After the Theft: Natural Distribution States and Prisoner's Dilemmas in the Paradise Story[1]

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Abstract

The paper identifies economic structures for the paradise story which Buchanan's constitutional economics termed "natural distribution states" and escalating prisoner's dilemma (PD) games. I constructed game matrices for God's and Adam & Eve's[2] decisions to respect or not to respect the rights of the other party. For Adam and Eve, the matrices specify decisions regarding theft from the "divine" trees. For God, punishment options in reaction to Adam and Eve's theft are paid special attention to. As regards how storytelling was set up at the outset of the Old Testament, the paper shows that the paradise story avoided a "game over" scenario in which Adam and Eve either were killed or were elevated to become gods themselves. In as much as a natural distribution state (even a PD outcome) prevailed as a result of these paradise interactions, I argue that this heuristically set up further storytelling about fairer social contracting between God and humans in the Old Testament.

Key words: Paradise Story, Prisoner's Dilemma, Natural Distribution States, Constitutional Economics, James Buchanan

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[1] The paper was presented at the *Religion and Capitalism*-Conference, University of Vienna, Austria, 17–19 November 2011. The revision of the paper greatly benefited from feedback of conference participants, as well as from referees of OTE.

[2] On a notational reference for this paper, I group Adam and Eve together as "one" actor, referring to them as "Adam & Eve," but only if they are referred to in the same sentence directly in relation to the "other" actor of the paradise story, "God." I am aware that the "&" normally may not be acceptable in academic writing. However, the use of "&" helps me to clearly distinguish and position "Adam & Eve" as a separate actor from God. If "God" is not mentioned in a specific sentence, I use the phrase "Adam and Eve."

After the Theft: Natural Distribution States and Prisoner's Dilemmas in the Paradise Story

> Kuhn's influential account of the role that paradigms play in the practice of any science raises serious questions about the sharp distinction between "theology" and "mathematics." … Mathematics … will always have its theological foundations.[3]

INTRODUCTION

The paper aims to target an interdisciplinary audience which branches out from economics, specifically constitutional economics, rational choice economics and economic game theory, into biblical scholarship, theology and research fields like the scholarly study of religion. For this reason, I kept mathematical notations and economic references to a less complex, more comprehensible level.

Previous constitutional economic research on the paradise story analyzed how principles of Buchanan's constitutional economics can be used to shed new light on reasons as to why interactions between God and Adam & Eve were frail and why interactions ultimately broke down.[4] This research, however, did not provide any conceptual or quantitative, logical-mathematical reconstruction of game matrices that could illuminate, from a game theoretical perspective, the breakdown of cooperation in the paradise story and why eviction was the most favorable option for God after Adam & Eve's theft. The present paper fills this gap in understanding by approaching it from an economic perspective. In this way, fundamentally new insights into the paradisiacal defection process and its outcomes, namely Adam and Eve's eviction from paradise, are gained.

Conversely to Heyne's comments on the relationship between theology and mathematics, as quoted in the motto above, this challenges theology and biblical scholarship to consider the contributions of economic game theory and rational choice

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[3] Paul Heyne, *"Are Economists Basically Immoral?" and other Essays on Economics, Ethics, and Religion* (ed. Geoffrey Brennan and A. M. C. Waterman; Indianapolis: Liberty Fund, 2008), 83, 95. What is the title of the "chapter" written by Heyne?

[4] Sigmund A. Wagner-Tsukamoto, *Is God an Economist? An Institutional Economic Reconstruction of the Old Testament* (Basingstoke, UK: Palgrave Macmillan, 2009), 45–72; Sigmund A. Wagner-Tsukamoto, "The Paradise Story: A Constitutional Economic Reconstruction," *Journal for the Study of the Old Testament* 34 (2009): 147–170; Sigmund A. Wagner-Tsukamoto, "Out of a Slave Contract. The Analysis of Pre-Hobbesian Anarchists in the Old Testament," *Constitutional Political Economy* 21 (2010): 288–307; Sigmund A. Wagner-Tsukamoto, "The Tree of Life: Banned or Not Banned? A Rational Choice Interpretation," *Scandinavian Journal of the Old Testament* 26/1 (2012): 102–122.

economics to Old Testament exegesis, specifically asking whether Old Testament research can have economic, logical-mathematical foundations.

The paper reconstructs in constitutional economic terms, supported by game theory and rational choice theory, reasons as to why the initial allocation of rights between God and Adam & Eve invited defection by a rationally acting, self-interested Adam and Eve (Adam and Eve modeled as "economic man," homo economicus); why eviction from paradise rather than killing Adam and Eve was the "best" – dominant – outcome, despite this outcome reflecting – under certain conditions – what has been termed "rational foolishness" in prisoner's dilemma (PD) analysis; and why there were no viable prospects of "real" cooperation between God and Adam & Eve in paradise, once the first defection had occurred. Abstract, conceptual conditions are spelled out for a PD outcome of the paradise interactions. These conditions relate to dominant decision strategies for both God and Adam & Eve. The analyzed game matrices specify rights and valuations of rights.

The proposed game theoretical, constitutional economic approach moves beyond Brams's[5] game theoretical analysis of the Old Testament, which also included the paradise story. He proposed the hypothesis that biblical characters, including God, were rational economic game players (*homo economici*). Like Brams, I have substantially drawn on rational choice theory as part of a game theoretical analysis of the paradise story. However, fundamental differences between Brams's analysis and the present paper exist. Regarding the conceptual focus, I have linked both rational choice theory and game theoretical analysis to a *constitutional economic reconstruction* of the paradise story, specifically to issues of natural distribution states, anarchy, violation of contract, and social contract in general. Such a conceptual focus is absent from Brams's work. Also in contrast to Brams, I conceptualize a *bundle of utilities* that were experienced ("consumed") by God and Adam & Eve and which influenced their rational choices (and impacted on conditions for dominant decision strategies as well as prisoner's dilemma conditions).

The central focus of this present paper provides an *abstract*, *conceptual* discussion and reconstruction of conditions for dominant decision strategies as well as of prisoner's dilemma conditions. Brams discussed dominant decision strategies only through *ordinal* analysis without specific values or abstract utilities being covered. Also, Brams did not look into the question of prisoner's dilemma issues.

These differences in approach enabled me to address and to answer the constitutional economic and game theoretical questions raised above. In this way, the present study conceptualizes the defection process in a different and more comprehensive way, especially when looking at a possible second defection of Adam and Eve in relation to

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[5] Steven J. Brams, *Biblical Games. A Strategic Analysis of Stories in the Old Testament* (Cambridge, MA: MIT Press, 1980); Steven J. Brams, "Game Theory and Literature," *Games and Economic Behavior*, 6 (1994): 32–54.

the tree of life, the question as to whether God should protect this tree after the first theft, and how the possibility of an anticipated second theft then influenced the valuation of utilities for future social contracting after the first theft.

In the first part of the paper, I briefly introduce the prisoner's dilemma game, which has been researched and discussed in great depth in economic and political sciences. Secondly, I briefly outline the nature and role of game theoretical analysis, in particular the prisoner's dilemma game in Buchanan's constitutional economics, and how I have drawn from this approach to interpret the Eden story. Thirdly, I propose and interpret game matrices that depict the allocation and valuation of rights between God and Adam & Eve. The matrices illustrate the nature and course of the defection process in the paradise story. Finally, I offer some conclusions.

THE PRISONER'S DILEMMA (PD) CONCEPT: A BRIEF INTRODUCTION

The prisoner's dilemma is a concept that has been widely applied in social studies that research cooperation and conflict problems. In subsequent parts of this paper, I argue that the application of the prisoner's dilemma concept to the paradise story generates fundamentally new and original insights into cooperation and conflict problems encountered by God and Adam & Eve in the Eden story.

Heap, Binmore, and Webb provided accessible surveys and introductions to the prisoner's dilemma game.[6] The classical text on this concept is Luce and Raiffa.[7] In the prisoner's dilemma, two parties (prisoners A and B) need to make choices. The two prisoners are held in custody and a prosecutor has sufficient evidence to get each one of the prisoners sentenced – for a minor crime – to one year imprisonment. There is also a strong suspicion that A and B were involved in a major crime, which would carry, together with the minor crime, a ten-year sentence. However, the prosecutor has insufficient evidence to convict A and B for the major crime.

