



**Enough and as Good:  
a Formal Model of Lockean First Appropriation**

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## Abstract

In developing a theory of the first appropriation of natural resources from the state of nature John Locke tells us that persons must leave “enough and as good” for others. Detailing exactly what this restriction requires divides right and left libertarians. Briefly, right libertarians interpret “enough and as good” as requiring no or very minimal restrictions on the first appropriation of natural resources, whereas left libertarians interpret “enough and as good” as requiring everyone be entitled to an equal share of unappropriated resources, able to claim no more beyond this equal share. This paper approaches the right versus left libertarian debate by developing a formal model that examines the welfare properties of different interpretations of the Lockean proviso. The model shows that underlying philosophical justifications for left libertarianism, when plausible assumptions hold, will be better served by a right libertarian proviso rather than a left libertarian one.

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“Lockean appropriation makes people no worse off than they would be *how*? This question of fixing the baseline needs more detailed investigation than we are able to give it here. It would be desirable to have an estimate of the general economic importance of original appropriation in order to see how much leeway there is for differing theories of appropriation and of the location of the baseline.”

- Robert Nozick, *Anarchy, State, and Utopia*, pp. 177.

## 1 Introduction

John Locke begins chapter five of the *Second Treatise of Government* with a puzzle: God gave to mankind the whole earth in common, yet individuals own things. How does this happen? To which Locke responds: persons acquire property by mixing their labor with those unowned resources in the state of nature: “Whatsoever then he removes out of the state of nature that nature hath provided. . . he hath mixed his labour with, and joined to it something that is his own, and thereby makes it his property.” (Locke 1690/1980: 19).

There are obvious objections to this theory of appropriation: what if someone tries to own *everything* by mixing her labor with the *entire* commons? Would it not be unfair for one person to own *so much*? And what about those latecomers who come generations down the line? What about those who are unable to initially appropriate? To which Locke responds by setting provisos or restrictions on his theory of appropriation. First, in the case of fruits and other thing capable of spoilage, persons may take “as much as anyone can make use of to any advantage of life before it spoils. . . whatever is beyond this, is more than his share, and belongs to others” (Locke 1690/1980: 20-21). Second, in the case of land and natural resources (things not subject to spoilage), persons may appropriate so long as they leave “enough, and as good” for others (Locke 1690/1980: 21). Most think provisos of this general nature are essential for any theory of property. As Robert Nozick notes: “. . . any adequate theory of justice in acquisition will contain a proviso. . . A process normally giving rise to a permanent bequeathable property right in a previously unowned thing will not do so if the position of others no longer at liberty to use the thing is thereby worsened.” (Nozick 1974: 178).

Though essential, what exactly these provisos permit and make impermissible is not obvious. Again following Nozick, clearly these provisos are “meant to ensure that the situation of others is not worsened” (Nozick 1974: 175). But as one of Nozick’s greatest detractors reminds: “Disagreement will come on what should here count as worsening another’s situation” (Cohen 1995: 75). This disagreement has led to an extensive literature debating the best way of understanding these provisos – though they all take Locke as their root

inspiration, these different versions of the provisos result in radically different conclusions concerning what is prohibited and what is permitted when it comes to the first appropriation of unowned resources from the state of nature.

This paper joins the debate by examining two different ways of interpreting the second Lockean proviso: the one pertaining to natural resources (land in particular) and other things not subject to spoilage, requiring we leave enough and as good for others. More specifically, the paper examines what we broadly call right libertarianism and left libertarianism. Briefly, right libertarians interpret “enough and as good” as requiring no or very minimal restrictions on the first appropriation of natural resources, and left libertarians interpret “enough and as good” as requiring everyone be entitled to an equal share of unappropriated resources, able to claim no more beyond this equal share.

There are, of course, many ways of examining and adjudicating between different interpretations of the Lockean proviso. First and foremost, one can analyze different versions of the proviso from an historical point of view: what exactly did Locke have in mind when he penned “enough, and as good” for others? If one is less interested in the history of thought and more interested in developing a contemporary theory of property (of which a theory of first appropriation plays an integral role), then one might evaluate different versions of the proviso from a moral point of view: which version seems most fair? Which version is favored by justice? Which is consistent with other features of Lockean libertarianism, such as self-ownership?

Our paper charts a third approach. Inspired by the Nozick passage taken as our epigraph, we examine right and left versions of the Lockean proviso from an economic point of view. More specifically, we examine right and left libertarianism according to their welfare properties. We are thus mainly concerned with the consequences of implementing different restrictions on first appropriation. In *A Theory of Justice* John Rawls reminds us that “all ethical doctrines worth our attention take consequences into account in judging rightness. One which did not would simply be irrational, crazy” (Rawls 1971: 30). We agree, which is why we take the particular approach we do in this paper. Interestingly, though there has been significant effort invested into formally modeling Thomas Hobbes’s state of nature (Gauthier 1969; Hampton 1986; Kavka 1986; Vanderschraaf 2001; Vanderschraaf 2006a; Vanderschraaf 2006b; Vanderschraaf 2010; Moehler 2009; Chung 2015), the authors cannot find one example of a formal model of Locke’s state of nature. Hopefully this paper not only helps adjudicate between the right versus left libertarian debate, but also inspires further employment of the tools of modern economics and political science to examine more closely Locke’s state of nature and his theory of the social contract.

Using a standard general equilibrium framework taken from economic theory, we show

that in the short term, a trade-off exists between leaving unowned land for future households that may be constrained in their ability to claim it in the first period, and improving the quality of land available for production in future periods. Therefore, if the value of investment in land is high and persistence in inequality of ability is high – thereby both raising the benefits and lowering the costs of allowing unconstrained appropriation – then the right libertarian proviso makes *all* types of households better off. We then proceed to show that in the long run, the right libertarian interpretation of the proviso is always Pareto dominant, so long as one adopts a long enough time horizon. Astonishingly, this holds even in a world in which *all* land is claimed by one household in the first period, making households that would like to claim land in future periods constrained in their ability to do so, thereby making them *prima facie* worse off. Despite having fewer resources in the middle term, however, these households are eventually made better off by the efficiency gains brought about by my intertemporal improvements of land. Generically, no feasible compensation regime can salvage the left libertarian proviso in the long run.

Though we initially set out focusing on the welfare properties of competing theories of first appropriation, we quickly learn that the model developed in this paper also sheds significant insight on moral dimensions of the debate. In the literature there are two prominent justifications for implementing a left libertarian scheme of property rights, one based on luck egalitarian considerations, and one based on Rawls’s idea of maximizing the welfare of the least advantaged. Our model shows that so long as certain – plausible, we believe – assumptions hold, these two justifications for left libertarianism *actually* lead one to endorse a right libertarian interpretation of the proviso, not a left libertarian one.

The structure of this paper is as follows. In the next section we offer an overview of right libertarian versus left libertarian interpretations of the Lockean proviso: we show what the two broad camps are committed to, who falls into what camps, and how the respective positions differ from one another. Section three presents the primitives of our model, and section four proceeds with the formal analysis. Section five uses the results of the prior section to examine the extent to which left libertarian premises actually entail left libertarian conclusions. There is a concluding section.

