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IRVINE

Essays on Inequality and the Economics of Education

DISSERTATION

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DOCTOR OF PHILOSOPHY

in Economics

by

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DEDICATION

To my parents, Anupam and Mridula.
You have always been my best-friend and my rock.
I hope that this achievement will complete the dream you had for me for which you gave me the best education you could.

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ABSTRACT OF THE DISSERTATION

Essays on Inequality and the Economics of Education

By

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This dissertation discusses some of the causes and consequences of inequality, vertical and horizontal, some theoretically and others empirically. In doing so, I try to touch upon old and new themes in the economics literature, as old as rent seeking and as new as the effect of cultural norms.

The first essay reflects on the inequality of opportunity as manifest in the quality of education available to families in India. The paper explores the relative roles of the quality of schools and household attributes on a household's choice of school in India. I find that income is the most important predictor of a household's choice of school, with a doubling of per capita income increasing the likelihood of choosing a private school over a public school by 10 percentage points. Public schools can rarely compete with private schools even with comparable infrastructure and free school supplies. As incomes rise (India's GDP has nearly doubled in the last 10 years), it is reasonable to expect that there will be de facto higher demand for private schooling and not public.

The second essay is a theoretical examination of inequality-generating rent seeking and the feedback mechanism between the two. In this paper, I model rent seeking in an unequal endowment economy to analyze the conditions under which more inequality leads to more rent seeking. I find that, when rent-seeking costs are fixed, a more unequal economy fosters

a greater proportion of rentiers. When rent-seeking costs are flexible, the proportion of rentiers shrinks with more inequality. However, both the quantity of rents per person and the resources wasted in pursuing rent-seeking activities increase.

In the third essay, I link the education choices of women to gender-specific norms of marriage. Hypergamy (the practice of women "marrying up" by caste, age, education or any indicator of economic well-being) implies that too much education could lower women's prospects of finding a suitable spouse. To understand its impact on pre-marital investments in education, this project studies women's choice of educational attainment as a function of men's. To do so, I examine the impact of an exogenous change in the schooling level of men on the schooling level of women in the United States in the last 50 years. The source of variation is the change in US immigration policy in 1965, which has been documented to have considerably altered the demographic and skill-pool in the US since 1965. I find evidence of a positive relationship between men and women's education outcomes. This is a result suggestive of hypergamy and its dragging effect on women's education. The result is robust to the use of another control group: immigrant women in the US.

Chapter 1

Determinants of School Choice: Evidence from India

1.1 Introduction

Recent evidence from India points to a disproportionate increase in private school enrolment in the last decade [Pratham (2012, 2013)]. This has been despite the massive rise in funds being devoted to universalize the outreach of public education. In 2012-13, the Indian union government devoted USD 12.4 billion to education and USD 7.3 billion to their flagship primary education program Sarva Shikha Abhiyan (SSA)[1]. Net enrolment has gone up as a result to almost 99% (District Information System for Education, 2011). Per student allocations have become more than threefold in the last five years, from $27 in 2007-08 to $93 in 2012-13 for Sarva Shikhsha Abhiyan (SSA). However, this hasn't slowed growth in the private education sector, and private school enrolment as a share of total enrolment has

[1]Initiative (2013). The SSA was initiated by the Indian government in the year 2000 to bring primary schooling to every child. The drive led to the construction of many more primary schools, so that every child has access to a functional public school in her neighbourhood.

gone up from 17% in 2005-06 to 36% in 2013-14[2]. This isn't just an urban phenomenon, rural households in India are also expressing the same choice. According to Muralidharan (2015), there is near universal access to free primary education in India. Still there has been a rapid growth of fee-charging private schools that cater to the poor. Most recent estimates for rural India show over 28% enrolment in private schools. The corresponding figure for urban areas is likely to be over 65% in 2012 (Rangaraju et al., 2012).

This parental preference for private education is reported to be arising from the low quality of public education in India. Private schools are perceived to be a better alternative in delivering learning outcomes and fulfilling parental aspirations (Save the Children UK, South and Central Asia, 2002; Tooley & Dixon, 2007). The Probe Report (1999) observed that

> In a private school, the teachers are accountable to the manager (who can fire them), and, through him or her, to the parents (who can withdraw their children). In a government school the chain of accountability is much weaker, as teachers have a permanent job with salaries and promotions unrelated to performance. This contrast is perceived with crystal clarity by the vast majority of parents.

However, whether the better performance by private schools is due to better quality of services or simply cream-skimming (or sorting) has not been conclusively proven in the literature. Kingdon (1996) finds that standardizing the home background and controlling for sample selection significantly reduces the advantage of private schools over public in Uttar Pradesh in India. Sonalde Desai et al. (2009) also find similar results using a nationally representative sample. In another study using data from two large states in India, Goyal &

[2] DISE (District Information System for Education) statistics. DISE is a census of recognized schools published by the Government of India. Data is available from the year 2002 onwards on school facilities, teachers, enrolment, etc., though information is scant and hence not very reliable for the early years. From the year 2011 onwards, Right to Education (RTE) compliance information on facilities in schools is also available.

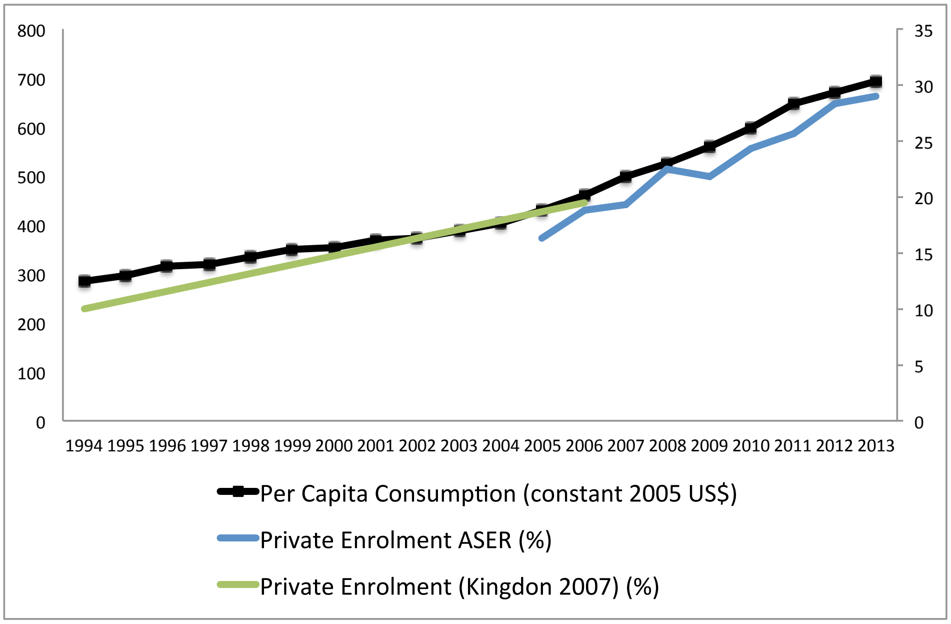
Pandey (2009) note that the private school advantage varies by state, school type and grade, being negligible in some cases. French & Kingdon (2010) analyze data for rural India and find only a modest advantage of attending private school using a number of methodologies including family fixed effects and panel data. Muralidharan (2015) use experimental data from Andhra Pradesh, India and find private school students performing slightly better than public school students in certain subjects.

If the immediate returns to schooling aren't vastly different between the two types of schools, then we need to understand the characteristics of families that self-select into each schooling system. The existing evidence clearly reveals preferences of parents for private education, who are becoming consumers of fee-charging private schools as opposed to being the beneficiaries of the public school system. Families spend a significantly larger amount of resources on private school fees, uniforms and books, all of which are effectively free in public schools in India. There could be several reasons why certain families prefer private over public schools, including but not limited to a status effect, symbolic consumption, perceived difference in returns to schooling, etc.

To understand why parents choose private over public education, we need to take a look at the families making that choice. The rise in privatization of education in India has been concurrent with the opening of the Indian economy and subsequent growth in incomes owing to financial liberalization in the 1990s (Kingdon, 2007). In the last decade alone, household consumption expenditures (in constant 2005 USD) have risen by 61%, from \$431 in 2005 to \$693 in 2013 (World Bank). If private schooling is considered superior to public education, then a natural consequence of these rising incomes would be more enrolment in private schools. It is important to understand such parental preferences for private schooling to make better public policies and use of public funds.[3] For example, the failure of public

[3] If school resources and teacher attributes have little influence on the effectiveness of schools, then the public expenditure on improving these facilities would not have the desired consequences of bringing and keeping children in government schools. Researchers and public policy specialists have suggested several other methods of effectively using public resources to fund education for all, including the use of vouchers

Figure 1.1: Private Enrolment and Consumption in India, 1994-2013



schools to attract or retain children could be less about the actual quality gap between the two types of schools, and more about the family background of the children. However, little is known about the relative importance of household characteristics vis-a-vis school-quality gap between private and public schools in a household's choice of school in India.

In this paper, I attempt to understand the relationship of pre-school characteristics (such as family income, parental education, social identity, gender of the child) and school quality information about the local private and public school, with the choice of type of school. I use data from the India Human Development Survey 2005, which has information on a nationally representative sample of about 42,000 households from both urban and rural India. Specifically, I attempt to quantify the income effect on private school enrolment. After controlling for the relevant household characteristics that affect perceptions of returns to private schooling, such as parental education and gender of the child, and school attributes related to quality and costs of schooling, the income effect must not be big, if the households are not credit constrained or there is no symbolic consumption of education (Banerjee, 2004).

and public-private partnerships in the education sector.

The remaining paper is organized as follows. Section II discusses the relevant literature and a simple theoretical model explaining the question. Section III describes the sample, explores the methodology used and interprets the results. Section IV concludes.

1.2 Theory and Literature

1.2.1 Literature

There has been some research on what matters for parents when choosing for a school type. Banerjee (2004) models the decision-making by families in alternative ways. The author studies implications of credit constraints and non-conventional preferences (such as symbolic consumption) on the family's investment decision in education. Observation 4 in the paper notes that there can be income effects and parental preference effects on investment in human capital if there is symbolic consumption of investment in human capital, even in the presence of perfect credit markets and a given interest rate.

Empirical studies on public and private schools have focussed on the relative effectiveness of each type of school. However, there has been some work on understanding the choice of school type based on both pre-school and school characteristics. Hastings et al. (2005) use data from the Charlotte-Mecklenburg School District to study parents' preferences for school characteristics including school test-scores and distance. They allow for heterogeneity of preferences among families belonging to different social categories and income brackets. The authors find that student income and own academic ability are positively related with the preference for school test scores. However, the authors don't study the choice of school for public-private school type classification.

Alderman et al. (2001) study the choice of schooling, and within schools differentiate between the public-private school type for poor neighborhoods in Lahore, Pakistan. Their results suggest that household consumption is the most important determinant of the decision on school investment. Among school attributes, class size, instructional fees and school distance matter most to families. In another paper, Glick & Sahn (2006) use data from the Madagascar Permanent Household Survey, a comprehensive, multi-purpose nation-wide survey of 4,508 households collected in 1993-1994, to explain primary school choice between public and private providers. Nishimura & Yamano (2013) provide evidence from rural Kenya using panel data from 2004 to 2007 on households' decision regarding attending a private or public school. They also include household, individual and school characteristics and find that the response of families to school quality differences between the two types of schools differs according to economic strata and gender of the child.

In all these papers, the sample size is relatively very small compared to the one used in the current study. Except for Glick & Sahn (2006), none of the studies have a nationally representative sample. Hence, their results are not generalizable for national policy making. In this paper, I use a specification similar to Alderman et al. (2001), with data from the India Human Development Survey 2005. The IHDS-2005 has extensive information on about 42,000 households from all states and union territories of India, including socio-economic aspects of the family as well as the community of the child. In that respect, I am able to generate more general results for policy analysis. Owing to the geographic range of the exercise, the IHDS collects information on only two representative schools in the family's neighborhood, one private and one public. Therefore, unlike Alderman et al. (2001), I do not have information on the location of all schools in the neighborhood, thereby not being able to use distance as a factor in the choice of a school type for families.

This paper contributes to the existing literature on school choice in three important ways. First, it is the first such exercise that studies the choice of school type by households for India. No other paper has assessed this household decision for such a large country before. Second, almost all papers use some index of household assets to proxy for household income. IHDS on the other hand uses detailed consumption patterns of about 30 categories of consumption items to get precise and reliable estimates of household consumption. This in turn helps in getting more precise estimates. Third, almost all studies on the intra-household decision-making on education choices find no difference in the effect of mother's or father's education on the child's school choice. However, I find a much stronger influence of the highest educated female in the family compared to the education of the male in selecting school type.

1.2.2 A Simple Theoretical Model

In classic economics literature, the choice of schooling has mostly been treated as the household's problem of maximizing expected lifetime utility subject to an economic constraint (Baland & Robinson, 2000; Ranjan, 2001; Stiglitz, 1974). The costs of schooling include direct costs such as tuition fee, and opportunity costs such as foregone labor wages or domestic help. The benefits include expected higher human capital and earnings in future. Thus, at the first stage, children whose parents can afford to send them to schools will attend one, whereas children of poor parents will be forced to either work outside or stay at home. In the second stage, parents make the choice of type of school - broadly public or private. The second stage choice problem exists due to a heterogeneity in school quality between the two school types. In what follows, I build a model of households' school choice based on a representative household maximizing expected utility given a budget constraint. I use a standard static model of household utility, assuming that a benevolent parent maximizes household consumption. I do not differentiate between consumption of the parent and the child.

Before moving to the formal model, here's a brief intuition of how the model would work. The tradeoff between a public and a private school is quality versus fee. A private school, offering better quality of services and expectations of higher human capital accumulation and earnings, is simply costlier. Hence families above a certain threshold of income only will afford private schooling, if they believe that the returns from private schooling are superior. On the other hand, the tradeoff between public schools and no schooling (or simply schooling and no schooling) is between the opportunity cost of schooling versus some human capital accumulation. In this case, there will be some families for whom the child's time is important in augmenting the meagre income of the family. It could be in the form of child labor wages or in the form of taking care of household chores and younger siblings while both parents are out to earn bread. For such families, the quality and fee difference between public and private schools is immaterial unless they can afford to forego the child's time at home or work. Throughout the paper we will assume the absence of credit markets, so these budget constraints are binding. It will be the middle-income group, which does not care about the forgone child labor income that will be most sensitive to the private fee versus quality tradeoff. When public school quality deteriorates, there will be more of such families transferring from public to private schools, willing to pay the higher fee now for higher future returns.

This is the essence of the argument provided to increase public spending on improving public school quality in the Indian policy debate today. However, an equally compelling reason for a shift from public to private schools is rising incomes. As the economy grows, more and more households find private education affordable. While competitive private schools have the incentives to adapt to the demands of a changing, global world, public schools lag behind. So the quality differential is maintained, and may in fact grow bigger over time. Changes such as reduction in the fee charged by private schools, or growth of affordable private schools will also have the same effect.

There is a continuum of households $\mathbb{I} = [0, 1]$ and each household $i \in \mathbb{I}$ comprises of one parent and one child. Each parent is initially endowed with an income A_i, which has a cumulative distribution function F, with $F' > 0$. The household's utility comprises of utility from consumption of net wealth and utility from the perceived returns to schooling. Net wealth comprises of the household's initial endowment, plus child labor wages if the child doesn't attend school, minus school fees if the child attends a private school. I assume that net costs of attending a public school are zero. Although there are costs other than the school fees such as those of books, uniforms, transportation, etc the government covers a majority of them through schemes that provide free books and uniforms to students. [4]

The perceived returns from schooling q^j are exogenous, $j \in \{p, g\}$, and are different for public and private schools, q^g and q^p respectively. Each period, a household has three choices: keep the child out of school ($e^l \in \{0, 1\}$), send child to a government school ($e^g \in \{0, 1\}$), or send child to a private school ($e^p \in \{0, 1\}$). These are mutually exclusive and exhaustive choices ($e^g + e^p + e^l = 1$). Government schools have no fee, and have a perceived return of q^g. Private schools have a fee f, and a perceived return of q^p. With the no-schooling option, a parent either sends the child to work outside which gets the family some child labor earnings, or takes the child's help for household chores or to take care of the younger siblings. This also saves some of the parent' time which can be used to go out and earn adult wages. Therefore, we assume that either way, the no-schooling option adds some wages w to the household's income, but has zero returns from education since the child is unable to learn to read. Other assumptions are: no credit markets; school fee, wages and quality are constant and exogenous, logarithmic utility function.

1.2.3 The Household's Problem

Thus, each period a household maximizes the combined utility of the parent and the child, comprising of net wealth and expected future returns, subject to the time constraint that

[4]In fact, the Indian government has a flagship program called the Mid-day meal scheme wherein attending students are provided with either cooked meals or dry grains to take home from the school. Thus the assumption of zero net costs of attending public schools may not be too much of a simplification.

the child can only do one of the three activities.[5] The household utility function is given by

$$U_i = log\{A_i + we^l - fe^p\} + log\{1 + q^g e^g + q^p e^p\} \tag{1.1}$$

subject to

$$1 = e^l + e^p + e^g \tag{1.2}$$

So, utility from choosing the no-schooling or labor option ($e^l = 1$, $e^p = e^g = 0$) is:

$$U^l = log\{A_i + w\}$$

Similarly utility from choosing a government school ($e^g = 1$, $e^p = e^l = 0$) is:

$$U^g = log\{A_i\} + log\{1 + q^g\} = log\{A_i(1 + q^g)\}$$

and from choosing a private school ($e^p = 1$, $e^l = e^g = 0$) is:

$$U^p = log\{A_i - f\} + log\{1 + q^p\} = log\{(A_i - f)(1 + q^p)\}$$

In this discrete choice framework, a household chooses a private school when $U^p \geq U^g$ and $U^p \geq U^l$; a government school when $U^g > U^p$ and $U^g \geq U^l$; and no school when $U^l > U^p$ and $U^l > U^g$.

[5]Although some children work after school to be able to supplement household income and/or cover the costs of schooling. In some cases, students enroll in both a public and a private school to take advantage of government schemes providing free schooling supplies and food at the public school, and good classes at the private school, we abstract from such cases here.

1.2.4 The Choice of School

Given this simple framework, the private schooling outcome (i.e $e^p = 1$, $e^g = 0$, $e^l = 0$) is observed when

$$log\{(A_i - f)(1 + q^p)\} \geq log\{A_i + w\}$$

and

$$log\{(A_i - f)(1 + q^p)\} \geq log\{A_i(1 + q^g)\}$$

i.e.,

$$A_i \geq \frac{f(1 + q^p)}{(q^p - q^g)} = A^*, \text{ and } A_i \geq \frac{w + f}{q^p} + f = \hat{A} \tag{1.3}$$

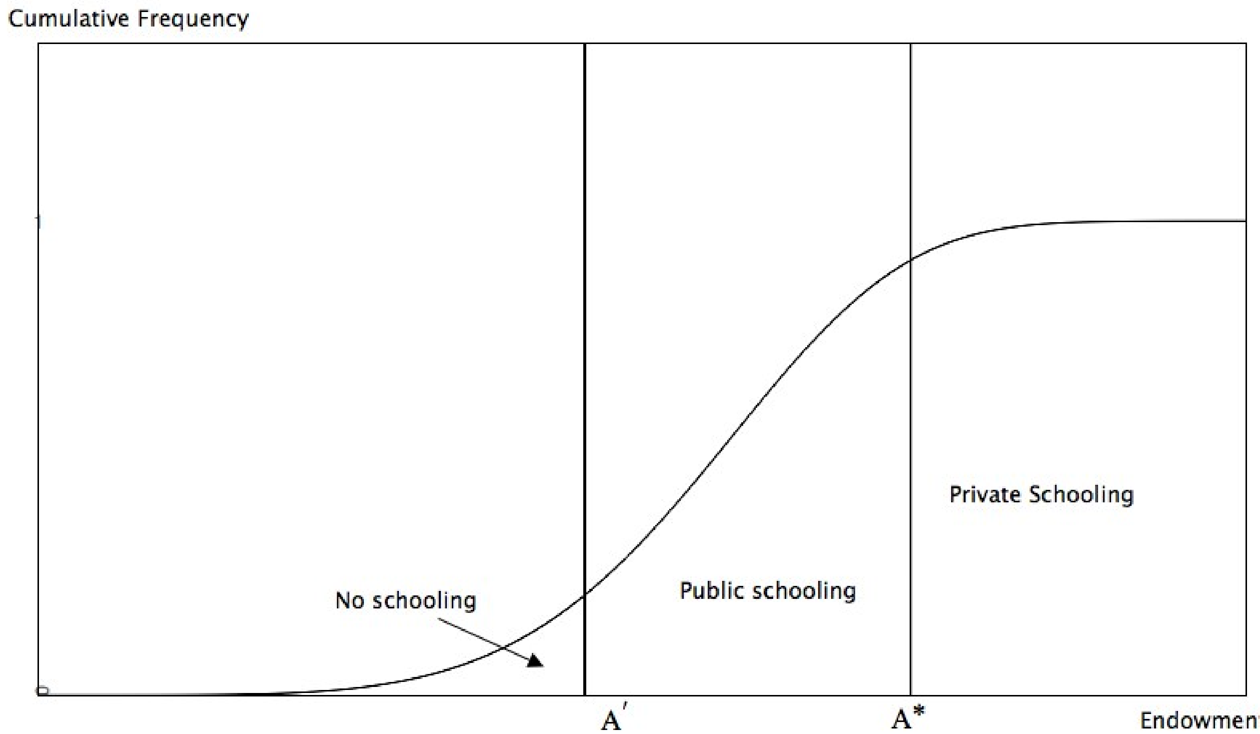
So household income has to be above a certain threshold for private schools to be chosen. This threshold depends positively on private school fee, child labor wages, and negatively on the difference in quality of public and priavte schools.[6]

Similarly, public school outcome will be observed when $U^g > U^p$ and $U^g \geq U^l$, or

$$A_i < \frac{f(1 + q^p)}{(q^p - q^g)} = A^*, \text{ and } A_i \geq \frac{w}{q^g} = A' \tag{1.4}$$

[6] $A^* > \hat{A} > A'$ when $A^* > A' = \frac{w}{q^g}$, i.e. if child labor wages are not too high and public school quality quality not too low, then we can say that A^* will be the binding constraint for private education. $\hat{A}$ turns out to be a linear combination of A^* and A' with weight $\frac{q^g}{q^p}$. Whenever $q^p > q^g$, $\hat{A}$ will be a convex combination of A^* and A'. I focus on this case, and when $A^* > A'$, we get the following cutoffs for the three school outcomes: Private Schooling: $A_i \geq A^* > \hat{A}$; Public Schooling: $A^* > A_i \geq A'$; No Schooling: $\hat{A} > A' > A_i$.

Figure 1.2: The three outcomes of school over the income distribution



and the no-school outcome will be observed when $U^l > U^p$ and $U^l > U^g$, or

$$A_i < \frac{w+f}{q^p} + f = \hat{A}, \text{ and } A_i < \frac{w}{q^g} = A' \tag{1.5}$$

Thus, combining (3), (4) and (5) we get a threshold level of parental endowment A^* such that families above that threshold will always choose a private school over a government school, and families with their endowments between A^* and A' will send their children to government schools. Families with endowments below A' will keep their children out of school.

Since the derivative of A^* with respect to private school quality q^p is always negative,

$$\frac{\partial A^*}{\partial q^p} = \frac{f(q^p - q^g) - f(1+q^p)}{(q^p - q^g)^2} < 0 \tag{1.6}$$

when the perceived private school quality (q^p) is raised, the threshold income to afford private schools A^* unambiguously goes down. This implies that the fraction of parents who send their kid to a private school, given by $1 - F(A^*)$ goes up. Thus if private school quality is not very different from that of public schools, then the required income to choose private schooling tends to infinity ($A^* \to \infty$), which makes the proportion of households choosing private schools close to zero ($1 - F(A^*)$). Again, if the relative costs of private education are very high (large f), it makes little sense for households to choose private schooling. These costs could include direct costs such as tuition, registration and other fees, cost of supplies such as books, stationary, uniforms, or indirect costs such as distance. Most government schools also offer scholarships and free supplies to students from economically and socially weaker backgrounds. Such help from public schools closes the cost gap between private and public schools, and weakens the influence of income on enrolment choice. Apart from relative costs, quality gap between schools is the other determinant of school choice. This quality gap depends not just on observable attributes of the schools that parents have access to, but also parents' perceptions of the quality gap. This might be biased towards one or the other type of school depending on the personal characteristics of the parent, her identity, educational background, etc. For example, parents from urban areas and with higher education attainment might favor a local private school because they perceive it to be better than the available local public schools. It could also be the case that if returns to education are perceived to be higher for a male child (for old age benefits from co-housing with sons), then private schooling will be more dominant for boys. In summary, the relative costs and perceived returns to schooling are the two primary factors in the model that affect the choice of school for parents.