The prosecutor now acts by separating A and B into different rooms so that they cannot communicate with each other and he offers each of the prisoners a crown witness deal. The deal goes as follows: should one of the prisoners confess to the major crime while the other one refuses to confess, the confessing crown witness would be rewarded with a very short prison sentence of a couple of months (length "0.3") while the other, non-confessing prisoner would be imprisoned for ten years. In the event that both prisoners confess to the major crime, the crown witness deal falls

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[6] Shaun Heap, *Game Theory. A Critical Introduction* (London: Routledge, 1995); Kenneth G. Binmore, *Game Theory. A Very Short Introduction* (Oxford: Oxford University Press, 2007); James N. Webb, *Game Theory. Decisions, Interactions and Evolution* (London: Springer, 2007).

[7] R. Duncan Luce and Howard Raiffa, *Games and Decisions. Introduction and Critical Survey* (New York: Wiley, 1957).

through but each of the prisoners would get a reduced sentence for confessing and showing goodwill in this respect (each prisoner then would be imprisoned for eight years). Should neither of the prisoners accept the crown witness deal, the prosecutor could only sentence each of them for the minor crime (one year each).

The key question economic game theory analyzes in this respect is how should a rational, self-interested A and B choose in this situation? Logically, the choices of A and B are interdependent: that means outcomes for each prisoner depend on the choices made by the other prisoner.

The insight which the prisoner's dilemma generates, is that the rational, self-interested choice in this situation leads to the worst outcome for the group (the "group" conceived as A and B), namely a total prison sentence of 16 years (eight years for A and B respectively). Matrix 1 of Figure 1 explains this outcome. In Matrix 1, the respective prison sentences are delineated for each prisoner showing the outcomes for confessing or not confessing to the major crime – in dependence of what the other prisoner chooses to do. Matrices 2 and 3 of Figure 1 illustrate how the outcome of Matrix 1 is reached, namely that both prisoners confess and thus earn a total of 16 years imprisonment. Matrix 2 shows that A's option to confess "dominates" the option not to confess ($8 < 10$ and $0.3 < 1$). Matrix 3 shows the same for prisoner B.

Insert Figure 1 about here

Figure 1: The Prisoner's Dilemma (PD)

(Source: Luce and Raiffa 1957, p. 95)

Matrix 1

A, B	Prisoner B's	
	option 1: confess	option 2: not confess
Prisoner A's option 1: confess	8, 8	0.3, 10
option 2: not confess	10, 0.3	1, 1

"Rational foolishness" as standard outcome: The group overall loses worst because of self-interested, rational choice (here: in terms of length of prison sentences)

Matrix 2

A's RATIONAL CHOICE: OPTION 1

A	Prisoner B's	
	option 1: confess	option 2: not confess
Prisoner A's option 1: confess	8	0.3
option 2: not confess	10	1

For prisoner A: option 1 dominates option 2

B's RATIONAL CHOICE: OPTION 1

Matrix 3

B	Prisoner B's	
	option 1: confess	option 2: not confess
Prisoner A's option 1: confess	8	10
option 2: not confess	0.3	1

For prisoner B: option 1 dominates option 2

There are various key insights the prisoner's dilemma game yields for the political or institutional, constitutional economic analysis of cooperation and conflict.

First, in situations like the prisoner's dilemma, outcomes for the group cannot be calculated by just adding up what each person can gain. Rather, *interdependent effects* of individual choices need to be considered. Each agent's choices influence outcomes

not only for this agent but also for all other agents that are involved in an interdependent choice situation.

Secondly, *incentive structures* (in the above situation, the methods used that determine how prison sentences are allocated to agents) need to be carefully looked at in order to understand why the group overall loses.

Thirdly, the prisoner's dilemma depicts a so-called *nonzero-sum* choice situation, or in other words, as a result of interactions, all parties can lose at the same time (or all can gain at the same time – only if cooperation succeeds).

Fourthly, normative political science and institutional economics asks how to resolve a prisoner's dilemma, aiming to generate a win-win situation for all parties involved. It does so by targeting situational intervention with incentive structures (that is, the system that allocates gains and losses to interacting agents). It avoids mere appeals to interacting agents, who are caught up in a prisoner's dilemma-like situation, to be more cooperative, more forthcoming, more communicative, *etcetera* in order to overcome dilemma outcomes. For instance, behavioral economics, which is highly critical of the model of the "self-interested, rational, economic man," here characterizes A and B as "rational fools."[8] However, other scholars have long warned that this latter strategy, which targets and criticizes the "human condition," is self-destructive – unless the incentive structures which caused the dilemma in the first place were altered.[9]

These insights serve as the starting point for the subsequent analysis in this paper of why and how cooperation broke down in the paradise story. In the next part of the paper, I outline how constitutional economics in the tradition of James Buchanan has applied the prisoner's dilemma concept to study cooperation problems and their resolution. Later parts of this paper then project Buchanan's research to the paradise story.

BUCHANAN'S ANALYTICAL STARTING POINT: NATURAL DISTRIBUTION STATES, VIOLATION OF CONTRACT, AND A PD SCENARIO

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[8] Amartya K. Sen, "Rational Fools: A Critique of the Behavioral Foundations of Economic Theory" in *Beyond Self-Interest* (ed. by Jane J. Mansbridge; Chicago: University of Chicago Press, 1990), 25–43.

[9] Garrett Hardin, "The Tragedy of the Commons," *Science*, 162 (1968): 1243–1248; Karl Homann, "Homo oeconomicus und Dilemmastrukturen" in *Wirtschaftspolitik in offenen Volkswirtschaften* (ed. by Hermann Sautter; Göttingen: Vandenhoeck & Ruprecht, 1994), 387–411; Sigmund A. Wagner-Tsukamoto, *Human Nature and Organization Theory. On the Economic Approach to Institutional Organization* (Cheltenham, UK: Edward Elgar, 2003), 36–38.

Buchanan starts the constitutional economic analysis of social contract with a two-person model.[10] He assumes that in a so-called natural distribution state one scarce x-good exists which both parties aspire to consume. Some initial distribution of the x-good exists between the two parties. However, the two parties ultimately contest the shares in the x-good. Connecting to Hobbes, Buchanan argues[11] that in this initial "state of nature" – the natural distribution state – cooperation breaks down:

> Each person has a '"right" to everything. Each would find it advantageous to invest effort, a "bad", in order to secure good x. Physical strength, cajolery, stealth – all these and personal qualities might determine the relative abilities of the individuals to secure and protect for themselves quantities of good x, which may be quite different from the relative quantities that were arbitrarily assigned by the initial disposition.

This process of defense of one's own share in the x-good and attack on the other party's share in the x-good is wasteful and costly. Buchanan goes on to suggest that these attack and defense costs are the key reason as to why contractual agreement on social order can ultimately (after anarchy may have initially erupted) be negotiated between rationally acting, self-interested agents. By reaching some kind of agreement, both parties can gain. This does not imply, as Buchanan stressed, that the x-good has to be equally shared between the two parties. Only mutual gains and contractual agreement are necessary for both parties to be better off "…whether rough symmetry prevails or whether one participant becomes a consumption giant [of the x-good] and the other a pygmy."[12]

To illustrate his argument further, Buchanan draws on a PD matrix (see Figure 2).[13] Cell 4 shows the natural distribution state depicting each party's utility payoffs for the consumption of the x-good as well as wasteful attack and defense costs regarding the x-good. Buchanan argues that rational agents who *anticipate* the reaction of the other party ultimately find themselves in cell 1. Cell 1 reflects that a contractual agreement has been reached between both parties, the parties assuring each other that rights to the x-good are respected and that consequently wasteful attack and defense costs regarding x can be avoided. Buchanan speaks in this connection of a stable "core" solution being reached in cell 1.

<mark>Insert Figure 2 about here</mark>

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[10] James M. Buchanan, *The Limits of Liberty. Between Anarchy and Leviathan* (Chicago: University of Chicago Press, 1975), 23–31.

[11] Buchanan, *Limits of Liberty*, 24. See also James M. Buchanan, *Freedom in Constitutional Contract. Perspectives of a Political Economist* (College Station, Texas: Texas A&M University Press, 1977), 22–23.

