Markets Versus Governments*

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Abstract

We provide a simple framework for comparing market allocations with government-regulated allocations. Governments can collect information about individuals' types and enforce transfers across individuals. Markets (without significant government intervention) have to rely on transactions that are ex post beneficial for individuals. Consequently, governments achieve better risk sharing and consumption smoothing than markets. However, politicians in charge of collective decisions can use the centralized information and the enforcement power of government for their own benefits. This leads to political economy distortions and rents for politicians, making government-operated allocation mechanisms potentially worse than markets. We provide conditions under which it is ex ante beneficial for the society to tolerate the political economy distortions in exchange for the improvement in risk sharing. For example, more effective controls on politicians or higher discount factors of politicians make governments more attractive relative to markets. Moreover, when markets cannot engage in self-enforcing risk-sharing arrangements and income effects are limited, greater risk aversion and greater uncertainty make governments more attractive relative to markets. Nevertheless, we also show theoretically and numerically that the effect of risk aversion on the desirability of markets may be non-monotonic. In particular, when markets can support self-enforcing risk-sharing arrangements, a high degree of risk aversion improves the extent of risk sharing in markets and makes governments less necessary. The same pattern may also arise because of "income effects" on labor supply. Consequently, the welfare gains of governments relative to markets may have an inverse U-shape as a function of the degree of risk aversion of individuals.

Keywords: governments, markets, mechanisms, political economy, risk sharing.

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1 Introduction

A central question of economics concerns the relative roles of markets and governments in the allocation of resources. The classical approach in economics, building on Adam Smith's invisible hand and the celebrated first welfare theorem, shows that under certain conditions concerning market structure and information, unfettered competition will achieve a Pareto optimal allocation of resources. In such environments, any insurance against individual risks are adequately provided by markets and any feasible allocation of resources preferred according to some social welfare criterion can be achieved by redistributing endowments. Economists soon realized, however, that this conception of the working of markets might be too optimistic. Alfred Pigou (1932), for example, pointed out that externalities and market failures cause various inefficiencies and may necessitate government intervention. Perhaps more importantly, economists influenced by socialist ideas such as Oscar Lange (1940) argued that a government operated "mechanism" that allocates resources, while collecting information from individual and potentially respecting their incentives, would be superior to the unfettered competition of the market economy. Lange also argued that there was no reason for why government allocation of resources could not replicate market allocations even if the first welfare theorem applied.

Lange's conception quickly came under attack, however. Various influential economists, including Abba Lerner (1944), Frederich von Hayek (1945), and Jacob Marschack (1955), criticized the feasibility and plausibility of a centrally-operated resource allocation mechanism. For example, Hayek developed his fundamental critique of central planning by pointing out that the informational requirements of centrally-operated mechanisms would be prohibitive and suggested instead that it is markets that provide the best and most economical means of aggregating useful information.

The origins of the mechanism design approach to economics also lies in this debate. Leonid Hurwicz (1960 , 1972, 1977, 1979) developed the formal mathematical language for modeling and evaluating centralized resource allocation mechanisms. A major question motivating Hurwicz's analysis was to develop an understanding of the conditions under which markets provide the best possible resource allocation systems. Subsequent contributions by, among others, Myerson (1979), Harris and Townsend (1981), Baron and Myerson (1982), Dasgupta, Hammond, and Maskin (1979), and Green and Laffont (1977), further developed the theory of mechanism design and showed both its wide ranging applications and its powerful intuitions. Nevertheless, part of the original objective of the mechanism designed literature envisioned by Hurwicz remained unfulfilled. The modern mechanism design approach implies that any allocation that can be achieved by decentralized markets can be replicated by centralized mechanisms. Moreover, as long as the economic environment is such that the first welfare theorem does not apply, mechanisms are typically strictly better than markets. So if anything, this impressive body of work vindicates the original view of Lange (1940) and suggests that government-operated centralized mechanisms may lead to improved allocation of resources relative to markets.

There are a number of reasons for questioning this conclusion, however. First, most resources in modern economies are allocated via markets, not by governments. While this may be a suboptimal outcome, one would naturally suspect that given the tendency of governments to intervene in many spheres of the economy, if there were clear advantages to government-operated mechanisms, we would not see such widespread use of market-based allocations. Second, the modern mechanism design literature does not explicitly model the difficulties involved in operating centralized mechanisms. To start with, the communication costs involved in reporting types and preferences to a centralized decision maker, which Hayek argued constituted the major cost of centralization, are not taken into account.[1] Equally important, mechanisms are typically assumed to be operated by social planners with benevolent objectives. Moreover, when the environment in question is dynamic, these planners are not only assumed to be benevolent, but also to possess the power to fully commit to future allocation rules.[2]

In this paper, we take a first step towards a systematic comparison of markets and governments (or centrally-operated mechanisms), incorporating the costs resulting from the fact that such mechanisms are not operated by benevolent planners with commitment power, but run by self-interested politicians without the ability to commit to future policies and with objectives significantly different from those of the rest of the population. We believe that modeling the costs resulting from the self-interested behavior of the government is essential because centrally-operated mechanisms concentrate enforcement power and information in the hands of a decision maker ("government" or "politician"). This decision maker is supposed to collect information and then redistribute resources on the basis of this information. But as the power to redistribute resources and information become centrally concentrated, it also becomes

[1] See Segal (2007) for a recent model developing this insight.

