current generation, irrespective of the size of the government. We also show that societies with low inherited human capital are considerably impatient and discount future more, resulting in low investment by the current generation

[15] As opposed to common convention in economic models, we do not bound β_t by the upper limit of unity. As proposed by Becker and Mulligan (1997) and by the 'catching up with the Joneses' hypothesis, β_t can be greater than one.

in human capital, regardless of government size. For intermediate ranges of inherited human capital, we show that both high and low growth equilibrium exist. Thresholds $\overline{\overline{H}}$ and $\underline{\underline{H}}$ are endogenous and are affected by policy variables α (ex-ante institutional controls) and z (ex-post institutional controls). Both are reduced by an increase in α as well as by an increase in z[16]. This implies that when we compare a country which has better quality institutions (high α and z) with a country which has low quality institutions (low α and z), the former will be in the high-growth steady-state equilibrium with relatively smaller inherited human capital as compared to the latter.

For intermediate levels of inherited human capital there are multiple equilibria. Specifically, we show that when inherited human capital is greater than the lower bound $\underline{\underline{H}}$ but less than $\underline{H} = \left(\frac{\ln\left(\frac{1-\alpha\varepsilon}{1-\varepsilon^2}\right)}{\beta_0 \ln\left[\frac{1-\varepsilon^2}{(1-z)[1-\alpha\varepsilon]}\right]}\right)^{\frac{1}{\lambda}}$, then there are two equilibrium regimes depending on the extent of government intervention, θ. For bigger size of the government, specifically when $\theta > \bar{\theta}$, there is a unique low-growth equilibrium, whereas for $\theta \leq \bar{\theta}$ both high-growth and low-growth equilibrium coexist.

[FIGURE 1 HERE]

Similarly, when inherited human capital is less than the upper bound $\overline{\overline{H}}$, but is greater than $\bar{H} = \left(\frac{\ln\left(\frac{1+\omega+(2-\alpha)\omega^2}{1+\omega}\right)}{\beta_0 \ln\left[\frac{1+\omega}{(1-z)[1+\omega+(2-\alpha)\omega^2]}\right]}\right)^{\frac{1}{\lambda}}$, then there are two growth regimes depending on the size of the government. Specifically, when $\theta < \underline{\theta}$, there is a unique high-growth equilibrium, whereas for all $\theta \geq \underline{\theta}$, both high-growth and low-growth equilibrium coexist.

[FIGURE 2 HERE]

In the intermediate range when inherited human capital is in between $\underline{H}$ and $\bar{H}$, there are three growth regimes. There is a unique high-growth equilibrium for all $\theta < \underline{\theta}$ and a unique low-growth equilibrium for all $\theta > \underline{\theta}$. Whereas for all $\underline{\theta} \leq \theta \leq \bar{\theta}$, both high-growth and low-growth equilibrium coexist[17].

[FIGURE 3 HERE]

8 Conclusion

This research explores the relationship between size of government and economic growth in the presence of both productive and unproductive capitals. Consistent with the recent empirical work, we model discount factor as an endogenous function of inherited human capital. High inherited human capital implies lower discounting of future, which promotes investment in productive human capital returns to which are realised in future.

We show that with endogenous discounting that depends on inherited human capital, growth outcome is history dependent. With higher level of inherited human capital, discount rate is low where agents

[16] For proof, see Appendix C.
[17] For proof, see Appendix C.

do not indulge in rent seeking, regardless of the extent of government intervention. In this equilibrium there is high investment in human capital, no investment in unproductive social capital and there is high growth rate. Similarly, with low levels of inherited human capital, there is heavy discounting of future where agents are rent seekers irrespective of the extent of government intervention. In this equilibrium there is low investment in human capital, high investment in unproductive social capital, and growth rate is low. With intermediate level of inherited human capital, there is intermediate discounting and there are multiple equilibria. In this scenario, steady state depends on the size of the government with bigger size there is low growth equilibrium and with smaller size there is high growth. The thresholds of inherited human capital that demarcate these different equilibrium regimes are endogenous and depend on quality of institutions. Thus countries with identical levels of inherited human capital and the size of government can be in different equilibrium regimes if they differ in quality of institutions. In all our sub-specifications, better institutions imply lower inherited human capital needed to be in the high-growth equilibrium.

9 References

[1] Acemoglu, D., Johnson, S., Robinson, J., & Thaicharoen, Y. (2003). Institutional Causes, Macroeconomic Symptoms: Volatility, Crises and Growth. *Journal of Monetary Economics*, 50(1), 49-123.