[12] Buchanan, *Limits of Liberty*, 24.

[13] Buchanan, *Limits of Liberty*, 27.

Figure 2: Buchanan's PD start-up scenario

Agent B

	Respect A's rights	Do not respect A's rights
Respect B's rights	19, 7 *Cell 1*	3, 11 *Cell 2*
Do not respect B's rights	22, 1 *Cell 3*	9, 2 *Cell 4*

Agent A

(Source: Buchanan 1975, p. 27)

Buchanan suggests that cells 2 and 3 reflect that each player has "private incentives" to violate the contractual agreement reached through the distribution of payoffs in cell 1.[14] Indeed, in a strict PD scenario, with a one-off game being played, for both players the defection option of "respect no rights" dominates the cooperation option of "respect rights." Therefore, cell 4 would result in this unavoidable outcome. It is worthwhile noting in this connection that Buchanan introduces the assumption of agents expecting a rational reaction of the other agent in the case of defection. Without this, cell 1 could not be a stable core solution. In the strict PD game, where only a one-off game is played, such assumptions cannot be made.

For the paradise scenario, it will be interesting to see whether and how far we find a one-off game, or continuous reaction games being played. Should it be that only one-off games are "played" regarding the respecting of rights, this would raise the question as to how far Buchanan's analysis applies even in aggravated form for the paradise story, especially regarding the lack of prospects to escape from a mutually disadvantageous PD outcome.

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[14] Buchanan, *Limits of Liberty*, 27.

Buchanan is somewhat vague at this point regarding how "time" and "future, anticipated reaction" may or may not be considered. On the one hand, he argues that the players would defect if they assumed that they could "do so unilaterally."[15] This implies some reasoning about the future and the consideration of a time element. Similarly, as noted above, he speaks of anticipated reactions regarding the other player's choices. On the other hand, Buchanan suggests that the initial model of Figure 2 did not consider time.[16] If this were truly the case, then anticipated reactions to defection could not be considered in the analysis implied by Figure 2 – and cell 4, a PD outcome (anarchy, the "natural distribution state") would result. In this respect, there seems to be some ambiguity as to how Buchanan initially considers time in the PD game. When I apply this game later to the analysis of the paradise story, I will make it clear as to how far time and thus the potential of reaction by God or Adam & Eve were covered by my analysis.

In subsequent steps, Buchanan relaxes some of the initial assumptions relating to his interpretation of the PD game of Figure 2. In particular, he moves to a "two-stage contract" model which is to cover many scarce x-goods, interactions of many persons, and explicitly, or so he claims, a time element. Regarding the time element, I have already commented that Buchanan at least implicitly covered this in his initial interpretation of the PD game when he spoke of anticipated reactions.

For the many x-goods scenario, Buchanan argues that basically the same process can be observed as for the one-good scenario. Over time, so he suggests, some contractual agreement will be negotiated which allows all interacting parties to reduce defense and attack costs. At this point, Buchanan invokes the idea of the "constitutional contract," which is set out in a first stage of contracting.[17]

In a second step, post-constitutional contracting goes on regarding the renegotiation of shares in x-goods depending on individual preferences for different x-goods. Buchanan refers to this type of contracting as the "traditional domain of economics."[18] For the paradise scenario, we will have to check to see if and how many x-goods were actually involved in distribution interactions between God and Adam & Eve. The tree of knowledge as the first target of a distribution dispute instantly springs to mind but there was also the tree of life, and there were utilities to be derived from other goods which could influence interactions already in the initial, natural state.

Buchanan seems to assume that x-goods can be consumed and valued without the interdependence of effects, that is, one party's consumption of an x-good would not devalue the consumption of the same x-good by another party. Exclusivity of consumption is not seen as a problem. For the paradise scenario, this may not be the

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[15] Buchanan, *Limits of Liberty*, 27.

[16] Buchanan, *Limits of Liberty*, 26.

[17] Buchanan, *Limits of Liberty*, 28; Buchanan, *Freedom in Constitutional Contract*, 38–39.

[18] Buchanan, *Limits of Liberty*, 29.

case, as the value and utility payoffs of the most prominent x-goods (fruits from the tree of knowledge and from the tree of life) are defined by the exclusive consumption of one party only. These goods reflect more than what Buchanan termed "rival" or "partitionable goods."[19] In the paradise scenario, there was little room for contractual agreement regarding redistributions of these goods for *joint* consumption.

To illustrate, if Adam & Eve had succeeded in eating even the smallest amount of fruit from both the tree of knowledge and the tree of life, they would have turned into gods, acquiring the godly privileges of ultimate knowledge and eternal life. This implies that in the paradise story, small or even just marginal re-distributions of both x-goods through contractual agreement between God and Adam & Eve cannot really be an issue from the outset. The only issue is whether or not some "forced" redistribution of the divine x-goods occurred which then subsequently altered utility payoffs for God and Adam & Eve, possibly resulting in a PD outcome.

Buchanan also relaxes the two-person assumption of his initial model by moving from "small numbers" to "large numbers" of interacting agents.[20] Buchanan argues that the large-numbers situation may be the most relevant factor which makes players defect, choosing "not to respect rights of others." In a large-numbers situation, so Buchanan argues, players may expect to unilaterally get away with defection, reaping private gains from defection, as illustrated by cells 2 and 3 of Figure 2 (for the two-player model). However, Buchanan reasons that ultimately a process gets under way which first enables small sub-groups and then larger ones to negotiate an escape from the natural distribution state. Contractual negotiations yield an outcome through the social aggregation of sub-groups and groups that is comparable to the small-numbers situation.

For the paradise story, this qualification for the large-numbers situation is not relevant since the paradise story only deals with very small numbers. I distinguish only two players – God and Adam & Eve.[21] This compares to Buchanan's initial start-up scenario where only two players interacted (see Figure 2). In this respect, Buchanan's and the Old Testament's start-up analysis of social order compare well. Only in the further course of the analysis of social order after the paradise story, the Old Testament may have considered large-numbers situations, "relaxing" the initial assumption of the two-player model. This has been analyzed elsewhere.[22]

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[19] Buchanan, *Limits of Liberty*, 30–31.

[20] Buchanan, *Limits of Liberty*, 31–34.

[21] Similarly argued Brams, *Biblical Games*, 14.

[22] Wagner-Tsukamoto, *God the Economist*; Wagner-Tsukamoto, "Paradise Story"; Sigmund A. Wagner-Tsukamoto, "State Formation in the Old Testament," *Journal for the Study of the Old Testament*, (forthcoming).

THEFT FROM THE TREE OF KNOWLEDGE: PUNISHING ADAM AND EVE THROUGH KILLING OR THROUGH EVICTION FROM PARADISE?

In the following, I transferred Buchanan's analysis of natural distribution states, violation of contract and a PD scenario[23] to the paradise story. I also connected with his Figure 2. Then I discussed how God and Adam & Eve could choose to respect or not to respect the rights of each other. Going further I then discussed rights in relation to various utilities of x-goods and other goods. This discussion of utilities for various goods, including x-goods, enabled me to conceptually widen an analysis of mere impositions of "constraints" on Adam and Eve's choice behavior, as done by Brams.[24] Through conceptualizing specific utilities for various goods, it is possible to analyze precisely exactly what influenced the rational choices of God or Adam & Eve and enabled them to decide one way or the other, and what kind of constitutional economic, game theoretical significance this carries.

I have set out utilities for x-goods as follows (on a notational reference: "U [good; actor]" stands for the *utility U* experienced by the *actor* in relation to a certain *good*. "Tree 1" stands for the *tree of knowledge*; "tree 2" stands for *the tree of life*; and "A & E" stands for *Adam and Eve*.):

Utilities *before* the theft:

- U[non-shared tree 1; God] > 0

- U[non-shared tree 2; God] > 0

- U[non-accessed tree 1; A & E] = 0

- U[non-accessed tree 2; A & E] = 0

Utilities *after* the first theft (from tree 1):

- U[shared tree 1; God] > 0 but U[shared tree 1; God] < U[non-shared tree 1; God]

- U[shared tree 1; A & E] > 0

- U[non-shared tree 2; God] > 0

- U[non-accessed tree 2; A & E] = 0

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[23] Buchanan, *Limits of Liberty, 27.*

[24] Brams, *Biblical Games*, 14–21.