## 2 Interpreting the Lockean Proviso

### 2.1 Right Libertarianism

What we consider to be right libertarianism can be broken down into three distinct subgroups. First (*i*) are those who are most radical, and simply deny that there is any proviso

on the first appropriation of natural resources at all. For these individuals, it is not a question of how to best interpret “enough, and as good,” for such restrictions on first appropriation are simply inapplicable. Second (*ii*) are those who do believe that there should be some proviso restricting first appropriation, but interpret this proviso such that the restrictions are quite lax: on our reading, this group sees relatively few instances of first appropriation as impermissible. Third (*iii*) are those who agree with the second group that there is indeed an enough and as good proviso regulating first appropriation of unowned property, but interpret this proviso as requiring individuals appropriate resources from the commons. We include all three groups under the heading “right libertarianism” because we believe that implementing the proposals of all three groups (no proviso, lax proviso, and proviso requiring appropriation) leads to relatively similar states of affairs in terms of what, and how much, is ultimately appropriated. As such, the formal model we develop of the right libertarian theory of first appropriation likely captures – or captures closely enough – groups (*i*)-(*iii*), at least in terms of resulting consequences. Still, we acknowledge that there are important moral differences between groups (*i*)-(*iii*), and further remain agnostic as to which group (if any) best captures what Locke actually meant to say.

The first (*i*) group rejects the notion that there should be any proviso restricting first appropriation at all. There are various reasons why one might hold such a position. Murray Rothbard – who calls the inclusion of the Lockean proviso in Locke’s theory of property “unfortunate” – rejects any proviso because (*a*) Rothbard agrees with Nozick that the proviso is best understood as not allowing appropriators to make the situation of others worse off, but (*b*) “there is no way of measuring or knowing when [persons] are worse off or not” (Rothbard 1998: 244). Edward Feser also rejects any kind of proviso restricting the initial acquisition of property. On Feser’s view, not only is there no such thing as unjust first appropriation of unowned resources, there is also no such thing as just first appropriation of unowned resources: “The concept of justice... simply does not apply to initial acquisition. It applies only after initial acquisition has already taken place” (Feser 2005: 58). Finally, John T. Sanders argues that we should abandon the Lockean proviso because it is self-defeating. On Sanders’s interpretation, (*a*) the Lockean theory of property is meant to make society more industrious, yet (*b*) the proviso (and, particularly, more stringent interpretations of the proviso) does just the opposite. In his words: “Abandoning the Lockean Proviso altogether would have the effect of making more resources available, as potential property, to the class of initial labor mixers... Since the whole point of the Proviso was to promote opportunity for acquiring property, it seems to be self-defeating” (Sanders 1987: 382).

It must be noted that those endorsing no proviso are not endorsing a state of affairs where property rights are not respected. As an interesting contrast, James M. Buchanan

(1975/2000) models a state of nature where individuals may allocate their time to either acquiring property (subject to no proviso) or predated on other players' acquired property. In saying that there are no restrictions on the first appropriation of property, those endorsing no proviso do not mean that individuals may permissibly predate as they do in Buchanan's model. Rather, the presumption is that property rights, once established via unrestricted first appropriation, must then be respected and not violated. The case of no proviso is not a state of total anarchy. There are simply no restrictions on the first appropriation of property; but once property has been acquired, it is presumed to be respected.

The second (*ii*) group contains those persons who do think first appropriation should be subject to a proviso, but think that this proviso imposes very limited restrictions indeed. Nozick is often thought to be in this category, though we read Nozick's discussion of the proviso to be rather speculative and non-committal. Following the literature, though, Michael Otsuka sets as his target what he calls "Nozick's proviso," defined as follows (Otsuka 2003: 23):

*Nozick's proviso.* You may acquire previously unowned land (and its fruits) if and only if you make nobody else worse off than she would have been in a state of nature in which no land is privately held but each is free to gather and consume food and water from the land and make use of it.

As we mentioned in the introduction, much of action in terms of debating different versions of the proviso is over how we ought to define exactly in what sense the proviso prevents us from making persons "worse off." Yet Nozick is often interpreted as understanding "worse off" in a quite flatfooted way. For example, it is thought that on Nozick's interpretation of the proviso, it is permissible for one individual to appropriate everything so long as that individual hires everyone else to work their newly acquired property, paying these persons a rather niggardly wage that is slightly greater than the meager hand-to-mouth existence they would have led as hunter-gatherers existing in the commons (Cohen 1995: 79; Otsuka 2003: 23). We are not convinced this is the most charitable reading of Nozick. Still, it serves as an example of what we consider a right libertarian proviso that does indeed impose some restrictions on first appropriation, though restrictions that are incredibly lax – to the point that they are almost never operational.

There are others in the second group who definitely do wish to impose provisos that are quite limited. As one example, Jan Narveson argues that "the only legitimate restriction on our activities is that we do not interfere with what others already have. The fact that in doing so appropriators deprive the others to do with x any of the things that are incompatible with initial users' uses of x is irrelevant" (Narveson 1999: 216). As another example, Eric

Mack defends what he calls the “self-ownership proviso,” which intends to defend “robust private property rights,” and to be “an integral element of classical-liberal political theory” (Mack 1995: 186).

Finally, there is the third (*iii*) group. This group agrees that there is a proviso regulating the initial acquisition of property, but thinks that this proviso requires individuals appropriate from the state of nature. David Schmidtz is the leading thinker in this group: “far from permitting us to remove goods from the commons, the Proviso may sometimes *require* us to remove scarce goods from the commons” (Schmidtz 1980: 507). According to Schmidtz, the proviso to leave enough and as good for others requires individuals appropriate because those resources left in the commons will not – as most assume – remain in unused, pristine condition. Here, Schmidtz appeals to the *tragedy of the commons*, first introduced by Garrett Hardin (1968). The tragedy of the commons shows that, when there is no right to exclude and everything is held in common, the dominant strategy for each individual is to overgraze these commons until they eventually disappear. With a system of property rights, though, property owners are incentivized to not overgraze their land, preserving resources for future use. Because of Hardin’s commons tragedy, “leaving resources *in the commons* does not leave enough and as good for others. The Lockean Proviso far from forbidding appropriation of resources from the commons actually requires appropriation under conditions of scarcity” (Schmidtz 1994/2008: 200).

Again, we categorize those in groups (*i*)-(*iii*) as right libertarians because we believe implementation of their preferred interpretation (or lack thereof) of the Lockean proviso leads to relatively similar states of affairs: there will be much appropriation, subject to little, if any, restriction. Moreover, the resulting land holdings after first appropriation, in all three cases, is likely to be unequal given the negligible (if any) restrictions on first appropriation all three groups impose. This, we shall see, differs greatly from left libertarian interpretations of the proviso. To reiterate: we do not wish to assert that there are no moral differences between the three groups; nor do we wish to assert that none of the three can be best defended as a matter of pure Locke scholarship. Our claim is simply that, for the purposes of examining the welfare properties of different interpretations of the proviso, groups (*i*)-(*iii*) all impose minimal enough restrictions on first appropriation to be lumped into the same category: right libertarianism.

## 2.2 Left Libertarianism

Like right libertarianism, left libertarianism is best understood as a cluster of views, all committed to, in some form, egalitarian ownership of natural resources as a starting baseline



from which first appropriation then proceeds. Following Peter Vallentyne, Hillel Steiner, and Michael Otsuka, consider the following four ways of fleshing out left libertarian interpretations of the proviso on first appropriation:

(i) Natural resources might be *owned in common* in the sense that each person is free to use (but not appropriate) them as long as she is not violating the self-ownership rights of others. (ii) Natural resources might be *jointly owned* in the sense that any use, or perhaps only any appropriation, requires collected (e.g., majority) approval. (iii) Unilateral appropriation of unappropriated resources may be permitted as long as one pays to the members of society their per capita share of the full competitive value (based on supply and demand) of the resources that one claims. (iv) Unilateral appropriation of unappropriated resources may be permitted as long as one appropriates no more than is compatible with everyone having an equally valuable opportunity for a good life (Vallentyne, Steiner, and Otsuka 2005: 202-203).