[2] See, for example, Albanesi and Sleet (2005), Golosov and Tsyvinski (2006), Golosov, Kocherlakota and Tsyvinski (2003), Kocherlakota (2005), Werning (2002), Battaglini and Coate (2005), and Golosov, Tsyvinski and Werning (2006) for applications of dynamic mechanism design approaches to risk-sharing and optimal taxation problems.

difficult to ensure that the government (and the politicians) entrusted with the allocation of resources do not use their power for their own benefits. This observation leads to the conclusion that a comparison of markets and governments (mechanisms) requires a detailed analysis of the *political economy of mechanisms* (or the political economy of controlling politicians in charge of mechanisms).[3]

A systematic study of the costs and benefits of market-based and mechanism-based allocations requires a number of modeling choices. First, we need to fix a particular environment, where mechanisms might potentially have a useful role relative to markets. Second, we need to decide how to model the political economy of mechanisms. Third, we need to make specific choices about how markets function. There are multiple useful choices that can be made regarding each of these three features. We will try to strike a balance between realism and tractability, by comparing two canonical models of markets (one corresponding to trading under full anonymity and the other allowing for self-enforcing arrangements) to a specific model of government-regulation incorporating political economy considerations.

In the environment studied in this paper, the key economic trade-off will be between insurance and incentives (in particular, along the lines of the seminal paper by Mirrlees, 1971). Individuals differ according to their productivity or marginal disutility of leisure and are risk averse. Individual types may be private information and individual histories (what they have done or reported to central authorities in the past) may or may not be observable by outside parties. This environment introduces a non-trivial role for mechanisms that collect information from individuals and allocate resources in order to reduce consumption volatility. In addition to the basic incentive-insurance trade-off featuring in Mirrlees's classic work, we will also focus on a dynamic economy, which highlights some of the political economy concerns in a more transparent manner.

On the modeling of the political economy of government-regulation (centralized mechanisms) we follow our earlier work, Acemoglu, Golosov and Tsyvinski (2006, 2007). Instead of a standard dynamic mechanism providing insurance and incentives to individuals, this work characterizes a *best sustainable mechanism,* which provides incentives to the government (politician

[3]Similar issues may arise in dynamic environments even when mechanisms are operated by social planners, if the planner is unable to commit to future allocation rules. See, for example, Roberts (1984), Freixas, Guesnerie and Tirole (1985), and Bisin and Rampini (2006), on the ratchet effect, whereby a benevolent government cannot commit to not using information revealed by a mechanism at later stages of implementation. See also recent work on mechanisms without commitment, for example, Bester and Strausz (2001), Skreta (2006), and Miller (2005).

in power) not to deviate from a prescribed allocation rule as well as incentives to individuals. In a best sustainable mechanism, the costs of centralized mechanisms will be the resources paid out as rents to politicians so as to convince them not to deviate from the prescribed actions (that is, from the implicitly-agreed mechanism for resource allocation) and the distortions in the allocation of resources induced by the presence of these rents. The best sustainable mechanism in Acemoglu, Golosov and Tsyvinski (2006) is typically non-stationary, providing different levels of "rents" to politicians depending on how long they have been in power. The non-stationarity of the incentives provided to politicians also implies that individual allocations change over time. In this paper, we focus not only on the best sustainable mechanisms, but also on *best stationary mechanisms*, which provide similar incentives to individuals and politicians, but are stationary. The focus on both types of mechanisms will help us clarify which comparative static results depend on the best sustainable mechanisms and which results also apply when we restrict individuals to use stationary strategies.

Finally, we will discuss a number of different approaches to modeling markets. Our baseline treatment will equate markets with *anonymous markets*, in which no information is observed about individuals' past transactions. This will imply that as in Bewley-Aiyagari style incomplete market models, individuals will only be able to smooth their consumption profile via "self-insurance," that is, by saving or varying the amount of labor they supply to the market (see, e.g., Bewley, 1977, Aiyagari, 1994). We will also compare centralized mechanisms to richer models of markets, in which limited insurance among agents can be achieved by using self-enforcing insurance arrangements such as those suggested in Kehoe and Levine (1993) or Kocherlakota (1996). We will highlight which insights regarding the comparison of markets to mechanisms depend on how markets are assumed to function.

It is important to note that in both of these cases we do not allow private insurance companies to play the role of the government (for example, by designing their own mechanisms and reallocating consumption among individuals based on reports as in Golosov and Tsyvinski, 2007). This is motivated by our argument above that any party entrusted by collecting information and with the power to enforce specific allocations of resources based on this information will have incentives to misuse this information or its power to extract resources from the society. Therefore, a large private insurance company running the mechanism will create exactly the same kind of distortions as a government, and thus one needs to incorporate the cost of providing incentives to this insurance company, which would be equivalent to the political economy costs of controlling government behavior in our model.[4]

Given our focus on the trade-off between incentives and risk sharing, our main results in this paper concern how the comparison between markets and centralized mechanisms (governments) changes as a function of the degree of risk aversion of the agents and the extent of risks that they are facing. We also present results about how preferences of the government, the extent of institutional controls, and the discount factor of the government affect the trade-off between markets and governments.

After a brief overview of the modeling of best sustainable (or best stationary) mechanisms, we provide a number of theoretical results on the comparison of markets versus governments. First, we show that irrespective of which model of the market we use, governments become more attractive relative to markets when there are more strict institutional controls on government behavior and the discount factor of the politician in power increases, because this makes the control of politicians more effective and thus reduces the costs of centralized mechanisms (in terms of rents paid to politicians).