Utilities after a *possible* second theft (from tree 2):

- U[shared tree 1; God] > 0 but U[shared tree 1; God] < U[non-shared tree 1; God]

- U[shared tree 1; A & E] > 0

- U[shared tree 2; God] > 0 but U[shared tree 2; God] < U[non-shared tree 2; God]

- U[shared tree 2; A & E] > 0

In addition to x-goods, utilities can also be set out for other goods. God may have gained further utility through obedient, faithful behavior by Adam and Eve; he may also have derived utility from his valuation of human life, humans being part of his creation. Adam and Eve may have gained additional utility from their life in material abundance inside paradise, being allowed to consume fruits from most plants (but not the divine trees) and to subordinate nature for their purposes. In addition, following a moral behavioral, psychological viewpoint, Adam and Eve may have derived some intrinsic psychological utility from being obedient to God. These utilities are unlikely to reflect x-goods in a strict sense but they provide positive utility to God and Adam & Eve and thereby influence their decision strategies. These additional utilities can be depicted as:

- U[obedience of A & E; God]

- U[human life; God]

- U[life in paradise; A & E]

- U[obedience to God; A & E]

In relation to the possible decision of God to evict Adam & Eve from paradise (once the theft had happened), we also need to introduce the following utilities for Adam and Eve:

- U[life outside paradise; A & E]

- U[prospect of contracting; A & E][25]

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[25] I prefer the more general term "U [prospect of contracting; A & E]" rather than "U [prospect of obedience; A & E]" since after the eviction of Adam and Eve from paradise new modes of social contracting between God and humans were able to emerge that were not necessarily based on strict obedience.

The utility U [prospect of contracting; A & E] refers to possible, future contracting of Adam & Eve with God, outside paradise. A comparable utility needs to be considered for God, too:

- U [prospect of contracting; God]

Prospective utilities may arise from possible future contracting and need to be considered, but only in relation to the eviction option. For the other scenarios, they are zero. I explain this later in more detail when I analyze Figure 4.

Merely for the purpose of illustration, I have quantified utilities regarding the observing or failure to observe rights. I then explained how I attached numerical utility values to the decisions of God and Adam & Eve. The numerical values can be questioned. For this reason, the paper also formulates conceptual, abstract, logical-mathematical conditions – Conditions (I) to (XI) – in order to explain the outcomes of the paradise interactions. The focus is on dominant decision strategies, which may even yield a PD. In this way, I conducted a theoretical sensitivity analysis which examined the concrete, numerical utility values.

Figure 3 discusses for Adam and Eve the two decision options, to eat or not to eat from the tree of knowledge (an x-good; "tree 1") and therefore whether to respect or to violate God's right in this divine tree. Figure 3 only discusses defection in relation to Adam and Eve eating from the tree of knowledge. This mirrors the defection process in the paradise story (Genesis 2: 17; 3: 1–13).[26] A possible second step of defection (Adam and Eve eating from the tree of life; "tree 2") is discussed later when Figures 4 and 5 are introduced.

For God, Figure 3 analyzes three decision options: (1) his decision to respect Adam and Eve's right to live in paradise and to harvest fruits in paradise; (2) God not respecting the right of Adam & Eve to live at all, that is, Adam & Eve are killed by God, which also implies that Adam & Eve can no longer harvest any fruits in paradise, or be obedient to God; and (3) God not respecting the right of Adam &Eve to live inside paradise, that is Adam & Eve are evicted by God from paradise. Through this differentiation of how God could violate the rights of Adam & Eve, I also examined alternative "punishment" options of God in relation to possible defection behaviors of Adam & Eve.

Insert Figure 3 about here

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[26] All Bible references are taken from: *Holy Bible*. New International Version ®. NIV ®. Copyright © 1973, 1978, 1984 by International Bible Society ©. All rights reserved worldwide. Used by permission of Hodder & Stoughton Publishers, A member of the Hachette Livre UK Group. All rights reserved. "NIV" is a registered trademark of International Bible Society. UK trademark number 1448790.

Figure 3: Theft from the tree of knowledge

Adam & Eve's decision

God, A & E	Respect God's right to the divine trees	Do not respect God's right to the tree of knowledge
Respect A & E's right to live and to harvest fruits in paradise	**N1** 240, 40 Cell 1	170, 70 Cell 2
Do not respect A & E's right to live (and to harvest fruits in paradise)	200, 0 'Game over' Cell 3	200, 0 'Game over' Cell 4
Do not respect A & E's right to live in paradise and harvest fruits: Eviction	240, 25 Cell 5	**N2** 175,60 Cell 6

God's decision *(label to the left of the rows)*

In Figure 3, we find in cell 1 an item that I termed natural distribution state N1. This is the initial start-up scenario in paradise. Allocations of rights were imposed by the rule-maker "God," and this had taken place even though no contracting over rights had been undertaken between the two parties. Also, the initial distribution of x-goods was very one-sided, God exclusively owning the divine trees. Here therefore, I use Buchanan's concept of the natural distribution state.[27] God's utility is determined in cell 1 by owning the two divine trees. For mere illustrative purposes, I quantified: U [non-shared tree 1; God] = 100 and U [non-shared tree 2; God] = 100. In the state N1, God gained additional utility from Adam and Eve being obedient to God: U [obedience of A & E; God] = 20. And further to this, God derived utility from Adam and Eve being part of God's creation: U [human life; God] = 20.

I have quantified these latter utilities at 20 each. These lower values, as compared to the values attached to the godly privileges of ultimate knowledge and eternal life, are

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[27] Buchanan, *Limits of Liberty*, 23–25, 28, 31.

arbitrary but it would appear to be logical to quantify them lower than the values for the godly privileges, thereby reflecting the status of the divine trees as "x-goods."

For Adam and Eve, cell 1 spells out utility derived from living inside paradise and from harvesting fruits in paradise (but not from the divine trees). I quantified this utility as U [life in paradise; A & E] = 20. In addition to this, Adam & Eve gained intrinsic psychological utility from being obedient to God: U [obedience to God; A & E] = 20.

Cell 2 describes that Adam and Eve reacted to what Buchanan described as "private incentives" and "predation." Adam & Eve could substantially better their utility pay-offs by not respecting God's right to the tree of life (if U [obedience to God; A & E] < U [shared tree 1; A & E]). Although they lose, in the case of defection, intrinsic psychological utility from being faithful to God, Adam & Eve were able to gain utility from accessing ultimate knowledge, which included knowledge to enable construction of their own ethical code in order to master their existence, as theology and biblical studies have put this.[28] The latter is especially significant for any analysis, including constitutional economic analysis, of social contracting in relation to the Old Testament.

Since ultimate knowledge was now shared between God and Adam & Eve, I split the previous value of this utility: U [shared tree 1; God] = 50 and U [shared tree 1; A & E] = 50. So in cell 2, God also lost utility that previously resulted from Adam & Eve having been faithful to him.

Cells 3 and 4 describe God's drastic action to kill Adam & Eve, in cell 3 for "no good reason" and in cell 4 as a kind of punishment that prevented Adam and Eve's defection. The question is, would a rational acting, self-interested God resort to a decision such as this? From a heuristic, theory building point of view of how story telling can be set out in an analysis of social order, one could cut short answering this question since cells 3 and 4 imply a "game over" scenario, humans being killed. This makes an analysis of social order – religious, economic, or any other type – lack feasibility.

Therefore it can be seen that, from an analytical, theory building point of view, the Old Testament, understood as a treatise of social order and social contract, needed to avoid this scenario. However, can the utilities as we find them in Figure 3 demonstrate how the avoidance of such a "game over" scenario can be reconstructed in game theoretical terms? Such a reconstruction leads us into a conceptual, abstract sensitivity analysis of utility values for Figure 3 (See below when *Conditions (I)* to *(XI)* are discussed).

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[28] Claus Westermann, *Genesis 1–11. A Commentary* (London: SPCK, 1984), 251–252; Ruth Gilboa, *Intercourses in the Book of Genesis* (Lewes, UK: Book Guild, 1998), 114, 131.