What we consider under the label “left libertarianism” going forward will not include groups (i) and (ii), and may possibly exclude group (iv) as well (more on this below). Group (i) is excluded because it rejects permissible appropriation of any kind: though left libertarian interpretations of the Lockean proviso are, to be sure, more restrictive than right libertarian interpretations, most commonly endorsed theories of left libertarian appropriation allow appropriation of some kind. We also exclude group (ii) because we believe the resulting state of affairs produced by implementation of the proviso proposed by group (ii) would look very different than those states of affairs produced by implementation of the provisos proposed by groups (iii) and (iv). Namely, we believe that the transaction costs of reaching agreement would be so high as to prevent much if not all appropriation from ever happening (Buchanan and Tullock 1962/2004; Rae 1975; Vallentyne and Vossen 2014). We are thus only concerned with left libertarian theories of first appropriation that do allow for appropriation (*contra* group (i)), that also allow for this appropriation to be unilateral (*contra* group (ii)). It should be noted, however, that most contemporary left libertarians are in groups (iii) and (iv), allowing the model we develop to still be quite general.

In group (iii) is perhaps the intellectual founder of contemporary left libertarianism, Steiner. According to Steiner:

Initially unowned things must be justly ownable. But how? The evident answer is that our equal original property rights entitle us to equal bundles of these things. That is, we each have a vested liberty to mix our self-owned labour with only as many of these things as would, in Locke’s famous phrase, leave “enough

and as good” for others. And the correlative original duties vesting that liberty are ones not to appropriate more than this amount. We are each entitled to an equal share of (at least) raw natural resources. Mixing our labour with more than this share constitutes a relinquishment to our titles of that labour (Steiner 1994: 235-236).

A literal reading of this passage suggests that one may appropriate one’s equal share of natural resources and then no more. According to Vallentyne, Steiner, and Otsuka, though, one may permissibly appropriate more than an equal share of unowned resources, so long as one compensates those whose equal share one has appropriated from. At first, our formal model does not address this possibility: each player is able to appropriate  $1/n$  of the resources available, where  $n$  is the total number of players in the appropriation game. This, we take it, is the left libertarian’s ideal state of affairs, and any *post hoc* redistribution that occurs when one takes more than one’s fair share is a second-best adjustment to non-ideal instances of first appropriation. We then extend the model, however, to include *post hoc* redistribution. As we shall see, adding such compensation to a left libertarian scheme of first appropriation does little to change the efficiency properties when compared to left libertarianism without *post hoc* compensation, which is a noteworthy result in and of itself.

Those in group (*iv*) do not endorse entitlement to an equal share of the world’s resources, but rather entitlement to a resource distribution ensuring everyone equal opportunity for living a good life. Notable in this group is Otsuka, who introduces what he calls the “Egalitarian proviso” (Otsuka 2003: 24):

*Egalitarian proviso.* You may acquire previously unowned worldly resources if and only if you leave enough so that everyone else can acquire an equally advantageous share of unowned worldly resources.

Otsuka is non-committal concerning what is meant by “equally advantageous”: “The phrase ‘equally advantageous shares of unowned worldly resources’ that I employ in the egalitarian proviso should be read as a term of art that is a neutral among a range of familiar welfarist and resource-based metrics of equality” (Otsuka 2003: 25). Still, Otsuka does wish to make clear that an equally advantageous share of resources is not synonymous with an equal share of resources *simpliciter*. In giving a thought experiment about appropriation of an unowned island, Otsuka rejects “the proposition that each person has an equal claim on the island’s resources. I would maintain that, *ceteris paribus*, someone who would, through no fault of his own on account of his mental and physical constitution, be worse off in terms of welfare than another under an equal distribution of resources, has a greater claim on the island’s

resources than another who would be better off than he in terms of welfare” (Otsuka 2003: 29).

Otsuka’s point is well-taken: if what we care about are equal levels of welfare, then granting equal shares of natural resources is not sufficient to guarantee this. We are not sure how to formally model Otsuka’s interpretation of the Lockean proviso. This leaves two possibilities. First, one can interpret our model as including those in group (iii) and only group (iii). Or, one might grant that in the real world, when it comes time to actually implement restrictions on first appropriation or *post hoc* redistributions of what has already been appropriated, making nuanced welfare judgments of the kind Otsuka has in mind will be incredibly difficult, if not impossible (relevant here are Anderson 1999’s criticisms of luck egalitarianism). As such, some rough-and-ready proxy for welfare will need to be employed, and when this is done, a plausible (though not the only plausible) candidate is *actual* shares of resources. As such, our formal model of left libertarianism is mainly meant to capture group (iii), and we leave it up to the reader to determine whether our model captures closely enough group (iv) for our conclusions to hold for Otsuka’s version of the proviso as well.

### 3 The Model

#### 3.1 Households

There exists a fixed population of two households,  $\{A, B\}$ , in the state of nature, which for simplicity we will assume live for a number of periods,  $T > 1$ , indexed by  $t \geq 1$ . Each household features a constant utility function in each period that is defined over their consumption  $x_i^t, y_i^t \geq 0$ , their leisure  $l_i^t \in [0, \frac{1}{2}]$ , and whether they invested in land this period  $I_i^t \in [0, 1]$ , with a common discount rate  $\beta \in (0, 1)$ . The only assumptions we make concerning utility functions, standard in the economic theory of general equilibrium, are that these functions are quasiconcave for each consumption good, that the two consumption goods are complements,  $\frac{\partial u}{\partial x_i} = \infty = \frac{\partial u}{\partial y_i}$  when  $x_i = y_i = 0$  (such that a little of each good is necessary), and that utility of leisure and not investing in land is linear and independent of consumption. Specifically, the utility function for each household can be written in the form:

$$U_i^t(x_i^t, y_i^t, l_i^t, I_i^t) = u(x_i^t, y_i^t) + \omega l_i^t - c_i^t I_i^t \tag{1}$$

where  $\omega > 0$  and  $c_i^t \in \{0, \bar{c}\}$ .

Households can work land to produce either of the two consumption goods. Land and labor can be mixed at a one-to-one rate to produce either good, with a rate of 1 unit of good

$x$  or  $\gamma^{\tilde{t}}$  of good  $y$ , where  $\tilde{t}$  is the number of periods in which the land has been invested. Therefore, we can think of  $x$  as a simple, natural consumption good (e.g., apples) that must only be harvested, while  $y$  is a good which is more amenable to structured production, and therefore mechanization (e.g., advanced agriculture).

The only heterogeneity between the two households concerns their ability to invest in land. In the first period, one household,  $A$ , will have cost function  $c_A^1 = 0$  and will therefore bear no cost from investing in land. The other household,  $B$ , will feature a cost of investment  $c_B^1 = \bar{c}$ , where  $\bar{c}$  is sufficiently high such that  $B$  will never invest in land.<sup>1</sup> Thus, one household faces a low cost of investment, either because of easier resource accessibility, sheer ability, or other forms of luck and opportunity. The other household faces a high cost of investment. We can refer to these states as *low-investment* and *high-investment* respectively.

These cost functions can vary over time. While one generation of a household may possess better opportunities or ability, there is no guarantee that the relative fortunes of the next generation will be the same – such is the way of the world. Given that a household  $i$  is the high-investment type in period  $t$ , they will remain the high-investment type in period  $t + 1$  with probability  $p$ . They will become the low-investment type (with household  $j$  becoming the high-investment type) with corresponding probability  $1 - p$ . Therefore, we can think of  $p$  as *persistence* in terms of place within the distribution of opportunities, and  $1 - p$  as *mobility*.

The revelation of the next period's skill distribution occurs just before consumption in the previous period. This captures the trade-off underlying the Lockean proviso: if  $A$  claims all the property in the first period, then the only way that  $B$  can ever become an investor is by purchasing land from  $A$ , making  $A$  even richer. Therefore, not only is  $A$  better able to take advantage of the land in period 1, they will then get to withdraw rents from  $B$  when  $B$  become the ones who are better able to invest.