1.2.5 A Closer look at the choice between Public and Private schools

All parents above income A^* will prefer a private school to a public school, where

$$A^* = \frac{f(1+q^p)}{(q^p - q^g)} \tag{1.7}$$

Let us normalize public school quality q^g to zero and private school fee f to 1. Then,

$$A^* = \frac{(1+q^p)}{q^p} = 1 + \frac{1}{q^p} \tag{1.8}$$

where q^p essentially is the quality gap between the local public and private school.

Above the curve, with higher parental income and private school quality, we observe private schooling whereas below the curve, with lower parental income and low private school quality, we observe public schooling. Since we've normalized public school quality to zero, the x-axis also denotes the difference between public and private school quality.

As the quality gap between public and private schools widens, the threshold level of income required for parents to switch from public to private schools falls. [7]

1.3 Data

1.3.1 Sample

The implications of this basic model can be tested using cross-section data on household income, measures of school quality as perceived by parents for both public and private schools in the neighborhood, and the choice of type of school by households. We use data from

[7] As private school fee f goes up, the curve separating private school with public school outcomes shifts upwards. Consequently, a smaller fraction of parents will be able to afford private schools over public schools.

the India Human Development Survey (IHDS 2005), which captures the required income and school parameters. The IHDS was conducted in all states and union territories of India [8] including data on 382 out of 612 districts in India in 2001. The sample was drawn using stratified random sampling, and consists 27,010 rural and 13,126 urban households. Households answered questions related to health, education, employment, socio-economic status, marriage, fertility, gender relations, and social capital. Children aged 8-11 completed short reading, writing and arithmetic tests. Additionally, for almost all of the villages and urban blocks sampled, an attempt was made to interview at least one public and one private primary school from the community (Desai et al. (2008)). The choice of school was based on popularity and enrolment.

This nationally representative sample of 41,554 households came from 1,503 villages and 971 urban neighborhoods in India. Of these, there were 29,207 children in the age group 6-14 years, who also had corresponding information from the schools dataset on at least one public and one private school in the Primary Survey Unit (PSU) of the family. [9] [10] In the analysis that follows, we use information on the families of these 29,207 children from the household survey, and on the attributes of one school of each type - both public and private - from the schools survey. It must be noted that the school attributes are not necessarily of the particular school attended by the child. For example, it is possible that the child attends a private school, say KK, in a PSU but the school survey collected information only on the private school, say AA, and the public school, say BB, in the PSU. Since we need information only on one 'representative' school for each type (public and private) in the community, this does not limit the analysis a lot. Table (1.1) gives some summary statistics

[8] The only exceptions were Andaman Nicobar and Lakshadweep Islands.

[9] A Primary Survey Unit (PSU) is a village in the rural context and a block in the urban context.

[10] The remaining 14,953 children in the relevant age group did not have corresponding information on at least one public and one private school in the area, and were dropped from the analysis for two reasons. One, it has not been documented in the survey whether the missing information for communities with data on one type of school was due to non-existence of the other type of school or due to field work limitations. Second, the presence (or absence) of either a private or government school in a community could be the result of a complex mix of supply and demand factors, which this paper does not analyze.

Table 1.1: Descriptive Statistics: Households and Students by Type of School

	Private School	Public School	Out of School	Total
Enrolled Students (#)	8,105	16,038	5,064	29,207
Male (%)	57	51	46	52
Urban (%)	36	13	13	19
	Household specific			
Monthly per capita consumption (Rs)	930	577	504	653
Average highest male education in the family (grade)	8	5	3	6
Average highest female education in the family (grade)	6	3	1	3
	Student specific			
Private tuitions (hours)	2	2	3	2
Private tuitions (Rs)	272	135	561	180
Reading Ability Level	3	2	0	2
Math Ability Level	2	1	0	1
Writing Ability Level	1	1	0	1

on the interviewed households used for the study.

We get a comparable sample of about 28% private school enrolment among school-going children in our subsample. The monthly per capita consumption is highest in families that send their children to private schools. We also observe that private schooling is more of an urban phenomenon, with 36% of private school enrolment coming from urban areas. There is also a marked difference in the gender composition of private and public schools. 57% of private-school enrolled children are boys, as opposed to only 51% among the public school students. This is indicative of the mindset of Indian parents that is biased against females when deciding to invest in their education. So far we dont see a large difference in either the income levels or gender composition between public school children and out of school children, though the out of school children do seem to be slightly worse off.

Table 1.2: Private Enrollment breakdown by per capita consumption quartiles in rural and urban areas

	Rural		Urban	
Quintile	cutoff (Rs.)	% Private	cutoff (Rs.)	% Private
1st		12%		38%
	359		534	
2nd		21%		47%
	529		797	
3rd		27%		63%
	798		1218	
4th		44%		77%
	N ≈ 18,153		N ≈ 5,990	

Surprisingly, some out of school children's families are spending substantial amounts on home tuitions. This may have several reasons (to be explored later). It could be due to the absence of any decent school in the neighbourhood, so the parents decided to home-school the child, employing private tutors. Or it could be due to a lack of faith in the formal schooling system.

Test scores of children from each school type corresponds well with the fact that children from private schools perform better on all three measures - reading, writing, and math. Out of school children have very little to no ability at solving simple math questions or reading small paragraphs or writing a small sentence. As can be seen from Table (1.2), enrolment goes up with higher income, with a steeper effect in urban areas.

School attributes are summarized in the Table (1.3). Private school fee is substantially higher than public school fee. There is a provision for free books and meals for all students in most public schools. Class size (or pupil-teacher ratio) is substantially less in private schools compared to public schools. Not only are class sizes much bigger, there are also multi-grade classrooms in many public schools. This also substantially dilutes the quality of teaching in the classroom in government schools in India. English instruction and computer

Table 1.3: School Attributes

	Private School	Public School
Average School fee	671	18
Free Meal or food (%)	13	87
Free books	16	88
Class size	30	41
English-medium of instruction (%)	51	27
Computer Education (%)	29	6
Full-time Teachers	7	5
Formal Teacher Evaluation	79	72
Average # classrooms	5	7
Chairs/desks for all students (%)	63	29
Hours electricity	2.2	3.8
Separate Toilets	62	46

education seems to be the forte of private schools, as is the popular perception, with public schools seriously lagging behind. Other major differences are in infrastructure facilities such as separate chairs and desks for all students and separate toilet facilities for boys and girls.

1.3.2 Estimation Equation

We know from the above model that a household i will choose school type j if $U_i^j \geq U_i^k$ where $j, k \,\epsilon \,\{Private\, school,\, Public\, school\}$. Let e_i^p be the dummy variable indicating household i's choice of private school. Then,

$$e_i^p = \begin{cases} 1, & if\ U_i^p \geq U_i^g, \\ 0, & if\ U_i^p < U_i^g \end{cases} \tag{1.9}$$

The choice probability is then

$$P_i = Prob(e_i^p = 1) = Prob(U_i^p > U_i^g) \tag{1.10}$$

The reduced model for this choice probability of individual i is:

$$P_i = \beta_0 + \beta_1 X_i + \beta_2 H_i + \beta_3 S_i + u_{it} \tag{1.11}$$

where X represents household income, H is a vector of household characteristics other than income and S is vector of covariates including school attributes, such that u_{it} is a random disturbance. We fit this model to the data to estimate the effect of income on the probability of private school enrolment (for the baseline year 2005) after controlling for school characteristics that may affect the choice.

If we find the coefficient of income significantly different from zero, then it seems reasonable to conclude that income affects private school enrolment. Since income increased over the years, it is not surprising that private enrolment increased. By multiplying the marginal effect of income from the baseline case (β_1) with the growth in incomes over the relevant years, we can account for some of the increase in private enrolment. The underlying assumption here is that the model's parameters are stable over time.

I fit a logit model on the data.[11] I also fit a multinomial logit model with out of school children. The coefficient of income for private schooling does not change, keeping public

[11] I also fit an LPM (both with and without fixed effects) for comparison. The estimates are similar in all cases.

schooling as the base. The results are presented in the next section.

1.3.3 Results

Tables (1.4) and (1.5) provide the estimates for regressing household choice of schooling on some parameters of household income, relative costs of schooling and factors that might influence perceptions of the returns from schooling from the two types of schools. We also include a multinomial regression to compare results, by including out of school children in the sample, which is a substantial 18%.

Interpretation of coefficients

Household Related variables

1. Income. For every doubling of per capita income, private school enrolment goes up by about 10%.

2. Highest education of a female adult in the family. This is the next most important predictor of private enrolment. An additional year of female education in the family increases the likelihood of private school enrolment by about 1.5%.

3. Highest education of a male adult in the family. Less important than adult female education in the family. An additional year of education for the male head Increases private school enrolment by about less than 1%.

4. Gender of pupil. Girls are about 6% less likely than boys to go to private schools. In the multinomial logit specification, girls are less likely to attend private schools but more likely to not go to any school relative to boys.

Table 1.4: Regression results of binary choice between private and public schools enrollment on household and school characteristics

Dependent: Private school=1, Public School=0	LPM			LOGIT
	No fixed effetcs	with State fixed-effects	with Village/Block fixed-effects	Marginal effects at mean
Log_2(Per capita consumption)	0.100	0.101	0.093	0.120
	(28.35)**	(26.82)**	(21.95)**	(27.39)**
Highest education (female)	0.013	0.016	0.014	0.013
	(16.59)**	(19.40)**	(17.51)**	(15.28)**
Highest education (male)	0.008	0.006	0.006	0.010
	(12.09)**	(9.42)**	(9.30)**	(12.23)**
Girl	-0.061	-0.059	-0.059	-0.071
	- (11.05)**	(-11.27)**	(-12.12)**	(-10.88)**
Age	-0.006	-0.005	-0.005	-0.007
	(5.16)**	(-4.72)**	(-5.28)**	(-5.08)**
Urban residence	0.188	0.191		0.194
	(24.96)**	(25.15)**		(25.06)**
Dummy for social identity (Base: Forward caste Hindu)				
Other Backward Caste	0.011	-0.022	-0.035	0.019
	(-1.37)	(-2.72)**	(-4.01)**	(2.15)*
Adivasi	-0.013	-0.024	-0.076	-0.048
	(-1.05)	(-1.98)*	(-4.94)**	(-2.64)**
Dalit	-0.063	-0.078	-0.104	-0.079
	(-7.36)**	(-9.25)**	(-11.02)**	(-7.57)**
Muslim	0.029	-0.01	-0.026	0.041
	(2.77)**	(-0.88)	(-1.87)	(3.61)**
Sikh/Jain/Christian	0.205	0.156	0.116	0.203
	(11.37)**	(8.14)**	(5.33)**	(9.96)**
School Quality Gap (base: Public Schools)				
Class size	0.0003	0.0004		0.0004
	(3.92)**	(4.56)**		(4.07)**
Grade English Instruction Begins	-0.003	0.0010		-0.003
	(-1.73)	(0.42)		(-1.57)
Separate toilet for girls*Girl dummy	0.015	0.012		0.015
	(1.78)	(0.42)		-1.44
Computer education	0.035	0.030		0.041
	(5.57)**	(4.76)**		(5.72)**
Log(School Fee)	-0.040	-0.026		-0.047
	(-12.77)**	(-7.82)**		(-13.52)**
Free meals	-0.028	0.001		-0.033
	(-3.47)**	(0.14)		(-3.49)**
Free books	-0.010	-0.005		-0.010
	(-2.78)**	(-1.34)		(-2.2)*
Free uniforms	0.040	0.004		0.046
	(9.86)**	(0.68)		(9.59)**
Scholarships	-0.027	-0.003		-0.030
	(-6.43)**	(-0.75)		(-6.16)**
Separate toilet for girls	-0.04	-0.010		-0.050
	(-6.58)**	(-1.65)		(-6.88)**
Constant	-0.656	-0.659	-0.554	-6.430
	(-19.67)**	(-18.30)**	(13.49)**	(-31.89)**
Adjusted R^2	0.22	0.26	0.40	0.18
N	24,134	24,134	24,134	24,134

Note: (1) figures in brackets are t-values or z-statistics.
(2) $*p < 0.05$; $**p < 0.01$

5. Age of pupil. Higher age leads to lower private school enrolment. This could be due to less access to a higher secondary school compared to primary schools in the locality. Although in the sample of older kids who were attending public schools, a significant proportion had access to at least one private school that taught the same or higher grade. It could also mean higher costs of private education for higher grades.

6. Caste group: Being from a high caste family not important. But being a Dalit or Adivasi reduces probability of private enrolment by about $4-8\%$.

7. Religion. Being a Muslim positively affects the likelihood of private enrolment, whenever significant. This could be due to enrolment in *Madrasas*, which are private establishments. Being either Sikh, Jain or Christian increases private enrolment probability in all specifications.

8. Urban residence. Next most important predictor of school choice after income. Urban families are 15% more likely to send their children to private schools. Rapid urbanization in the last decade in India could also be a major driver of privatization of education in India.

School Related Variables

We need variables that parents think affect the returns to schooling. The following variables are constructed as differences between private and public schools, with public school as a base.

1. Pupil-teacher ratio or class size. Positive and significant, but very small. Here public schools with bigger class sizes reflect inferior quality for parents, perhaps even multi-grade teaching. However, bigger class size in private schools is a signal of better quality, as there are small unrecognized fly-by-night type private schools also that mushroom

anywhere but don't stay for long. This is not a possibility with public schools which are more often than not overstuffed.

2. Medium of instruction: English is preferred, for its importance in the job-market, and hence higher expected returns of future earnings, although the coefficient is not significant in most specifications above. I also used an English-medium-school dummy, instead of the grade that english instruction begins. The variable is still not significantly different from zero in most specifications.

3. Use of computers. Positive and significant effect. Computer education increases private enrolment probability by about 3%.

4. Separate Toilets for girls. When interacted with the girl dummy, this gives the expected positive sign. However, the estimate is not significantly different from zero.

5. School fees. Significant and negative, denoting that parents care about the cost of schooling when choosing between private and public schools. Private schools are less preferred if they charge very high fee, or are unaffordable.

Other incentives, such as :

- Free Meal. Not significant
- Free Uniform. Positive and significant effect.
- Free Supplies (textbooks and stationary). Sign not consistent across models. Not signicant most of the times.
- Scholarship. Important (in some specifications) but negative coefficient.

Broadly, only class size, school fee and computer education are important in determining the choice of school. The estimates are significant and of the expected sign, but the magnitude is extremely small, especially compared to the size of the household characteristics estimates. Other than these factors which are clearly important, parents seem to not consider the other factors while choosing type of school, such as free supplies and scholarships. Contrary to what has been found in other studies, I do not find evidence of separate toilets for girls or English-instruction being important determinants of the choice of school type. It seems to mainly rest on household characteristics, which defines not just the ability to afford private education, but also perceptions of the differential returns from public and private education.

In Table (1.5), I use a multinomial model specification, including characteristics for out of school children also from the data. Keeping government schools as the base category for easy comparison with the results of the previous models, I find that the estimates are almost the same for children attending private schools as in earlier models. For out-of-school children, estimates of household income, parental education, girl dummy and age are opposite in sign to those of private school children. This reflects the fact that keeping children out of school is the less preferred option for parents compared to putting them in a public school. Girls are more likely to stay out of school compared to boys, and older children more likely to drop out from the education system. All the socially disadvantaged classes and minorities are more likely to have their children out of school compared to the base of forward caste Hindus. Urban residence is no longer significant in explaining the choice of schooling and no-schooling.

For private-public school characteristics, higher private school fee leads to more schools from staying outside the education system. Similarly bigger class sizes in private schools leads to less children out of school. This could be evidence of the role of private schools in providing more educational opportunities and choices for families when the public system is already constrained. Free meals are the most important factor attracting children into schools,

Table 1.5: Regression results of multinomial choice between privateschool, public school, and no school enrollment on household and school characteristics

Dependent: Private school=2, Public School=1 (BASE), No-School=0	MULTINOMIAL LOGIT Marginal effects at mean (z-values)	
	Private School	No School
Log_2(Per capita consumption)	0.108	-0.044
	(29.83)**	(-15.41)**
Highest education (female)	0.013	-0.010
	(17.62)**	(-13.72)**
Highest education (male)	0.009	-0.008
	(14.14)**	(-15.51)**
Girl	-0.067	0.040
	(-6.44)**	(9.67)**
Age	-0.005	0.005
	(-6.46)**	(5.19)**
Urban Residence	0.154	0.013
	(24.45)**	(2.27)
Dummy for social identity (Base: Forward caste Hindu)		
Other Backward Caste	0.007	0.028
	(1.02)	(3.77)**
Adivasi	-0.061	0.073
	(-4.03)**	(7.36)**
Dalit	-0.080	0.058
	(-9.08)**	(7.64)**
Muslim	0.012	0.084
	(1.33)	(10.44)**
Sikh/Jain/Christian	0.156	0.020
	(9.4)**	(0.98)
School Quality Gap (base: Public Schools)		
Class size	0.0004	-0.0004
	(5.27)**	(-8.14)**
Grade English Instruction Begins	-0.002	-0.005
	(-0.93)	(-1)
Separate toilet for girls*Girl dummy	0.014	-0.002
	(-1.64)	(-0.54)
Computer education	0.038	-0.013
	(6.28)**	(-2.49)
Log(School Fee)	-0.037	0.003
	(-12.86)**	(1.2)
Free meals	-0.033	0.034
	(-4.33)**	(5.69)**
Free books	-0.006	0.002
	(-1.65)	(0.8)
Free uniforms	0.038	-0.005
	(9.66)**	(-1.55)
Scholarships	-0.022	-0.005
	(-5.47)**	(-1.75)*
Separate toilet for girls	-0.036	-0.005
	(-6.09)**	(-1.06)
Constant	-6.265	0.441
	(-32.07)**	(2.01)*
R_2	0.1374	
N	29,196	

Note: (1) figures in brackets are z-statistics. (2) $*p < 0.05$; $**p < 0.01$

providing strong justification for the Mid-day Meal Scheme in India of providing free meals to children for attending school. Scholarships could also be important in bringing about this outcome of bringing children to schools.

1.3.4 Issues in interpreting the coefficients

Although the analysis establishes a high correlation of private enrolment with average household consumption, I can't claim that it identifies the true effect of income in choosing a school type. There is a possible omitted variable problem, and a possible endogeneity problem. The omitted variable bias could result for several reasons, including but not limited to the child's innate ability and the choice of location by private schools, which affects distnace from the school. For example, if more high ability children come from more resourceful households, and they also prefer private schooling, then the income effect would be upward biased. Similarly, if private schools locate in relatively rich localities, then income would be negatively correlated with relative distance from private schools vis-a-vis public schools. A smaller distance to school is associated with more private enrollment, making the income effect upward biased. However, there is some evidence that poor families prefer to choose schools closer home to reduce costs (Hastings et al. (2005)). Hence, distance from private school could be negatively correlated with income as well, making the income estimate downward biased.

Even if we believe these estimates, we don't know how much of the income effect is indicating credit constraints and how much is an exogenous taste for private education[12]. But either way, there are implications for inequality and social mobility. If it is the poorer and socially disadvantaged families who cannot afford private schools, thus being stuck with either the less effective public school system or deciding to keep thier children completely out of schools, then this will perpetuate the socio-economic inequalities rampant in the Indian society.

[12]The taste for private education could be due to symbolic consumption, or Akerlof-Kranton type identity homogenization.

Considering that public schools are also less adept at equipping children with skills that are desirable for a better and more secure future, this might be a channel through which intra-household gender inequities and inter-household social injustice are maintaining their hold, despite state efforts to bring change.

1.4 Conclusion

With a near doubling of incomes in the last decade in India, we can say now that the corresponding rise of about $13-18\%$ in private enrolment is not surprising. Most of it, about 10%, can be explained by the characteristics of households, and the general perceptions in the economy. This does not say that efforts to improve the quality of pedagogy in public schools is misplaced. On the contrary, this study notes that to keep up the demand for public schools, the pace of improvement has to be quickened. Not only does the public education sector need to provide better supplies and resources to students, it perhaps also needs to engage with students and parents on other levels, and change its overall reputation of not delivering results.

More important are the estimates of female versus male education in the family in driving children into schools or better schools. Previous studies in other countries on the subject have always found the effect of mother's and father's education similar on the schooling decision of children. However, estimates using the IHDS-2005 data strongly point towards the salience of mother's education in determining education investments in the family. This is also consistent with the literature on intra-household transmission of identity and values to the children through the mother.

Further work is needed to pin down the exact role of income in the education decisions of families, be it for evidence of credit constraints or non-conventional preferences of parents.

More detailed data analysis using models of intra-household decision-making would also be useful in identifying the changing role of mothers and their education in the family decision-making process.

Chapter 2

Rent-Seeking Induced Inequality Traps

2.1 Introduction

Does rising inequality affect rent seeking? Does rent seeking, in turn, affect the distribution of wealth, creating an inequality trap? These questions have been at the heart of the development discourse and political debates for over a decade and their answers will shape development policy in the coming decades. The World Development Report, 2006 brought the issue of equity to the forefront of the development world. In recent years, researchers such as Piketty and Milanovic have revolutionized our understanding and added further interest to the political economy of inequality[1]. However, much remains to be understood. Specifically, there is a need to examine the causes of extreme inequality beyond theories of marginal productivity[2].

[1]Piketty's most prominent work is Capital in the 21st Century, 2014. For a summary of his idea, read Piketty & Saez (2014). Branco Milanovic's research has focused on global inequality, both within and between countries. Some of his recent works are The Haves and the Have-Nots, 2010 and Global Inequality, 2006.

[2]The welfare losses due to rent seeking were first highlighted by Tullock (1967). Krueger was among the first to acknowledge rent seeking as an important cause of inequality as early as the 1970s. In her seminal work where she coined the phrase 'rent seeking' (Krueger, 1974), she wrote "In the United States, rightly or wrongly, societal consensus has been that high incomes reflect - at least to some degree - high social product.

In this paper, I address the above questions by modeling an inequality trap in an economy characterized by rent seeking. I do so by formalizing the idea that a more unequal society will be more vulnerable to rent seeking. In turn, rent seeking itself will transform the distribution of wealth, making it more skewed. The two feed back into each other, creating a cycle of endemic inequality - an inequality trap induced by rent seeking. The equilibrium rent seeking and inequality are history-dependent in that they depend on the initial level of inequality. Thus, the paper presents rent seeking as both a cause as well as consequence of rising inequality.

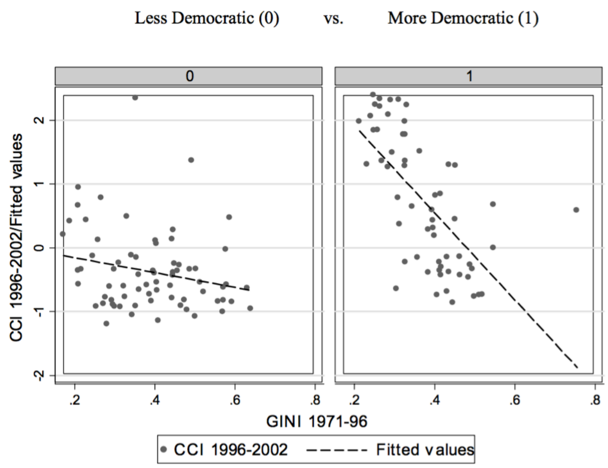
The idea that unequal societies are more susceptible to rent seeking has been present in the social sciences literature. Economists have argued that high inequality provides the rich with the resources and reasons to maintain their economic status (Acemoglu & Robinson, 2006; Banerjee et al., 2001). Large distributional inequities place a disproportionate amount of power with a few, be it bargaining power, influence, personal connections or resources to bend the rules in their favor. As Glaeser et al. (2003) point out, if courts are corruptible, then the legal system will favor the rich over the just. Similarly, if regulatory institutions can be 'captured' [3] by wealth or influence, they will gratify the influential, not the efficient. Moreover, if political actors value campaign contributions, they will accommodate and even facilitate special interests[4]. In political science, prominent work has been done by Uslaner (2004) who argues that inequality breeds lower trust and more rent seeking. Jong-Sung &

As such, the high American per capita income is seen as a result of a relatively free market mechanism and an unequal distribution is tolerated as a by-product. If, instead, it is believed that few businesses would survive without exerting "influence," even if only to bribe government officials to do what they ought in any event to do, it is difficult to associate pecuniary rewards with social product." More recently, a prominent research agenda in economics has been to understand and explain persistent inequality induced by factors other than productivity differences (Bourguignon et al., 2007; Jacobs, 2015; Kanbur & Stiglitz, 2015; Stiglitz, 2012)

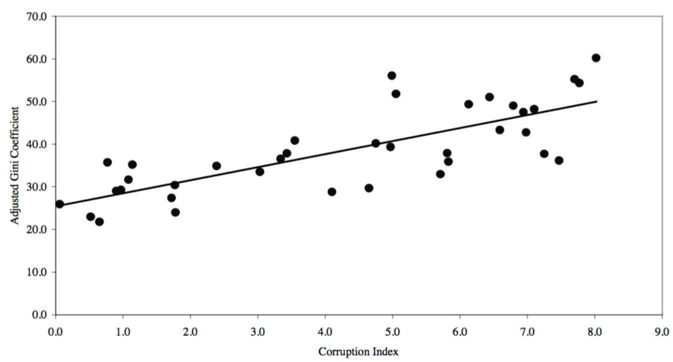
[3] The pioneering work on regulatory capture was done by Stigler (1971) For a more recent review of developments in this literature, see Dal Bó (2006).