Cells 5 and 6 spell out a different decision option for God regarding the "not respecting" of rights of Adam & Eve. Cell 5 reflects that God evicts Adam & Eve for no good reason from paradise. God's utility as compared to cell 1 does not change. For Adam and Eve utility decreases when comparing cells 1 and 5 (if U [life in paradise; A & E] > U [life outside paradise; A & E]). Their utility gains for being obedient to God is still at U [obedience to God; A & E] = 20. However, their utility derived from living a carefree life in paradise lapses. After eviction, they find themselves outside paradise: I quantified U [life outside paradise; A & E] at 5.

The result reached in cell 6 can be described as natural distribution state N2. It pictures the outcome which we can actually observe in the paradise story: Adam & Eve acquiring God's privilege in ultimate knowledge, and God choosing to evict Adam & Eve from paradise. God's utility remains the same to the one in cell 2 but for one difference: some additional utility can be considered for God (and also for Adam & Eve) since eviction, in contrast to killing or allowing Adam & Eve to remain in paradise, has raised the prospect for future social contracting between God and humans. If such prospective utilities for future contracting are included in cell 6, for instance, U [prospect of contracting; God] = 5 and U [prospect of contracting; A & E] = 5, then the possibility of a "real" prisoner's dilemma emerges. This is discussed further below.

Abstract, Mathematical-logical Sensitivity Analysis of the Eden Story

The way I quantified utilities in Figure 3 for the purpose of illustration does not yield any dominant decision for God. In a first step, I now conceptually, abstractly reconstruct dominant decision options for both God and Adam & Eve. This illuminates what happened in the paradise scenario, with cell 6 being the result. A dominant decision for God to evict Adam & Eve from paradise can be reconstructed for Figure 3 if decision option three ("to evict") dominates both option one ("to respect Adam & Eve's rights") and option two ("to kill Adam and Eve"). The following logical conditions need to be satisfied:

Condition (I):   (cells 5 & 6 dominate cells 1 & 2)

U [prospect of contracting; God] > 0

Condition (II):   (cells 5 & 6 dominate cells 3 & 4)

U [non-shared tree 1; God] < U [shared tree 1; God] + U[human life; God] + U[prospect of contracting; God]

Condition (I) reflects that God placed, despite the theft, some positive value on the prospect of future cooperation with Adam and Eve. Also, it can be safely assumed:

Statement (III):

U [non-shared tree 1; God] > U [shared tree 1; God]

Condition (III) implies that God was not altruistically predisposed to sharing the tree of knowledge with Adam & Eve: God did not gain an even higher utility from sharing the tree of knowledge than from prohibiting this tree to Adam and Eve (and thereby retaining "sole" ownership of ultimate knowledge). Otherwise, an initial ban regarding the tree of knowledge, as we find it in the paradise story, does not make much sense. Theology speaks in this connection of a "jealous" God who does not want to share fruits from the tree of knowledge and who wants to prevent humans from becoming gods.[29] Hence: U [non-shared tree 1; God] – U [shared tree 1; God] > 0. We can reformulate condition (II):

Condition (IIa):

U [non-shared tree 1; God] – U [shared tree 1; God] < U [human life; God] + U [prospect of contracting; God]

Condition (IIa) reflects that the utility loss God suffered as a result of Adam & Eve's theft from the tree of knowledge must have been more than compensated for by the combined utilities he derived from his valuation of human life and the prospect of future social contracting with humans after the theft. Only then does cell 6 dominate cell 4, with eviction rather than killing Adam and Eve being the result (and as we see later, then a PD results for God unavoidably in cell 6, too).

This is an important insight: already in the paradise interactions between God and humans, God's valuation of human life played a very significant role as did his interest in future contracting with humans (once defection happened). If this was otherwise, we would not be able to explain why humans were not killed by God as a result of their theft in paradise. This insight clearly challenges suggestions, as voiced by some theological interpreters,[30] that only with the patriarchal covenants after eviction, did human life become fully respected and honored by God.

In order to reconstruct a dominant decision for Adam and Eve to steal fruit from the tree of knowledge, the following condition alone needs to be fulfilled:

Condition (IV):

U [obedience to God; A & E] < U [shared tree 1; A & E]

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[29] Erich Fromm, *You Shall be as Gods. A Radical Interpretation of the Old Testament and its Tradition* (London: Jonathan Cape, 1967), 22–23, 37, 64, 159 ; Philip S. Alexander, "The Fall into Knowledge: The Garden of Eden/Paradise in Gnostic Literature," *Journal for the Study of the Old Testament. Supplement Series*, 136 (1992), 91–104 (p. 100).

[30] Fromm, *Gods*, 25.

Condition (IV) reflects that Adam & Eve must have derived a higher value from their theft from the tree of knowledge as compared to the intrinsic psychological value they gained from obedience to God in the initial, start-up situation of social contracting in paradise (this contract having been imposed unilaterally by God without any consultation of Adam & Eve, and which reflected a mode of social contracting that favored faithful, obedient behavior). A further, uncritical condition for the dominance of Adam and Eve's decision to violate God's rights is:

Condition (V):

U [prospect of contracting; A & E] > 0.

Taking these conditions (I) to (V) together, Figure 3 illustrates that cell 6 results as a stable core solution in the course of the defection process (independent of whether it is a "true" prisoner's dilemma or not; this is discussed below). State N2 (cell 6) happens because it reflects dominant decision options for both God and Adam & Eve.

However, due to the one-off nature of the defection game "played" in the paradise story, neither cell 6 nor cell 1 of Figure 3 can be maintained as a core solution *over time*. The very nature of the contested x-good "tree of knowledge" implied this: once stolen, a renegotiated different way of sharing this good could not be an issue. The one-off scenario implies that the consideration of a time element, namely regarding anticipated reactions and repeat games, is not a crucial issue in the Eden story, or at least much less so than in the start-up scenario of Buchanan's analysis. In this respect, the paradise story begins the analysis of social contract with an aggravated scenario and merely a one-off game being played, as compared to Buchanan's discussion of Figure 2. The scenario in the Old Testament necessarily required eviction (in cell 6 of Figure 3) in order to subsequently overcome N2 (but then outside paradise).

On a related point, even for the small-numbers situation depicted in the paradise story, the Old Testament invoked predation, as Buchanan uses this term, the giving in to "private incentives" and ultimately the breakdown of cooperation. In this way, but here being more cautious than Buchanan who "especially" for large-numbers situations expected predatory behavior, the Old Testament aggravates the agents involved, who act unilaterally by giving in to "private incentives" and believing they could get away with such behavior, free-riding on a very small crowd.

Prisoner's Dilemma (PD) Analysis of the Eden Story

Whether a "true" prisoner's dilemma occurred in cell 6 depends on various, additional conditions. A PD outcome is conceptually very interesting: I will explain subsequently why this should be so, connecting especially to Buchanan's work. The

above conditions only demonstrate that cell 6 results as a matter of dominant decisions. In order for a PD in cell 6 to happen, both God and Adam & Eve need to "suffer" lower utilities as compared to cell 1. For God, the following condition needs to be fulfilled:

Condition (VI):

U [non-shared tree 1; God] + U [obedience of A & E; God] > U [shared tree 1; God] + U [prospect of contracting; God]

We can reformulate condition (VI) as:

Condition (VIa):

U [non-shared tree 1; God] – U [shared tree 1; God] > U [prospect of contracting; God] – U [obedience of A & E; God]

Condition (III) already implies that U [non-shared tree 1; God] – U [shared tree 1; God] > 0. We can also assume:

Condition (VII):

U [prospect of contracting; God] – U [obedience of A & E; God] < 0

Condition (VII) states that God derived a higher utility from the initially established mode of social contracting in paradise, based on obedience and faith, in contrast to the only potential prospect of cooperation with humans after the eviction of Adam and Eve from paradise. Condition (VII) appears in this respect uncritical. Therefore, condition (VI) is uncritical for a PD to result on God's side: This implies that only dominance needs to be assured in order for a PD to result for God. As discussed, for deriving dominance of God's decision option three, conditions (I) and (II) need to be fulfilled. These conditions fundamentally clarify and specify in constitutional economic terms what Brams referred to as a "poor outcome" for God to happen in a "constraints" game with Adam & Eve.[31]

For Adam and Eve, the diagnosis of a PD outcome in cell 6 is *ambivalent*. A PD only emerges if the following condition is satisfied:

Condition (VIII):

U [obedience to God; A & E] + U [life in paradise; A & E] > U [shared tree 1; A & E] + U [life outside paradise; A & E] + U [prospect of contracting; A & E]

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[31] Brams, *Biblical Games*, 21.