Once the next period's skill distribution has been revealed, the households, using wealth acquired from wages and land, can purchase either of the two goods and/or land for the next period. These will be sold at market prices in a standard general equilibrium framework, as neither party is a monopsony buyer nor a monopoly seller.<sup>2</sup>

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<sup>1</sup>Note that an alternative interpretation of this assumption is that  $B$  is a household which is not born until the second period, and hence cannot appropriate land in the first period, for  $B$  simply has not been born yet. Therefore, the model as presented also embeds a model with population growth.

<sup>2</sup>For an overview of general equilibrium theory, and a defense for the use of two party frameworks to model an N-person environment, see Mas-Colell, Whinston, and Green 1995.

## 3.2 Land

In the state of nature there exists an (initially unowned) unit interval of land. In keeping with any (standard) interpretation of the Lockean proviso, we will assume that the act of mixing one's labor with some portion of land  $L$  as investment confers a property right in that land. The household  $i$  which appropriated the land will have control rights over that portion of land going forward. From that period on, the household that owns the land will be able to decide what is done with any goods produced from the land, as well as have the ability to transfer control rights both as present-day rentals, and in future periods.

Of course, working the land for the purpose of further production inherently removes the ability of the general population to work that land and reap its returns. The key difference between competing interpretations of the Lockean proviso emerges precisely in how households can appropriate initially unowned land for their own purposes, as discussed above:

***Definition 1:** If property appropriation adheres to the **right libertarian proviso (RLP)**, then any household  $i$  can gain a property right in any unowned land.*

***Definition 2:** If property appropriation adheres to the **left libertarian proviso (LLP)**, then any household  $i$  can only gain a property right by appropriation in  $L \leq \frac{1}{2}$ .*

Both parties have full control rights over the goods that are produced from the land appropriated. There can be trade between the parties, which occurs at the culmination of each period. Control rights can also be transferred for future periods, such that land that was held by household  $i$  in period  $t$  will be owned by  $j$  in period  $t + 1$ .

To sum up, the timing of each period is as follows:

1. Any unowned land may be claimed (as allowed by the relevant version of the proviso) via investment, and any owned land may also feature further investment.
2.  $\{c_i^{t+1}\}_{i=A,B}$  is revealed.
3. Goods are produced using land and labor.
4. Trade of  $x$ ,  $y$ , and  $L_{t+1}$  occurs in a general equilibrium framework.

As befitting the stationary nature of the state variable across time, the equilibrium concept across periods is Markov Perfect Equilibrium (MPE), while the equilibrium concept within periods will be standard Walrasian equilibrium. Therefore, we will focus on strategies that map only from the state variables (the structure of land ownership, the level of previous investment  $\int \gamma^{\tilde{i}} \partial L$ ,  $\{c_i^t\}_{i=A,B}$ , and  $\{c_i^{t+1}\}_{i=A,B}$ ) onto strategies (investment decisions and general equilibrium production and trade).

## 4 Welfare Analysis

### 4.1 Two Periods

An initial observation between the two differing versions of the Lockean proviso – which follows directly from definitions – is that more land will be claimed within the first period given the *RLP* when compared to the *LLP*. In particular, there is no reason for *A* to leave *any* land unowned in the first period, as it simply restricts their ability to sell the land for rents in the future. Therefore:

**Observation 1:** *All land will be claimed in period 1 by A under the RLP. Otherwise,  $\frac{1}{2}$  of the land will be claimed by A.*

This is a direct implication of  $c_A^1 = 0$ . Unconstrained, the household which faces lower investment costs will claim the land which is viewed as too costly to acquire by the other household. Hence, when the investment costs of one household is non-existent (which is by assumption true in the first period for *R*), they will claim everything that is left behind by the poor household.

A corollary of this is that the *RLP* will maximize the amount of total investment over time. This will have a direct impact upon *total* utility (that is, the sum of utility for both *A* and *B*):

**Proposition 1:** *The RLP will maximize total investment, total utility, and the utility of A.*

One argument made by economists for something resembling the *RLP* is that it is the *growth-maximizing* interpretation of the proviso. By incentivizing investment, the marginal cost to society of producing an additional unit of utility via land – that is, the shadow price of producing an additional unit of utility via land – *ceteris paribus* falls, and as a result total utility rises. This is not dissimilar to the standard argument for private property rights in general: by internalizing the benefits of further investment, maximizing private ownership of property will maximize the total production of utility in society. Moreover, we see Locke recognize as well the value of investment in terms of growth: “To which let me add, that he who appropriates land to himself by his labour, does not lessen, but increase the common stock of mankind: for the provisions serving to the support of human life, produced by one acre of enclosed and cultivated land, are (to speak much within compass) ten times more than those which are yielded by an acre of land of an equal richness lying waste in common” (Locke 1690/1980: 23).

This does not, however, tell us whether *B* is made better off given the increased investment under the *RLP*. In particular, because *B*'s ability to claim land for free is limited, it

is not *ex ante* obvious that  $B$  will be able to take advantage of this additional investment carried out by household  $A$ . Total inequality will be higher under the *RLP*, but to actually consider the richer utility implications, one must analyze the equilibrium outcomes under both interpretations of the proviso.

In the two-period example, we can do this by backwards induction.

Due to the linear nature of production, the results will be equivalent to production with a single profit-maximizing firm. Therefore, we can quickly use zero-profit conditions to identify the equilibrium prices (as positive profits for either good would imply that either household should be producing more of one good than the other). Similarly, since the cost of providing labor is linear, and the supply of usable land is perfectly inelastic, the wages can be pinned down in terms of utility returns. Specifically,  $w^t$  will equal the minimum wage that provides  $\omega$  utility in period  $t$  to the agent who owns more land. This is due to the concavity of utility: it will require more consumable goods to entice the household with greater land ownership (who receives a return from both rents and potentially the permanent sale of the land) to provide their labor. Since both households' labor is necessary to use all available land, the wage must be high enough to entice both to work.

Note, a corollary of these three prices:

**Proposition 2:** *The more investment in periods  $\{1, \dots, t - 1\}$ , the smaller  $w^t$ ,  $p_x^t$ , and  $p_y^t$ .*

This arises due to investment reducing the price of consumable good  $y$ . As a result, the shadow price of one unit of utility falls, which lowers the wage, further reducing the prices of both goods. This does not mean that investment intrinsically makes the low-investment type better off; if  $B$  owns no land,  $B$  will still get the same utility (due to the lower wage).

Therefore, what remains to be seen in each period is the total production/allocation of both goods and the returns from selling land in the first period. Note that it is trivial that land will have no permanent sale value in the terminal period, and hence  $r_{\gamma^i}^2 = 0$  for all levels of investment. As such, there are two determinants which affect the sale price of land in the first period: (i) the increased wealth that comes with renting land in that period, and (ii) the impact ownership of land has upon investment.

For the same level of land ownership, the effect of (i) is identical due to identical utility functions. Therefore, the difference in the incentives to purchase land for the next period result solely from the effect of (ii). In this case, those with  $c_i^2 = 0$  have a higher incentive to own the land. This leads to the following result:

**Proposition 3:** *If  $c_i^{t+1} = 0$ , then land ownership will be greater in period  $t + 1$  than if  $c_i^{t+1} = \bar{c}$ .*

We are now in a position to examine the welfare properties under two different cases. First, consider when  $c_B^2 = \bar{c}$ . Here,  $B$  will also be unable to invest in the second period.

By Propositions 1 and 2, we know that the prices and wages will be lower under the *RLP*. However, since the wage moves stepwise with prices to keep both workers working, these effects will net out and have no impact upon  $B$ 's total utility. Therefore, the effective wage of  $B$  will be the same.