[2] Anderson, C. L., Dietz, M., Gordon, A., & Klawitter, M. (2004). Discount Rates in Vietnam. *Economic Development and Cultural Change*, 52(4), 873-887.

[3] Armey, R. (1995). *The Freedom Revolution,* Washington DC: Regnery Publishers.

[4] Azariadis, C., & Drazen, A. (1990). Threshold Externalities in Economic Development. *The Quarterly Journal of Economics*, 105(2), 501-526.

[5] Bairam, E. (1990). Government Size and Economic Growth: The African Experience, 1960–85. *Applied Economics*, 22(10), 1427-1435.

[6] Barro, R. J. (1990). Government Spending in a Simple Model of Endogenous Growth. *Journal of Political Economy*, 98(5 pt 2).

[7] Bauer, M., & Chytilová, J. (2008). A Model of Human Capital, Time Discounting and Economic Growth (No. 14/2008). IES Working Paper.

[8] Bauer, M., & Chytilová, J. (2010). The Impact of Education on Subjective Discount rate in Ugandan villages. *Economic Development and Cultural Change*, 58(4), 643-669.

[9] Becker, G. S., & Mulligan, C. B. (1997). The Endogenous Determination of Time Preference. *The Quarterly Journal of Economics*, 112(3), 729-758.

[10] Bisin, A., & Verdier, T. (1998). On the cultural transmission of preferences for social status. *Journal of Public Economics*, 70(1), 75-97.

[11] Bisin, A., & Verdier, T. (2000). " Beyond The Melting Pot": Cultural Transmission, Marriage, And The Evolution Of Ethnic And Religious Traits. *Quarterly Journal of Economics*, 955-988.

[12] Bisin, A., & Verdier, T. (2001). The economics of cultural transmission and the dynamics of preferences. *Journal of Economic Theory*, 97(2), 298-319.

[13] Bisin, A., & Verdier, T. (2005). Cultural Transmission. The New Palgrave Dictionary of Economics.

[14] Bisin, A., & Verdier, T. (2010). *The Economics of Cultural Transmission and Socialization* (No. w16512). National Bureau of Economic Research.

[15] Björklund, A., & Salvanes, K. G. (2011). Chapter 3-Education and Family Background: Mechanisms and Policies. Volume 3 of Handbook of the Economics of Education, 201–247.

[16] Colombier, C. (2009). Growth Effects of Fiscal Policies: An Application of Robust Modified M-estimator. *Applied Economics*, 41(7), 899-912.

[17] Dohmen, T., Falk, A., Huffman, D., & Sunde, U. (2010). Are Risk Aversion and Impatience Related to Cognitive Ability?. *The American Economic Review*, 100(3), 1238-1260.

[18] Duflo, E. (2006). Poor but rational. *Understanding Poverty*, 367-378.

[19] Ehrlich, I., & Lui, F. T. (1999). Bureaucratic Corruption and Endogenous Economic Growth. *Journal of Political Economy*, 107(S6), S270-S293.

[20] Glaeser, E. L., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2004). Do Institutions Cause Growth?. *Journal of Economic Growth*, 9(3), 271-303.

[21] Glomm, G., & Ravikumar, B. (1992). Public versus Private Investment in Human Capital Endogenous Growth and Income Inequality. *Journal of Political Economy*, 100(4), 818-34.

[22] Goel, R. K., & Nelson, M. A. (1998). Corruption and Government Size: A Disaggregated Analysis. *Public Choice*, 97(1-2), 107-120.

[23] Grossman, P. J. (1988). Government and Economic Growth: A Non-linear Relationship. *Public Choice*, 56(2), 193-200.

[24] Haaparanta, P., & Puhakka, M. (2004). Endogenous Time Preference, Investment and Development Traps (No. 4/2004). Bank of Finland, Institute for Economies in Transition.

[25] Harrison, G. W., Lau, M. I., & Williams, M. B. (2002). Estimating Individual Discount Rates in Denmark: A Field Experiment. *American Economic Review*, 1606-1617.

[26] Haveman, R., Wolfe, B., & Spaulding, J. (1991). Childhood Events and Circumstances Influencing High School Completion. *Demography*, 28(1), 133-157.

[27] Hryshko, D., Luengo-Prado, M. J., & Sørensen, B. E. (2011). Childhood Determinants of Risk Aversion: The Long Shadow of Compulsory Education. *Quantitative Economics*, 2(1), 37-72.