A PD results for Adam and Eve if Adam & Eve place a higher value on the sum of U[obedience to God; A & E] + U[life in paradise; A & E] than the sum of U[shared tree 1; A & E] + U[life outside paradise; A & E] + U[prospect of contracting; A & E]. This interpretation can be sharpened. We reformulate:

Condition (VIIIa):

> U [life in paradise; A & E] > U [life outside paradise; A & E] + U [prospect of contracting; A & E] + U [shared tree 1; A & E] – U [obedience to God; A & E]

Condition (IV) implies: U [shared tree 1; A & E] – U [obedience to God; A & E] > 0. Hence, (VIIIb) follows:

Condition (VIIIb):

> U [life in paradise; A & E] >> U [life outside paradise; A & E] + U [prospect of contracting; A & E][32]

If this is the case, a "true" PD and "rational foolishness" can be diagnosed for Adam and Eve, an inferior utility outcome resulting for them on the grounds of rational, self-interested choice (as highlighted by the dominance condition (IV) for Adam and Eve). Numerically, such a PD outcome results, connecting to Figure 3, by setting U [life in paradise; A & E] at 45 instead of 20 (and leaving all other utility values unchanged).

This "foolishness," PD explanation on the side of Adam and Eve can be linked, in a philosophical poetic tradition, for instance, to the approach of John Milton, with his "Paradise Lost" interpretation. Such an interpretation suggests that Adam and Eve strongly desired a comparatively carefree life inside paradise and it considers the theft, at least implicitly, as irrational. This type of interpretation is also compatible with many mainstream biblical studies and conventional theological approaches, which interpret the outcome of the paradise story negatively as the fall of humans into sin, tragedy, *etcetera*.[33]

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[32] ">>" stands for "substantially bigger than."

[33] Robert Graves and Raphael Patai, *Hebrew Myths. The Book of Genesis* (London: Cassell, 1964); Benedikt Otzen, Hans Gottlieb, and Knud Jeppsen, *Myths in the Old Testament* (London: SCM Press, 1980); James K. West, *Introduction to the Old Testament* (New York: Macmillan Publishing, 1981); Samson R. Hirsch, *Genesis* (Gateshead: Judaica Press, 1982); Francis C. Blessington, *Paradise Lost. Ideal and Tragic Epic* (Boston: Twayne Publishers, 1988); Gary A. Anderson, "The Penitence Narrative in the Life of Adam and Eve," *Hebrew Union College Annual*, 63 (1992): 1–38; August Dillmann, *Die Genesis erklärt* (Piscataway, NJ: Gorgias Press, 2007).

Examining this outcome further, with a "true" PD resulting in cell 6 (for both God and Adam & Eve), we can observe what Buchanan's constitutional economics predicts unfair start-up situations of social ordering, as reflected by state N1 in Figure 3. Buchanan argues if an x-good is too one-sidedly distributed in the natural state (such as N1), theft and predatory behavior will escalate. This ultimately makes both parties worse off, inevitably leading to a PD.

Such a poor result can be found in Figure 3 in cell 6, when the natural state N2 results, even as a PD (with the above conditions for a PD being fulfilled). In the state N2, attack and defense costs of x-goods have to be paid by interacting parties. However, as Buchanan notes, these very costs encourage the opening up of potential for overcoming natural states by subsequently negotiating some new social contracts that guarantee, on economic grounds, certain rights to interacting parties. In the paradise story itself, we cannot observe such a negotiation of a new social contract between God and humans since a "one-off" game was played. Only in later stories, when, for instance, the covenants are discussed, does this happen in the Old Testament.[34]

Nevertheless, as noted, there is ambivalence in the paradise story regarding the occurrence of a PD as a final outcome. If the PD condition (VIII) is not fulfilled (on Adam and Eve's side) it is difficult to speak of "rational foolishness" on their behalf or the "fall of humans," as mainstream theology does. In game theoretical terms, we would then only observe "rational foolishness" on God's side. Looked at in this way, condition (VIII) can also be interpreted as Adam and Eve's choice – choice to be understood in terms of how Adam and Eve attached utilities to various goods – between a carefree but comparatively dull life in paradise, abiding to God in relative having no access to knowledge (and eternal life or at least longevity, too), and a life with knowledge outside paradise. Outside paradise, then the need arises to work much harder for a living than inside paradise and further contracting with God is only a future prospect (but then possibly fairer and more equal contracting is feasible in difference to the initial, natural distribution state N1). This interpretation is compatible with critical theological analysis which explains the "fall" of humans positively, for instance, as the "fall into maturity" or "fall into knowledge."[35]

This is a fundamental insight: The ambivalence of PD condition (VIII) allows us to reconcile conflicting positive and negative theological interpretations of the theft in

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[34] Wagner-Tsukamoto, *God the Economist,*74–108; Wagner-Tsukamoto, "Slave Contract," 295–299.

[35] Fromm, *Gods*, 121–123; Alexander, "Fall into Knowledge,"98–103; David Jobling, "Myth and its Limits in Genesis 2.4b–3.24" in *The Sense of Biblical Narrative. Volume II. Structural Analyses of the Hebrew Bible* (ed. David Jobling; JSOTSup 39; Sheffield: JSOT Press, 1986), 17–43; Sam Dragga, "Genesis 2–3: A Story of Liberation," *Journal for the Study of the Old Testament*, 55 (1992): 3–13; Kim I. Parker, "Mirror, Mirror on the Wall, Must We Leave Eden, Once and for All? A Lacanian Pleasure Trip Through the Garden," *Journal for the Study of the Old Testament*, 83 (1999): 19–29; Dmitri M. Slivniak, "The Garden of Double Messages: Deconstructing Hierarchical Oppositions in the Garden Story," *Journal for the Study of the Old Testament*, 27 (2003): 439–60.

paradise. We can side with mainstream theology which interprets the theft negatively as the fall into sin if Adam and Eve found themselves in a PD after the theft (Condition (VIII) being fulfilled). Contrary to this, if the PD condition (VIII) is *not* fulfilled, it then becomes difficult to speak of a "fall" since Adam and Eve then gained more than they lost (comparing their utilities for N2 and N1).

Taking another viewpoint, it then proves possible to side with critical theology which positively evaluates the defection of Adam and Eve as a "fall" into knowledge, maturity and liberation. Utility ("capital") gains due to defection then outweigh utility ("capital") losses for Adam and Eve. To be concise, the conceptual ambivalence behind PD condition (VIII), on Adam and Eve's side, is analytically of great value, since it is the very source for overcoming conflicting interpretations of the quality and nature of Adam and Eve's defection, as they are posed by both mainstream theology and critical theology.

LETTING ADAM AND EVE STAY IN PARADISE AFTER THE FIRST THEFT?

Here I subsequently discuss why there was no prospect *in paradise* for mutually negotiated cooperation between God and Adam & Eve once the first defection had occurred. This explains why cell 2 of Figure 3 did not consider any utility for future cooperation between God and Adam & Eve, neither for God nor for Adam & Eve. I have identified two scenarios: first, one in which the tree of life was not protected by God (Figure 4), and second, a scenario in which God did protect the tree of life (Figure 5).

For both Figures 4 and 5, cell 2 of Figure 3 provides the reference point, with interactions between God and Adam & Eve continuing within paradise. In Figure 4, I discuss the point that God and Adam & Eve continued to interact in paradise while God did not protect the tree of life. For the purposes of illustration, I utilized the same numerical utility values as already introduced above. For God, I discuss the two decision options to let Adam & Eve live in paradise or to kill Adam and Eve; for Adam & Eve, I discussed the two options to respect or not to respect God's right to the tree of life.