The only change between the two periods comes in the form of available land. By Proposition 1, the land available for  $B$  to purchase at the end of period 1 will be of higher marginal value than the land which was available in the first period. An alternative way to think about this is that the *effective price* of land will be lower under the *RLP*. This means that  $B$  can only be made better off. If  $B$  buys no land under either regime,  $B$  will have the same utility under both. However, if  $B$  buys land under the *RLP* (where the effective price is lower),  $B$  will get a greater return in terms of production capacity. Therefore, households that stay perpetually poor can only be made better off by letting  $A$  claim (and invest in) all the land in the first period.

Now consider when  $c_B^2 = 0$ . Here,  $B$  is now the high-investment type in the second period. In this state of the world, there is a trade-off. Let  $L_B^{RLP}$  be the amount of land  $B$  would buy under the *RLP*. We know this is greater than  $\frac{1}{2}$  the total land. Now consider the *LLP*. In this case,  $B$  will buy  $L_B^{LLP} - \frac{1}{2} < L_B^{RLP}$  from  $A$ , while also claiming the remaining unclaimed land. Therefore,  $B$  receives  $\frac{1}{2}$  an interval of land for free, which  $B$  would have had to compensate the other household for under the *RLP*. However, that land will now be lower quality, and the price of effective land will be higher for that which  $B$  still has to buy.

Therefore, there exists a general trade-off between the two regimes when examining strictly two periods. The *RLP* provides higher quality land, while the *LLP* increases equality *when* there is mobility that will eventually allow  $B$  to invest in land in the second period. The formal model allows us to make precise the circumstances under which each will maximize the welfare of  $B$ :

**Theorem 1:**  *$B$  will be made better off ex ante by the *RLP* with two periods if and only if:*

- *Investment quality  $\gamma$  is sufficiently high, and*
- *Persistence  $p$  is sufficiently high*

As the trade-off between the two regimes is clear within the formal framework, we can pin down comparative statics vis-a-vis the primitives of the model.

One clear outcome is that when investment quality  $\gamma$  is high, the benefit of greater investment in the first period is higher. Therefore, the *RLP* becomes a relatively more



efficient regime. In addition, when persistence  $p$  is high (i.e., mobility is low), the *LLP*'s benefit (greater equality) will never obtain. Therefore, it is better for the low-investment household to simply allow  $A$  to claim all the land in the first period and improve it.

This result tells us that when households face larger and more permanent differences in natural ability, it is actually better to have a land appropriation regime which allows for these differences, rather than one that attempts to impose a form of equality that likely will never be helpful for either household, but particularly the less-advantaged household. The key lesson: when evaluating land acquisition regimes, it is important to note that general equilibrium effects allow even the household with less opportunity to take advantage of the investments made available by those naturally endowed with more opportunity.

## 4.2 Long Run

We now examine how the welfare evaluations differ when extending the life of the households (i.e.,  $T > 2$ ). This is necessary when examining initial property acquisition, for we need to understand the long-run implications of initial acquisition over several generations, not just two time periods.

Begin by noting that until all land is owned, we know by the preceding section that everyone is made (weakly) better off under the *RLP* than under the *LLP*, as the additional land would never be used under the latter interpretation of the proviso.

In addition, if in some period  $\hat{t}$   $B$  becomes the high-investment type, in all future periods  $\hat{t} + 1$  and forward, all land will be owned and traded. The only difference lies in the effective quality of land available to the households in the market for each period. By Proposition 1, there will have been less investment under the *LLP* than the *RLP*. There will be higher-quality land under the *RLP* from this point forward. Since this reduces the shadow price of utility, both households will be made better off from period  $\hat{t} + 1$  forward.

Thus, the long-run trade-off is between the one-time rent cost in period  $\hat{t}$  (as described in the preceding section) and these future payoff gains:

**Theorem 2:** *There exists a  $\hat{T} < \infty$  such that if  $T > \hat{T}$ , the *RLP* will make both actors sufficiently better off.  $\hat{T}$  is decreasing in all the same variables as in Theorem 1.*

That is, given a long enough time horizon, even  $B$  will be made better off given the *RLP* when compared to the *LLP*. Since the first trade for property rights in land is a one-shot cost, and any increase in the price driven by increases in the length of household life will be based on the margin and therefore not capture the full increase in surplus, then, so long as there are enough future periods to take advantage of the additional investment, even  $B$  will see a rise in utility. The comparative statics are the same as with Theorem 1 as they are

driven by the determinants of the price of land, and the benefits of additional investment.

### 4.3 Compensation

Thus far our interpretation of the left libertarian proviso (the *LLP*) says that households may claim  $1/n$  of the available land, where  $n$  is the number of players in the appropriation game. This, clearly, is the ideal articulated by what we called group (*iii*) in section 2.2 above. But we also noted in section 2.2 above that those in group (*iii*) allow for appropriators to take more than their  $1/n$  share so long as they compensate others for doing so. We now enrich our model by redefining the left libertarian proviso to account for this, for it is at least intuitively plausible that permitting greater appropriation under the left libertarian proviso but then requiring transfers by those who took more than their fair share will allow the left libertarian proviso to better approximate the desirable welfare properties of the right libertarian proviso.

**Definition 3:** *If property appropriation adheres to the **alternative left libertarian proviso (LLP\*)**, then any household  $i$  can only gain a property right by appropriation in  $L \leq \frac{1}{2}$  for free. For all land claimed above  $\frac{1}{2}$ , they must pay a flow transfer  $\tau$  to the other household.*

The *LLP\** is the same as the *LLP* except for one important twist. Under the *LLP* our households can only claim  $\frac{1}{2}$  of the available land, full stop. Under the *LLP\**, however, households may claim up to  $\frac{1}{2}$  of the available land, and, if they claim more than this (which they are now able to do under the *LLP\**), then they must pay a transfer to the household whose fair share they have taken from. Though it might *prima facie* seem that this will make a difference in terms of left libertarianism's welfare properties, our model shows that this is not the case.

**Corollary 1:** *There exists a  $\hat{T} < \infty$  such that if  $T > \hat{T}$ , the *RLP* will make both actors sufficiently better off relative to *LLP\**.  $\hat{T}$  is decreasing in all the same variables as in Theorem 1.*

The intuition behind Corollary 1 flows directly from our Theorem 2 above. Begin by noting that for any  $\tau > 0$ ,  $A$  will not invest in *all* of the land within the first period, as  $A$  does in the *RLP*. As a result of this, given a long enough time horizon, the efficiency gains from early investment in land will eventually outweigh the temporary transfer gain in the first period by  $B$  under the *LLP\**, just as it outweighs  $B$ 's gain in the middle period under the standard interpretation of the *LLP*. The logic behind the result is thus exactly the same as Theorem 2: gains from early investment eventually pay off in a general equilibrium

framework, which suggests that the earlier investment occurs, the better. Since forcing  $A$  to pay a transfer to  $B$  if  $A$  takes more than  $\frac{1}{2}$  of the available land under the  $LLP^*$  has the effect of incentivizing  $A$  to not claim all of the available land as  $A$  does under the  $RLP$ , the result is the same.

## 4.4 Possible Extensions

Note that the model can be extended to include a more realistic examination of economies emerging out of the state of nature. There are extensions that would improve the *relative* performance of the  $LLP$ . For example, if there existed transaction costs for trade, or monopolistic advantages in the market for land, then the  $RLP$ 's advantages of further initial investment in land will dissipate. However, as long as these do not become so large as to prevent *all* profitable trade (which, we think, is incredibly unlikely), Theorems 1 and 2 will still hold and there will still exist a sufficiently long time horizon such that the  $RLP$  better maximizes the welfare of all parties when compared to the  $LLP$ .<sup>3</sup>

In addition, many such extensions will actually make the wedge between the  $RLP$  and  $LLP$  greater. For example, adding interior costs of investment (i.e., making  $\bar{c}$  not rule out all investment and/or setting  $c_A^1 > 0$ ) limits the ability of  $A$  to take everything in the first period. This actually attenuates the one benefit of the  $LLP$  (the equality of land ownership). Similarly, if there were greater degrees of specialization (i.e., in the ability to produce either of the two goods) or savings markets between the two periods, this would provide greater general equilibrium benefits to the  $B$  household from  $A$ 's investment. Therefore, it is possible that our model actually understates the welfare benefits of the  $RLP$ .