More interesting are the comparisons with respect to risk aversion and the extent of risk in the economy. We show theoretically that when markets do not allow for self-enforcing risk sharing arrangements and preferences are "quasi-linear" so that the extent of income effects are limited, greater risk aversion makes governments more attractive relative to markets. This comparative static result is intuitive. Greater risk aversion makes anonymous market allocations more costly and increases the value of government-provided insurance, so that the society is willing to pay the additional (political economy) costs involved in government intervention in order to receive consumption insurance. In contrast, when individuals are not very risk averse, market allocations are preferred to government intervention.

Despite this powerful intuition, the effect of risk aversion on the comparison of markets to governments is *not always* unambiguous. The first reason for this is the presence of "income effects," which imply that risk aversion affects equilibrium labor supply. This has two effects on the comparison of markets to governments: (1) markets become more attractive since individuals may obtain some degree of self-insurance by varying the amount of labor they supply; (2) government intervention becomes less attractive, since with the greater amount of labor supply

[4] This argument rules out the possibility of "separation of powers," whereby the power of some branch of government or private party, such as an insurance company, is checked by some other branch of government where part of the enforcement powers are vested. The impact of such arrangements on the comparisons of markets to governments is an interesting area for future research.

politicians need to be paid more rents so as to prevent them from deviating and expropriating the output of the economy. Using numerical examples, we show that with significant income effects the comparison of governments to markets leads to a non-monotonic relationship, whereby markets are preferred at low and high levels of risk aversion, but not at intermediate levels. Intuitively, at low levels of risk aversion there is no need for government intervention, while at very high levels of risk aversion, self-insurance by varying the amount of labor supply becomes preferable to paying significant rents to politicians. Second and more interestingly, we show that a similar result, with a non-monotonic pattern, also applies when we compare centralized mechanisms to markets with self-enforcing risk sharing arrangements. Here the intuition is rather different. The difference between markets and governments in this setup lies in the ability of the government to enforce contracts. In the markets environment, contracts have to be self-enforcing and have to provide incentives to individuals not to walk away from their promises. Instead, governments can enforce contracts, and thus the no-deviation constraints on individuals are removed. But in return government-regulated allocations introduce the political economy distortions necessary to provide incentives to politicians. We show that when the degree of risk aversion is low, there is limited need for insurance and thus markets are preferred to governments. When individuals are highly risk-averse, then self-enforcing risk sharing arrangements in markets become easier to sustain because exclusion from future risk sharing becomes very costly. Therefore, markets are also preferred to governments for sufficiently high levels of risk aversion. Only for intermediate levels of risk aversion government-operated mechanisms are preferred to self-enforcing markets.

Overall, our analysis reveals that incorporating the self-interested objectives of politicians that control the redistributive tools of the society leads to a nontrivial comparison of markets and governments, potentially vindicating some of the arguments against Lange's centralized resource allocation mechanisms. Our analysis also shows that the details of how the market is modeled—or more substantively, how successful the markets are in providing insurance without governments—has important effects on how the extent of risk aversion and the amount of risk in the society affects the comparison between markets and governments. This implies that a careful modeling of how markets function in the presence of asymmetric information and risks is necessary for a satisfactory model of which resources should be allocated or supervised by governments.

In addition to the mechanism design and the dynamic mechanism design literatures mentioned above, our paper is related to recent work on political economy, which models how the self-interest to the objectives of politicians affects the allocation of resources.[5] None of these papers, except our previous work, Acemoglu, Golosov and Tsyvinski (2006, 2007), provide a systematic analysis of the political economy of mechanisms nor do they compare the ex ante welfare of market-based and government-operated allocations.[6] Our earlier work also does not include a detailed comparison of markets and governments. In addition, our paper is also related to the small literature on the comparison of governments versus markets. For example, Hart, Shleifer and Vishny (1997), Chari (2000) and Acemoglu, Kremer and Mian (2003) also contrast the incentive costs of governments and markets. Nevertheless, none of these papers derives the costs of governments from the centralization of power and information in the process of operating a mechanism.

The rest of the paper is organized as follows. Section 2 describes the basic environment. Section 3 describes various different ways of modeling market equilibria. Section 4 starts the analysis of sustainable mechanisms. In this section, we setup the problem of constructing sustainable mechanisms under various assumptions and provide some characterization results. Section 5 provides a number of theoretical results on the comparison of government-operated mechanisms and markets. Section 6 provides further comparisons using simple calibrations of our baseline models. Section 7 concludes.

2 The Environment

In this section, we describe preferences, technology, and possible information structures.

The model economy is infinite horizon in discrete time. It is populated by a continuum 1 of agents, each denoted by i. We denote the set of individuals in the economy by I. In addition, there is an infinite number of potential politicians, which can operate allocation mechanisms in case the society decides to use centralized mechanisms for resource allocation. These politicians can be thought of as a single agent or as a group of agents such as a bureaucracy, whose preferences can be consistently represented by a standard von Neuman-Morgenstern utility

[5] See, among others, Buchanan and Tullock (1962), North and Thomas (1973), North (1981), Olson (1982), North and Weingast (1989), Eggertsson (2005), Dixit (2004), and Acemoglu, Johnson, and Robinson (2005). Austen-Smith and Banks (1999), Persson and Tabellini (2000) and Acemoglu (2007) provide introductions to various aspects of the recent developments and the basic theory.