[4] See Stiglitz (2012) for a well-rounded discussion on the nature, causes and perils of inequality in the modern economy with rent seeking.

Figure 2.1: Two-way relationship between corruption and inequality



(a) Corruption is a function of inequality. A high value of the Gini coefficient implies a low Control of Corruption Index (CCI). Source: Jong-Sung & Khagram (2005)



(b) Inequality is a function of corruption. A high value of the corruption index implies a high level of inequality. Source: Gupta et al. (2002)

Khagram (2005) provide cross-country evidence that high inequality leads to an increase in perceptions of corruption 2.1a.

Evidence for the backward link between rent seeking and inequality is also wide. Corruption, one of the more egregious forms of rent seeking, has been shown to increase inequality (Gupta et al., 2002; Li et al., 2000; Murphy et al., 1993). 2.1b shows the relationship from Gupta et al. (2002). Winters discusses other forms of rent-extraction by oligarchs (Winters, 2011). They are able to do so because a skewed wealth distribution can result in differences in the allocation of property rights, voting rights (adult suffrage), public resources or education. These differences could arise for two reasons. First, inequality could reduce redistribution and public good provision (Rodriguez, 2004), because economic resources determine the ability to influence political outcomes (Acemoglu & Robinson, 2006). Second, the poor may lack the resources to push their political agenda, such as better public protection of property rights, more investment in overhead capital, etc. Thus, a system where the rich can take away from the less well-off also changes the allocation of wealth, perpetuating existing inequities.

None of the above papers, however, endogenizes the distribution of wealth as a function of rents and vice-versa. Alesina & Angeletos (2005) endogenize the wealth distribution by modeling rent-seeking as embezzlement of tax money by bureaucrats in a voting model. They posit that more inequality leads to demands for bigger government (more progressive redistribution) which fosters more corruption. This fact, coupled with either asymmetric abilities for corruption or norms of fairness, leads to a positive feedback loop between corruption and inequality. In this paper, I model rent seeking in a more general form, including rents from monopoly profits, quota restrictions, lobbying, campaign finance and feudal tax systems. A more general model of rent-seeking arising from an unequal distribution of wealth has been presented in Chakraborty & Dabla-Norris (2006). The authors develop a baseline model of rent-seeking that arises due to disparities in wealth. However, they do not examine the effects of a change in inequality on rent-seeking and vice-versa. Matsuyama (2000).

This paper is the first attempt, that the author is aware of, that presents rent seeking as the main mechanism for an inequality trap[5]. The methods introduced in this paper to statistically model an inequality trap can be easily adapted to illustrate inequality traps in other situations. I start with a population where the only source of heterogeneity across agents is the level of wealth. Agents have two activities to choose from: engage in rent-seeking behavior or pay rents. Rentiers have to incur a fixed cost to collect rents, which captures the increasing returns from rent seeking necessary to generate a split between the rich and poor in terms of occupational choice.[6] In what follows, I will show that more inequality gives rise to more agents choosing the rent-seeking option when costs are fixed. Thus, rising inequality perpetuates rent seeking as a strategic response to the threat of being appropriated from by the wealthy, pushing more and more agents at the margin into rent-seeking. However, when the cost of rent seeking is endogenized to maximize a sovereign's revenue, costs increase with more inequality, reducing the proportion of agents who choose to be rentiers. In both cases, the resultant distribution is more unequal than before. A feedback loop is generated between inequality and rent seeking, leading to an inequality trap.

The rest of the paper is organized as follows. In the next subsections, I discuss the interpretations of the parameters used in the model. Section 2 lays out the base model with fixed rent-seeking costs and its results. Section 3 endogenizes the costs from the sovereign's point and interprets the changes in results. Section 4 presents some brief work-in-progress ideas

[5]Endogenous inequality has been modeled before as primarily a result of the combination of credit market imperfections and differences in skills or tastes (Banerjee & Newman, 1993; Matsuyama, 2000; Mookherjee & Ray, 2003) or increasing returns to scale (Engerman & Sokoloff, 1997; Freeman, 1996).

[6]Increasing returns in rent-seeking activities have been explained by Murphy et al. (1993). The occupational choice model was pioneered by Banerjee & Newman (1993).

and concludes.

2.1.1 Rent-seeking

In this section, I talk about what activities are labeled as rent-seeking in the economics literature. Traditionally rents are described as the return to a factor of production that is accrued irrespective of any effort on the part of the owner. This broad definition over time has come to encompass monopoly profits, quota-rents from import restrictions and profits from the exclusive rights to mine a natural resource. It may also include indirect and direct transfers and subsidies from the government, profits from laws that limit competition or poor enforcement of existing competition laws, exclusive rights that allow corporations to pass on costs to the rest of society. In some countries rent-seeking can also take its most egregious form: corruption, where bureaucrats frequently take bribes for completing activities that are part of their usual job description or taking away scarce resources from the public exchequer. More often than not, agents make payments to secure high-paying bureaucratic positions, in return for which, they expect a future stream of payments with a certain present value.

All of the above are different forms of regressive redistribution, with the transfer of resources from the bottom of the pyramid to the top. This transfer always comes at a cost, be it funds spent on lobbying efforts to secure subsidies and transfers from the government or on other forms of influence in changing the competition laws. Lobbyists not only include large corporations in the private sector. In most countries, civil service unions have a remuneration structure that far exceeds that in the private sector. While some part of the wage differential stems from differences in the type of contract and tasks involved, a large part also comes from union rents.[7]

[7] See Bellante & Long (1981) for early evidence in the U.S. labor market.

Apart from lobbying expenses, rentiers are known to maintain connections with those in power which can be very costly. Historically, the feudal lords had to pay monies to the king for rights to collect taxes, maintain an army as well as a big house with the status appropriate for their station. Financing political campaigns is another major source of costs for rent-seekers to get favorable legislation enacted in return which may include exclusive mining, drilling or distribution rights. Revolving-door lobbying has its price including but not limited to the promise of lucrative industry positions post the political tenure (Blanes i Vidal et al., 2012). For every piece of legislation enacted to unfairly favor rentiers, there is an increased burden on the rest of the population. Each of these inefficient transactions imposes a fee that is distortionary in nature.

In countries with weak law enforcement and poor institutions, the costs of rent-seeking may take the form of traditional arms keeping, as in by gangs and paid criminals. In a more mainstream setting, many forms of bargaining for a higher share of profits could take the form of rent-seeking, with expenses including but not limited to hiring better lawyers or bribing the jury. The latter amounts to judicial corruption and may be restricted depending upon the state of institutions in the country, but the former is perfectly legal and openly practiced.

The easiest way to model this process of rent-seeking is by assuming an appropriation rate on all non-rentier agents, which is transferred to the rentiers. While rentiers also usually pay an appropriation cost, their burden is smaller owing to the rents they accrue. Thus, one could assume a single appropriation rate (subsequently γ) on non-rentiers which captures the differential burden on them due to the social costs of rent-seeking. The higher the wealth, the bigger the loss from paying distortionary rents. The costs of rent-seeking, on the other hand, can be modeled as fixed costs (hereafter θ), to obtain the increasing returns necessary to drive a wedge between the rich and poor. While it is possible that these costs also have a variable component, I keep costs fixed for now for simplicity of exposition.[8] θ could also be thought of as including the investment cost in protection technology (say arms and ammunition or other general protection from having to pay rents). In modeling rent seeking in this manner, I capture its essential attribute of regressive redistribution while maintaining its general features such as the fact that it is a negative-sum game with strategic incentives.

I abstract from production. To model rent-seeking in an economy with production requires considerations such as distortion of incentives, prices, markups, etc. The advantage is to be able to capture the impact of rent-seeking activities on growth. This has been the subject of much research already and is therefore not discussed in this paper.

Finally, I'd like to discuss how rentiers are able to change θ and γ, i.e. the cost and benefit from rent seeking respectively. θ could be seen as an investment choice for the rentier and is easily manipulable by her. In this context, a rentier would choose the optimal investment amount considering her returns from the investment. On the other hand, θ and γ could together be seen as the state of institutions in society with a higher cost of rent-seeking implying stronger institutions. For example, if bureaucrats, judges, and politicians are incorruptible, or if the penalty for being caught accepting bribes is prohibitively high, a rentier will have to pay a lot to influence the system in her favor, implying a higher θ and lower γ. Institutions also change over time but that is likely a much slower process and not solely determined by the rentier class. In this paper, I take up the case of θ as the rentier's investment choice, with γ as an increasing concave function of it. The case of $[\theta, \gamma]$ as intitutions is equally interesting and will be pursued later.

[8] An example of corruption that hurt the public exchequer without changing the efficient allocation of resource is the 2G scam in India. Bureaucrats gave away the 2G spectrum at throwaway prices to phony companies affiliated with their relatives. But Sukhtankar (2013) shows that eventually the spectrum was auctioned off efficiently. The only concern was the transfer of resources belonging to the national chequers to private agents.

2.1.2 Inequality Traps

In a broader sense, an inequality trap refers to a system of economic, political and social structures that lead to persistent inequality in the distribution of resources (in wealth, power and social status) (Tilly, 1998). Inequality traps are similar to poverty traps in that they keep the poor from getting out of the cycle of poverty. But they differ from them in that inequality traps talk about the whole distribution of resources, not just the left tails. In an inequality trap, the entire distribution is stable such that even the rich (the right tails of the distribution) are protected from downward mobility (Rao et al., 2006). In other words, poverty traps are at an individual level while inequality traps are about the entire distribution.

In the technical sense, Bourguignon et al. (2007) define inequality traps using two assumptions: first, the relative positions in the distribution be persistent across time; second, that this be a result of the features of the overall distribution. The second condition implies that the circumstances that each agent finds herself in is a direct consequence of her position in the distribution of resources. For example, if the children of the poor remain poor because they go to bad schools and the quality of schools reflects the economic status of parents, then we have an equilibrium with an inequality trap. Another example with a clear case of rent seeking arises in industries with government-granted licences such as patents, mining rights and spectrum allocation. If it is the larger firms that are able to purchase the licence and grants, and access to a licence generates bigger profits, then we again have an equilibrium with an inequality trap. These industries, with lower levels of competition, ensure that small firms remain small and large firms remain large. In other words, the relative position of firms in the distribution of firm size remains stable.

These are only two examples of market situations that can generate increasing and persistent inequality through rent-seeking behavior. One can think of several other cases such as discrimination or lower aspirations of disadvantaged population groups, also discussed in Rao et al. (2006), Ferreira & Walton (2006) and Bourguignon et al. (2007), which also lead to ex-post distributions of resources that are inferior to the initial ones. In each of the cases, a redistribution of initial resources breaks down the equilibrium which leads to higher inequality. Hence, an important part of formalizing an inequality trap is the existence of multiple equilibria, at least one of which does not result in the inferior inequality distribution.

In the subsequent sections, I formalize the idea of an inequality trap by modeling inequality-generating rent seeking in a static framework. While the framework is different than the dynamic framework discussed in Bourguignon et al. (2007), it is, nevertheless, the simplest starting point. There are rich comparative statics generated even in this setting, with insights for path dependence. Ideally, one would want to study the dynamic evolution of this system. I will discuss the challenges to developing a dynamic model and some suggestions on how to overcome them in later sections. In the next section, we move on to spelling out the model and its results.

2.2 The Baseline Model of Rent-seeking

2.2.1 Environment: Regressive Redistribution

The economy consists of a continuum of agents, i, distributed over the interval $[0, 1]$. All agents are endowed with some initial wealth w_i, which is drawn from the distribution $F : [\underline{w}, \infty) \longrightarrow [0, 1]$, where $\underline{w}$ is the minimum wealth level. Agents have identical preferences and care about their net wealth. There is full information about the draws of wealth in the economy.

The costs and benefits of rent-seeking. The economy is characterized by the following kind of rent-seeking: Each agent i has the choice to pay a cost $\theta \in [0, \infty)$ from her endowment w^i to appropriate from those who don't make this payment. I will refer to agents who pay θ as rentiers (R) and those who don't pay θ as non-rentiers (NR). I assume that one rentier cannot appropriate from another rentier. Hence, θ serves the dual purpose of the cost of appropriation from non-rentiers and the cost of protection from other rentiers. The total rents collected from the non-rentiers are distributed equally among all the rentiers.[9]

All non-rentiers need to pay a fraction $n\gamma$ from their endowment. Here $\gamma \in [0, 1]$ is a fixed appropriation rate and n is the mass of rentiers in the economy, $n \in [0, 1]$. Thus, γ can be thought of as the maximum rate of appropriation when everyone is a rentier ($n = 1$).[10]

One could interpret the set of parameters $\{\theta,\gamma\}$ as the state of institutions in the economy. An economy with higher θ, all else equal, implies that it is costlier to appropriate or influence the government through lobbying or regulatory capture. Fewer agents are able to afford a much higher value of θ, thereby discouraging rent-seeking activities. Similarly, a large value of γ, all else equal, signifies a larger burden of direct or indirect appropriation on the non-rentier class. Taking the ratio of these two parameters gives us another comprehensible measure of the state of institutions in the society: the effective cost of rent-seeking ($\frac{\theta}{\gamma}$). Well-functioning polities that value an equitable sharing of resources will have a high value of θ and a low value of γ, thus, a very large effective cost of rent-seeking. Polities with more

[9] This is an assumption that arises naturally as a consequence of the assumption of equal payment of θ. In a later section, we relax the assumption of a fixed θ and let it be determined endogenously. However, we maintain the requirement that everybody still pays the same θ. An interesting case for future work is where rents are distributed proportionately to the initial draw of wealth or agents can choose different levels of θ or a combination of both.

[10] As noted above, when everyone is a rentier ($n = 1$), everyone is protected. There is no redistribution in this case.

tolerance towards rent-seeking activities or weaker institutions will have a lower effective cost of rent-seeking.

2.2.2 Choice of Occupation

The assumptions above imply a type of occupational choice: agents draw their endowment from a known distribution, knowing which, they have to decide whether to invest in θ or not. Investing in θ makes an agent a rentier and benefit from appropriation. Not paying θ makes her a non-rentier and hence vulnerable to appropriation. Given the fixed nature of the cost θ, it can be anticipated that there will be a cut-off level of wealth above which it will be profitable to be a rentier.

Net Rewards. We can now determine the net rewards to an agent from occupational choice. The net payoff for a non-rentier will be her initial wealth endowment, minus the appropriation rate:

$$U^{NR}(w|n,\gamma) = w(1-n\gamma)$$

The net payoff for a rentier is his wealth, w, plus the rent per capita net of the fixed cost θ. The rent per capita is the quantity of total rents collected from the non-rentiers ($\int_{\underline{w}}^{w^*} \gamma nwdF(w)$) divided by the mass of rentiers (n). That is,

$$U^R(w|n,\theta,\gamma) = w - \theta + \gamma K$$

where K is the expected total[11] of the non-rentiers' wealth for a given n:

$$K \equiv \frac{n \int_{\underline{w}}^{w^*} w dF(w)}{n} = \int_{\underline{w}}^{w^*} w f(w) dw$$

Here, w^* is the cutoff level of wealth (to be determined endogenously) below which agents choose to be non-rentiers and $\underline{w}$ is the lower bound of the wealth distribution.

An agent chooses the occupation that generates a higher net expected payoff, which in turn depends on the proportion of rentiers (n) in the economy. Thus, an agent i will choose to be a rentier if:

$$U_i^R - U_i^{NR} \geq 0$$

or

$$w_i \geq \frac{\frac{\theta}{\gamma} - K}{n}$$

The higher the effective cost of rent-seeking ($\frac{\theta}{\gamma}$), the fewer agents will prefer to become rentiers. A larger K (cumulative rents) implies more incentives for agents to be rentiers. Finally, the more rentiers there are, the more the strategic incentives to become a rentier.[12]

[11] K is also the unconditional mean of the non-rentiers' wealth. For the conditional mean, we would divide by $(1 - n^*)$. For the purpose of this model, we need the total wealth of NR. Since the appropriation rate is $n\gamma$, the total value of rents collected is $n\gamma K$. Thus each of the n rentiers gets γK as their share of the rents pie.

[12] More rentiers implies a higher appropriation rate. Detailed discussion on this is in section 2.2.6.

2.2.3 Equilibrium (with θ as a sunk cost)

All agents in the economy simultaneously decide whether to invest in rent-seeking (pay θ) or to remain a non-rentier (pay γ). Agents have rational expectations about the proportion of agents who will choose the rentier occupation. A Nash equilibrium of this game can be one of the following three cases:

- $n = 0$ and $U^{NR} \geq U^{R}$
- $n = 1$ and $U^{NR} \leq U^{R}$
- $0 < n < 1$ and $U^{NR} = U^{R}$

Corner solutions, in the first two cases, will result under certain parametric conditions, which are characterized below in Section 2.2.4. For the third case, there will be an interior solution, obtained at the threshold level of wealth (w^*) above which everyone in the distribution will want to be a rentier, for a given value of n^*. Therefore, w^* and n^* will jointly solve:

$$U^{NR}\{w^*, n^*\} = U^{R}\{w^*, n^*\} \tag{2.1}$$

Equation (2.1) gives us the equilibrium pair (w^*, n^*) for $0 < n^* < 1$. Now, if all individuals expect a proportion n of rentiers, and if this expectation is to be fulfilled, then n must also be identical with the proportion of agents with wealth above the critical level. Hence,

$$n^* = 1 - F(w^*) \tag{2.2}$$

Substituting 2.1 into 2.2 gives us a fixed point equation. Distributional assumptions on $F(w)$ and the set of institutional parameters $\{\gamma,\, \theta\}$ give conditions for existence, stability, and uniqueness of the equilibria. In the analysis below, I use the simple Pareto distribution to obtain a closed form solution for the equilibrium variables $\{w^*,\, n^*\}$. The Pareto distribution is useful in giving the analysis a real-world paradigm since this distribution is designed to most closely approximate actual wealth distributions around the world (Jones, 2015; Piketty & Saez, 2014). The Pareto inequality parameter (in this case $\alpha \in [1, \infty)$) also has a simple inverse relationship with the Gini coefficient, thus making the results easy to interpret[13].

2.2.4 Results

Using the simple Pareto distribution, with endowments drawn over a support of $w \in [\underline{w}, \infty)$ and α as the inequality parameter, the per capita value of rents is:

$$\gamma K(w^*) = \gamma w^m \left[1 - \left(\frac{\underline{w}}{w^*}\right)^{\alpha-1}\right] \tag{2.3}$$

where w^m is the mean value of endowments for the entire distribution[14]. Using the above expression in 2.3 and the expression for n^* in terms of w^* from (2.2), and substituting them in (2.1), we obtain the following equilibrium solution:

$$\boxed{n^* = \left[\frac{w^m - \frac{\theta}{\gamma}}{w^m - \underline{w}}\right]^{\frac{\alpha}{\alpha-1}}} \tag{2.4}$$

[13]The properties of the general Pareto distribution used throughout in this paper are provided in the appendix, section A.1

[14]The mean of a Pareto distribution $w^m = \frac{\alpha}{\alpha-1}\underline{w}$ is also given in the Appendix A.1

and

$$\boxed{w^* = \underline{w}\left[\frac{w^m - \underline{w}}{w^m - \frac{\theta}{\gamma}}\right]^{\frac{1}{\alpha-1}}} \tag{2.5}$$

(Complete derivations are provided in Appendix A.2.1 and A.2.2).

In the expression for n^* in (2.4), the denominator is always a positive number since it is the difference between the mean and the lower bound of the wealth distribution. The numerator could be positive or negative depending on the relative position of the effective rent-seeking cost to the mean wealth. The term in the square brackets is raised to a power greater than unity. The value for n^* must be bounded between 0 and 1, we have the following results:

Proposition 2.1. *Equilibrium Rent-seeking*

a. *Interior solution: There is some rent-seeking activity in the economy ($0 < n^* < 1$) when $0 < w^m - \frac{\theta}{\gamma} < w^m - \underline{w}$ for positive values of w^m and $\underline{w}$. In other words, there is an interior solution when the effective cost of rent-seeking lies between the mean and lower bound of wealth for the entire distribution($\underline{w} < \frac{\theta}{\gamma} < w^m$)*

b. *Full rent-seeking: $n^* = 1$ when $0 < w^m - \underline{w} < w^m - \frac{\theta}{\gamma}$ for positive values of w^m and $\underline{w}$. This condition holds when $\frac{\theta}{\gamma} < \underline{w} < w^m$. Thus, when effective rent-seeking costs are less than the endowment of the poorest person, everyone will be able to afford to engage in rent-seeking activities*

c. *No rent-seeking: $n^* = 0$ when $0 > w^m - \frac{\theta}{\gamma}$. This condition holds when $\underline{w} < w^m < \frac{\theta}{\gamma}$. When rent-seeking costs are higher than the mean wealth of the distribution, no one finds engaging in rent-seeking activities profitable enough*

(Full proofs in Appendix A.2.2.)

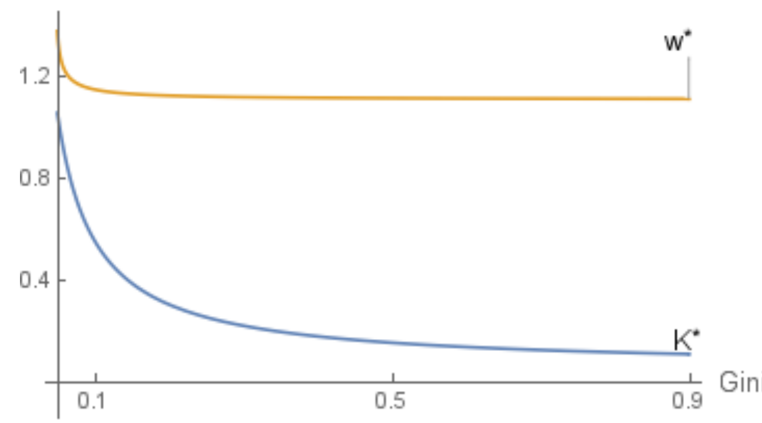
It can be shown that $n^* = 0$ is an equilibrium strategy profile because $U^{NR} > U^R$ whenever $\frac{\theta}{\gamma} > w^m$. Here is an economy where the effective cost of rent-seeking is so high that no one invests in it. Everyone takes home their initial draw of wealth. Similarly, it can also be shown that $n^* = 1$ is an equilibrium strategy profile because $U^R > U^{NR}$ whenever $\frac{\theta}{\gamma} < \underline{w}$. In this economy, the effective cost of rent seeking is very low and affordable by everyone. Since being part of the rentier class also provides protection against the other rentiers, everyone chooses to invest in it, even though there are no rents to be collected in return. Thus, if everyone else becomes a rentier, it is Nash for an agent to become a rentier as well. The two corner solutions are stable. An example of such an economy would be rentier states such as Saudi Arabia. I discuss more on this later.

Thus, for the given parameters of the rent-seeking technology and the initial conditions given by the Pareto distribution parameters, the existence of an equilibrium is guaranteed. Moreover, the equilibrium is stable for each of the three cases discussed above.

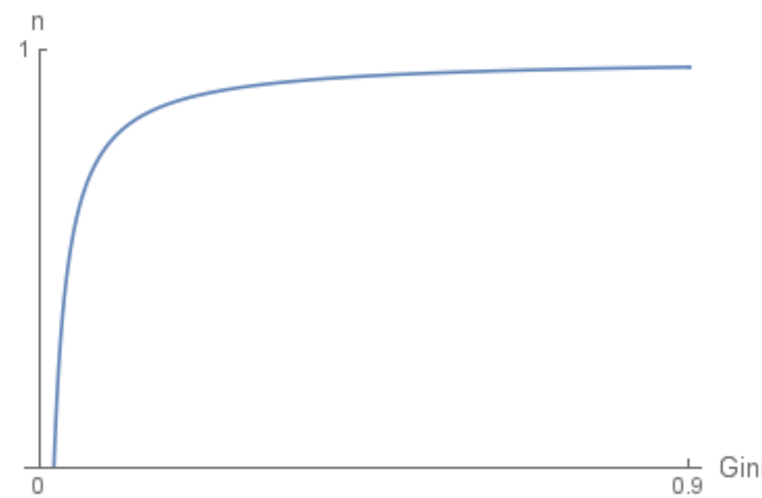
2.2.5 Comparative Statics

It is easy to now analyze the change in the proportion of rentiers (n^*) in this economy as inequality increases. The comparative statics depend upon the sign of the derivative of n^* with respect to the inequality parameter α. The Gini coefficient of inequality is inversely related to α. To show that the proportion of agents choosing to be rentiers increases with a more unequal distribution of endowments, we need to show that n^* decreases with α. As we will see, these conditions can be shown to be a function of the relative position of rent-seeking costs ($\frac{\theta}{\gamma}$) to the mean wealth (w^m) and lower bound of wealth ($\underline{w}$).