Insert Figure 4 about here

Figure 4: God letting Adam and Eve stay in paradise (tree of life unprotected)

Adam & Eve's decision

God, A & E	Respect God's right to the tree of life	Do not respect God's right to the tree of life: A & E turning 'God'
Respect A & E's right to stay in paradise and harvest fruits in paradise	190,90 *'Game over' Cell 7*	100,100 *'Game over' Cell 8*
Do not respect A & E's right to live: Kill A & E	200,0 *'Game over' Cell 9*	Cell 8 or cell 9 prevails, depending who defected first. *'Game over' Cell 10*

God's decision

In cell 7, God's total utility is: U [shared tree 1; God] + U [non-shared tree 2; God] + U [obedience of A & E; God] + U [human life; God]. Adam and Eve's total utility is: U [shared tree 1; A & E] + U [obedience to God; A & E] + U [life in paradise; A & E]. Cell 8 describes Adam and Eve's theft from the tree of life and thereby turned "God" themselves. Their new utility became: U [shared tree 1; A & E] + U [shared tree 2; A & E] + U [life in paradise; A & E]. They gain utility as long as U [shared tree 2; A & E] > U [obedience to God; A & E].

God substantially loses utility in cell 8 as compared to cell 7. His utility is: U [shared tree 1; God] + U [shared tree 2; God]. Cell 9 specifies that Adam and Eve were killed, therefore their utility is zero. God's utility returns to: U [non-shared tree 1; God] + U [non-shared tree 2; God]. The values for cell 10 are ambivalent since speed of decision making intervenes. Whoever defected first, God or Adam & Eve can maximize utility, cell 10 then either reflecting the outcome of cell 9 (if God defected before Adam and Eve) or the outcome of cell 8 (if Adam and Eve defected before God). This consideration complicates conventional PD game analysis. Only cell 7 or cell 10 can possibly reflect an outcome of dominant decision strategies. Here I formulate dominance for cell 10 (For cell 7, dominance had to be formulated by

inverting the following conditions). For Adam and Eve, the following condition needs to be satisfied:

Condition (IX):

U [obedience to God; A & E] < U [shared tree 2; A & E]

This appears to be an even less critical condition than condition (IV) since theft from the second tree was not just "another" theft which brought some additional utility but yielded the status of being "God." It can be suggested that the second theft even produced exponentially higher utility gains for Adam and Eve as compared to the first theft, which still had left Adam and Eve being human. One could even re-conceptualize: U [shared tree 1; A & E] + U [shared tree 2; A & E] := U [Becoming God; A & E][36] with U [Becoming God; A & E] >> U [shared tree 1; A & E] + U [shared tree 2; A & E].

For God, we need the following condition fulfilled in order for cell 10 to be dominant:

Condition (X):

U [non-shared tree 1; God] > U [shared tree 1; God] + U [obedience of A & E; God] + U [human life; God]

This can be reformulated as:

Condition (Xa):

U [non-shared tree 1; God] – U [shared tree 1; God] > U [obedience of A & E; God] + U [human life; God]

This implies that dominance through killing rests on the utility loss God suffered through Adam & Eve's first theft from the tree of knowledge as compared to the combined utility he derived from obedient behavior by Adam and Eve and the value he attached to human life. Since God *continued* "playing" with Adam and Eve in Figure 4, starting out from cell 2 in Figure 3, condition (Xa) appears to be difficult to fulfill. Therefore, we can deduce that the more likely outcome in cell 10 is that Adam & Eve succeeded in acquiring the privilege of becoming God.

Even so, a PD analysis for cell 10 does not make too much sense at this point since the two defection options considered for God and for Adam & Eve exclude each other: whoever defected first could maintain "his" state of affairs as reflected by cells 8 and 9. However, as previously noted, it could be speculated, when looking at the

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[36] ":=" means "implies," "corresponds to."

respective dominance conditions for God and Adam & Eve, that the valuation calculus for defection favored Adam and Eve to defect first, which then would have resulted in Adam and Eve acquiring the godly privileges (either in cell 9 or in cell 10).

The most important insight we can derive from this brief analysis of Figure 4 is that cell 7 is a highly unstable solution, especially on Adam and Eve's side. For them, defection is almost a foregone conclusion considering the utility gains they could acquire. Whether we can assume a rational God at this point who was able to anticipate this issue is the critical question. If so, God would have realized that Adam & Eve staying in paradise in the presence of an unprotected tree of life was not a rational option and, that being the case, he would not have continued to "play" with Adam and Eve in paradise. This leads us back to Figure 3 and the eviction outcome we discussed there for cell 6. Anticipating the possible defection logic behind Figure 4, and God having learned something from the first defection, namely that Adam & Eve may not be trustworthy and may be prone to defection if there were sufficient incentives, then God as rule-maker would have avoided the scenario described by Figure 4. This is the actual outcome we observe in Genesis (3: 24) – with God protecting the tree of life after the first theft (and evicting Adam and Eve).

From a heuristic, theory building point of view of how the Old Testament can be understood as a treatise of social order and social contract, we can further argue that Figure 4 is not a feasible analytical route. Basically, all four cells of Figure 4 reflect "game over" solutions for an analysis of social contract that involves conflict and/or freedom of choice among the interacting parties. In cell 7, the negotiation and resolution of conflict is handled through an obedience model (grounded in metaphysical guidance), reminiscent of N1, and no free, democratic contracting is visible. In the other cells of Figure 4, humans either are killed or turn God-like, which ultimately makes an analysis of social conflict and social contract superfluous.

Apparently, an unprotected tree of life cannot set out the analysis of social order and the resolution of social conflict in the Old Testament. This leaves the question as to whether a social contract could be sensibly analyzed and conceptualized in light of the protection measures that are taken by God in relation to the tree of life, *while at the same time* letting Adam & Eve stay in paradise. Figure 5 deals with this issue. Figure 5 sets out the same decision options for God and for Adam & Eve as Figure 4.

However, utilities in the matrix have changed since the tree of life is now protected from theft. At this point we can take up the proposal of protection measures as we actually find it in Genesis (3: 24), with God placing "cherubim and a flaming sword" in front of the tree of life once the first theft had occurred. Should Adam and Eve now transgress the ban to eat from the tree of life, immediate death and thus a zero utility would result. On the other hand, "cherubim and a flaming sword" implies defense costs *C* for God: I introduced C [tree 2; God] and quantified this cost for illustrative purposes at 10. This cost has to be factored in for God's decision calculus in all four cells of Figure 5.

Insert Figure 5 about here

Figure 5: God letting Adam and Eve stay in paradise (tree of life protected)

Adam & Eve's decision

God, A & E	Respect God's right to the tree of life	Do not respect God's right to the tree of life: A & E turning 'God'
Respect A & E's right to stay in paradise and harvest fruits in paradise	180,90 *'Game over' Cell 11*	190,0 *'Game over' Cell 12*
Do not respect A & E's right to live: Kill A & E	190,0 *'Game over' Cell 13*	190, 0 *'Game over' Cell 14*

God's decision

In Figure 5, we arrive at a dominant, stable core solution in cell 11 if God's utility for cell 11 is larger than the one for cell 13:

Condition (XI):

> U [shared tree 1; God] + U [obedience of A & E; God] + U [human life; God] > U [non-shared tree 1; God]

This is the only condition that needs to be fulfilled. Adam and Eve could only derive in cell 11 some positive utility anyway (namely: U [shared tree 1; A & E] + U [obedience to God; A & E] + U [life in paradise; A & E]). In all other cells of Figure 5, Adam and Eve are killed and therefore their utility is zero. Consequently, respecting God's rights is a "dominant" decision option for Adam & Eve from the outset; no real decision alternative exists.