[6] Acemoglu, Golosov and Tsyvinski (2007) contains and significantly extends the main results of our earlier working paper, Acemoglu, Golosov and Tsyvinski (2006). Parts of this latter paper not included in Acemoglu, Golosov, and Tsyvinski (2007) are the starting point of the current paper, though the current paper also includes a variety of theoretical results, especially all of the results in Section 5, which were not present in that paper.

function.

Each individual agent i has a type $\theta_t^i \in \Theta \equiv \{\theta_0, \theta_1, ..., \theta_N\}$ at each time t. We adopt the convention that θ_j corresponds to "higher skills" than θ_{j-1}, and in particular, θ_0 is the worst type. We drop the index i when this causes no confusion and use the standard notation θ^t to denote the history of θ_t^i up to and including time t. We assume that θ_t^i follows an irreducible first-order Markov chain, with the realization for each individual being independent of those for all other individuals. Throughout the paper, there would be no loss of generality if the reader considered the realizations of θ_t^i to be independent and identically distributed over time. Independence across individuals within a time periods enables us to appeal to the weak law of large numbers, so there is no aggregate risk in any period. Moreover, we assume that the distribution of θ's in each period is the same and assigns positive probability to each element of Θ. We denote the cumulative distribution function corresponding to this invariant distribution by $G(\theta)$. This assumption implies that each individual always faces a positive probability of becoming any of the types in Θ in the future.

We will consider two environments. The first is a *private information economy* in which both the current values of the individual types, the θ_t^i's, and their past realizations are private information. The second is an economy in which individual types are publicly observed.

The instantaneous utility function of individual i at time t is given by

$$u\left(c_t^i, l_t^i \mid \theta_t^i\right) \tag{1}$$

where c_t^i is the consumption of this individual and l_t^i is his labor supply. We assume that labor supply comes from a compact interval, i.e., $l_t^i \in \left[0, \bar{L}\right]$. In addition, we make a number of standard assumptions on u. Let $\mathbb{R}_+$ denote the nonnegative real numbers and $\mathbb{R} \cup \{-\infty\}$ the one-sided extended real numbers.

Assumption 1 ***(utility function)***

1. *For all $\theta \in \Theta$, $u(c, l \mid \theta) : \mathbb{R}_+ \times \left[0, \bar{L}\right] \to \mathbb{R} \cup \{-\infty\}$ is extended real valued. Moreover, on its effective domain, u is increasing in c, decreasing in l, jointly strictly concave in c and l and twice continuously differentiable in both of its arguments, with partial derivatives denoted by u_c and u_l.*

2. *For all $\theta \in \Theta \backslash \{\theta_0\}$, $u_c(0, 0 \mid \theta) > -u_l(0, 0 \mid \theta)$.*

3. *The utility function u satisfies single crossing in the sense that $u_c(c, l \mid \theta) / |u_l(c, l \mid \theta)|$ is increasing in θ for all c and l.*

These assumptions are standard. The first part imposes the typical concavity and differentiability assumptions. The second part states that for all types, with the possible exception of the lowest type θ_0, the marginal utility of consumption at zero consumption and labor supply is greater than the marginal disutility of labor. This assumption ensures that in the absence of distortions ("taxes" or "wedges"), there will be positive production by all types (except possibly for the lowest type). The third part imposes the standard single-crossing property, which will enable us to reduce the number of incentive compatibility constraints for individual reporting.

This formulation with the general utility function of the form $u\left(c_t^i, l_t^i \mid \theta_t^i\right)$ is useful for a number of reasons. First, this utility function nests the two most common formulations of risk in the literature: (1) shocks to the marginal utility of consumption as in Atkeson and Lucas (1992); (2) productivity shocks changing the marginal productivity of labor for each agent as in the baseline Mirrlees (1971) economy (in particular, productivity shocks would correspond to the case where $u\left(c_t^i, l_t^i \mid \theta_t^i\right) = u\left(c_t^i, l_t^i/\theta_t^i\right)$). Second, this general utility function also nests two special functional forms we will use below. The first is the *quasi-linear* utility function where

$$u\left(c_t^i, l_t^i \mid \theta_t^i\right) \equiv u\left(c - g\left(\frac{l_t^i}{\theta_t^i}\right)\right), \tag{2}$$

where u on the right hand side is a real-valued function of a single variable and g is convex and increasing. With a slight abuse of notation, we use the same symbol both for the more general function on the left and for the more specific function on the right; since the context will make it clear which function we are referring to, this should cause no confusion. The quasi-linear utility function is useful because it removes income effects, in the sense that labor supply allocations in autarchy (when agents receive no insurance) are unaffected by the degree of risk aversion, captured by the concavity of the u function (see below). The second common special case is the separable utility function used in much of the dynamic optimal taxation literature, where

$$u\left(c_t^i, l_t^i \mid \theta_t^i\right) \equiv u(c) - g\left(\frac{l_t^i}{\theta_t^i}\right). \tag{3}$$

While the separable utility function is tractable, it may imply potentially large "income effects," and the amount of labor supply by some types may increase significantly as their risk aversion increases. This behavior of labor supply to risk aversion is of economic interest, since it captures "self-insurance via labor supply," but it also affects the comparison between markets and governments. Below, we will present additional results for the case with quasi-linear utility functions (see, in particular, Proposition 10).