# 5 The Foundations of Left Libertarianism

## 5.1 Luck Egalitarianism

We now wish to further explore the philosophical implications of our model's results by taking a closer look at the foundations of left libertarianism. What do we mean by "foundations"? Right and left libertarian interpretations of the Lockean proviso are rules of property governing the use and distribution of scarce resources. But what justifies the employment of one specific set of property rights to govern the use of scarce resources over another?

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<sup>3</sup>Similarly, one could imagine that due to, e.g., environmental degradation, use of land to make good  $x$  actually reduces the future effective land for producing  $x$  (in contrast to production of  $y$ ). Again, as long as this degradation is not greater than the investment value in  $y$  (an unrealistic assumption given real world growth rates), Theorems 1 and 2 will still hold.

What usually does the justificatory work here is an underlying normative theory or principle (Vossen 2009). In the case of right libertarianism, for instance, what justifies many right interpretations of the Lockean proviso and right libertarian theories of property more generally is a firm commitment to some robust conception of natural rights (Nozick 1974), or possibly some underlying moral principle such as the non-aggression principle (Rothbard 1998). Alternatively, some might justify right libertarian schemes of property based on consequentialist considerations (Friedman 1989). These underlying normative commitments entail structuring property rights in a specific way, of which one component is a very minimal reading of “enough and as good.”

When it comes to left libertarians, most are usually committed to equal ownership of natural resources via some form of *luck egalitarianism*. Roughly, luck egalitarianism holds that “an unequal distribution whose inequality cannot be vindicated by some choice or fault or desert on the part of (some of) the relevant affected agents is unfair, and therefore, *pro tanto* unjust” (Cohen 2008: 7). That is, luck egalitarianism holds that deviations from perfect equality are only justified if the deviations are the result of non-arbitrary factors about the affected parties. Putting the two together, many left libertarians endorse equal ownership of natural resources because they believe it is the scheme of property that mitigates unequal distributions arising from undeserved differences: it prevents people, for example, from owning more than others simply because they were there first, which is an arbitrary fact about the affected parties indeed. In the words of Steiner: “Left libertarianism is a luck egalitarian theory, or, more precisely, a family of luck egalitarian theories” (Steiner 2011: 110).<sup>4</sup>

Though many left libertarians do seem to endorse a form of luck egalitarianism, some have forcefully argued that luck egalitarianism and the joint left libertarian commitments to self-ownership and egalitarian ownership of natural resources are incompatible. Cohen, for instance, holds that “no egalitarian rule regarding external resources alone will, together with self-ownership, deliver equality of outcome,” where “equality of outcome” is to be understood in a luck egalitarian manner (Cohen 1995: 105). The main issue here is that differences in ability – even when coupled with equal ownership of natural resources – will lead to inequalities in outcome. Since individual ability is the result of brute luck and not something people can be held responsible for, such inequalities violate luck egalitarian standards of equity. And, because left libertarians are also committed to self-ownership, coercive redistribution to remedy these inequities is impermissible so long as they are not part of any *post hoc* redistribution to satisfy egalitarian ownership of natural resources. As such, left

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<sup>4</sup>Following Quong (2011: 75-76), for evidence that most left libertarians are committed to luck egalitarianism, see Steiner (1997: 311); Otsuka (2003: 23-27); Vallentyne (2002).

libertarian conceptions of property fail to satisfy luck egalitarian conceptions of justice. This spells trouble for those left libertarians that take a luck egalitarian conception of equality as foundational.<sup>5</sup>

What does our model say about luck egalitarianism as a foundation for left libertarianism? Clearly the model indicts such arguments in defense of left libertarianism, for reasons similar to those given in the paragraph above. Indeed, our model can be interpreted as a formal proof of Cohen's unproven assertions: that there will be inequality given a left libertarian interpretation of the Lockean proviso solely due to differences in the ability to invest in land which, the luck egalitarian holds, is an arbitrary fact about the affected parties. In our model the two households ( $A$  and  $B$ ) do not acquire equal distributions given the left libertarian proviso in either the two-stage analysis or the long-run analysis.

Now here it might be argued that, though our model shows that both right and left libertarian interpretations of the Lockean proviso result in arbitrary inequalities, our model *also* shows that left libertarianism results in less inequality when compared to right libertarianism. Thus, left libertarianism can be seen as something of a second-best institutional arrangement for luck egalitarianism: though it does not eliminate arbitrary inequalities – and here it should be noted that, as a practical matter, complete elimination of such inequalities is likely impossible in the real world – it certainly *minimizes* them, at least when compared to right libertarianism.

The above may, but not necessarily, be true. As we saw with clarity in the two-stage analysis in §4.1, if there is high persistence in differences in ability (low mobility), then there may be *less* inequality under right libertarianism, as the high-investment type creates more net resources and provides more high-quality land for the low-ability type to make use of. Therefore, if we believe there is stickiness in those inequalities which must be attributed to luck, left libertarianism may actually make the problem worse. Given that the left libertarian cannot resort to coercive means to correct sticky inequalities in ability without violating their commitment to self-ownership – they cannot, for instance, offer publicly-funded high-quality schooling for all – it is not implausible to think that there *will* be high persistence of inequalities in ability in a world where the claims of self-ownership are taken seriously. This suggests that the luck egalitarian, when certain reasonable assumptions hold concerning persistence in differences in ability, should actually endorse a right libertarian interpretation of the proviso to minimize the distributional consequences of such brute luck. For recall: all

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<sup>5</sup>It might be thought that including germ line genetic information as part of what counts as natural resources and thus the subject of equal ownership as Steiner (1999) argues in later work can make left libertarianism compatible with luck egalitarian conceptions of equality. For a response, see Quong (2011: 70-72). Moreover, as Dan Moller (2017: §6) forcefully argues in a recent piece, it is not clear to what extent left libertarianism remains a libertarian view after this move is made.

inequalities in our model are ultimately grounded in differences in ability (whether households are the high-investment type or low-investment type), which is determined in the second stage of each time period randomly, qualifying as what luck egalitarians would call “brute luck.”

But suppose for the sake of argument that left libertarianism *always* unambiguously minimized distributional inequalities when compared to right libertarianism which, we have just seen, will only be true when certain assumptions hold. Still, our model creates a dilemma for those luck egalitarians who wish to embrace left libertarianism under such a presumption. The leveling down objection to egalitarianism confronts the egalitarian with two states of affairs: the first (*a*) where there is perfect equality, and the second (*b*) where there is inequality, yet such inequality Pareto dominates the first, completely equal state of affairs (Nozick 1974: 229; Raz 1986: 227, 235; Tempkin 1993: 247-248). If one is committed to equality – as the luck egalitarian is – then one should endorse state of affairs (*a*). Yet, intuitively, this does not seem right. It seems here that one should endorse state of affairs (*b*) as better than state of affairs (*a*): after all, how could (*b*) be worse than (*a*) when everyone is better off in (*b*) than they are when compared to (*a*)? If the luck egalitarian endorses left libertarianism because it minimizes inequalities that arise from brute luck when compared to right libertarianism then our model shows that they must essentially endorse state of affairs (*a*) over state of affairs (*b*) when certain conditions hold. For, by Theorem 1, right libertarianism Pareto dominates left libertarianism if investment quality is sufficiently high and if there is little mobility in terms of the initially skilled household *A* later becoming the unskilled household in a two-stage game. And, by Theorem 2, right libertarianism Pareto dominates left libertarianism *regardless* investment quality and mobility if one adopts a long enough time horizon. Now clearly there will be some who are willing to do this – who are willing to say that equality of outcome in terms of minimizing differences resulting from brute luck cannot be outweighed by superior welfare considerations. Many will reject this response, however. For many, accepting state of affairs (*a*) as better than state of affairs (*b*) is simply too big a bullet to bite. If one joins this crowd and refuses to bite such a bullet, then our model shows that when certain plausible assumptions hold one cannot endorse left libertarianism via some kind of luck egalitarian argument.