Figure 2.2: Rent-seeking dynamics with inequality



(a) Equilibrium wealth threshold and total rents as a function of the Gini coefficient



(b) Proportion of rentiers as a function of Gini coefficient

The derivative of n^* with respect to the inequality parameter α is:

$$\frac{dn^*}{d\alpha} = \frac{n^*}{(\alpha-1)^2}\left[ln(\frac{1}{x}) + \alpha(1-\frac{1}{x})\right] < 0 \tag{2.6}$$

where $x = \left[\frac{w^m - \frac{\theta}{\gamma}}{w^m - \underline{w}}\right]$.

Proposition 2.2. *For values of* $0 < n^* < 1$, *more inequality in the economy* ($\alpha \downarrow$) *leads to a higher proportion of rentiers* ($n^* \uparrow$), *lowering of the threshold wealth* ($w^* \downarrow$) *and lowering of the mean non-rentier wealth* ($K^* \downarrow$).

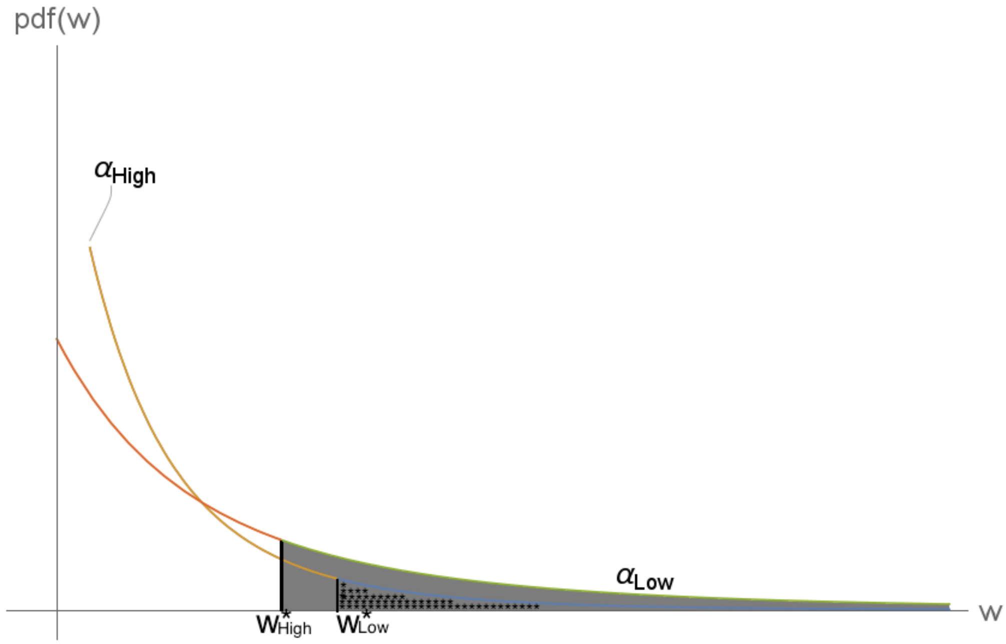
Proof. For values of $0 < n^* < 1$, $0 < x < 1$ implying that $1/x > 1$. The term outside the square brackets is positive. The term inside the square brackets depends on the relative values of $ln(1/x)$ and $1/x$. Since the ln of a value is much smaller than itself, the square bracketed expression's sign is dominated by the second term inside, which is negative. □

Proposition 2.3. *Both non-rentiers and rentiers are worse off than before* ($U_i^k < w_i$ *for* $k = R, NR$).

Proof. The return to rent-seeking is $\gamma(1-n^*)K^*$. For equilibrium values of n^* and K^*, this return is less than the cost of rent-seeking (θ) for all interior values of n^*. Detailed proof in Appendix A.2.4. □

Thus, as α falls and wealth becomes concentrated with fewer and fewer agents, more inequality leads to more rent-seeking in this economy. Figure (2.2a) maps the declining values of the threshold wealth level (w^*) and the per capita value of rents (K^*) in equilibrium with respect to the Gini coefficient (also a function of α). Higher inequality in the economy pulls the cut-off level of wealth in the economy down, making rent-seeking a more affordable option for the agent at the margin. This happens despite the returns to rent-seeking, as

Figure 2.3: The marginal agent is pushed into rent-seeking activity as inequality rises



Higher α denotes lower inequality. The dotted area denotes the mass of rentiers in the low-inequality economy. As inequality rises, the marginal agent is pushed into rent seeking. The gray shaded area denotes the increased mass of rentiers in the high-inequality economy.

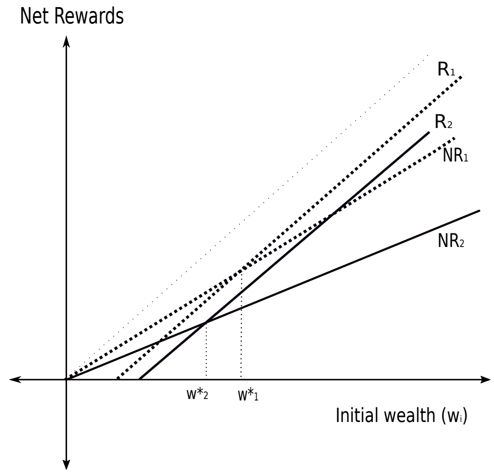
captured by K, falling with more inequality. Non-rentiers just below the cut-off are pushed into rent-seeking as inequality rises. This happens despite a reduction in the returns from rents. Figure (2.2b) redraws the same plot with the proportion of rentiers in equilibrium (n^*) on the y-axis.

2.2.6 Discussion

Why does an increase in inequality, with all else the same, lead to an increase in the proportion of rentiers? This is because the increase in inequality (lower α) here implies adding more people to the top of the wealth pyramid[15]. Once the rich class expands, for a given threshold wealth level, n increases. This changes the tradeoff for the marginal agent in two

[15] One may want to study the effect of an increase in inequality by adding more people at both the top and the bottom. It can be implemented in the same framework by rescaling all observations by the new lower bound and taking into account the resulting further decrease in α.

Figure 2.4: Net Returns from rent seeking and non-rent seeking



R and NR are the returns to rentiers and non-rentiers' respectively. The dotted lines denote returns functions in a low-inequality economy; the corresponding threshold for rent seeking is high (w_1^*). The solid lines denote returns functions in a high-inequality economy. High inequality lowers the return to both rentiers and non-rentiers. The burden is higher on non-rentiers. The marginal agent is pushed towards rent seeking. The corresponding threshold for rent seeking is low (w_2^*).

ways. As a non-rentier, she pays a higher rent rate ($n\gamma$). As a rentier, the size of the rents pie shrinks and is divided among more people. Hence, each rentier receives less. The loss from an increase in rent burden on non-rentiers is greater than the loss from a smaller share for rentiers. Thus, higher inequality burdens the non-rentiers disproportionately more than the rentiers.

The mechanism becomes clear in Fig 2.4. As inequality increases, the non-rentiers' rewards fall from NR_1 to NR_2. The intersection of NR_2 and R_1 gives us the impact of adding more people to the top of the pyramid. The higher rent rate on non-rentiers generates positive incentives for rent seeking and the threshold w^* falls. However, because of fewer non-rentiers, the size of the rent pie shrinks, reducing rent-seeking incentives. This tradeoff is evident from the intersection of NR_2 and R_2, which moves w^* to the right, increasing the threshold wealth to become a rentier. Another fact clear from the figure is that we get a unique *in-*

terior equilibrium for each set of parameter values so long as the net rewards functions are monotonically increasing.

The type of (regressive redistributive) rent-seeking assumed here captures three aspects of rent-seeking as discussed in the social sciences literature. First, the motives for rent-seeking depend strategically on the choices of others in the economy. For the agent at the margin, even though the net benefit from rent-seeking ($\theta - \gamma K^*$) is lowered with more rentiers around, it is better than facing the increased probability of extortion (n^*) as a non-rentier. In other words, the loss of wealth due to insecure property rights is higher compared to the resources needed to secure protection and be part of the rentier club. Thus the marginal agent is pushed into rent-seeking as inequality grows in the economy, as shown in Figure (2.3).

Secondly, all rentiers spend more resources net of what they gain, thus having a negative payoff, i.e.

$$\gamma K^* - \theta < 0 \tag{2.7}$$

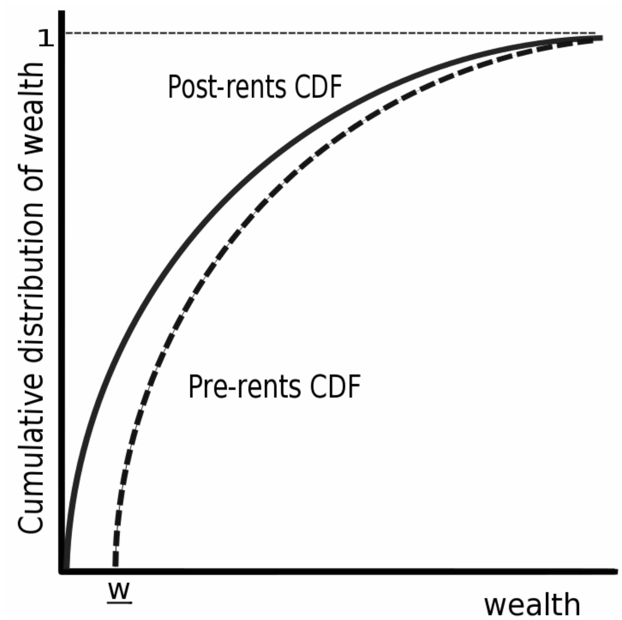
Some forms of rent seeking are perceived as negative-sum games in the economics literature. The investment required in protection technology itself is a dead-weight loss to the economy. It diverts resources ($n^*\theta$) away from productive capacity. As such, total wealth in the economy decreases. However, with even rentiers worse off than if they didn't have to engage in rent seeking and pay θ, the implication is that rent-seeking in this environment is unambiguously welfare-reducing or Pareto-inefficient. With more inequality and consequently more rentiers, the rate of wealth loss increases. In a dynamic setting, over time as the size of the pie shrinks, rent-seeking may have implications for growth. This will be especially true over the short-run to medium-run when rent-seeking costs are not flexible. This result matches intuitively with the literature on growth and rents, where under very diverse settings it has been shown that rent-seeking activities are growth-reducing (Murphy et al., 1991, 1993). Modern economies that have amassed wealth through cartelization of natural resource rents, for example, the Gulf countries, have grown slower than the economies relying on innovation and productivity increase to foster economic growth (Stiglitz, 2012). Such economies, also known as rentier states, are an example of economies where everyone chooses to be a rentier. The cost of rent-seeking is low compared to wealth in the economy. As such almost everyone who has citizenship rights chooses to invest in these protection and rent-seeking technologies. Such economies are characterized by increasing inequality and low growth rates.

Third, building on the last two points, the rent-seeking equilibrium above is a like a prisoner's dilemma. It is a dominant strategy for an agent to pay her respective dues, the γn^* rent rate for non-rentiers and the $\theta - \gamma K^*$ for rentiers, given her draw of wealth. This kind of rent-seeking behavior becomes a tradition: everybody agrees it is bad for them, but it requires a collective effort by society to move out of it. In a dynamic setting, the welfare-enhancing strategy would be to coordinate and agree to not invest in θ at all. Without an infinitely repeated game, however, the possibility of coordination is limited. Moreover, another strand of research in economics says that chances of coordination decrease as the number of players involved increase. In an entire economy, such costly coordination could be possible with a major institutional change, such as a change in the government regime or better investments in property rights.

2.2.7 The Inequality Trap

We have so far shown that a more unequal initial distribution increases the proportion of rentiers in the economy, leading to more regressive redistribution. It is intuitive that a

Figure 2.5: The CDF before and after the redistribution.



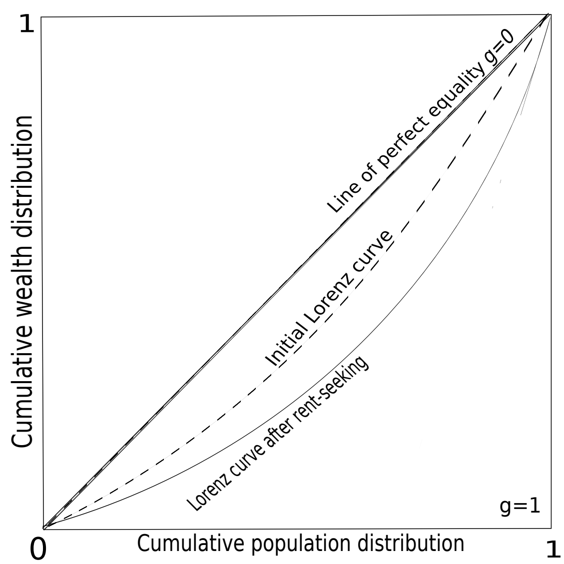
The dotted line is the cumulative distribution function of the initial distribution of wealth. The solid line is the cdf of the new distribution of wealth after redistribution. The initial cdf stochastically dominates (first order) the new.

regressive redistribution will lead to a more unequal society. Here I present results using a formal analytical proof on how inequality can feed into itself in the presence of rent-seeking activities. Since any redistribution changes the characteristics of the statistical distribution, I use the Gini coefficient to compare initial and ex-post inequality. In this respect, the simple Pareto distribution is useful as it has a closed-form parametric solution for the Gini coefficient.

Proposition 2.4. *Gini coefficient for the ex-post rent-seeking distribution of wealth is greater than the initial Gini coefficient.*

Proof. We begin by partitioning the initial wealth distribution into two parts: non-rentiers' (W_{NR}) and rentiers' wealth (W_R). Let V_j be a linear transformation of w for $j = NR, R$. We compute the CDF for the new transformed variable V_j by joining the CDF's for each of the partitions, conditioned over their support; denote this new CDF as $F_V(w)$. From here it is

Figure 2.6: The Lorenz curve with pre and post rent-seeking distributions



The Lorenz curve of the economy after rents have been distributed is further away from the line of perfect equality than before the redistribution. The Gini coefficient is the ratio of the area between the Lorenz curve and the line of perfect equality with respect to the total area under the triangle (= 1/2). The Lorenz curve closer to the line of perfect equality represents the more egalitarian economy.

straightforward to compute the Lorenz curve for the new CDF: $L(F_V)$, and the subsequent Gini coefficient: $G(F_V)$. Comparing the new 'ex-post' Gini coefficient with the initial Gini ($\bar{G} = \frac{1}{2\alpha-1}$), it can be shown that the ex-post Gini ($G(F_V)$) is greater than the initial Gini coefficient. (Detail derivations in Appendix A.3.) □

Thus, any economy which is characterized by the kind of rent-seeking technology used here will end up with higher inequality. Figure 2.5 captures the lowering of the overall wealth of all agents in the economy. We already showed in the preceding section that higher inequality is responsible for more rent-seeking agents. Figure 2.6 captures the Lorenz curves corresponding to the same pre- and post- rent-seeking economies. The transfer of wealth from lower wealth to higher wealth agents leaves the economy more unequal than before.

2.2.8 Discussion

Th equilibrium discussed here is a function of the Pareto distribution's parameters. This implies that the system has multiple equilibria, with each equilibrium corresponding to unique initial conditions (in the space of permissible α, $\underline{w}$ values). Any distribution with some initial inequality in the allocation of resources leads to a more unequal ex-post distribution. The only distributional allocation that leads to no subsequent increase in inequality is the one with perfect equality.

Proposition 2.5. *When $\alpha \to \infty$, we have the following two cases of rent seeking:*

- $n^* = 0$ *when* $\frac{\theta}{\gamma} \geq \underline{w}$
- $n^* = 1$ *when* $\frac{\theta}{\gamma} < \underline{w}$

Proof. The equilibrium value of rent seeking (n^*) can be expressed as a function of α:

$$n^* = \left(\alpha(1 - \frac{\theta}{\underline{w}\gamma}) + \frac{\theta}{\underline{w}\gamma}\right)^{\frac{\alpha}{\alpha-1}} \tag{2.8}$$

As $\alpha \to \infty$, the power function tends to unity. The value in round brackets tends to either $+\infty$ or 0 or $-\infty$ when $\frac{\theta}{\gamma} < \underline{w}$ or $\frac{\theta}{\gamma} = \underline{w}$ or $\frac{\theta}{\gamma} > \underline{w}$ respectively. From Proposition (2.1), this implies a value of $n^* = 1$ for the first case or $n^* = 0$ for the last two cases. □

Thus, a redistribution of resources that levels the playing field will break down the rent seeking equilibrium, thereby bringing the economy out of the inequality trap.

As discussed earlier, ideally, one would want to extend the above model to a dynamic framework. An overlapping-generations model seems the ideal framework to study the comparative statics over multiple time periods. The challenge to develop a dynamic model stems from the discontinuity in the pdf of the ex-post wealth distribution, which is a piece-wise Pareto distribution. Hence, an analytical solution is no longer elegant or even possible. One either needs to change the rent-extraction structure or use simulation to develop the OLG framework and study the Gini coefficient of the resulting distribution.

2.3 Rent-seeking with endogenous prices

The last section gave us some insights about how inequality affects the size of the rentier population when the costs are fixed. In this section, I endogenize the effective cost of rent-seeking by letting the sovereign choose the optimal size of the rent-seeking class. This is a natural extension in a static setting where the sovereign state sets the costs and determines the returns to rent-seeking to optimize their revenue[16]. The state faces the trade-off on the intensive versus extensive margin since a higher θ implies more direct revenue per agent but reduces the size of the rent-seeking class.

I assume that the rate of rent extraction depends on the cost of rent seeking. This is plausible because the amount of resources spent on rent seeking may influence the rate of rent extraction, just as investing resources in fiscal capacity affects the state's ability to tax citizens[17]. To obtain closed form solutions, I assume the following rent-extraction function:

$$\gamma = \beta\theta^{1-\epsilon} \tag{2.9}$$

Here, $\epsilon \in (0,1)$ and $\beta \in \Re_+$ such that γ is a proportion. Thus, the elasticity of γ with respect to θ is given by $1-\epsilon$: a higher value of ϵ implies that the extraction rate is less sensitive to changes in θ. From the last section, we know that the sovereign's revenue is given by $n\left(\frac{\theta}{\gamma}\right)^{*}\theta$. In what follows, I extend the framework to a two-stage game, where first, the state decides the revenue-maximizing cost of appropriation (θ), anticipating the size of the rentier class based on $\frac{\theta}{\gamma}$. In the second stage, agents choose whether to be rentiers or non-rentiers.

[16] Another way to endogenize costs would be to let all agents invest in a θ to maximize their return non-cooperatively (contest). For the rentiers, it could be used to bring in rents, while for the non-rentiers it could provide some protection from rentiers. Modeling this requires two things: first, a protection technology (contest success function) and second, a third party that provides the protection such as a police or a government. It would also raise concerns for additional modeling features such as voting and/or collective action problems. Instead I use θ to capture the differential cost of investment between rentiers and non-rentiers. γ is then an increasing but concave function of θ, capturing the dependency of rents on the rent-seeking technology. Preliminary work suggests there will be multiple equilibria in this setting for each initial condition, with some stable and some unstable. This is the subject of another paper I am working on.

[17] Fiscal capacity is the ability of the state to raise revenues from their own sources in order to pay for a basket of goods and services. For literature on fiscal capacity, see Besley & Persson (2011, 2013)

2.3.1 Model Set-up

The state faces te following optimization problem:

$$\underset{\theta}{\text{Maximize}} \quad n\left(\frac{\theta}{\gamma}\right)\theta$$
$$\text{subject to} \quad \gamma = \beta\theta^{1-\epsilon}$$

Let the revenue-maximizing θ be denoted by θ^* and the corresponding effective cost of rent-seeking be $\left(\frac{\theta}{\gamma}\right)^*$. Knowing this ratio, agents face the same optimization problem as in the last section with exogenous costs. The equilibrium size of the rent-seeking class will be given by:

$$n\left(\frac{\theta}{\gamma}^*\right) = \left[\frac{w^m - \frac{\theta}{\gamma}^*}{w^m - \underline{w}}\right]^{\frac{\alpha}{\alpha-1}}$$

2.3.2 Equilibrium with endogenous costs

From backward induction, the state's optimization problem reduces to the following simple problem:

$$\underset{\theta}{\text{Maximize}} \quad \theta\left[\frac{w^m - \frac{\theta}{\beta\theta^{1-\epsilon}}}{w^m - \underline{w}}\right]^{\frac{\alpha}{\alpha-1}}$$

The revenue-maximizing value of θ is given by

$$\theta^* = \left[\frac{\alpha\underline{w}\beta}{\alpha - 1 + \alpha\epsilon}\right]^{\frac{1}{\epsilon}} \tag{2.10}$$

The corresponding value of $\frac{\theta}{\gamma}$ and n^* are given by

$$\frac{\theta}{\gamma} = \frac{\alpha \underline{w}}{\alpha - 1 + \alpha\epsilon} \tag{2.11}$$

and

$$n^*(\alpha) = \left[\frac{\alpha^2\epsilon}{\alpha - 1 + \alpha\epsilon}\right]^{\frac{\alpha}{\alpha-1}} \tag{2.12}$$

2.3.3 Comparative statics

We can now analyze how rent-seeking activities change in the economy when inequality increases. Once again, we can analyze the effect of a change in inequality by differentiating the expressions of interest with respect to the inequality parameter.

Proposition 2.6. *The cost of rent seeking increases as inequality increases.*

Proof. The derivative of θ with respect to α is

$$\frac{d\theta^*}{d\alpha} = \frac{1}{\epsilon} y(\alpha)^{\frac{1}{\epsilon}-1} \frac{dy}{d\alpha} \tag{2.13}$$

where $y(\alpha) = \frac{\alpha \underline{w} \beta}{\alpha - 1 + \alpha\epsilon} > 0$ and $\frac{dy}{d\alpha} = \left(\frac{-1}{(\alpha-1+\alpha\epsilon)^2}\right) \underline{w}\beta < 0$. Hence,

$$\frac{d\theta^*(\alpha)}{d\alpha} < 0 \tag{2.14}$$

(Detailed derivation in apendix A.4.1). □

Proposition 2.7. *The proportion of rentiers decreases as inequality increases.*

Proof. The derivative of n^* with respect to α is:

$$\frac{dn^*(\alpha)}{d\alpha} = \frac{n^*}{\alpha - 1}\left(1 - \frac{1}{(\alpha - 1 + \alpha\epsilon)} + \frac{-lnf(\alpha)}{(\alpha - 1)}\right) > 0 \tag{2.15}$$

for all values of ϵ and α. (Full derivation in Appendix A.4.2). □

All rentiers optimize by increasing investments in θ when endowments become more unequal. As a result, they are able to appropriate a higher fraction of resources from the non-rentiers. The concavity of γ makes the effective cost of rent seeking increase in equilibrium with more inequality. However, the proportion of rentiers ($n^*(\alpha)$) in the economy shrinks. Therefore, with more inequality, we have a smaller proportion of rentiers, with each rentier spending more on appropriation.

2.3.4 Inequality Trap

With the above results, we can still say something about the level of ex-post inequality in the economy relative to the initial one.

Proposition 2.8. *The Gini coefficient for the ex-post rent-seeking distribution of wealth is greater than the initial Gini coefficient.*

Proof. In the section with the exogenous $\frac{\theta}{\gamma}$, we proved the Lorenz curve dominance of the initial distribution over the ex-post distribution for any value of $\frac{\theta}{\gamma}$ such that n^* is interior (or $\underline{w} < \frac{\theta}{\gamma} < w^m$). Here, $\left(\frac{\theta}{\gamma}\right)^* = \frac{\alpha\underline{w}}{\alpha-1+\alpha\epsilon}$. For $\alpha\epsilon > 0$, this value is smaller than the mean wealth

w^m. For $\alpha > \alpha - 1 + \alpha\epsilon$ or $\alpha\epsilon < 1$, this value is greater than $\underline{w}$. Therefore, the inequality trap result holds for $0 < \alpha\epsilon < 1$. □

The above result shows the robustness of the inequality trap to changes in rent-seeking institutions. The class of rentiers may shrink (as shown before) but they still command a greater proportion of society's wealth. Unless rent-seeking costs are so exorbitantly high as to eliminate all rent-seeking behavior, rents will always work to redistribute wealth regressively.