Each individual maximizes the discounted sum of their utility with discount factor β, so their objective function at time t is

$$\mathbb{E}\left[\sum_{s=0}^{\infty} \beta^s u\left(c_{t+s}^i, l_{t+s}^i \mid \theta_{t+s}^i\right) |\theta_t^i\right]$$

where $\mathbb{E}\left[\cdot|\theta_t^i\right]$ denotes the expectations operator conditional on knowing that the type of the individual is θ_t^i (in addition to any public information). This expression makes it explicit that the individual only knows her current type θ_t^i and bases her expectations on this (by the first-order Markov assumption).

The production side of the economy is simple. We assume that there is no capital and savings are not allowed, so total output is simply the sum of individual outputs, i.e.,[7]

$$Y_t = \int_{i \in I} l_t^i di.$$

3 Markets

By markets, we refer to a situation in which centralized mechanisms, especially centralized enforcement of contracts or risk-sharing arrangements, are not allowed. Different conceptions of markets are possible, and comparison between governments and markets will, to some degree, boil down to how well markets function, and how successful they are in providing collective goods, enforcing contracts, and allocating risks across individuals and over time. We will discuss two canonical models of markets. The first, which we refer to as *fully anonymous markets*, allows for individual trades, but all transactions are anonymous. This anonymity rules out any type of insurance mechanism, leaving self-insurance as the only option to individuals. Therefore, our model of anonymous markets is analogous to the Bewley-Aiyagari incomplete markets economy in which individuals can only insure against idiosyncratic risk by means of self insurance. The second, which we refer to as *self-enforcing markets*, allows the formation of self-enforcing coalitions among individuals. Since there is no government, any individual who

[7] Capital is included in Acemoglu, Golosov, and Tsyvinski (2007), but is left out of the current model to simplify the analysis, especially the modeling of anonymous markets.

deviates from a particular risk-sharing arrangement can only be punished by being excluded from future risk-sharing coalitions. This second conception of the market is similar to the economies considered by, among others, Kehoe and Levine (1993, 2001), Kocherlakota (1996), Alvarez and Jermann (2000), Krueger and Perri (2006).

3.1 Fully Anonymous Markets

With fully anonymous markets, there is no information about the past transactions of individuals. This implies that any insurance that involves risk sharing among individuals is impossible. With capital, fully anonymous markets will allow self-insurance via savings as in the Bewley-Aiyagari models. Instead, since there is no capital in our economy, fully anonymous markets are equivalent to "autarchy". In particular, in each period each individual has to consume his output, i.e., $c_t^i = l_t^i$. This, combined with the intertemporal separability of individual utility, implies that an equilibrium in a fully anonymous market is a solution to the following strictly concave maximization problem for each individual of type $\theta \in \Theta$ at each t:

$$\begin{aligned} &\max_{c,l} u(c, l \mid \theta) \\ &\text{subject to } c = l. \end{aligned}$$

We therefore have the following straightforward result:

Proposition 1 *In fully anonymous markets, there exists a unique equilibrium where each individual with type θ at time t chooses labor supply and consumption $\bar{c}(\theta) = \bar{l}(\theta)$ such that*

$$u_c\left(\bar{l}(\theta), \bar{l}(\theta) \mid \theta\right) = -u_l\left(\bar{l}(\theta), \bar{l}(\theta) \mid \theta\right).$$

The following corollary to this proposition will be useful in Section 5.

Corollary 1 *Suppose that individual utilities take the quasi-linear form given in (2). Then in the unique equilibrium of the fully anonymous markets economy, each individual with type θ at time t chooses labor supply and consumption $\bar{c}(\theta) = \bar{l}(\theta)$ such that*

$$\frac{1}{\theta} g'\left(\frac{\bar{l}(\theta)}{\theta}\right) = 1,$$

which is independent of the utility function u.

This corollary clarifies the sense in which quasi-linear preferences remove "income effects": the level of labor supply in fully anonymous markets is independent of the degree of risk aversion. In contrast, it can be verified that with separable utility greater risk aversion will increase the labor supply of at least some types.

For future reference, it is also useful to define the ex ante utility of anonymous market equilibrium. Let $\mathbf{u}(\theta)$ be the life-time utility of an individual that starts with type θ at time $t = 0$. Then

$$\mathbf{U}^{AM} = \int_{\Theta} \mathbf{u}(\theta)\, dG(\theta),$$

which can be interpreted as the utility of an individual before knowing his type (i.e., behind a veil of ignorance) would be $\mathbf{U}^{AM}$. Although behind a veil of ignorance comparisons are unattractive to make political economy claims, in the context of the model here, it is useful to compare the behind a veil of ignorance utility of anonymous markets and sustainable mechanisms. $\mathbf{U}^{AM}$ is useful for this reason.

3.2 Self-Enforcing Markets

The alternative conception of markets allow for decentralized self-enforcing risk sharing arrangements. To capture this role of markets in the simplest possible way, we can follow Kehoe and Levine (1993) and assume that a group of individuals can form a *self-enforcing risk-sharing coalition*. Let us take this coalition to be the entire society.[8] An important assumption in this setup is that individual types and histories are *publicly observed* (and can be conditioned upon). Since the risk-sharing coalition faces no aggregate risk, if it wishes, it can achieve full consumption smoothing. However, since there is no government with enforcement power, each individual can at any moment in time walk out of this coalition. If this happens, this individual is identified by all others in the society, and will not be part of any future risk-sharing arrangement. Therefore, an individual who deviates when his type is θ will receive lifetime utility $\mathbf{u}(\theta)$ as defined above (as in the fully anonymous market equilibrium). A self-enforcing market equilibrium is a subgame perfect equilibrium of the risk sharing arrangement within this coalition.[9]

Given this, we can write a program to determine a self-enforcing market equilibrium that maximizes ex ante welfare of all individuals. Recall that $\theta^t \in \Theta^t$ is the history of types for

[8] This is for simplicity. Equivalently, the society could be partitioned into a number of coalitions, each consisting of a continuum of individuals so as to diversify away aggregate risks.