## 5.2 Rawlsian

In response to the problems associated with adopting luck egalitarian foundations, one move the left libertarian can make here is to adopt different theoretical foundations; that is, the left libertarian can drop luck egalitarianism as the underlying justification for self-ownership and equal ownership of worldly resources. One recent attempt to do this has been pursued

by Jonathan Quong (2011). On Quong’s view, instead of adopting some form of luck egalitarianism, left libertarians ought to endorse a Rawlsian-based theory of *justice as reciprocity*. To understand this alternative view we need to introduce some terminology. Call *telic theories of egalitarianism* those theories that strictly evaluate states of affairs. Call *deontic theories of egalitarianism* those theories that regulate how persons treat or relate to one another (Quong 2011: 79). Luck egalitarianism is a telic theory of egalitarianism: it assesses the resulting states of affairs that different rules of property produce in terms of whether the property scheme is able to eliminate (or at least reduce to a large degree) inequalities resulting from arbitrary factors. How persons relate or treat one another is not of primary concern.

Quong’s first move is to reject telic conceptions of egalitarianism in favor of deontic conception of egalitarianism. Recall the problem with luck egalitarianism and left libertarianism: discrepancies in ability, even when coupled with shared ownership of resources, will lead to unequal outcomes resulting from arbitrary features; self-ownership prevents us from correcting this through coercive redistribution. And, if one tries to simply minimize inequalities based on arbitrary differences, then, by our formal model, one must bite the bullet in the face of the leveling down objection or, depending on certain assumptions, actually embrace the right libertarian proviso. On Quong’s view, though, we should not focus on the resulting states of affairs left libertarianism produces *as such*. Rather, we should focus attention on whether left libertarianism promotes the right kinds of relations between persons as participants in social cooperation. Namely, once individuals decide to engage in a mutual scheme of cooperation, justice as reciprocity aims to make sure that this cooperation is carried out on terms that all can reasonably endorse – that is, on terms that are to the advantage of all suitably idealized persons. The left libertarian commitments to self-ownership and shared ownership of natural resources, Quong believes, best define these terms.

More needs to be said about what justice as reciprocity concretely requires. Famously, Rawls thought justice as reciprocity led to the *difference principle*, which holds that the basic structure of society – things like laws regulating the acquisition of property, for instance – must be organized so that it maximizes the expectations of those least advantaged in society. The difference principle relates to the notion of justice as reciprocity in that the idea of reciprocity lies “between” the idea of altruism (being moved by the general good), and the idea of mutual advantage (everyone being better off than they are now when they examine their future situation). The difference principle fleshes out this notion by permitting inequality only when it benefits everyone, yet restricting inequality in that the particular kind of inequality permitted is that form that makes those worst off best when compared to all other forms of mutually advantageous inequality. Because of this, “the two principles

of justice with the difference principle, with its implicit reference to equal division as a benchmark, formulate an idea of reciprocity between citizens” (Rawls 1993/2005: 16-17).

So justice as reciprocity – which, according to Quong, is best satisfied by a left libertarian scheme of property rights – entails the difference principle, which requires we maximize the life prospects of the least advantaged. But note what our model shows: by Theorem 1 right libertarianism dominates left libertarianism if investment quality is sufficiently high and if there is little mobility in terms of the initially skilled household  $A$  later becoming the unskilled household in a two-stage game. And, by Theorem 2, right libertarianism dominates left libertarianism regardless investment quality and mobility in the long run. Thus, if one is to (i) embrace justice as reciprocity, and if one (ii) adopts a long-run view of welfare over generations, then one must be a right libertarian rather than a left libertarian, for the right libertarian proviso will make those worse off better off when compared to the left libertarian proviso. Hence, our model shows that Quong’s attempt to provide new foundations for left libertarian schemes of property fails: it does not, in fact, maximize the welfare of the least advantaged.

Note that we cannot necessarily conclude that the right libertarian proviso *does* maximize the welfare of the least advantaged, thus satisfying the difference principle. Any claim to Pareto optimality is always contingent on the alternatives one is comparing the putatively optimal state *to*. If the relevant comparisons were just the left libertarian proviso and the right libertarian proviso then the right libertarian proviso *would* satisfy the difference principle for, when compared to the one alternative, it does maximize the welfare of the least advantaged. But there could be a third proviso we have not considered that has yet to be articulated that makes those worst off better off when compared to the right libertarian proviso. Indeed, it might be that, given the relevant alternatives, right libertarianism is not even Pareto optimal, let alone the unique point on the Pareto frontier that maximizes the welfare of those worst off. But still, we *can* conclude that the difference principle does *not* entail the left libertarian proviso, so long as right libertarianism is one of the eligible provisos to implement.

Here, one might object: there is no need for justice as reciprocity to embrace the difference principle and *only* the difference principle. Perhaps justice as reciprocity can endorse a different distributive principle of justice that is able to justify left libertarian schemes of property ownership over right libertarian schemes. Indeed, Quong himself asserts that he “deliberately leaves the specific content of this principle undefined” when he argues for justice as reciprocity broadly construed to replace luck egalitarianism as the foundation of left libertarianism (Quong 2011: 81). To back this response up even more, Rawls eventually admitted that reasonable persons committed to the idea of society being a fair system of



social cooperation and thus committed to the idea of justice as reciprocity could disagree about matters of justice – that is, such persons could reasonably reject the difference principle as being the best interpretation of the idea of justice as reciprocity (Rawls 1993/2005: xxi).

In response, since the idea of justice as reciprocity includes the idea of mutual advantage, any plausible interpretation of justice as reciprocity will require, at the very least, a Pareto efficient distribution: if all parties could be made better off, the idea of mutual advantage requires that such gains are exhausted. Indeed, Rawls’s first articulation of the idea of justice as reciprocity did not require the difference principle explicitly, but permitted any form of inequality so long as it Pareto dominated equality: “an inequality is allowed only if there is reason to believe that the practice with the inequality, or resulting in it, will work for the advantage of every party engaging in it. Here it is important to stress that every party must gain from the inequality” (Rawls 1958/1999: 50). But note, our model shows that right libertarianism *does* Pareto dominate left libertarianism as it is better for both the high-ability type ( $A$ ) and low-ability type ( $B$ ), as shown by our two theorems so long as certain plausible assumptions hold. So long as justice as reciprocity includes the idea of mutual advantage, and so long as mutual advantage requires we take Pareto gains when they are available, then even rejecting the difference principle as the most plausible interpretation of justice as reciprocity fails to save the left libertarian. Again, this does not imply that *all* versions of justice as reciprocity imply the right libertarian proviso because we do not know what the relevant comparison class should be. But we do know that, so long as the right libertarian proviso is one of the relevant options, then any version of justice as reciprocity will not entail the left libertarian proviso.<sup>6</sup>

## 6 Conclusion

This paper approached the debate over different interpretations of the Lockean proviso through a new theoretical lens, by examining the welfare properties of different interpretations of the proviso. Our formal model produced an interesting result: right libertarian interpretations of the proviso will be better for both the naturally advantaged and naturally disadvantaged, given plausible empirical assumptions. Though we set out focusing exclusively on economic dimensions, our model also shed major insight on moral dimensions of

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<sup>6</sup>One final rejoinder the Rawlsian could here make is that we are to care about ensuring the basic liberties are secured before we care about reaching an efficient distribution, and that respecting the *fair value* of the political liberties may require us to take an inefficient distribution. Since Rawls holds that it is inequality that threatens the fair value of the political liberties, our response to this objection is appealing to those results canvassed in §5.1 above, where we note that under plausible conditions right libertarianism reduces inequalities compared to left libertarianism.

the right versus left libertarian debate as well. Namely, it showed – when certain assumptions hold – first that luck egalitarianism can either not ground left libertarian conceptions of property, or, if it does, then one must accept the leveling down objection. Further, it also showed that new attempts at giving Rawlsian foundations to left libertarianism actually lead to the opposite result: justice as reciprocity requires we endorse a right libertarian interpretation of the Lockean proviso, not left – again, when certain plausible assumptions hold. Given these two implications of our model, it is not clear where left libertarians turn so that they may provide coherent foundations to their favored account of property.