One can also see more clearly how different metrics that are used to measure rent-seeking in the economy change with inequality. On the one hand, we have a lower fraction of agents opting to become rentiers, as opposed to what we had in the case of exogenous costs. On the other hand, the per rentier expense or investment into rent-seeking increases, as does the rent rate. Thus at the pecuniary level, one would observe bigger amounts of wealth or resources spent on rent-seeking and bigger distortions in the economy due to rising inequality. But the club of rentiers will consequently be more exclusive and limited to a few very wealthy. Any empirical analysis thus must be careful in assessing inequality's impact evaluation on rent-seeking as the interpretation is sensitive to the metric of rent seeking used.

2.4 Conclusion

In this paper, I have attempted to answer whether more inequality indeed increases rent-seeking activities in the economy. The answer for exogenously given costs is yes. The answer for endogenous costs is mixed. With endogenous costs, more inequality reduces the proportion of elites, although they are each now wasting more resources on rent-seeking activities. The simplicity of the setting offers some clear insights regarding the welfare implications of such regressive redistribution. Rent-seeking activities are unambiguously Pareto inefficient and lead to the destruction of wealth. This aspect of the model is in line with the view that rent-seeking is a negative-sum game.

Developing a dynamic model with a more direct link between inequality, rent seeking, and more inequality will require some modeling variations. Alternatively, using simulation for such an environment will lead to more clear answers in this direction. An inequality metric comparable across distributions such as the Gini coefficient can be used to draw inferences on the impact on ex-post inequality.

A possible extension with centralized planning and voting can provide the likelihood of multiple equilibria in this economy. Consider the same framework but with two parties competing for votes. Their election platform is setting the optimal level of institutions $\{\theta, \gamma\}$ in the economy. The median voter theorem can be invoked in this setting with some additional assumptions. As this economy becomes more unequal, the mean and median wealth go up. At the same time, the equilibrium threshold of wealth w^* dividing rentiers from non-rentiers goes down. For a critical value of $\alpha^\star$ the median agent will switch from being a non-rentier to a rentier. Supposing that rentiers are pro- weaker institutions, a more unequal society will demand weaker institutions. I leave this extension to future work on the model.

Another possibility for future work mentioned briefly earlier is a non-cooperative game among the rentiers for sharing the rents pie. A contest with infinite agents makes the analysis complex. However, there has been recent progress on the topic of large games which may be exploited to study the dynamics in such a setting. Preliminary work shows the existence of multiple equilibria for each set of initial conditions when rentiers have to contest for a share of the rents pie.

The analysis presented here renders itself to several empirical applications. The case of rentier states, as noted before, and their political economy can be understood better using the framework used here. This paper also speaks to the vast literature on corruption, connections and political kickbacks that perpetuate inequalities in developing economies. There is evidence from some developing countries with long stable rules of dictators, for example, Suharto in Indonesia, that show an increase in corruption under the dictatorial rule, favoring allocation of scarce resources to certain groups that could provide kickbacks (Fisman, 2001). There is also evidence of increased within-sector inequality and a general worsening of institutions over the same time period in these places. A future extension of this paper will work on such an empirical application, linking sectoral inequality with measures of corruption and institutions. Lastly, this paper and its results can add to the analysis on intra- or inter-generational mobility. Countries with more progressive taxation schemes, better institutions of accountability and campaign finance management do better in distributing their national wealth more equitably. More concrete empirical evidence on these inter-linkages between inequality, rent-seeking, and institutions is clearly needed.

Chapter 3

Marital Norms and Women's Education

3.1 Introduction

Cultural norms have implied that men and women in the same percentile of the distribution of human capital may have very different labor and marriage market outcomes. More years of schooling imply a better earnings potential as well as improved marriage prospects for men. Women also find their earnings potential rise with more years of schooling. However, their marriage prospects may not show the same positive return. Studies from sociology and evolutionary biology help us understand why this difference exists (Eagly & Wood, 2013; Wood & Eagly, 2012; Zentner & Mitura, 2012). the marital norm of hypergamy (the practice of women "marrying up" by caste, age, education or any indicator of economic well-being) implies that too much education could be a source of penalty in the marriage market for women. Several studies in economics find lowered prospects of marriage for women in the right tails of the education distribution (Bertrand et al., 2014; Hwang, 2015; Qian, 2012; Rose, 2005).

Women may be facing a constrained decision regarding education choice. On the one hand, more education improves earnings and expected quality of potential spouse. On the other hand, it reduces the likelihood of finding a 'suitable' partner. In light of the above argument, it is natural to ask how women, as forward-looking agents, optimize pre-marital investments in human capital, specifically education. Given the labor market - marriage market trade-off, one would expect that a change in men's education in one period would affect women's education, on average, more than men's in the next period. This is because the impact through channels such as labor market and peer effects would be the same in the same industry on both genders. However, women would be affected via the marriage market effect of the marrying-up norm as well.

Marital outcomes are an important part of the return to education for many people largely due to the selection of the quality of spouse (in other words, making oneself attractive). For women, roughly half of the correlation between education and consumption operated through the marriage channel (Lefgren & McIntyre, 2006). If women obtain less education than is 'optimal' with respect to their ability, they receive lower utility from both lower earnings and potentially lower quality of spouse. It may be a sub-optimal outcome for society as well if some agents do not contribute to the economy to their full potential. On the other hand, if women acquire 'too much' education, they experience a marriage squeeze (Qian, 2012), higher likelihood of divorce (Bertrand et al., 2015) or a skill penalty (Bertrand et al., 2014; **?**; **?**). As a result, many women drop out of the labor force after marriage or having children. Getting this trade-off right may imply choices that reduce earnings, like reporting lower ambitions to potential employers (Bursztyn et al., 2017) or less working hours (Bertrand et al., 2015).

It is possible that the choice of education itself is also affected in the process of getting this trade-off right. In other words, ‘optimal’ education for women may be lower in the presence of gender norms such as hypergamy. To find empirical evidence in support of this argument is challenging, to say the least. One possible identification strategy is to find a source of exogenous variation in the marriage market and see its impact on women’s education choices in the relevant market. In this paper, I examine the impact of an exogenous change in the human capital pool of men on the human capital pool of young women in the United States. The source of variation is the change in US’ immigration policy, which has been documented to have altered the demographic and skill-pool in the US considerably after 1965.

I find evidence of a positive relationship between men and women’s education outcomes. This is a result suggestive of hypergamy and its dragging effect on women’s education. The increase in the proportion of men with higher education potentially relaxed the constraint on women’s education after the 1970s. By this theory, spousal investments in education are complements (Chiappori et al., 2009; Lafortune, 2013). I use robustness checks to find if the same result holds for another potential control group: immigrant women in the US. The results are again supportive of the hypothesis of hypergamy constraining women’s education.

While the evidence is reassuring for the theory here, it should not yet be considered causal. There could be other reasons for the same results, such as the women’s movement in to the labor force around the same time, the feminist movement, the advent of the pill, etc. There is clearly scope for more robustness checks and better inferential analysis, towards which I am currently working. These methods and procedures are discussed in the section on future work.

The remaining paper is organized as follows. I discuss closely related literature, followed by a simple model of education choice in the presence of hypergamy. The main theoretical proposition is tested in the subsequent sections. I conclude by discussing ideas for further work that I am currently working on. The final section concludes.

3.2 Literature

Cultural norms and identities have been shown to affect economic behavior in a variety of ways. For example, the discussion on 'opting out' in the literature where highly qualified female graduates drop out of the labor market after marriage or childbirth relates to women in both developing and developed economies (Goldin & Katz, 2008; Shamsi, 2015). Women feel less interested in pursuing Science, Technology, Engineering, and Math (STEM) fields in order to avoid the conflict with communal roles (Diekman et al., 2010). Several policies that fail to take into account cultural attitudes achieve little towards their goal of gender parity. Hence, it is critical to understand that policies that weaken the constraints stemming from cultural identity or that change gender stereotypes may be very effective at correcting gender imbalances in education and labor market outcomes.

Two studies that complement the analysis in this paper are Bertrand et al. (2015) and Bursztyn et al. (2017). Bertrand et al. (2015) finds that married women in the US reduce their working hours to keep their incomes less than their husband's, a result corroborated by Wieber & Holst (2015) for Germany. Bursztyn et al. (2017) demonstrate results from a field experiment showing that unmarried women report reduced ambitions, such as number of weekly working hours and monthly travel days, in the presence of other men, relative to married women. They argue that career ambition traits, which are rewarded in the labor market, are regarded negatively in women in the marriage market.

Some studies have examined the change in sex-ratios in the marriage market and its impact on education and marriage outcomes for men and women (Angrist, 2002; Lafortune, 2013; Lefgren & McIntyre, 2006). However, none of them account for the (human capital) quality of men relative to women in the marriage market. The independent variable should not be the simple sex-ratios, but sex-ratios adjusted by educational attainment. For example, in the presence of hypergamy, the demographic change resulting from a large influx of low-skilled men should be very different from that of highly-skilled men.

3.3 Model: Women's Education with Hypergamy

Here, I discuss a brief model that helps understand the relationship between women's and men's education through norms of marriage. The idea is as follows: if getting more education reduces the probability of women finding 'suitable' partners, then they will restrict their schooling up to the schooling level of their expected potential partner. An increase in men's schooling level increases the schooling level of women's expected potential partner, thereby relaxing their constraint and leading to an increase in women's level of schooling.

3.3.1 Agents

Let k be the gender of an agent, with $k \in K = \{m, f\}$. Let each agent belong to an ethnicity j, with $j \in J = \{H, M, L\}$. Here high (H), medium (M) and low (L) denotes the average level of men's schooling in each ethnicity. There is a continuum of agents in each ethnicity and gender group, $i|j,k$, with $i \in I|j,k = [0,1]$.

Schooling

The level of schooling of an agent i, in number of years, is denoted by s_i. Let $F(s|j,k)$ be the distribution of schooling among agents in ethnicity j and gender group k.
All analysis will be done for gender groups in the same ethnicity until section 3.3.3. Hence, I will suppress the ethnicity subscript j for brevity.

Productivity and the Labor Market

Each agent's productivity is denoted by A_i. The labor market earnings net of schooling costs are given by $\lambda_{ik}(s)$, where

$$\lambda_{ik} = A_i * s_{ik} \tag{3.1}$$

3.3.2 Preference: Norms of Marriage

Endogamy: agents prefer to marry within their own ethnicity. This implies that when making pre-marital investments in their schooling, agents optimize based on the expected schooling level of the opposite sex in their own ethnic group. Table (3.1) shows the prevalence of endogamy by race for the United States.[12]
Marrying-up: I assume that society prefers couples where the male partner is more educated than the female partner. This implies that a woman finds men with schooling higher

[1] One could also justify such optimization based on information frictions. If people grow up around people from the same ethnicity or grow up hearing about people in their families who belong to the same ethnicity, their ideas about the distribution of schooling for either sex will come predominantly from people in their own ethnicity.

[2] Owing to rising levels of inter-ethnic marriages in the U.S., one could relax this assumption by adding a disutility component for "distance in identity". The more the distance from one's own identity (ethnic), the more an agent needs to be compensated in terms of more schooling of the expected spouse. See Banerjee et al. (2013) for estimates of the tradeoff between schooling and caste for men and women in West Bengal, India.

Figure 3.1: Endogamy in the U.S.

Year	Marriage	Intra-race
1950	77.12	76.96
1960	74.47	74.18
1970	72.94	72.44
1980	68.79	67.7
1990	62.94	61.13
2000	59.92	56.66
2010	59.17	55.81

(a) Rates of marriage and Endogamy in the U.S, 1950-2010. The endogamy or intra-race marriage rate is a function of the total population.

Married couples in the United States in 2010				
	White Wife	Black Wife	Asian Wife	Other Wife
White Husband	**97.70%**	0.30%	1.00%	0.90%
Black Husband	8.60%	**89.20%**	0.90%	1.30%
Asian Husband	7.00%	0.30%	**91.80%**	0.90%
Other Husband	44.00%	1.60%	3.40%	51.00%

Source: U.S. Census Bureau

(b) Breakdown of couples' ethnicity in the US, 2010. The rows sum up to unity.

than her more attractive than men with schooling less than her own.[3] For a given woman, I refer to the set of men with more schooling than hers as the 'preferred set' of men. Likewise, for a given man, the 'preferred set' of women consists of all women in his ethnicity with schooling lesser than his.

3.3.3 Matching Probability in the Marriage Market

Let $P(\cdot)$ denote the probability of meeting one's 'preferred' prospective spouse. I use ''marriage' here to mean all types of domestic romantic partnerships. Given the preference for marrying-up, a woman would like to match up with a man such that $s_m \geq s_{if}$. Thus, the probability that a woman with schooling level s_i is matched up with a man in the 'preferred set' (say P_i) can be computed to be

$$P_i = 1 - F(s_i|m) \tag{3.2}$$

where $F(\cdot|m)$ is the cumulative distribution function of schooling among males. The probability of matching is increasing in the proportion of men with education higher than one's own.

3.3.4 Consumption

In the case of no marriage, each agent consumes their own earnings in the labor market, λ_{ik}. In the case an agent gets married, I assume that each agent shares her earnings equally with

[3]One could argue that the preference for marrying-up is multi-dimensional, with earnings, age and height being important factors other than education. As years of schooling are positively correlated with earnings, and education is also associated with status, I argue that years of schooling can be both directly used as a determinant of marrying-up and indirectly as a proxy for earnings and status.

her spouse. Let s_{im}^{A} be the schooling level of the male partner a woman with schooling level s_{if} *aspires* to marry from within her 'preferred set'. For notational convenience, I denote the productivity of this aspirational partner of woman i as B. A person's aspirations could reflect and capture several factors such as upbringing, location, personality, etc. Then the earnings available to the woman for consumption in this couple will be the average earnings of the couple from the labor market

$$\bar{\lambda}_{ik} = \frac{A_i * s_{if} + B * s_{im}^{A}}{2}$$

3.3.5 Utility

I assume that agents derive utility from consumption and finding a partner and all earnings are fully consumed. If an agent succeeds in finding a partner/spouse, she consumes the average earnings of the couple. She also derives intrinsic utility from being in the partnership.[4] If the agent fails to be matched with a suitable partner from her 'preferred set', she consumes her own earnings from the labor market.

Each agent has the following utility function:

$$U_{ik} = P_i(\bar{\lambda}_{ik} + \mu) + (1 - P_i)\lambda_{ik} \tag{3.3}$$

where μ is the utility derived from being in a domestic partnership. For a representative female i, her utility is a function of her own schooling and productivity, her potential spouse's

[4]It is important to add this intrinsic utility for modeling the men's side of the decision-making process in future extensions. Without this added utility, men who earn more than their spouse will prefer to not enter the partnership.

schooling and productivity, and the distribution of schooling among males in her ethnicity:

$$U_{if} = (1 - F(s_{if}|m)) * \left(\frac{A_i * s_{if} + B * s_{im}^A}{2} + \mu \right) + F(s_{if}|m) * A_i * s_{if}$$

3.3.6 Optimal pre-marital investment in schooling

Each agent decides her schooling level to maximize utility. I assume that investments in education are made before a match in marriage is realized. Both men and women make optimal investments in schooling based on utility expectations from the labor and marriage markets. Thus, each agent is part of a two-stage game:

[1st]: Pre-marital investments in education are made based on labor market returns and the distribution of men's schooling.

[2nd]: The matching process concludes. In case of no match, agents consume their own earnings. In case of a match, earnings from the partnership are consumed.

I solve the game using backward induction. The objective function for a female is given by:

$$U_f = (1 - F(s|m, j)) * \left(\frac{A * s_f + B * s_m^A}{2} + \mu \right) + (F(s|m, j) * A * s_f \tag{3.4}$$

Maximizing the utility with respect to s_f, the optimal level of schooling for females is given by

$$s_f^* = \frac{B * s_m^A + 2\mu}{A} + \frac{(1 + F_m(s_f^*))}{f_m(s_f^*)} \tag{3.5}$$

If there is an influx of men with more schooling than s_f^*, then $1 - F_m(s_f^*)$ goes up, ceteris paribus.[5]

Similarly, the results are the opposite for a representative male with respect to changes in women's schooling distribution. I ignore the men's side of the market in the subsequent analysis for a focussed exposition of the main results above.

3.3.7 Comparative Statics

Proposition 3.1. *Female schooling (s_f^*) increases with an increase in $1 - F(s_f^*)$, the proportion of men with schooling level greater than s_f^*.*

Proof. As evident from equation (3.5), an increase in the proportion of men with schooling level higher than s_f^* implies that $F(s_f^*)$ becomes smaller, ceteris paribus.

$$\frac{\partial s_f^*}{\partial F_m} < 0$$

□

The above condition is similar to saying that the distribution's location shifts to the right while it's shape remain the same.

[5] The height of the pdf at s_f^* need not change due to the influx of more educated men, and if it does, the direction of the change can go either way. This is because if $1 - F$ increases, the overall shape of the pdf will change to accommodate the increase and keep the area under the curve unity.

Proposition 3.2. *Female schooling (s_f^*) increases with an increase in the schooling of the aspirational partner.*

Proof. Female schooling increases as aspirational partner's schooling increases:

$$\frac{\partial s_f^*}{\partial s_m^A} = \frac{B}{A} > 0$$

□

This condition states that, given the same distribution of males' education, women who want to marry more educated men will acquire more schooling than women who do not have such aspirations.

Proposition 3.3. *Female schooling is less responsive to the aspirational spouse's schooling when her own productivity is higher*

Proof. The cross-partial derivative of a representative female's schooling level with respect to her aspirational partner's schooling and her own productivity is negative

$$\frac{\partial^2 s_f^*}{\partial s_m^A \partial A} = -\frac{B}{A^2} < 0$$

□

This result states that more productive women are less affected by their potential spouse's expected schooling level. It helps explain the presence of highly educated women who decide to stay single.

3.4 Testing the model

In this section, I take proposition (3.1) to the data to see if an exogenous change in the distribution of men's schooling affects women's schooling in the expected direction. I use the American Immigration and Nationality Act of 1965 as a source of such plausibly exogenous variation. The Act (as I will refer to it hereafter) removed quota restrictions by country of origin from several Eastern European, Asian, African and South American countries. The new American immigration policy prioritized high-skill immigrants and the kin of U.S. citizens. The skilled-immigration or work visas channel increased the proportion of people with higher education in the US. There is also evidence of negative selection in education for those who immigrated based on family connections (Bodvarsson & Van den Berg, 2009). There is a consensus in the literature that it lead to an increase in the immigration of highly educated professionals from nationalities that had only restricted entry before.

3.4.1 Data

The data for this study comes from U.S. Census and ACS samples (1940 - 2014), 5% where available, 1% otherwise. The relevant information on schooling level, citizenship, and nationality, gender, race and age are all available in this dataset. Additionally, there is also information on income, ethnicity, language and marriage.[6]

I first explore the data at the individual level for people born in the four decades around the implementation of the Act (1950-1980). This is done by pooling all individuals from across different Census and ACS years and then putting them into separate bins by decade of birth. Upon satisfactory results, I further look into data from a longer range of ACS years up to

[6]Ideally, I would also like to have information on religion but the Census and ACS do not collect information on it.

Table 3.1: Summary Statistics: US-born Men versus Women

	Men	Women
Observations	1,716,383	1,931,002
Average Years of Schooling	11.96	11.69
	(3.60)	(3.16)
High School Completion Rate	0.69	0.69
	(0.46)	(0.46)
Graduation rate	0.19	0.14
	(0.40)	(0.34)
Age	47.00	49.04
	(15.62)	(16.80)
Age of First marriage	21.22	19.80
	(9.42)	(8.11)
% ever married	.88	.91

US-born men and women 25-64 years old.

the ACS 2014. Here, I reduce the dataset to birth cohort - Census year - ethnicity - gender - nativity cells. The underlying data consists of people 25-64 years of age. Years of schooling are computed following the procedure used in DeLong et al. (2003).

3.4.2 Method

I will use a differences-in-differences identification strategy to understand the impact of a change in men's education pool on women's education, controlling for the relevant covariates and fixed effects. The outcome and treatment variables are measured in terms of years of schooling and rates of graduation and post-graduation degrees in the population subgroup. I also exploit the variation in norms of marriage (endogamy) and differences in average schooling levels across ethnic groups.

To the extent that ideas about one's education level, the field of study and broad career choices are made while growing up, one could imagine that people form expectations on the education levels of the pool of their potential partners before they enter the marriage market. It is also true that women prefer to marry older men. Ideally, the effect of interest on women's education is the impact of changes in men's education 5-10 years older in age than them. Hence, to find the effect of men's education in the last period on the educational attainment of women in the current period, the primary equation of interest is:

$$S_t^g = \beta_0^M + (\beta_0^F - \beta_0^M)F + \beta_1^M S_{t-1}^M + (\beta_1^F - \beta_1^M)S_{t-1}^M * F + \gamma_t + \varepsilon_t^g \tag{3.6}$$

where S_t^g is the years of schooling for gender g in time t, F is the dummy for female, and γ_t is the time fixed effect. $\beta_1^F - \beta_1^M$, the differential effect on females relative to males, is the coefficient of interest.

It is possible that there are different time trends for men and women due to the feminist movement, the introduction of the pill, or changes in labor market laws against gender discrimination, and their possible correlation with $S_{t-1}^M * F$. The 1965 Immigration Act helps us to instrument for S_{t-1}^M in (3.6). The "first-stage" equations are:

$$S_{t-1}^M = \delta_0 + \delta_1 ACT_t + \delta_2 F + \gamma_t + v_t \tag{3.7}$$

$$S_{t-1}^M F = \theta_0 + \theta_1 ACT_t F + \theta_1 F + \gamma_t + u_t \tag{3.8}$$

where ACT is a dummy variable for whether or not the Act has passed yet. The IV assumption is that ACT_t is uncorrelated with ε_t^g. Thus, if there is an omitted trend that picks up the feminist movement, the ACT is a sudden shock that should be uncorrelated with it. Plugging the first-stage equations in the equation of primary interest, we obtain:

$$S_t^g = c + \beta_0' F + \beta_1^M \delta_1 ACT_t + (\beta_1^F - \beta_1^M)\theta_1 ACT_t F + \gamma_t' + \eta_t^g$$

where $c = \beta_0^M + \beta_1^M \delta_0 + (\beta_1^F - \beta_1^M)\theta_0$, $\beta_0' = (\beta_0^F - \beta_0^M) + \beta_1^M \delta_2 + (\beta_1^F - \beta_1^M)\theta_2$ and $\gamma_t' = \gamma_t + \beta_1^M \gamma_t + (\beta_1^F - \beta_1^M)\gamma_t$. We can't separately identify ACT_t and γ_t'. So, we can rewrite this as:

$$S_t^g = c + (\beta_0^F - \beta_0^M)F + (\beta_1^F - \beta_1^M)\theta_1 ACT_t F + \gamma_t'' + \eta_t^g \tag{3.9}$$

The diff-in-diff coefficient of interest is now $(\beta_1^F - \beta_1^M)\theta_1$. In the next section, I will take equation (3.9) to the data to see if there is an evidence for differential trends for women before and after the implementation of the Act.

3.4.3 Results

I find that, for people born in the US, years of schooling increase for women relative to that of men after the 1965 Act.