[9] The fact that an individual who deviates from the risk sharing arrangements of the coalition will be excluded from future risk sharing and receives the continuation utility $\mathbf{u}(\theta)$ is a simple consequence of a well-known result in the theory of repeated games. In particular, $\mathbf{u}(\theta)$ is the lowest equilibrium payoff (or the min-max payoff) that an individual of type θ can receive and any subgame perfect equilibrium can be sustained by using the lowest equilibrium continuation utilities (e.g., Abreu, 1988).

an individual. Let $c_t : \Theta^t \to \mathbb{R}_+$ and $l_t : \Theta^t \to \mathbb{R}_+$ the allocation rules as functions of entire histories. Also let $G^t(\theta^t)$ denote the distribution of θ^t. Then the ex ante welfare-maximizing self-enforcing equilibrium is a solution to the following program:

$$\max_{\{c_t(\theta^t), l_t(\theta^t)\}_{t=0}^{\infty}} \mathbb{E}\left[\sum_{t=0}^{\infty} \beta^t u\left(c_t\left(\theta^t\right), l_t\left(\theta^t\right) \mid \theta_t\right)\right] \tag{4}$$

subject to

$$\int_{\Theta^t} c_t\left(\theta^t\right) dG^t\left(\theta^t\right) \leq \int_{\Theta^t} l_t\left(\theta^t\right) dG^t\left(\theta^t\right) \tag{5}$$

for all t, and

$$\mathbb{E}\left[\sum_{s=0}^{\infty} \beta^s u\left(c_{t+s}\left(\theta^{t+s}\right), l_{t+s}\left(\theta^{t+s}\right) \mid \theta_t\right)\right] \geq \mathbf{u}\left(\theta_t\right) \tag{6}$$

for all $\theta^t \in \Theta^t$ and for all t.

Clearly, (5) is the resource constraint ensuring that total consumption does not exceed total output. Constraint (6) ensures that following any history each individual prefers to share risks within the coalition rather than break with the coalition and receive his autarchy utility, $\mathbf{u}(\theta_t)$.

At this level of generality, there is little we can say about the structure of self-enforcing equilibria. However, the following result is immediate given the continuity and strict concavity of the objective function and the compactness and convexity of the constraint set:

Proposition 2 *There exists a unique ex ante welfare maximizing self-enforcing market equilibrium.*

When this will cause no confusion, we will also refer to the value of the objective function (4) in this unique equilibrium by $\mathbf{U}^{AM}$.[10] In Section 5 we will show how the comparison of government-regulated mechanisms to self-enforcing markets depends on attitudes to risk.

4 Sustainable Mechanisms

4.1 Politicians, Political Economy, and Private Histories

When the allocation of resources is determined by a centralized mechanism, a politician will be in charge of it. In the context of our model, the fact that a politician needs to be entrusted

[10] While $\mathbf{U}^{SM}$ might be a better notation, we use this to refer to the ex ante utility of "sustainable mechanisms". Moreover, it is convenient for our comparison results below to have a single notation that covers both anonymous markets and self-enforcing markets, and thus we use $\mathbf{U}^{AM}$ to denote the ex ante utility under both types of markets.

to carry out the allocation of resources is a natural consequence of the need to concentrate enforcement power and information about individual preferences and endowments in a centralized authority. The presence of self-interested politicians will imply that the society has to provide incentives to the politician in power so that he does not take courses of action that are detrimental to society's overall welfare. Overall, our model is a version of the classical Barro (1973) and Ferjohn (1986) model of electoral accountability.

As noted above, we assume that there is a large number of potential (and identical) politicians whose utility at time t is given by

$$\sum_{s=0}^{\infty} \delta^s v\left(x_{t+s}\right),$$

where x denotes the politician's consumption (rents), $v : \mathbb{R}_+ \to \mathbb{R}$ is the politician's instantaneous utility function. Notice also that the politician's discount factor, δ, is potentially different from that of the citizens, β. To simplify the analysis, we assume that potential politicians are distinct from the citizens and never engage in production.

Assumption 2 ***(politician utility)*** *v is twice continuously differentiable and satisfies $v'(x) > 0$, $v''(x) < 0$ for all $x \in \mathbb{R}_+$ and $v(0) = 0$. Moreover $\delta \in (0, 1)$.*

We next describe the structure of mechanisms. To simplify the exposition, in this paper we focus on two special classes of environments and corresponding mechanisms. In the first environment, which will be our focus in this section, individual types will be private information and we will also assume that histories (i.e., past actions and reports) are also private information. This will enable us to focus on mechanisms with *private histories*. The behavior of individual allocations in dynamic incentive problems may be very complicated even in the absence of sustainability constraints on politicians (e.g. Green, 1987, Phelan and Townsend, 1991, Atkeson and Lucas, 1992, Phelan, 1994). Our focus on private histories enables us to simplify the exposition and to highlight the effects of political economy interactions on the efficiency of government-operated mechanisms. The more general case of *history-dependent* mechanisms, where allocations are conditioned on the entire history of reports is analyzed in Acemoglu, Golosov and Tsyvinski (2006). The results in that paper show that the qualitative results we focus on here continue to hold with general history-dependent mechanisms. In the second environment, which will be discussed further in Section 5, individuals' types and actions are observed. Recall from the previous section that it is precisely these observations that make self-enforcing market arrangements feasible. Symmetrically, in this environment, we will also allow mechanisms to condition on the entire history of past types and actions.