The critical question which arises in this context is whether we can still identify for Adam and Eve a "decision" calculus, "social contracting" and "cooperation" as we would normally understand the meaning of these concepts. A rationally acting, self-interested Adam and Eve basically had no choices in the situation depicted by Figure 5. The way incentives are staked and protective measures are taken, Adam and Eve are forced to stick with cell 11. Conflict, free will and freedom of choice are no longer

feasible, as God had initially created these features within human nature, most explicitly so when he placed Adam and Eve in paradise in the face of the – transgressive – ban not to eat from the divine trees. In this respect, cell 11 does not reveal a cooperation "solution" that could be reached through free contracting and negotiation. However, this very kind of analysis is defining for constitutional economics,[37] as it is for any meaningful, philosophical or theological analysis of human behavior.[38] For cell 11, comparisons to "slavery-like" treatment may even spring to mind.[39] Buchanan's warning of a Leviathan controlling human fate applies.[40]

Furthermore, all four cells of Figure 5 reflect "game over" scenarios for the analysis and conceptualization of social order and contracting. In cells 12, 13, and 14, Adam and Eve are killed, and in cell 11, as previously noted, they are coerced into stringent obedience without the possibility of violating God's rights (in relation to the tree of life). "Sinful" behavior is no longer a possibility. As discussed, this scenario not only acts to prevent any constitutional economic start-up analysis of social problems on natural distribution states, violation of contract, and PDs but it also prevents theological or moral philosophical analyses, too (apart from critically reviewing the "slave-like" treatment of Adam and Eve).

In a nutshell, neither Figure 4 nor Figure 5 can set out any feasible route to the analysis of social contract, especially a route to social contracting which ultimately asks the question of how humans themselves can overcome natural distribution states. Once the first theft had occurred, both the protection of the tree of life *and* the eviction of Adam and Eve from paradise were necessary in order to enter meaningful cooperation analysis in the Old Testament.[41] We can observe such analysis in great depth, variation and scope after the paradise story when problems of social contracting are discussed in the various books of the Old Testament.

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[37] James M. Buchanan, "What Should Economists Do?" *Southern Economic Journal*, 30 (1964): 213–222 (p. 221); James M. Buchanan, "The Constitution of Economic Policy," *American Economic Review*, 77 (1987): 243–250 (p. 250); James M. Buchanan and Victor Vanberg, "Interests and Theories in Constitutional Choice" in *Choice, Contracts and Constitutions. Collected Work* (ed. James M. Buchanan, Indianapolis: Liberty Fund, 2001), 171; Alain Marciano, "Buchanan's Constitutional Political Economy: Exchange vs. Choice in Economics and in Politics," *Constitutional Political Economy*, 20 (2009), 47, 53–54.

[38] See, for instance, for theology and biblical studies, Westermann, *Genesis 1–11*, 265; Fromm, *Gods*, 28.

[39] Wagner-Tsukamoto, *God the Economist*, 51–54; Wagner-Tsukamoto, "Paradise Story," 157–158; Wagner-Tsukamoto, "Slave Contract," 293–295.

[40] Buchanan, *Limits of Liberty*, 15, 33, 246–247, 250.

[41] See also Wagner-Tsukamoto, "The Tree of Life," 110, 120.

CONCLUSION

The paper reconstructed through game theoretical analysis the breakdown of cooperation in paradise between God and Adam & Eve. Figure 3 illustrated that Buchanan's game theoretically based, start-up analysis of social contract projects well to the paradise story. As in Buchanan's analysis, we find in the paradise story two players who face the decision to respect or not to respect the rights of the other party. For the paradise story, some of Buchanan's suggestions even applied in aggravated form. The Old Testament sharpened in this way the start-up analysis of social order. For example, Buchanan suggested that *repeat* games are played in a pre-contract state of social order. They undermine social order, so he argues, as long as no social contract has been set out that binds agents already on grounds of mutually advantageous, self-interested choice. Such repeat games are not visible in the paradise story: We find a *one-off* game being played regarding the tree of knowledge; then, repeat theft, the handing back of goods, or the generation of mutual gains through new negotiations could not be an issue *inside* paradise. Also, Buchanan's discussion of how to relax the two-person assumption is not really needed for the paradise story since we only find two players (God versus Adam & Eve).

By spelling out dominance conditions for utility payoffs that God and Adam & Eve could reap for x-goods and other goods, the paper reconstructed the breaking down of cooperation in paradise, when Adam and Eve committed the theft of fruit from the tree of knowledge. The dominance conditions identified by Figure 3 for Adam and Eve's defection and for God's eviction of Adam and Eve were not severe. This applies more so on Adam and Eve's side both for a first defection and a possible second defection (in the event of the tree of life being left unprotected; Figure 4). This explains from a game theoretical perspective why defection so readily happened in the paradise scenario. Indeed, it was strongly invited by the initial start-up situation of how rights were distributed and valued. This situation yielded a "natural distribution state," even a PD. Once in this situation, God and Adam & Eve had no chance to escape from it *inside paradise* because (a) due to the very nature of x-goods involved (which could not be handed back and which set out the godly privileges of ultimate knowledge and eternal life) and (b) due to the way incentives were staked for Adam and Eve for further defection had they remained in paradise (as illustrated through Figure 4).

On God's side, the most important condition regarding both dominance and the emergence of a PD in cell 6 of Figure 3 was that, after the first theft, his valuation of human life and of the prospect of future social contracting with humans must have outweighed the utility loss he suffered through Adam and Eve's theft from the tree of knowledge. On Adam and Eve's side, a PD only resulted in the event that Adam and Eve's desire for a "carefree" life inside paradise substantially outweighed the utilities they would derive from life outside paradise and the looming prospect of future social contracting with God after eviction. I diagnosed an *ambivalent* PD in this respect. This ambivalence proved to be a rich source of insight, since it enables us to reconcile

conflicting theological interpretations of the fall of humans in the Eden story, as they are advocated by mainstream biblical scholarship and critical biblical scholarship.

Figures 4 and 5 specified the lack of any prospect of social contracting between God and Adam & Eve in paradise after the first theft, regardless of whether the tree of life were left unprotected (Figure 4) or were protected (Figure 5). Once the first theft had occurred, eviction was the only way to re-negotiate social contracts but this then had to happen outside paradise, with all the new implications that this entailed.

On a related point, eviction was necessary for humans to retain essential features of human nature in the Old Testament, such as free will or freedom of choice. Such features are vital for any meaningful analysis of social contract. The first theft elevated such crucial features of human nature, and eviction preserved these features while preventing the possibility that humans either were killed or turned God-like had they remained in paradise after the first theft. In this way, subsequent stories in the Old Testament could address anew the question of how social contracts should be organized. This happened initially by involving God as a dominating sovereign in the early stories of Genesis, for example in the stories of Noah, Abraham or Isaac. Later, fairer routes to social contract were set out between God and humans, ultimately even shifting analysis to social contracts among humans, for example in the stories of Jacob or Joseph.[42]

One could even further sharpen this argument: from the outset of storytelling in the Old Testament, both the first theft and the subsequent eviction from paradise were conceptually needed in order to start meaningful analysis of social contract, drawing on concepts such as an initial breakdown of social order, violation of contract, anarchy, natural distribution states, and even a PD – as we also encounter these ideas in modern constitutional and institutional economics. Paradise had to be lost to begin a discourse on social order in the Old Testament.

To sum up, game theory, as illustrated in the presented paper, can serve well to shed light on constitutional economic, mathematical-logical motifs of the paradise story, and also how plot construction concerning social contracting was rather systematically and rationally developed in the Old Testament from the outset. I view the paradise story in this connection not as a solely mystical, primitive, or archaic part of the Old Testament, which some authors even suggest should have been omitted from the Old Testament and which is claimed to link very poorly to subsequent stories in the Old Testament.[43]

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[42] Wagner-Tsukamoto, *God the Economist,* 89, 107, 128–135; Wagner-Tsukamoto, "Slave Contract," 296–304; Sigmund A. Wagner-Tsukamoto, "Homo Economicus and the Stories of Jacob: On the Methodological Relevance of Rational Choice Theory for Studying the Hebrew Bible," *Method and Theory in the Study of Religion* (forthcoming 2012/2013).

[43] Westermann, *Genesis 1–11*, 238.

The present paper stresses that only through humans defecting and acquiring one of God's features – his knowledge of good and evil – could the Old Testament set up the analysis of the influence of free will on social contract. In many of the subsequent Old Testament stories, free will then featured, at times even in a very evil, unscrupulous manner, such as "predatory behavior (for instance, in the stories of Jacob). However, this analysis ultimately aims at the overcoming of problems that were instigated by negative forms of self-interest, namely through negotiating new social contracts – or "covenants," as seen within theology.

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