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## A Proofs

### A.1 Proposition 2

Normalize the rental rate for the marginal quality of land to 1.

Therefore, the prices are

$$p_x = 1 + w \tag{2}$$

$$p_y = \frac{1 + w}{\gamma^{\bar{t}}} \tag{3}$$

First consider wages and prices in equilibrium for a given level of investment. As the wage is the cost of purchasing  $\omega$  utils, the wage can be thought of as an strictly increasing, monotonic function in the price level (due to the quasilinearity of utility). Note that the prices are a strictly increasing, monotonic function of the wages. Generically, therefore, there will exist a single equilibrium wage and price-level.

An increase in investment from  $\tilde{t}$  to  $\tilde{t}'$  is a downward shock in the price-level (by reducing  $p_y$ ). However, this leads to a decrease in the wage. This in turn reduces *both*  $p_x$  and  $p_y$ . Therefore, in addition to an increase in the equilibrium price level, both prices reduce.

### A.2 Proposition 3

Note that in equilibrium, the price of land will be equal to  $\beta \frac{\partial U}{\partial L_B^{t+1}} = \beta \frac{\partial U}{\partial L_A^{t+1}}$ , unless the high-investment type purchases all the land.

If the high-investment type purchases all the land, then Proposition 3 is true trivially.

Suppose they do not. First, by contradiction, suppose that  $L_A^{t+1} = L_B^{t+1}$ . As the high investment type is able to invest in the land in the next period, and their wealth is otherwise identical (based entirely on equilibrium wages and land rents), the marginal utility for the high type from an extra unit of land will be higher, as his purchasing the land will reduce the price level (by proposition 2), as well as increase the re-sale value of the land. Therefore, this cannot be an equilibrium.

The same procedure can be followed to show that  $L_B^{t+1} > L_A^{t+1}$  cannot be an equilibrium, given that  $B$  is the low-investment type, and vice-versa.

### A.3 Theorem 1

We can split the two-period version of the model into two states: i) when the distribution of ability is constant in both periods, and ii) when the distribution of ability flips.

We will normalize the rental rate of land to 1.

First consider state i, which occurs with probability  $p$ . Note that  $B$ 's utility from state i is:

$$\operatorname{argmax} u(x_i^t, \frac{w^t \frac{1}{2} - p_x^t x_i^t - p_L^t L_i^{t+1}}{p_y^t}) + \beta(u(x_i^{t+1}, \frac{w^{t+1} \frac{1}{2} + L_i^{t+1} - p_x^{t+1} x_i^{t+1}}{p_y^{t+1}})) \quad (4)$$

where the prices have the natural definition.

Note first that, since the wage in period  $t$  is set to provide exactly  $\omega$  utils in equilibrium, it will have no direct effect on ex post utility. Therefore, we must only examine differences in the prices of each of the goods.

By the envelope condition, it is sufficient to show that  $p_x$ ,  $p_y$ , and  $p_L$  will all be lower (relative to  $r_1$ ) under the RLP. By the linear nature of production,  $p_x^t$  and  $p_y^t$  are defined by the zero profit condition.

The price of land will be equal to  $\beta \frac{\partial U}{\partial L_P} = \beta \frac{\partial U}{\partial L_R}$ , unless  $A$  purchases all the land. If  $A$  does so, then  $B$ 's utility is constant under both the RLP and LLP. If not, then note that  $A$  consumes more under the RLP than the LLP. Due to the quasiconcavity of  $U$ ,  $\frac{\partial U}{\partial L_R}$  will be lower under the RLP. By proposition 2, the prices of goods  $x$  and  $y$  are decreasing under the RLP relative to the LLP. Therefore, under state i,  $B$ 's utility will be weakly larger.

Now consider state ii. Here,  $B$ 's utility will be, under the RLP:

$$\operatorname{argmax} u(x_i^t, \frac{w^t \frac{1}{2} - p_x^t x_i^t - p_L^t L_i^{t+1}}{p_y^t}) + \beta(u(x_i^{t+1}, \frac{w^{t+1} \frac{1}{2} + L_i^{t+1} - p_x^{t+1} x_i^{t+1}}{p_y^{t+1}})) \quad (5)$$

and under the LLP:

$$\operatorname{argmax} u(x_i^t, \frac{w^t \frac{1}{2} - p_x^t x_i^t - p_L^t L_i^{t+1}}{p_y^t}) + \beta(u(x_i^{t+1}, \frac{w^{t+1} \frac{1}{2} + (L_i^{t+1} + \frac{1}{2}) - p_x^{t+1} x_i^{t+1}}{p_y^{t+1}})) \quad (6)$$

By the same argument as above,  $p_x$ ,  $p_y$ , and  $p_L$  will all be lower under the RLP. However, there is an endowment shock under the LLP of  $\frac{1}{2}$ . Therefore, there is a tradeoff.

Note that if  $p$  is equal to 1, we will always be in state i. Therefore,  $B$  will always be weakly better off under the RLP. In addition, if  $\gamma$  is large, the impact upon the prices of  $x$ ,  $y$ , and  $L$  will be larger. Therefore, by the continuity of the utility function, there exists a sufficiently large  $\gamma$  such that  $B$  is better off under the RLP.

## A.4 Theorem 2

Note that in all periods before  $B$  becomes the high-investment type, we will be in the equivalent of state  $i$  from A.3. Therefore,  $B$ 's utility is weakly higher under the RLP for some number of periods  $\hat{t} - 1$ , where  $\hat{t}$  is the period when  $B$  becomes high-type.

Note as well that in period  $t \geq \hat{t} + j$ , where  $j \geq 1$ ,  $B$ 's utility is:

$$\operatorname{argmax} U = u(x_i^t, \frac{w^{\frac{t-1}{2}} + L_i^t + \int_{\hat{t}}^t p_L^t \partial L_i^t - p_x^t x_i^t - \int_{\hat{t}}^t p_L^t \partial L_i^{t+1}}{p_y^t}) + \beta U' \quad (7)$$

under both the LLP and RLP.

As the average quality of land is higher under the RLP, the price level will be lower (as in state  $i$ ), and therefore utility will be weakly higher by the envelope condition. Therefore, in all periods  $\hat{t} + j$ ,  $B$ 's utility will be strictly higher.

Consider an infinitely-lived version of the game. As  $j \rightarrow \infty$ ,  $U_B^{RLP} - U_B^{LLP} \rightarrow \infty$ . Therefore, with infinite periods, the RLP makes  $B$  better off.

By the continuity of the utility function, the value function will be continuous in  $t$ . Therefore, there exists a  $\hat{t} < \infty$  such that the RLP makes  $B$  better off as long as the total number of periods is greater than  $\hat{t}$ .

To see the comparative statics, repeat as in the proof of Theorem 1.