For now, focusing on the environment with private histories, we can represent the mechanism as corresponding to the choice by the politician in power of a sequence $\{c_t(\theta), l_t(\theta)\}_{\theta \in \Theta}$ at each t, or, equivalently, a function $\mathbf{c}_t$ from the set of labor supplies to levels of consumption, such that if an individual supplies labor $l_t(\theta)$ for some $\theta \in \Theta$, then he receives consumption $c_t(\theta)$.[11] If there is no $\theta \in \Theta$ for which $l_t^i = l_t(\theta)$, then $c_t^i = 0$. With this formulation, the incentive compatibility constraints, which ensure that appropriate incentives are provided to individuals to reveal their types and choose labor supply consistent with the social plan (implicitly-agreed mechanism), can be written as

$$u(c_t(\theta), l_t(\theta) \mid \theta) \geq u(c_t(\hat{\theta}), l_t(\hat{\theta}) \mid \theta) \tag{7}$$

for all $\hat{\theta} \in \Theta$, for all $\theta \in \Theta$, and for all t.[12] Since at every date there is an invariant distribution of θ denoted by $G(\theta)$, when the constraints in (7) are satisfied, we can express aggregate labor supply and aggregate consumption as $L_t = \int_\Theta l_t(\theta)\, dG(\theta)$ and $C_t = \int_\Theta c_t(\theta)\, dG(\theta)$. In what follows, we will suppress the range of integration, Θ, when this will cause no confusion.

Given this structure, we can now summarize the timing of events. At each time t, the timing of events is as follows.

1. Individuals make labor supply decisions, denoted by $[l_t^i]_{i \in I}$, where $l_t^i \geq 0$. Output $Y_t = \int_{i \in I} l_t^i di$ is produced.

2. The politician in power chooses the consumption function $\mathbf{c}_t : [0, \bar{L}] \to \mathbb{R}_+$, which assigns a level of consumption for each level of labor supply, and also decides the amount of rents x_t. We assume that x_t cannot exceed ηY_t for some $\eta \in (0, 1]$. The parameter η is therefore a measure the institutional constraints that limit the ability of the politician to appropriate rents. The budget constraint on the politician is

$$C_t + x_t \leq Y_t,$$

   where $C_t = \int_{i \in I} \mathbf{c}_t(l_t^i)\, di$ is aggregate consumption.

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[11] Notice that $\mathbf{c}_t$ is a mapping from $[0, \bar{L}]$ into $\mathbb{R}_+$, while c_t is a mapping from Θ into $\mathbb{R}_+$ (thus justifying the notation $c_t(\theta)$).

[12] Moreover, given the single crossing property, (7) can be reduced to a set of incentive compatibility constraints only for neighboring types. Since there are $N + 1$ types in Θ, this implies that (7) is equivalent to N incentive compatibility constraints between neighboring types.

3. Elections are held and citizens jointly decide whether to keep the politician or replace him with a new one, denoted by $\rho_t \in \{0, 1\}$, where $\rho_t = 1$ denotes replacement. Replacement of politicians is without any costs.

This timing of events introduces elections as means of controlling politician behavior as in the classical Barro-Ferejohn model of electoral accountability (see also, Persson and Tabellini, 2000). This is a workhorse model of political economy and enables us to have a tractable setup in which politicians can take actions to further their own interests, but are constrained behavior in this by the potential replacement decisions of citizens.

The important feature of this political game is that even though individuals make their economic decisions independently, they make their political decisions—elections to replace the politician—jointly. This is natural since there is no conflict of interest among the citizens over the replacement decision. Joint political decisions can be achieved by a variety of procedures, including various voting schemes (see, for example, Persson and Tabellini, 2000, Chapter 4). Here we simplify the discussion by assuming that the decision $\rho_t \in \{0, 1\}$ is taken by a randomly chosen citizen (see Acemoglu, Golosov and Tsyvinski, 2007, for further discussion).

4.2 Equilibrium

We first look focus on the best (subgame perfect) equilibrium that will arise in the political economy setup. In Acemoglu, Golosov and Tsyvinski (2007), we referred to this subgame perfect equilibrium in the corresponding equilibrium mechanism as the *best sustainable mechanism* (in other words, a best sustainable mechanism is defined as the subgame perfect equilibrium of the game between individuals and politicians that yields the highest ex ante level of utility to the individuals). If there are coordination problems that lead to other equilibria in this game, governments will be less attractive relative to markets. Without a specific theory of what these coordination problems might be and which equilibrium we might expect in the repeated game between politicians and citizens, we find that it is most transparent to focus on the best equilibria. Clearly, if market allocations are preferred to the best sustainable mechanism, they will be, a fortiori, preferred to any other type of government regulation (or to any other selection of equilibrium in the repeated game between the politicians and the society).

Alternatively, we will also look at *best stationary mechanism*, which corresponds to the best subgame perfect equilibrium in which strategies are restricted to be stationary (that is, the stationary subgame perfect equilibrium that gives the highest ex ante payoff to individuals).