Figure (3.2) plots the effect of interest from equation (3.9) for men and women born in the US in the decades before and after the 1965 Act. The x-axis plots year-of-birth cohorts by decade. The vertical line at year 1940 denotes the change for people born in the 1940s who attained 25 years of age *after* 1965 when the Act was passed. Thus, the treatment group consists of people born after 1940; the group born before 1940 (who were already more than 25 years old when the Act was passed) is treated as the control group. There is evidence for parallel trends between men and women in the period before 1965. The trend for years of schooling after 1965 is non-linear. There is a consistent difference of about 0.75 years of

Table 3.2: Difference-in-Difference Estimates: US-born Men versus Women

Control Group: US-born Males (age: 25-64)

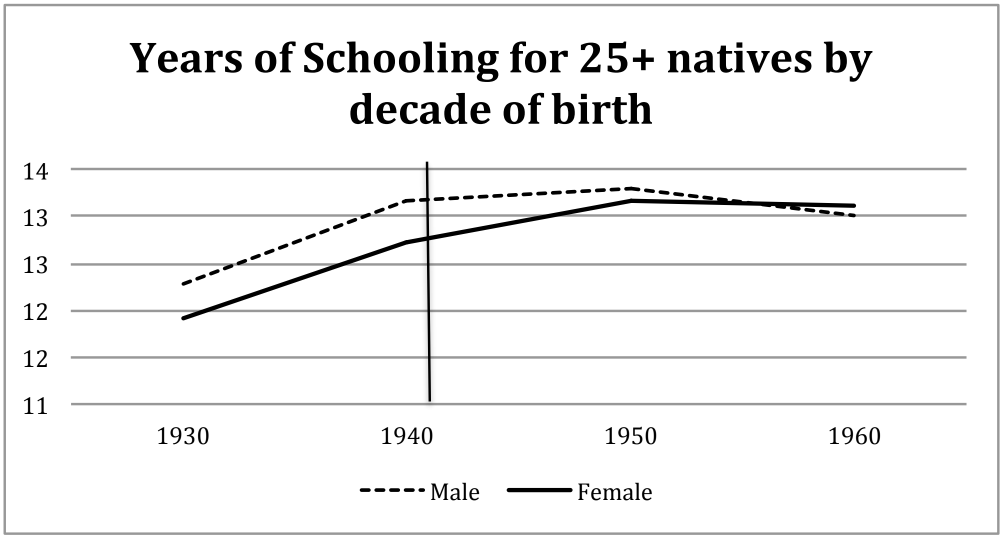
			Years of Schooling	High School Completion Rate	Graduation Rate
	US women x Decade of Birth				
A	1955	US women	0.08	0.003	-0.004
			(0.01)***	(0.001)**	(0.001)**
B	1975	US women	0.32	0.009	0.06
			(0.01)***	(0.001)***	(0.002)***
C	1985	US women	0.57	0.020	0.09
			(0.01)***	(0.002)***	(0.002)***
D	US women		-0.45	-0.003	-0.08
			(0.007)***	(0.001)***	(0.001)***
	US Men x Decade of Birth				
E	1955	US men	-0.90	-0.109	-0.07
			(0.007)***	(0.001)***	(0.001)***
F	1975	US men	0.11	0.052	-0.02
			(0.007)***	(0.001)***	(0.001)***
G	1985	US men	-0.17	0.048	-0.05
			(0.01)***	(0.001)***	(0.001)***
H		Const.	13.18	0.835	0.27
			(0.005)***	(0.001)***	(0.001)***
	Number		2,086,681		
	ADJUSTED R2		0.0305	0.0325	0.0141

The table presents regression results of equation 3.9. Graduation and high-school completion are constructed as $\{0, 1\}$ dummy variables for completing at least 16 years and 12 years of schooling respectively. Row H combined with Rows E, F, G gives the trend line for 25-years and plus US-born men before (1930) and after (1950, 1960) the Act was passed. Row D combined with rows A, B, C plots the trend line for 25-years and plus US-born women before (1930) and after (1950, 1960) the Act was passed.

schooling between men and women before 1965. After 1965, the gap not only closes, the trend reverses with women's years of schooling becoming more than that of men.

To understand the source of the change, I look into high school completion rates and graduation rates, defined as the proportion of the population at the given point in time with the respective degree. I find a similar picture for these outcomes of interest as well, with the divergence in trends between men and women more pronounced for graduation rates than for high-school completion rates (Figure 3.3). There is a gap of 8% in the graduation rates between men and women for those born in the 1930s. For the generation born in the 1950s, the gap closes down to 2.5%. By the 1960s, the gap in graduation rates is closed, with the

Figure 3.2: US born: Men versus Women



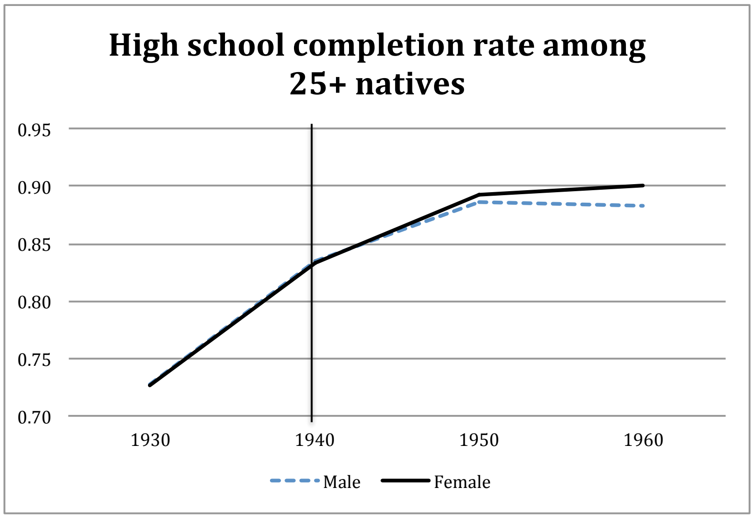
The y-axis measures years of schooling. The x-axis plots the decade of birth. At the time of the enactment of the Act, the reference period, the birth decade of 25-years and older people will be 1940s and pre-1940s. The underlying population consists of 25-64 years old men and women born in the United States. The dotted line plots the estimated years of schooling for men and the solid line for women from the regression equation 3.9, also reported in Table 3.2.

possibility of a reversal in trend. This effect is statistically significant. The effect on high-school completion rates is relatively small. Men and women born in the 1930s and 1940s have similar high-school completion rates. In the 1950s and 1960s, women's high-school completion rates increase relative to that of men, with a difference of about 2% which is statistically significant.

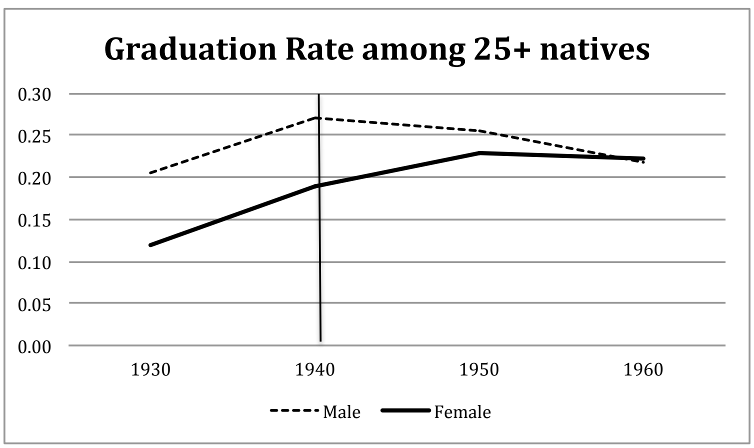
3.4.4 Robustness Check

While the diff-in-diff results are encouraging, one could argue that the difference in schooling trends between men and women could potentially be a result of several factors other than marriage norms. For example, labor discrimination laws changed around the same period and we could be picking up the effect of those changes for women relative to men in the above graphs. Therefore, we need a control group in the same gender. In this section, I use

Figure 3.3: US born: Men versus Women



(a) High-school completion rate



(b) Graduation Rate

Figure 3.3a plots the proportion of people in each population subgroup who completed at least 12 years of schooling. Figure 3.3b plots the proportion of people in each population subgroup who completed at least 16 years of schooling. The x-axis plots the decade of birth. At the time of the enactment of the Act, the reference period, the birth decade of 25-years and older people will be 1940s and pre-1940s. The underlying population consists of 25-64 years old men and women born in the United States. The dotted line plots the estimated years of schooling for men and the solid line for women from the regression equation 3.9, also reported in Table 3.2.

Table 3.3: Summary Statistics: US-born and Foreign-born Women

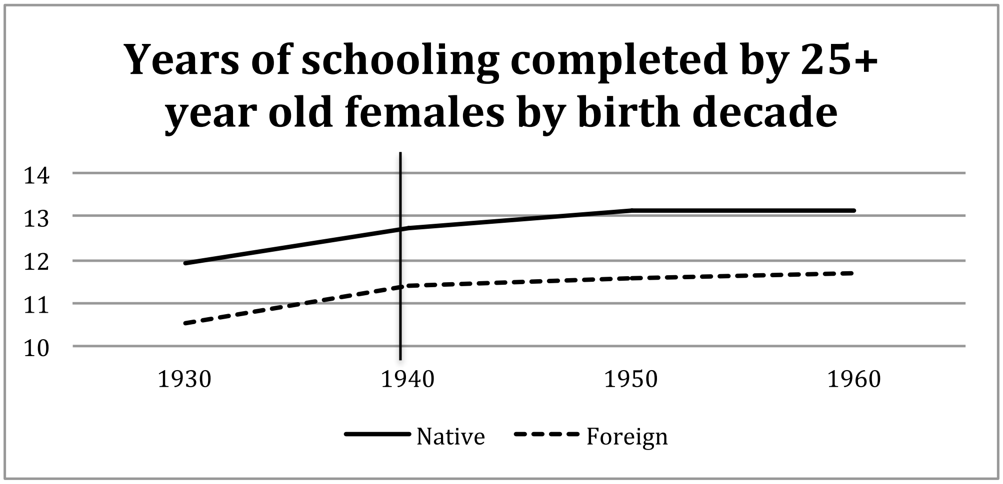
	US Born	Foreign Born
Observations	1,931,002	189,768
Average Years of Schooling	11.69	10.03
	(3.16)	(4.58)
High School Completion Rate	0.69	0.53
	(0.46)	(0.50)
Graduation rate	0.14	0.12
	(0.34)	(0.33)
Age	49.04	51.38
	(16.81)	(18.13)
Age of First marriage	19.80	21.76
	(8.12)	(8.90)
% ever married	.91	.91

US-born and foreign-born women, 25-64 years old.

foreign-born women in the same birth cohorts residing in the US as another control group for a robustness check. There is complete information on all the relevant statistics for this demographic group as well in the Census and ACS data. The gender-specific labor market trends for US-born women will be more similar to immigrant women than to US-born men.

I expect that US-born women will respond more to a change in the distribution of schooling for men in the US than immigrant women. I make the assumption that immigrant women have better access to their home country marriage markets than US-born women from the same nationalities or ethnicities. For example, high-skilled workers who move to the US for work are more likely to look for a partner in their home countries than people born in the US. First-generation immigrants are more likely to marry other first-generation immigrants from the same ethnicities than second-generation or higher immigrants within their communities. Second-generation or higher immigrants, or people born in the US, are unlikely to go back to their country of origin to find a suitable mate because of differences in lifestyles, upbringing, societal expectations, etc. Hence, immigrant women are more likely to be affected by

Figure 3.4: Women: US-born versus foreign born



The y-axis measures years of schooling. The x-axis plots the decade of birth. At the time of the enactment of the Act, the reference period, the birth decade of 25-years and older people will be 1940s and pre-1940s. The underlying population consists of 25-64 years old US-resident women born within and outside the United States residing. The dotted line plots the estimated years of schooling for foreign-born women and the solid line for US-born women from the regression equation 3.9, also reported in Table 3.4.

marriage market shifts in their country of origin than in the US. There are also women who emigrate after marriage, who will not be affected by changes in the US marriage market at all, assuming they do not consider marrying again or have completed their education investments.

Figure (3.4) plots the years of schooling for women born in the US versus those born who immigrated to the US before and after the 1965 Act change. The x-axis again is the decade of birth. There is a parallel trend in years of schooling, with US-born women having about 1.5 more years of schooling than immigrant women in the 1930s and 1940s. After the 1960s, there is a slight increase in the years of schooling for US-born women relative to the foreign-born women.

Looking closer into the source of the change, I find that the change in difference is high for both in high-school completion rates and graduation rates. Native women have about a 15%

Table 3.4: Difference-in-Differences Estimates: US-born versus Foreign-born Women

	Control Group: Immigrant Females (age: 25-64)			
		Years of Schooling	High School Completion Rate	Graduation Rate
	US women x Decade of Birth			
A	1955	0.07	-0.02	0.003
		(0.02)***	(0.003)***	(0.003)
B	1975	0.30	0.04	0.020
		(0.02)***	(0.003)***	(0.003)***
C	1985	0.11	0.02	0.014
		(0.03)***	(0.004)***	(0.004)***
D	US women	1.32	0.16	-0.007
		(0.02)***	(0.002)***	(0.002)***
	Immigrant Women x Decade of Birth			
E	1955	-0.88	-0.08	-0.073
		(0.09)***	(0.003)***	(0.003)***
F	1975	0.14	0.02	0.019
		(0.02)***	(0.003)***	(0.003)***
G	1985	0.28	0.05	0.020
		(0.03)***	(0.004)***	(0.004)***
H	Const.	11.41	0.67	0.20
		(0.02)***	(0.002)***	(0.002)***
	Number of obs	1,166,481		
	Adjusted R2	0.0518	0.0444	0.0136

The table presents regression results of equation 3.9, replacing US-born males with 25-years or older immigrant females in the US. Graduation and high-school completion are constructed as $\{0,1\}$ dummy variables for completing 16 years and 12 years of schooling respectively. Row H combined with Rows E, F, G gives the trend line for 25-years and plus foreign-born women before (1930) and after (1950, 1960) the Act was passed. Row D combined with rows A, B, C plots the trend line for 25-years and plus US-born women before (1930) and after (1950, 1960) the Act was passed.

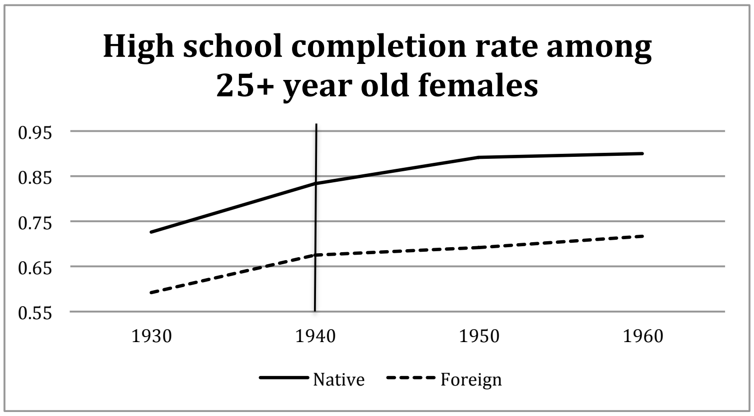
higher high-school completion rate than immigrant women in the 1930s. By the 1960s, this difference goes up to 20%. For graduation rates, immigrant women had a slightly higher graduation rate than native (born in the US) women in the 1930s. After the Act, the trend reverses, with a higher proportion of native women acquiring college degrees than immigrant women.

It is possible that this result is driven by the change in the selection of women who immigrate to the US after 1965 by educational background. I propose to distinguish information on women who immigrate early in their formative years, say before 6 years of age when children typically start school, and those who immigrate after they are 40 years of age when most marital and educational decisions have been made. The advantage of this approach would be that older (40+ years) women who immigrated after they were 40, before and after 1965, will give us a more clean control group which would not be affected by US marriage market shifts at all, while younger immigrant women who have been raised in the US are more likely to be affected by social changes in the US marriage market.

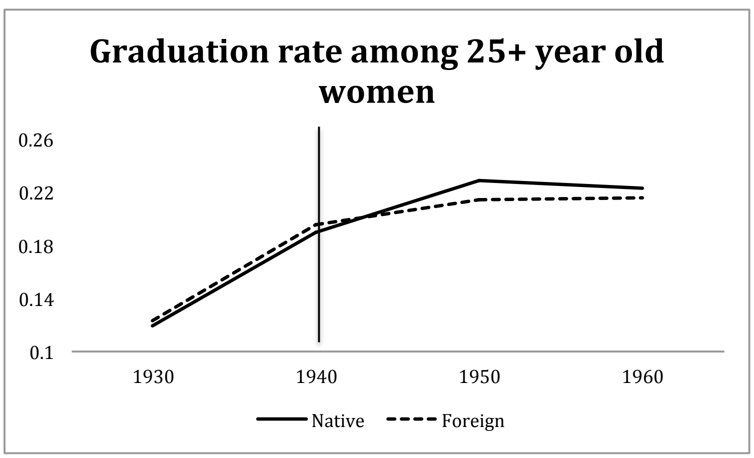
3.4.5 Extended Data

I add more Census years to extend the analysis to all available data. Figure (3.6) plots years of schooling for both the control groups used before with respect to US-born women for birth cohorts from 1876 to 1989. The x-axis in the plots is concurrent years when people are 25 years or older (unlike birth cohorts directly as before). The underlying data here is not at the individual level but aggregated by birth cohort - Census/ACS year - ethnicity - gender - US nativity status. Dividing by ethnicity gives us more observations for each birth-cohort and gender. The grey lines demarcate the period of the passage and implementation of the Act, used as reference years. The figures provided the broad trends in education over a period of more than a hundred years.

Figure 3.5: Women: US-born versus Foreign-born



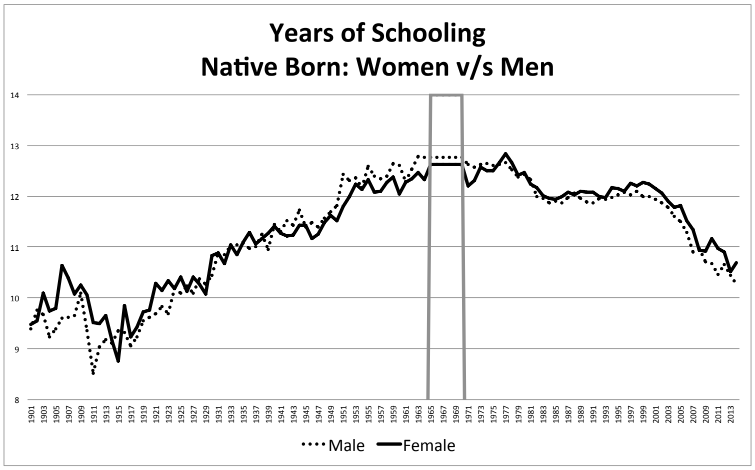
(a) High-school completion rate



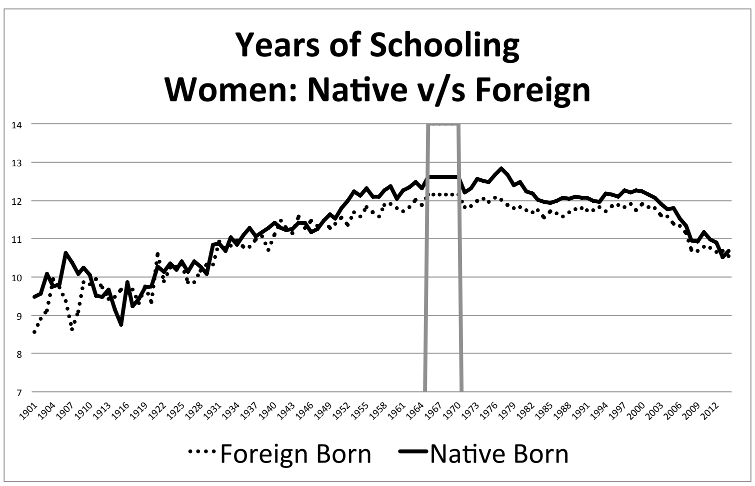
(b) Graduation Rate

Figure 3.5a plots the proportion of people in each population subgroup who completed at least 12 years of schooling. Figure 3.5b plots the proportion of people in each population subgroup who completed at least 16 years of schooling. The x-axis plots the decade of birth. At the time of the enactment of the Act, the reference period, the birth decade of 25-years and older people will be 1940s and pre-1940s. The underlying population consists of 25-64 years old US-resident women, born within or outside the United States. The dotted line plots the estimated years of schooling for foreign-born women and the solid line for US-born women from the regression equation 3.9, also reported in Table 3.4.

Figure 3.6: Years of Schooling (1901-2014)



(a) Average years of schooling for U.S. born men and women, before and after the Immigration Act 1965



(b) Average years of schooling for U.S. born and foreign-born women, before and after the Immigration Act 1965

These figures plot years of schooling for the same population subgroups used before: US-born men and women, and US-born and foreign-born women. The data comes from Census and ACS years 1960-2014. Individuals are grouped by their year of birth instead of decade of birth for finer trend lines. The grey lines from 1965-1971 denote the period of the Act's implementation, treated as the reference period. The x-axis plots the concurrent years when the individuals are 25-years or older, not the year of birth. The underlying population consists of 25-64 years old residents of the United States, both citizens and non-citizens.

3.5 Future Work: Ethnic Variation

Since marital norms vary by ethnicity/race, and the rate of marriage within one's own race and ethnicity is still high in the US, one could use this variation in norms to get more precise results. The variation in norms and the resulting elasticity of change in women's education due to a change in men's could also throw valuable insights into the underlying causes of the impact.

In on-going work, I have classified people into ethnic brackets by country of origin, ancestry, language and race. I take the 10 largest ethnic immigrant groups in the last six decades (MPI, 2015). The equation of interest will be:

$$\begin{aligned} S_t^{gR} &= \beta_0^{MW} + (\beta_0^{FW} - \beta_0^{MW})F + (\beta_0^{MB} - \beta_0^{MW})B + (\beta_0^{FB} - \beta_0^{FW} + \beta_0^{MW} - \beta_0^{MB})FB \\ &+ \beta_1^M S_{t-1}^{MR} + (\beta_1^F - \beta_1^M) S_{t-1}^{MR} F + \gamma_t + \gamma_t B + \varepsilon_t^g \end{aligned}$$

where R is for ethnicity/race and FB is the interaction of female and black. I will use the 1965 Immigration Act to instrument for S_{t-1}^{MR} in (3.10) as before. Additionally, I will do something race-specific, like instrument using the predicted S_{t-1}^{MR} based on Bartik's shift-share approach.[7] [8]

[7] Preliminary results suggest that more patriarchal ethnicities, such as Chinese and Indians, have more elastic responses to changes in me's schooling distribution than less patriarchal ethnicities such as those from the Nordic countries.

[8] I would also like to do a field-specific study using data available from the U.K. Universities and Colleges Admissions Service (UCAS) samples (1972 -1993). It is possible to identify the impact of an exogenous change in men's *choice of major* on women's choice of major in the same cohort. The identification will come by exploiting the natural variation in the choice of men's major each year, after controlling for the relevant covariates and trends in the economy. This variation can be exploited to assess whether and how

3.6 Conclusion

Closing gender disparities in education and employment have become a critical policy priority for policymakers (OECD, 2012). Substantial progress has been made on several key indicators such as college enrollment, the wage gap, the math-gender gap, etc. (Goldin et al., 2006). However, important barriers to gender equality still exist, more so in developing economies (Duflo, 2012), but not entirely absent in the economically advanced ones (Goldin, 2014).

In this paper, I study the effect of a change in the distribution of skills as measured by years of schooling on the education choices of women. The results suggest that an increase in the number of high-skill individuals in the economy increases women's education relative to that of men. The same effect is evident when changing the control group to immigrant women in the US. In doing so, I hope to add to the empirical literature on the social aspect of education choice.

Lastly, the results presented in this paper should not be considered causal. There are several competing theories other than hypergamy that may give rise to the same results. However, even these results are interesting in themselves and worthy of further exploration.

women's choice of major is influenced by exposure to men's choices in their own cohort. The outcomes and treatments will be measured in terms of the percent of majors in different fields of specializations such as STEM fields.

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Appendix A

Inequality

A.1 Pareto Properties

- Support: $w \in [\underline{w}, \infty)$
- Pdf: $f(w) = \frac{\alpha \underline{w}^{\alpha}}{w^{\alpha+1}}$, for $w \geq \underline{w}$
- Cdf: $F(w) = 1 - (\frac{\underline{w}}{w})^{\alpha}$ for $w \geq \underline{w}$
- Mean: $w^m = \frac{\alpha \underline{w}}{\alpha - 1}$, for $\alpha > 1$
- Median: $w^{med} = \underline{w}(2)^{\frac{1}{\alpha}}$
- Gini coefficient: $G(\alpha) = \frac{1}{2\alpha - 1}$, for $\alpha > 1$

The Pareto distribution used in this paper is defined by two prameters: α, which is the shape parameter, and $\underline{w}$, which is the location parameter. Throughout this paper, I restrict $\alpha > 1$ because for values $0 < \alpha < 1$, the mean of the Pareto distribution is infinite. I restrict the $\underline{w} > 0$ (the lower bound of the wealth distribution).

With more inequality (i.e. lower α), there are more draws of w in the right tail. Both the mean (w^m) and the median (w^{med}) increase as a result. One way to interpret the decrease in α and the subsequent increase in inequality is that, relative to the poorest person's wealth, the wealth of the rich increases (the poorest person's wealth is the normalized lower bound of the wealth distribution, $\underline{w}$). Thus, even if the wealth distribution spreads out from both the left and the right, we can always normalize the new lower bound and construct a new wealth distribution relative to this lower bound with a higher α.

A.2 Proofs

A.2.1 Equilibrium Total Non-Rentier Wealth K

The following section derives the value of total non-rentier wealth K for equation 2.1. $K(w)$ is defined as:

$$K(w^*|f(w)) = \int_{\underline{w}}^{w^*} wf(w)dw$$

Using the general Pareto pdf, $f(w) = \alpha\frac{\underline{w}^\alpha}{w^{\alpha+1}}$, we get:

$$
\begin{aligned}
&K(w^*|\underline{w}, \alpha)\\
&\qquad = \int_{\underline{w}}^{w^*} w\alpha \frac{\underline{w}^{\alpha}}{w^{\alpha+1}} dw\\
&\qquad = \alpha \underline{w}^{\alpha} \int_{\underline{w}}^{w^*} w^{-\alpha} dw\\
&\qquad = \frac{\alpha \underline{w}^{\alpha}}{-\alpha+1} [w^{-\alpha+1}]_{\underline{w}}^{w^*}\\
&\qquad = -\left(\frac{\alpha \underline{w}^{\alpha}}{\alpha-1}\right) \left[\frac{1}{w^{*\alpha-1}} - \frac{1}{\underline{w}^{\alpha-1}}\right]\\
&\qquad = \left(\frac{\alpha \underline{w}}{\alpha-1}\right) \left[\frac{w^{*\alpha-1} - \underline{w}^{\alpha-1}}{w^{*\alpha-1}}\right]\\
&\qquad = w^m \left[1 - \left(\frac{\underline{w}}{w^*}\right)^{\alpha-1}\right]
\end{aligned}
$$

where w^m is the mean of the Pareto distribution. The above expression makes it transparent that K^* (short for the above expression) is never bigger than the mean wealth of this economy ($\underline{w} \leq w^*$ for all w^* by construction). Hence, γK^* will also always be less than the mean wealth.