[28] Kirby, K. N., Godoy, R., Reyes-Garcıa, V., Byron, E., Apaza, L., Leonard, W., ... & Wilkie, D. (2002). Correlates of delay-discount rates: Evidence from Tsimane'Amerindians of the Bolivian rain forest. *Journal of Economic Psychology*, 23(3), 291-316.

[29] Krueger, A. O. (1974). The Political Economy of the Rent-seeking Society. *The American Economic Review*, 291-303.

[30] Lucas Jr, R. E. (1988). On the Mechanics of Economic Development. *Journal of Monetary Economics*, 22(1), 3-42.

[31] Lui, F. T. (1986). A Dynamic Model of Corruption Deterrence. *Journal of public Economics*, 31(2), 215-236.

[32] Manski, C. F., Sandefur, G. D., McLanahan, S., & Powers, D. (1992). Alternative Estimates of

the Effect of Family Structure During Adolescence on High School Graduation. *Journal of the American Statistical Association*, 87(417), 25-37.

[33] Mauro, P. (1995). Corruption and Growth. *The Quarterly Journal of Economics*, 681-712.

[34] Mullainathan, S. (2005). Development Economics through the Lens of Psychology. In *Annual World Bank Conference in Development Economics 2005: Lessons of Experience.*

[35] Perez-Arce, F. (2011). The Effect of Education on Time Preferences.

[36] Romero-Ávila, D., & Strauch, R. (2008). Public Finances and Long-term Growth in Europe: Evidence from a Panel Data Analysis. *European Journal of Political Economy*, 24(1), 172-191.

[37] Sarkar, J. (2007). Growth Dynamics in a Model of Endogenous Time Preference. *International Review of Economics & Finance*, 16(4), 528-542.

[38] Stern, M. L. (2006). Endogenous Time Preference and Optimal Growth. *Economic Theory*, 29(1), 49-70.

[39] Tullock, G. (1980). Efficient Rent-Seeking. *Toward a Theory of the Rent-Seeking Society.* Buchanan, J.M., Tollison, R.D., and Tullock,G. eds. (College Station: Texas A&M University Press, 1980): 97-112.

[40] Wadho, W. A. (2014). Education, Rent seeking and the Curse of Natural Resources. *Economics & Politics*, 26(1), 128-156.

[41] Zee, H. H. (1997). Endogenous Time Preference and Endogenous Growth. *International Economic Journal*, 11(2), 1-20.

10 Appendix D

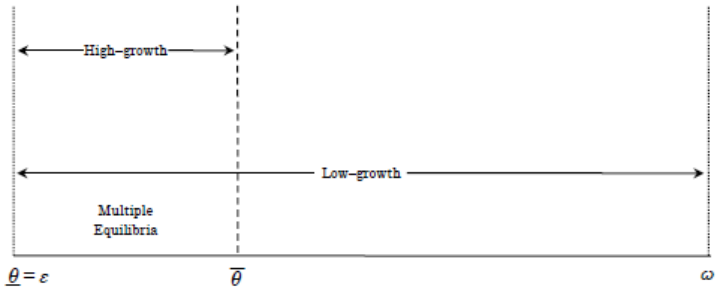

Figure 1

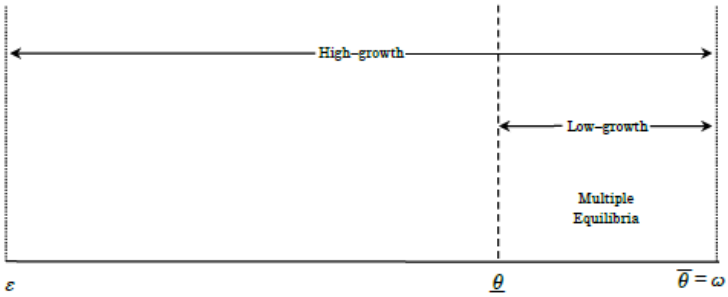

Figure 2

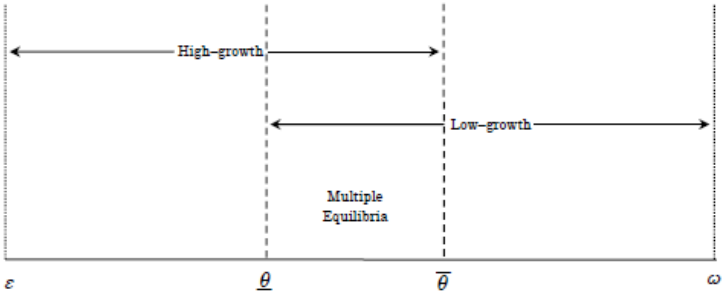

Figure 3