K^* can also be expressed as a function of n^* by using the equilibrium relationship between n^* and w^*, i.e. $n^* = 1 - F(w^*)$ or $w^* = \underline{w} n^{*-\frac{1}{\alpha}}$

$$
\begin{aligned}
K(n^*) &= w^m \left[1 - \left(\frac{\underline{w}}{\underline{w} n^{*-\frac{1}{\alpha}}}\right)^{\alpha-1}\right]\\
&= w^m \left[1 - \left(n^{*\frac{1}{\alpha}}\right)^{\alpha-1}\right]\\
&= w^m \left[1 - n^{*\frac{\alpha-1}{\alpha}}\right]
\end{aligned}
$$

A.2.2 Equilibrium closed form solutions of w^*, n^* and K^*

For w^*:

Substitute $K(w^*) = w^m \left[1 - \left(\frac{\underline{w}}{w^*}\right)^{\alpha-1}\right]$ and $n^* = 1 - F(w^*)$ into $\frac{\theta}{\gamma} = w^* n^* + K^*$.

$$\begin{aligned}
\frac{\theta}{\gamma} &= w^* \left(\frac{\underline{w}}{w^*}\right)^{\alpha} + w^m \left[1 - \left(\frac{\underline{w}}{w^*}\right)^{\alpha-1}\right] \\
\frac{\theta}{\gamma} &= \frac{\underline{w}^{\alpha}}{w^{*\alpha-1}} + w^m - \frac{w^m \underline{w}^{\alpha-1}}{w^{*\alpha-1}} \\
\frac{w^m \underline{w}^{\alpha-1} - \underline{w}^{\alpha}}{w^{*\alpha-1}} &= w^m - \frac{\theta}{\gamma} \\
\left(\frac{\underline{w}}{w^*}\right)^{\alpha-1} (w^m - \underline{w}) &= w^m - \frac{\theta}{\gamma} \\
\left(\frac{\underline{w}}{w^*}\right)^{\alpha-1} &= \frac{w^m - \frac{\theta}{\gamma}}{w^m - \underline{w}} \\
w^* &= \underline{w} \left[\frac{w^m - \underline{w}}{w^m - \frac{\theta}{\gamma}}\right]^{\frac{1}{\alpha-1}}
\end{aligned}$$

Let $x = \left[\frac{w^m - \frac{\theta}{\gamma}}{w^m - \underline{w}}\right]$. Then w^* can be expressed as

$$w^* = \underline{w} x^{-\frac{1}{\alpha-1}} \tag{A.1}$$

An alternative expression for x can be obtained by collecting either the α term:

$$x = \frac{\theta}{\gamma \underline{w}} - \left(\frac{\theta}{\gamma \underline{w}} - 1\right) \alpha \tag{A.2}$$

or the $\frac{\theta}{\gamma}$ term:

$$x = \alpha - \left(\frac{\alpha - 1}{\underline{w}}\right)\frac{\theta}{\gamma} \tag{A.3}$$

For $x \leq 0$, we let $w^* \to \infty$. ?

For n^*:

Substitute w^* from the above expression into $n^* = 1 - F(w^*) = (\frac{\underline{w}}{w^*})^\alpha$:

$$n^* = \left(\frac{\underline{w}}{\underline{w}x^{-\frac{1}{\alpha-1}}}\right)^\alpha$$
$$n^* = x^{\frac{\alpha}{\alpha-1}}$$
$$n^* = \left[\frac{w^m - \frac{\theta}{\gamma}}{w^m - \underline{w}}\right]^{\frac{\alpha}{\alpha-1}}$$

Thus, specifying n^* completely, we have

$$n^* = \begin{cases} 0, & \text{if } x < 0 \\ \left[\frac{w^m - \frac{\theta}{\gamma}}{w^m - \underline{w}}\right]^{\frac{\alpha}{\alpha-1}}, & \text{if } 0 \leq x \leq 1 \\ 1, & \text{if } x > 1 \end{cases}$$

For K^*:

Substitute $n^* = x^{\frac{\alpha}{\alpha-1}}$ from above into $K^* = w^m \left[1 - {n^*}^{\frac{\alpha-1}{\alpha}}\right]$.

$$
\begin{aligned}
K^* &= w^m \left[1 - (x^{\frac{\alpha}{\alpha-1}})^{\frac{\alpha-1}{\alpha}}\right] \\
&= w^m \left[1 - x\right] \\
&= w^m \left[1 - \frac{w^m - \frac{\theta}{\gamma}}{w^m - \underline{w}}\right] \\
&= w^m \left[\frac{\frac{\theta}{\gamma} - \underline{w}}{w^m - \underline{w}}\right] \\
&= \frac{w^m(\alpha-1)}{\underline{w}} \left(\frac{\theta}{\gamma} - \underline{w}\right) \\
&= \alpha \left(\frac{\theta}{\gamma} - \underline{w}\right)
\end{aligned}
$$

As inequality increases (smaller α), K^* decreases. K^* also falls when the effective cost of rent seeking comes closer to the lowest wealth level. This is because a smaller difference between cost and lowest wealth means a larger fraction of rentiers, smaller fraction of non-rentiers, thus decreasing the size of the pie which is K^*.
For $\frac{\theta}{\gamma} < \underline{w}$, we let $K = 0$.

Corner solutions stability check

The no-rent seeking equilibrium is stable if $U_i^{NR} > U_i^R$ for all i. When $n^* = 0$, $U_i^{NR} = w_i$ and $U_i^R = w_i - \theta + \gamma K$. For $\frac{\theta}{\gamma} > w^m$ (the parametric condition that gives $n^* = 0$), it is also true that $\frac{\theta}{\gamma} > w^m > K$ (as noted in the derivation of K in section A.2.1. Therefore, $\theta > \gamma K$ which implies that $U_i^{NR} > U_i^R$ for all i. Hence, the corner solution with no rentiers is stable.

The full-rent seeking equilibrium is stable if $U_i^{NR} < U_i^R$ for all i. When $n^* = 1$, $U_i^{NR} = w_i(1-\gamma)$ and $U_i^R = w_i - \theta$. $U_i^R > U_i^{NR}$ if $\theta < w_i\gamma$ or $\frac{\theta}{\gamma} < w_i$ for all i. Since $\frac{\theta}{\gamma} < \underline{w}$ is the parametric condition to obtain $n^* = 1$, the effective cost of rent-seeking is less than all possible values that wealth can take. Hence proved.

A.2.3 Comparative Statics

Deriving equation 2.6: What happens to rent seeking in equilibrium when inequality is increased? In the context of a Pareto distribution, an increase in inequality implies reducing the value of α. If the derivative of n^* with respect to α is negative, we can say that more inequality gives rise to more rent seeking.

Taking logs of the $n^* = x(\alpha)^{\frac{\alpha}{\alpha-1}}$ expression, where $x(\alpha) = \frac{\theta}{\gamma\underline{w}} - \left(\frac{\theta}{\gamma\underline{w}} - 1\right)\alpha$, we have

$$ln(n^*) = \frac{\alpha}{\alpha - 1} lnx(\alpha)$$

Differentiating both sides with respect to α:

$$
\begin{aligned}
\frac{1}{n^*}\frac{dn^*}{d\alpha} &= lnx(\alpha)\frac{d\left(\frac{\alpha}{\alpha-1}\right)}{d\alpha} + \left(\frac{\alpha}{\alpha-1}\right)\frac{1}{x(\alpha)}\frac{dx(\alpha)}{d\alpha} \\
\frac{dn^*}{d\alpha} &= \frac{n^*}{(\alpha-1)^2}[-lnx(\alpha) - \alpha(\alpha-1)\frac{\left(\frac{\theta}{\gamma\underline{w}}-1\right)}{x(\alpha)}] \\
&= -\frac{n^*}{(\alpha-1)^2}[lnx(\alpha) + \frac{\alpha}{x(\alpha)}(\alpha-1)\left(\frac{\theta}{\gamma\underline{w}}-1\right)] \\
&= -\frac{n^*}{(\alpha-1)^2}\left[lnx(\alpha) + \frac{\alpha}{x(\alpha)}\left((\alpha-1)(\frac{\theta}{\gamma\underline{w}}) - (\alpha-1)\right)\right] \\
&= -\frac{n^*}{(\alpha-1)^2}\left[lnx(\alpha) + \frac{\alpha}{x(\alpha)}\left(1-\alpha+(\alpha-1)(\frac{\theta}{\gamma\underline{w}})\right)\right] \\
&= -\frac{n^*}{(\alpha-1)^2}\left[lnx(\alpha) + \frac{\alpha}{x(\alpha)}(1-x(\alpha))\right] \\
&= -\frac{n^*}{(\alpha-1)^2}\left[lnx(\alpha) + \alpha\left(\frac{1}{x(\alpha)}-1\right)\right]
\end{aligned}
$$

For interior values of n^*, $0 < x < 1$. Therefore, $1/x > 1$. This makes both the terms in the square brackets in the above epression always positive for $0 < x < 1$. Hence, when $\underline{w} < \frac{\theta}{\gamma} < w^m$, such that $0 < n^* < 1$, rent seeking increases as inequality increases.

A.2.4 Equilibrium properties

Negative Sum game

The net wealth of society is less than before when θ is a sunk cost of rent seeking. The initial total wealth (or mean wealth, since its a continuum of agents over $[0, 1]$ interval) of this economy is w^m. The net wealth after rent seeking (denote by v^m) is $w^m - n^*\theta$.

Proof: Net wealth (v^m) = wealth of non-rentiers + wealth of rentiers

$$\begin{aligned}
v^m &= \int_{\underline{w}}^{w^*} w(1-\gamma n^*)dF(w) + \int_{w^*}^{\infty} (w - \theta + \gamma K^*)dF(w) \\
&= \int_{\underline{w}}^{w^*} wdF(w) + \int_{w^*}^{\infty} wdF(w) - \gamma n^* \int_{\underline{w}}^{w^*} wdF(w) - (\theta - \gamma K^*) \int_{w^*}^{\infty} dF(w) \\
&= \int_{\underline{w}}^{\infty} wdF(w) - \gamma n^* \int_{\underline{w}}^{w^*} wdF(w) - (\theta - \gamma K^*) \int_{w^*}^{\infty} dF(w) \\
&= w^m - \gamma n^* K^* - (\theta - \gamma K^*) n^* \\
&= w^m - \gamma n^* K^* - \theta n^* + \gamma n^* K^* \\
&= w^m - \theta n^*
\end{aligned}$$

Rentiers also worse off

Relative to θ, the net gain of rentiers is negative if

$$\begin{aligned}
\gamma K^* - \theta &< 0 \\
\gamma\alpha\left(\frac{\theta}{\gamma} - \underline{w}\right) - \theta &< 0 \\
(\alpha - 1)\theta - \gamma\alpha\underline{w} &< 0 \\
(\alpha - 1)\theta &< \gamma\alpha\underline{w} \\
(\alpha - 1)\frac{\theta}{\gamma} &< \alpha\underline{w} \\
\frac{\theta}{\gamma} &< w^m
\end{aligned}$$

which is true for an interior solution, $0 < n^* < 1$.

A.3 Trap: Exogenous θ

From the last section, we know that both rentiers and non-rentiers are worse off than before, i.e. both lose some part of their wealth net of gains in the rent-seeking process. The normalized total (mean) wealth of society falls from w^m to $w^m - n^*\theta$. In this section, I check how rent-seeking activity transforms the wealth distribution.

One way is to parametrically see that happens to the wealth random variable post rent seeking.[1] If the ex-post random variable is a linear transformation of the ex-ante random variable, then the Pareto distribution's properties are preserved. We may then compare the pre and post distributions' Pareto properties to comment on the effect on inequality.

Outline of proof:

1. The wealth of both rentiers and non-rentiers is a linear transformation of the initial draw of wealth. Rentiers' wealth is $w - \theta + \gamma K^*$. Non-rentiers' wealth is $(1 - \gamma n^*)w$.

2. Any linear transformation of a random variable preserves the distribution. Therefore, we can construct the ex-post distribution as a joint of two different Pareto distributions.

3. Once the complete ex-post distribution is constructed, I can compute the new Lorenz curves as a function of the new cdf's.

[1] The other way to compare the pre and post distributions would be to simulate and see if the ex-post distribution resembles a known distribution, and compare its properties with the initial Pareto distribution. If the ex-post distribution were also a Pareto, we could compare the parameters (location and shape) of the two distributions. The location clearly shifts to the left. It'd be of more interest to know what happens to the inequality (shape) parameter. If inequality increases, we have an inequality-rent-seeking trap.

4. Integrating the two Lorenz curves gives the Gini coefficient of the new distribution. The Gini of the old distribution is $\frac{1}{2\alpha-1}$. Comparing the two sheds light on the size of inequality relative to the initial.

A.3.1 Two Linear Transformations of Wealth

Non-rentiers' wealth: Non-rentiers pay a fraction $(n^*\gamma)$ of their initial wealth in equilibrium. Their final take home wealth is then $(1-n^*\gamma)w$. Let V denote the ex-post wealth and v the random variable, just as W denotes initial wealth and w the random variable. Thus, $v = (1-n^*\gamma)w$ for $w \in [\underline{w}, w^*]$. For simplicity, let us use $T = (1-n^*\gamma)$ to denote this transformation. So, $V = TW$ for $w \in [\underline{w}, w^*]$.

Rentiers' wealth:: Rentiers pay θ and gain γK^* in return. Their net wealth is therefore $w - \theta + \gamma K^*$. Let us use $c = \theta - \gamma K^*$ to denote this linear transformation. Therefore, the rentiers' wealth can be denoted as $V = W - c$ for $w \in [w^*, \infty)$.

There is continuity at w^* by definition. As in, the ex-post distribution has $Tw^* = w^* - c$ since the equilibrium (w^*) was computed using this as a rule.

Thus, we can integrate this information and write the ex-post random variable of wealth as:

$$V = \begin{cases} TW, & \text{if } \underline{w} < w < w^* \\ W - c, & \text{if } w^* < w. \end{cases} \tag{A.4}$$

The new support of the distribution is $v \in [T\underline{w}, \infty)$.

A.3.2 General rule for transformation of Pareto variable

Let $V = a + hW$ where $a \in \Re$ and $h > 0$. Let

$$pdf_W(w) = \frac{\alpha \underline{w}^\alpha}{w^{\alpha+1}}$$

and

$$cdf_W(w) = 1 - \left(\frac{\underline{w}}{w}\right)^\alpha$$

.

Then, the distribution of the linear transformed variable V can be written as follows:

$$
\begin{aligned}
cdf_V(w) &= P\{V \leq w\} \\
&= P\{a + hW \leq w\} \\
&= P\{W \leq \frac{w-a}{h}\} \\
&= P_W\left(\frac{w-a}{h}\right) \\
&= cdf_W\left(\frac{w-a}{h}\right) \\
&= 1 - \left(\frac{h\underline{w}}{w-a}\right)^{\alpha}, \text{ if } w > a + h\underline{w}
\end{aligned}
$$

Therefore,

$$\boxed{cdf_V(w) = 1 - \left(\frac{h\underline{w}}{w-a}\right)^{\alpha}, \text{ for } w > a + h\underline{w}} \tag{A.5}$$

The corresponding pdf will be

$$pdf_V(w) = \frac{\alpha(h\underline{w})^{\alpha}}{(w-a)^{\alpha+1}} \tag{A.6}$$

For non-rentiers ($\underline{w} < w \leq w^*$), $V_{NR} = TW$, implying $h_{NR} = T$ and $a_{NR} = 0$. For rentiers ($w \geq w^*$), $V_R = W - c$, implying $a_R = -c$ and $h_R = 0$.

A.3.3 Corresponding Pareto CDF

Let F be the initial Pareto distribution of wealth, $F = 1 - (\frac{\underline{w}}{w})^{\alpha}$. Let $F_{NR}(w)$ and $F_R(w)$ be the ex-post non-rentiers' and rentiers' wealth distributions respectively, as a function of initial wealth. Then,

$$f_V(w) = \begin{cases} \frac{\alpha(T\underline{w})^\alpha}{w^{\alpha+1}}, & \text{if } T\underline{w} \le w \le Tw^* \\ \frac{\alpha \underline{w}^\alpha}{(w+c)^{\alpha+1}}, & \text{if } Tw^* = w^* - c < w. \end{cases} \tag{A.7}$$

and

$$F_V(w) = \begin{cases} 1 - \left(\frac{T\underline{w}}{w}\right)^\alpha, & \text{if } T\underline{w} \le w \le Tw^* \\ 1 - \left(\frac{\underline{w}}{w+c}\right)^\alpha, & \text{if } Tw^* = w^* - c < w. \end{cases} \tag{A.8}$$

The area under the f_V curve over $[T\underline{w}, Tw^*]$ will be the same as the area under the f_W curve over $[\underline{w}, w^*]$, i.e. $1 - n^*$. Alternatively,

$$F_W(w^*) = F_V(Tw^*) = 1 - n^* \tag{A.9}$$

Correspondingly, the inverse cdf will be

$$v(F) = \begin{cases} T\underline{w}(1-F)^{-\frac{1}{\alpha}}, & \text{if } 0 \le F \le (1-n^*) \\ \underline{w}(1-F)^{-\frac{1}{\alpha}} - c, & \text{if } (1-n^*) < F \le 1. \end{cases} \tag{A.10}$$

where T:

$$T = 1 - \gamma n^* = 1 - \gamma x^{\frac{\alpha}{\alpha-1}}$$

and c:

$$c = \theta - \gamma K^* = \theta - \gamma w^m(1 - x)$$

Let $v_{NR}(F)$ denote the inverse cdf for non-rentiers and $v_R(F)$ for rentiers.

The pdf of v is discontinuous at Tw^*, while the cdf is continuous.

A.3.4 Lorenz Curve

The Lorenz curve is a function of the cdf F, and maps the ratio of cumulative wealth upto F and total wealth under the distribution. Specifically,

$$L(F) = \frac{\int_0^F v(F')dF'}{\int_0^1 v(F')dF'}$$

where $v(F')$ is the inverse cdf of F. Lorenz curve values range is given by $[0, 1]$ just like that for F. If wealth is equally distributed, then half the population will have exactly half the wealth of the economy. Thus, the Lorenz curve value corresponding to $F = 0.5$ will be 0.5. We can make similar assessments for other values of $F \in [0, 1]$. Hence, the 45° line plotting $L(F)$ represents the Lorenze curve corresponding to an equal wealth distribution. For unequal distributions, the Lorenz curve will be away from the 45° line.

In the context of a Pareto distribution, as used throughout this paper, the Lorenz curve can be computed to be

$$L(F) = [1 - (1 - F)^{\frac{\alpha-1}{\alpha}}] \tag{A.11}$$

Thus $\alpha = 1 \Rightarrow L(F) = 0$ should denote high inequality and $\alpha \to \infty \Rightarrow L(F) = F$ should denote perfect equality. The $\alpha \to \infty$ Pareto's Lorenz curve lies on the 45° line. As the inequality parameter (α's) value decreases, inequality increases, and the Lorenz curve moves away from the 45° line.

For the purpose of this proof, we need to compute the following Lorenz function:

$$L(F) = \begin{cases} \frac{\int_0^F v_{NR}(F')dF'}{\int_0^1 v(F')dF'} & \text{, if } 0 \leq F \leq (1-n^*) \\ \frac{\int_0^{(1-n^*)} v_{NR}(F')dF' + \int_{(1-n^*)}^F v_R(F')dF'}{\int_0^1 v(F')dF'} & \text{, if } (1-n^*) < F \leq 1. \end{cases}$$

The denominator of the Lorenz function is the normalized total wealth of society. For the ex-post distribution:

$$den\{L(F)\} = \int_0^1 v(F')dF' = w^m - \theta n^*$$

As was also evident from the previous section, the total ex-post wealth (normalized) falls from w^m to $w^m - \theta n^*$. The new total normalized wealth is positive for interior solutions, i.e. $w^m > \frac{\theta}{\gamma}$ because that implies $w^m > \gamma w^m > \theta > n^*\theta$, since γ and n^* are weakly less than unity.

For the numerator for non-rentiers:

$$\begin{aligned}
num_{NR}\{L(F)\} &= \int_0^F v_{NR}(F')dF' \\
&= \int_0^F \{T\underline{w}(1-F')^{-\frac{1}{\alpha}}\}dF' \\
&= T\underline{w}\int_0^F (1-F')^{-\frac{1}{\alpha}}dF'
\end{aligned}$$

Using chain rule of integration, let $y = 1 - F'$. Then, $dF' = -dy$.

$$\begin{aligned}
num_{NR}\{L(F)\} &= -T\underline{w}\int_0^F y^{-\frac{1}{\alpha}}dy \\
&= \frac{-T\underline{w}}{-\frac{1}{\alpha}+1}[y^{-\frac{1}{\alpha}+1}]_0^F \\
&= \frac{-T\underline{w}}{\frac{\alpha-1}{\alpha}}[y^{\frac{\alpha-1}{\alpha}}]_0^F \\
&= -T\underline{w}\frac{\alpha}{\alpha-1}[(1-F')^{\frac{\alpha-1}{\alpha}}]_0^F \\
&= -Tw^m[(1-F)^{\frac{\alpha-1}{\alpha}} - (1-0)^{\frac{\alpha-1}{\alpha}}] \\
&= Tw^m[1-(1-F)^{\frac{\alpha-1}{\alpha}}]
\end{aligned}$$

Thus, the Lorenz curve for the non-rentiers' part of the population is given by

$$L_{NR}(F) = \frac{Tw^m[1-(1-F)^{\frac{\alpha-1}{\alpha}}]}{w^m - \theta n^*} \tag{A.12}$$

The numerator of the Lorenz curve for the rentiers can be computed using:

$$\begin{aligned}
num_R\{L(F)\} &= \int_0^{(1-n^*)} v_{NR}(F')dF' + \int_{(1-n^*)}^{F} v_R(F')dF' \\
&= \int_0^{(1-n^*)} \{T\underline{w}(1-F')^{-\frac{1}{\alpha}}\}dF' + \int_{(1-n^*)}^{F} \{\underline{w}(1-F')^{-\frac{1}{\alpha}} - c\}dF'
\end{aligned}$$

For the first term, we can use the derivation for non-rentiers sum of wealth and plug $(1-n^*)$ in place of F. We break down the second term into two parts and use the chain rule for the first part of the two.

$$\begin{aligned}
num_R\{L(F)\} &= Tw^m[1-(1-(1-n^*))^{\frac{\alpha-1}{\alpha}}] + \int_{(1-n^*)}^{F} \{\underline{w}(1-F')^{-\frac{1}{\alpha}} - c\}dF' \\
&= Tw^m[1-n^{*\frac{\alpha-1}{\alpha}}] + \underline{w}\int_{(1-n^*)}^{F} (1-F')^{-\frac{1}{\alpha}}dF' - c\int_{(1-n^*)}^{F} 1.dF' \\
&= Tw^m[1-x] - \frac{\underline{w}\alpha}{\alpha-1}[(1-F')^{\frac{\alpha-1}{\alpha}}]_{(1-n^*)}^{F} - c[F']_{(1-n^*)}^{F} \\
&= Tw^m[1-x] - w^m[(1-F)^{\frac{\alpha-1}{\alpha}} - (1-(1-n^*))^{\frac{\alpha-1}{\alpha}}] - c[F-(1-n^*)] \\
&= Tw^m[1-x] - w^m[(1-F)^{\frac{\alpha-1}{\alpha}} - n^{*\frac{\alpha-1}{\alpha}}] - c[F-1+n^*] \\
&= Tw^m[1-x] - w^m[(1-F)^{\frac{\alpha-1}{\alpha}} - x] - c[F-1+n^*]
\end{aligned}$$

The final Lorenz function that we will use to compute Gini coefficients is

$$L(F) = \begin{cases} \frac{Tw^m\{1-(1-F)^{\frac{\alpha-1}{\alpha}}\}}{w^m-\theta n^*} & \text{, if } 0 \le F \le (1-n^*) \\ \frac{Tw^m(1-x)+c(1-n^*)-cF+w^m[x-(1-F)^{\frac{\alpha-1}{\alpha}}]}{w^m-\theta n^*} & \text{, if } (1-n^*) < F \le 1. \end{cases}$$

Like the cdf of v, the Lorenz function is also continuous at $F' = 1-n^*$.

For $F' = 1 - n^*$, cumulative wealth as a ratio of total wealth is

$$L(F') = \frac{Tw^m(1-x)}{w^m - \theta n^*}$$

To see that $L(F) > L(F')$ at $1 - n^*$,

$$\begin{aligned}
(1-x) &> \frac{Tw^m(1-x)}{w^m - \theta n^*} \\
w^m - \theta n^* &> Tw^m \\
(1-T)w^m &> \theta n^* \\
(1-(1-n^*\gamma))w^m &> \theta n^* \\
\gamma w^m n^* &> \theta n^* \\
w^m &> \frac{\theta}{\gamma}
\end{aligned}$$

which is true for all interior values of n^*.

A.3.5 Lorenz dominance and the Gini coefficient

The above discussion on the Lorenz curve brings us to the last step here: prove that the ex-post Lorenz curve lies below the initial Lorenz curve. Another way to show the above, which may be modeled using computation, is comparing the respective Gini coefficients. The Gini is the ratio of the area between the Lorenz curve and the 45° line to the total area of triangle under the Lorenz curve. When there is perfect equality, the Lorenz lies on the 45° line, and Gini coefficient is 0. Higher inequality Lorenz curves lie below lower inequality ones.

I start by showing that the ex-post Lorenz curve lies below the initial Lorenz curve at all points. I do this in two parts, one for the non-rentier part and one for the rentier part of the ex-post Lrenz curve. The initial Lorenz curve has the same shape all over.

Part 1: Non-rentiers

$$
\begin{aligned}
L(F') &< L(F) \\
\frac{Tw^m\{1-(1-F)^{\frac{\alpha-1}{\alpha}}\}}{w^m-\theta n^*} &< 1-(1-F)^{\frac{\alpha-1}{\alpha}} \\
Tw^m &< w^m-\theta n^* \\
(1-n^*\gamma)w^m &< w^m-\theta n^* \\
\frac{\theta}{\gamma} &< w^m
\end{aligned}
$$

from the last section, and which is true for all interior values of n^*.

Part 2: Rentiers

$$
\begin{aligned}
L(F') &< L(F) \\
\frac{Tw^m(1-x) + c(1-n^*) - cF + w^m[x-(1-F)^{\frac{\alpha-1}{\alpha}}]}{w^m - \theta n^*} &< 1-(1-F)^{\frac{\alpha-1}{\alpha}} \\
Tw^m(1-x) + c(1-n^*) - cF + w^m[x-(1-F)^{\frac{\alpha-1}{\alpha}}] &< \{w^m - \theta n^*\}\{1-(1-F)^{\frac{\alpha-1}{\alpha}}\} \\
Tw^m(1-x) + (\theta - \gamma w^m(1-x)) - (\theta - \gamma w^m(1-x))n^* & \\
-(\theta - \gamma w^m(1-x))F + w^m x - w^m(1-F)^{\frac{\alpha-1}{\alpha}} &< w^m - \theta n^* - \{w^m - \theta n^*\}(1-F)^{\frac{\alpha-1}{\alpha}} \\
(1-n^*\gamma)w^m(1-x) + (\theta - \gamma w^m(1-x)) + \gamma w^m(1-x)n^* & \\
-(\theta - \gamma w^m(1-x))F + w^m x &< w^m + \theta n^*(1-F)^{\frac{\alpha-1}{\alpha}} \\
\theta - \gamma w^m(1-x) - (\theta - \gamma w^m(1-x))F &< \theta n^*(1-F)^{\frac{\alpha-1}{\alpha}} \\
(\theta - \gamma w^m(1-x))(1-F) &< \theta n^*(1-F)^{\frac{\alpha-1}{\alpha}} \\
(1-F)^{\frac{1}{\alpha}} &< \frac{\theta n^*}{(\theta - \gamma w^m(1-x))} \\
(1-F)^{\frac{1}{\alpha}} &< \frac{\theta n^*}{(\theta - \gamma\alpha(\frac{\theta}{\gamma} - \underline{w}))} \\
(1-F)^{\frac{1}{\alpha}} &< \frac{\frac{\theta}{\gamma} n^*}{(\alpha\underline{w} - (\alpha-1)\frac{\theta}{\gamma})} \\
(1-F)^{\frac{1}{\alpha}} &< \frac{\frac{\theta}{\gamma} n^*}{(\alpha-1)(\frac{\alpha}{\alpha-1}\underline{w} - \frac{\theta}{\gamma})} \\
(1-F)^{\frac{1}{\alpha}} &< \frac{\frac{\theta}{\gamma}\frac{n^*}{\underline{w}}}{\frac{(\alpha-1)}{\underline{w}}(\frac{\alpha}{\alpha-1}\underline{w} - \frac{\theta}{\gamma})} \\
(1-F)^{\frac{1}{\alpha}} &< \frac{\theta}{\gamma}\frac{n^*}{x\underline{w}} \\
(1-F)^{\frac{1}{\alpha}} &< \frac{\theta}{\gamma}\frac{x^{\frac{\alpha}{\alpha-1}-1}}{\underline{w}} \\
(1-F)^{\frac{1}{\alpha}} &< \frac{\theta}{\gamma\underline{w}} x^{\frac{1}{\alpha-1}} \\
(1-F) &< \left(\frac{\theta}{\gamma\underline{w}}\right)^{\alpha} n^*
\end{aligned}
$$

Therefore, if $(1-F) < \left(\frac{\theta}{\gamma \underline{w}}\right)^{\alpha} n^*$, then the ex-post Lorenz is lower than the initial Lorenz everywhere. For the rentiers' part of the Lorenz curve, the largest value that the LHS can take is when F is smallest, i.e., $F = 1 - n^*$. Proving the above inequality for the largest LHS will prove it for the remaining part of the curve since the RHS is fixed.

$$
\begin{aligned}
n^* &< \left(\frac{\theta}{\gamma \underline{w}}\right)^{\alpha} n^* \\
1 &< \frac{\theta}{\gamma \underline{w}} \\
\underline{w} &< \frac{\theta}{\gamma}
\end{aligned}
$$

which is true for all interior values of n^*. Hence proved.

Gini

I also show that the area under the $L(F)$ curve is greater than area under $L(F')$ curve, i.e. the Gini coefficient is higher for the ex-post distribution.

Area under $L(F) = [1-(1-F)^{\frac{\alpha-1}{\alpha}}]$ curve:

$$
\begin{aligned}
A = Area\{L(F)\} &= \int_0^1 L(F)dF \\
&= \int_0^1 [1-(1-F)^{\frac{\alpha-1}{\alpha}}]dF \\
&= \frac{\alpha-1}{2\alpha-1}
\end{aligned}
$$

Corresponding Gini coefficient is

$$\begin{aligned} Gini(F) = 1 - 2A = 1 - 2\frac{\alpha - 1}{2\alpha - 1} \\ = \frac{1}{2\alpha - 1} \end{aligned}$$

which is a known quantity for the standard Pareto used throughout this paper.

The $L(F')$ curve is given by:

$$L(F') = \begin{cases} \frac{Tw^m\{1-(1-F')^{\frac{\alpha-1}{\alpha}}\}}{w^m-\theta n^*} & \text{, if } 0 \leq F \leq (1-n^*) \\ \frac{Tw^m(1-x)+c(1-n^*)-cF'+w^m[x-(1-F')^{\frac{\alpha-1}{\alpha}}]}{w^m-\theta n^*} & \text{, if } (1-n^*) < F \leq 1. \end{cases}$$

Area under the $L(F')$ curve can be computed as:

$$\begin{aligned} A' = Area\{L(F')\} \\ = \underbrace{\int_0^{1-n^*} L(F')dF'}_{A'_1/(w^m-\theta n^*)} + \underbrace{\int_{1-n^*}^1 L(F')dF'}_{A'_2/(w^m-\theta n^*)} \end{aligned}$$

Now,

$$\begin{aligned} A'_1 = \int_0^{1-n^*} Tw^m\{1-(1-F')^{\frac{\alpha-1}{\alpha}}\}dF' \\ = Tw^m\left(\int_0^{1-n^*} 1.dF' - \int_0^{1-n^*} (1-F')^{\frac{\alpha-1}{\alpha}} dF'\right) \\ = Tw^m\left((1-n^*) - \frac{-1}{\frac{\alpha-1}{\alpha}+1}[(1-F')^{\frac{\alpha-1}{\alpha}+1}]_0^{1-n^*}\right) \\ = Tw^m\left((1-n^*) - \frac{\alpha}{2\alpha-1}[1-n^{*\frac{2\alpha-1}{\alpha}}]\right) \end{aligned}$$

and

$$A_2' = \int_{1-n^*}^{1} \left(Tw^m(1-x) + c(1-n^*) - cF' + w^m[x - (1-F')^{\frac{\alpha-1}{\alpha}}] \right) dF'$$

$$= n^*\{w^m(1 - \frac{\alpha}{2\alpha-1}x) - \frac{n^*}{2}(\theta + \gamma w^m(1-x))\}$$

(Full derivations available upon request.)

Lets compare areas under the Lorenz curve for F and F' separately for the domains $[0, 1-n^*]$ and $[1-n^*, 1]$.

Let A_1 be the area under the $L(F)$ curve and $A'_{NR} = \frac{A'_1}{w^m - \theta n^*}$ be the area under the $L(F')$ curve from $[0, 1-n^*]$.

$$A_1 = \int_0^{1-n^*} L(F)dF$$

$$= (1-n^*) - \frac{\alpha}{2\alpha-1}[1 - n^{*\frac{2\alpha-1}{\alpha}}]$$

Now there would be greater inequality in the ex-post distribution if $A_1 > A'_{NR}$, i.e.

$$(1-n^*) - \frac{\alpha}{2\alpha-1}[1 - n^{*\frac{2\alpha-1}{\alpha}}] > \frac{Tw^m\left((1-n^*) - \frac{\alpha}{2\alpha-1}[1 - n^{*\frac{2\alpha-1}{\alpha}}]\right)}{w^m - n^*\theta}$$

$$\Rightarrow w^m - n^*\theta > Tw^m$$

This holds because the numerator is a positive quantity being area under a curve.

$$\begin{aligned} w^m(1-T) &> n^*\theta \\ \Rightarrow w^m &> \frac{\theta}{\gamma} \end{aligned}$$

which is true for interior solution of n^*.

Similarly, let A_2 be the area under the $L(F)$ curve and A'_R be the area under $L(F')$ curve from $[1-n^*, 1]$.

$$A_2 = \int_{1-n^*}^{1} L(F)dF \tag{A.13}$$

$$= n^*\left(1 - \frac{\alpha}{2\alpha-1}x\right) \tag{A.14}$$

Now there would be greater inequality in the ex-post distribution if $A_2 > A'_R$, i.e.

$$\begin{aligned} n^*\left(1 - \frac{\alpha}{2\alpha-1}x\right) &> \frac{\{w^m n^*(1-\frac{\alpha}{2\alpha-1}x) - \frac{n^{*2}}{2}\left(\theta + \gamma w^m(1-x)\right)\}}{w^m - n^*\theta} \\ \Rightarrow -n^*\theta A_2 &> -\frac{n^{*2}}{2}\left(\theta + \gamma w^m(1-x)\right) \\ \Rightarrow \theta A_2 &< \frac{n^*}{2}\left(\theta + \gamma w^m(1-x)\right) \end{aligned}$$

Replacing the value of A_2 from equation 29,

$$\Rightarrow \theta n^* \left(1 - \frac{\alpha}{2\alpha - 1}x\right) < \frac{n^*}{2}\left(\theta + \gamma w^m(1-x)\right)$$
$$\Rightarrow \underline{w}(1 - \frac{1}{2\alpha}) < \underline{w} < \frac{\theta}{\gamma}$$

which holds for all interior solutions. Hence the inequality holds and we can say that $A_2 > A'_R$. Since both A_1 and A_2 are respectively greater than A'_{NR} and A'_R, the following is also true:

$$A_1 + A_2 > A'_{NR} + A'_R$$
$$\Rightarrow 1/2 - (A_1 + A_2) < 1/2 - (A'_{NR} + A'_R)$$
$$\Rightarrow Gini(F) < Gini(F')$$

Hence, inequality increases in the ex-post distribution.

A.4 Endogenizing θ and γ

Let

$$\gamma(\theta) = \beta\theta^{1-\epsilon} \tag{A.15}$$

where $0 < \epsilon < 1$ and $\beta \in R_+$ such that γ is a proportion.

Then,

$$\frac{\theta}{\gamma} = \frac{1}{\beta}\theta^{\epsilon} \tag{A.16}$$

In the second stage, n^* is given by

$$n^* = \left[\frac{w^m - \frac{1}{\beta}\theta^{\epsilon}}{w^m - \underline{w}}\right]^{\frac{\alpha}{\alpha-1}} \tag{A.17}$$

The revenue as a function of θ:

$$Rev = \left[\frac{w^m - \frac{1}{\beta}\theta^{\epsilon}}{w^m - \underline{w}}\right]^{\frac{\alpha}{\alpha-1}} \theta \tag{A.18}$$

Simplifying the above expression:

$$\begin{aligned} Rev &= \left[\alpha - \frac{(\alpha-1)}{\beta\underline{w}}\theta^{\epsilon}\right]^{\frac{\alpha}{\alpha-1}} \theta \\ &= x^{\frac{\alpha}{\alpha-1}}\theta \end{aligned}$$

The first-order condition is given by

$$
\begin{aligned}
\frac{dRev}{d\theta} &= 0 \\
\Rightarrow \frac{\alpha}{\alpha-1}[x]^{\frac{\alpha}{\alpha-1}-1} - \frac{(\alpha-1)\epsilon}{\beta\underline{w}}\theta^{\epsilon-1}\theta + x^{\frac{\alpha}{\alpha-1}} &= 0 \\
\Rightarrow x^{\frac{\alpha}{\alpha-1}} &= (\frac{\alpha\epsilon}{\beta\underline{w}}\theta^{*\epsilon})x^{\frac{1}{\alpha-1}} \\
\Rightarrow x^{\frac{\alpha-1}{\alpha-1}} &= (\frac{\alpha\epsilon}{\beta\underline{w}}\theta^{*\epsilon}) \\
\alpha - \frac{(\alpha-1)}{\beta\underline{w}}\theta^{\epsilon} &= \frac{\alpha\epsilon}{\beta\underline{w}}\theta^{*\epsilon} \\
\alpha &= \frac{(\alpha-1)}{\beta\underline{w}}\theta^{\epsilon} + \frac{\alpha\epsilon}{\beta\underline{w}}\theta^{*\epsilon} \\
\alpha &= \frac{(\alpha-1+\alpha\epsilon)}{\beta\underline{w}}\theta^{*\epsilon}
\end{aligned}
$$

Therefore, the value of θ which maximizes the revenue is:

$$
\theta^* = \left[\frac{\alpha\underline{w}\beta}{\alpha-1+\alpha\epsilon}\right]^{\frac{1}{\epsilon}} \tag{A.19}
$$

This value of θ^* is smaller than $(\beta w^m)^{\frac{1}{\epsilon}}$ for $\alpha\epsilon > 0$.

The corresponding value of $\frac{\theta}{\gamma}$ is

$$
\begin{aligned}
\frac{\theta}{\gamma} &= \frac{\theta^{\epsilon}}{\beta} \\
&= \frac{\alpha\underline{w}}{\alpha-1+\alpha\epsilon} \\
&< \frac{\alpha\underline{w}}{\alpha-1} = w^m
\end{aligned}
$$

Thus, the revenue-maximizing value of the effective cost of rent seeking is less than the mean wealth of the economy. Recall that when the effective cost of rent seeking is greater than the mean wealth, rent seeking is not profitable for anyone, thereby giving the corner solution of no rent seeking. We obtain an interior solution when $\frac{\theta}{\gamma}$ greater than $\underline{w}$ as well. This will happen when $\alpha\epsilon < 1$. Since $\epsilon < 1$ and $\alpha > 1$, an interior solution exists for some values of α, for a given ϵ.

Equilibrium n^*:

$$
\begin{aligned}
n^* &= \left(\alpha - \frac{(\alpha-1)}{\underline{w}\beta}\theta^{*\epsilon}\right)^{\frac{\alpha}{\alpha-1}} \\
&= \left(\alpha - \frac{(\alpha-1)}{\underline{w}\beta}\frac{\alpha\underline{w}\beta}{\alpha-1+\alpha\epsilon}\right)^{\frac{\alpha}{\alpha-1}} \\
&= \left(\alpha - \frac{\alpha(\alpha-1)}{\alpha-1+\alpha\epsilon}\right)^{\frac{\alpha}{\alpha-1}} \\
&= \left[\alpha\left(\frac{(\alpha-1+\alpha\epsilon)-(\alpha-1)}{\alpha-1+\alpha\epsilon}\right)\right]^{\frac{\alpha}{\alpha-1}} \\
&= \left(\frac{\alpha^2\epsilon}{\alpha-1+\alpha\epsilon}\right)^{\frac{\alpha}{\alpha-1}}
\end{aligned}
$$

For what values of α and ϵ will $0 \leq n^* \leq 1$? When $0 \leq \alpha^2\epsilon \leq \alpha - 1 + \alpha\epsilon$.

$$
\begin{aligned}
\alpha^2\epsilon &\leq \alpha - 1 + \alpha\epsilon \\
\alpha^2\epsilon - \alpha\epsilon &\leq \alpha - 1 \\
\alpha\epsilon(\alpha - 1) &\leq (\alpha - 1) \\
\alpha\epsilon &\leq 1
\end{aligned}
$$

Hence, $0 \leq n^* \leq 1$ when $0 \leq \alpha\epsilon \leq 1$.

A.4.1 Comparative statics with endogenous θ and γ

We will do comparative statics for interior values of n^*, i.e., $0 \leq \alpha\epsilon \leq 1$. How does the equilibrium cost per person (θ^*) and the effective cost of rent-seeking ($\frac{\theta}{\gamma}$) change with α?

$$
\theta^* = y(\alpha)^{\frac{1}{\epsilon}} \tag{A.20}
$$

where $y(\alpha) = \frac{\alpha w \beta}{\alpha - 1 + \alpha\epsilon}$. So,

$$
\frac{d\theta^*}{d\alpha} = \frac{1}{\epsilon} y(\alpha)^{\frac{1}{\epsilon} - 1} \frac{dy}{d\alpha} \tag{A.21}
$$

Hence, $\frac{d\theta^*}{d\alpha} < 0$ if $\frac{dy}{d\alpha} < 0$.

$$
\begin{aligned}
&\frac{dy}{d\alpha} \\
&\quad = \frac{d\left(\frac{\alpha}{\alpha-1+\alpha\epsilon}\right)\underline{w}\beta}{d\alpha} \\
&\quad = \left(\frac{1(\alpha-1+\alpha\epsilon)-\alpha(1+\epsilon)}{(\alpha-1+\alpha\epsilon)^2}\right)\underline{w}\beta \\
&\quad = \left(\frac{-1}{(\alpha-1+\alpha\epsilon)^2}\right)\underline{w}\beta \\
&\quad < 0
\end{aligned}
$$

Thus, as inequality increases, the cost of rent seeking per agent also increases. Similarly, the effective cost of rent seeking ($\frac{\theta^{\epsilon}}{\beta}$) also increases with more inequality.

A.4.2 n^* dynamic with inequality

What about the dynamics of equilibrium proportion of rentiers with respect to changes in inequality?

Let $n^* = f(\alpha)^{g(\alpha)}$, where $f(\alpha) = \frac{\alpha^2\epsilon}{\alpha-1+\alpha\epsilon}$ and $g(\alpha) = \frac{\alpha}{\alpha-1}$. Taking logs on both sides, we have $ln(n^*) = g(\alpha)lnf(\alpha)$. Differentiating both sides w.r.t. α, we get:

$$
\begin{aligned}
&\frac{1}{n^*}\frac{dn^*}{d\alpha} \\
&\qquad = g(\alpha)\frac{1}{f(\alpha)}f'(\alpha) + g'(\alpha)lnf(\alpha)
\end{aligned}
$$

Now,

$$
\begin{aligned}
f'(\alpha) &= \epsilon\frac{2\alpha(\alpha-1+\alpha\epsilon)-\alpha^2(1+\epsilon)}{(\alpha-1+\alpha\epsilon)^2} \\
&= \epsilon\frac{2\alpha^2-2\alpha+2\alpha^2\epsilon-\alpha^2-\alpha^2\epsilon)}{(\alpha-1+\alpha\epsilon)^2} \\
&= \epsilon\frac{\alpha^2-2\alpha+\alpha^2\epsilon}{(\alpha-1+\alpha\epsilon)^2}
\end{aligned}
$$

and

$$
\begin{aligned}
g'(\alpha) &= \frac{(\alpha-1)-\alpha}{(\alpha-1)^2} \\
&= \frac{-1}{(\alpha-1)^2}
\end{aligned}
$$

Putting things together, we get

$$
\begin{aligned}
&\frac{1}{n^*}\frac{dn^*}{d\alpha} \\
&\quad= \left(\frac{\alpha}{\alpha-1}\right)\left(\frac{\alpha-1+\alpha\epsilon}{\alpha^2\epsilon}\right)\left(\epsilon\frac{\alpha^2-2\alpha+\alpha^2\epsilon}{(\alpha-1+\alpha\epsilon)^2}\right)-\frac{1}{(\alpha-1)^2}lnf(\alpha) \\
&\quad= \left(\frac{\alpha-1+\alpha\epsilon}{\alpha(\alpha-1)}\right)\left(\frac{\alpha^2-2\alpha+\alpha^2\epsilon}{(\alpha-1+\alpha\epsilon)^2}\right)-\frac{1}{(\alpha-1)^2}lnf(\alpha) \\
&\quad= \left(\frac{\alpha^2-2\alpha+\alpha^2\epsilon}{\alpha(\alpha-1)(\alpha-1+\alpha\epsilon)}\right)-\frac{1}{(\alpha-1)^2}lnf(\alpha) \\
&\quad= \left(\frac{\alpha-2+\alpha\epsilon}{(\alpha-1)(\alpha-1+\alpha\epsilon)}\right)-\frac{1}{(\alpha-1)^2}lnf(\alpha) \\
&\quad= \left(\frac{\alpha-1+\alpha\epsilon}{(\alpha-1)(\alpha-1+\alpha\epsilon)}-\frac{1}{(\alpha-1)(\alpha-1+\alpha\epsilon)}\right)-\frac{1}{(\alpha-1)^2}lnf(\alpha) \\
&\quad= \left(\frac{1}{\alpha-1}-\frac{1}{(\alpha-1)(\alpha-1+\alpha\epsilon)}\right)-\frac{1}{(\alpha-1)^2}lnf(\alpha) \\
&\quad= \frac{1}{\alpha-1}\left(1-\frac{1}{(\alpha-1+\alpha\epsilon)}+\frac{-lnf(\alpha)}{(\alpha-1)}\right)
\end{aligned}
$$

nstarprime.pdf

We are interested in values of $f(\alpha)$ such that $0 \leq f(\alpha) \leq 1$ (for $0 \leq n^* \leq 1$). therefore, for the purposes of this study, $lnf(\alpha) \leq 0$.

Now, $n^{*\prime} \lesseqgtr 0$ iff

$$\begin{aligned}
1 - \frac{1}{(\alpha - 1 + \alpha\epsilon)} + \frac{-lnf(\alpha)}{(\alpha - 1)} &\lesseqgtr 0 \\
1 - \frac{1}{(\alpha - 1 + \alpha\epsilon)} &\lesseqgtr \frac{lnf(\alpha)}{(\alpha - 1)} \\
\frac{\alpha + \alpha\epsilon - 2}{\alpha - 1 + \alpha\epsilon} &\lesseqgtr \frac{lnf(\alpha)}{(\alpha - 1)} \\
\frac{(\alpha - 1)(\alpha + \alpha\epsilon - 2)}{\alpha - 1 + \alpha\epsilon} &\lesseqgtr lnf(\alpha)
\end{aligned}$$

On the LHS, $(\alpha - 1) > 0$ and the denominator is also positive. On the RHS, $lnf(\alpha) \leq 0$. So, $n^{*\prime} > 0$ if

$$(\alpha + \alpha\epsilon - 2) > 0 \tag{A.22}$$

So, $n^{*\prime} > 0$ for all values of α such that

$$\begin{aligned}
\alpha + \alpha\epsilon &> 2 \\
\alpha(1 + \epsilon) &> 2 \\
\alpha &> \frac{2}{(1 + \epsilon)}
\end{aligned}$$

Re-arranging in terms of the elasticity of γ with respect to θ, we get $n^{*\prime} > 0$ if

$$1 - \epsilon < 2(\frac{\alpha - 1}{\alpha}) \tag{A.23}$$

Thus, the proportion of rentiers is likely to decline with more inequality ($n^{*\prime} > 0$) when the elasticity of rent rate with respect to θ is low. Likewise, for very high values of elasticity $1 - \epsilon$, n^* is likely to rise with more inequality.