Restriciting atteniton to stationary mechanism is not without loss of generality because stationarity limits the society's ability to provide intertemporal incentives to politicians and thus may introduce additional distortions compared to the sustainable mechanisms. In Acemoglu, Golosov and Tsyvinski (2007), we show how certain qualitative results are affected when the restriction to stationary strategies is removed.[13] The construction of equilibria corresponding to both of these are discussed in detail in Acemoglu, Golosov and Tsyvinski (2006, 2007), where we show how the provision of incentives to individuals and governments can be separated by setting up an auxiliary maximization problem, which we referred to as a "quasi-Mirrlees program." Here, we do not repeat the same steps and simply note the following main result:

Proposition 3 *In the political economy game described above, the best sustainable mechanism is a solution to the following program:*

$$\mathbf{U}^{SM}=\max_{\{c_t(\theta),l_t(\theta),x_t\}_{t=0}^{\infty}} \mathbb{E}\left[\sum_{t=0}^{\infty}\beta^t u\left(c_t\left(\theta\right),l_t\left(\theta\right)\mid\theta_t\right)\right] \tag{8}$$

subject to the resource constraint

$$\int c_t\left(\theta\right)dG\left(\theta\right)+x_t\leq\int l_t\left(\theta\right)dG\left(\theta\right), \tag{9}$$

a set of incentive compatibility constraints for individuals, (7), for all t and for all $\theta\in\Theta$, and the sustainability constraint of the politician

$$\sum_{s=0}^{\infty}\delta^s v\left(x_{t+s}\right)\geq v\left(\eta\int l_t\left(\theta\right)dG\left(\theta\right)\right), \tag{10}$$

for all t. Moreover, any solution to this program is a best sustainable mechanism.

Proof. See Acemoglu, Golosov and Tsyvinski (2006). ■

Note that if individual types were publicly observed, then we would not need the incentive compatibility constraints (7). In addition, if we did not restrict ourselves to private histories, individual allocations would be functions of entire individual histories, i.e., $\left\{c_t\left(\theta^t\right),l_t\left(\theta^t\right)\right\}_{t=0}^{\infty}$ instead of $\left\{c_t\left(\theta\right),l_t\left(\theta\right)\right\}_{t=0}^{\infty}$. We postpone the presentation of the relevant maximization problem when allocations can be conditioned upon past histories to Section 5, since it will not play any role before then.

[13] Most of the previous literature has focused on this type of stationary equilibrium, in particular, assuming that individuals vote "retrospectively" according to some fixed threshold (see, for example, Persson and Tabellini, 2000, Chapter 4).

The details of why the solution of this program can be sustained as a subgame perfect equilibrium and why no other subgame perfect equilibrium can give higher ex ante utility are provided in Acemoglu, Golosov and Tsyvinski (2007).[14] Here we only give the intuition. Briefly, the best equilibrium has to satisfy the incentive compatibility constraints of individuals given by (7), so that they reveal their types correctly, while at the same time provide sufficient rents to the politician in power so that he prefers to follow the best sustainable mechanism rather than deviate and expropriate a fraction η of the total output of the economy. The constraint (10) ensures this and for this reason is referred to as *the sustainability constraint* on the politician.

Similarly, we have the following result for the best stationary mechanisms (proof omitted).

Proposition 4 *In the political economy game described above, the best stationary mechanism is a solution to the following program:*

$$\mathbf{U}^{SM} = \max_{\{c(\theta),l(\theta)\},x} \mathbb{E}\left[u\left(c\left(\theta\right),l\left(\theta\right)\mid\theta\right)\right]$$

subject to the resource constraint

$$\int c\left(\theta\right)dG\left(\theta\right) + x \leq \int l\left(\theta\right)dG\left(\theta\right),$$

a set of incentive compatibility constraints for individuals, (7), for all $\theta \in \Theta$, and the sustainability constraint of the politician in the case with stationary strategies,

$$\frac{v\left(x\right)}{1-\delta} \geq v\left(\eta\int l\left(\theta\right)dG\left(\theta\right)\right). \tag{11}$$

Moreover, any solution to this program is a best stationary mechanism.

The reasoning for why this program gives the best stationary mechanism is similar to before. The main difference is that the best stationary mechanism is written as a static problem. This is because the payments to the politician can no longer be a function of how long the politician has been in power, thus x replaces x_t. This implies that (11), which replaces (10) as the sustainability constraint, has to be stationary. When the same amount of rent, x, is given to the politician at all dates, allocations also become stationary, leading to the static optimization problem in Proposition 4. When the context makes it clear which program we are referring to, we will use the term sustainability constraint for both (11) and (10).

[14] In fact, Acemoglu, Golosov, and Tsyvinski (2007) show that the solution to this program can also be supported as a renegotiation-proof subgame perfect equilibrium.

A key concept for us will be *aggregate distortions*, which measure how the presence of a self-interested government creates further distortions relative to an allocation with a benevolent social planner. In our previous paper we defined aggregate distortions in terms of an *indirect utility function*, which was itself derived from an auxiliary maximization problem (the so-called "quasi-Mirrlees program"). One can think of such distortion as an additional aggregate tax or an additional wedge in the consumption-labor margin in the "aggregate;; indirect utility. While we can do the same here, this indirect utility function does not play a major role in our analysis, thus instead we simply state the following result:

Proposition 5 *The marginal tax rate on the highest type θ_N, at time t is equal to* aggregate distortions *at time t.*

Proof. See Acemoglu, Golosov and Tsyvinski (2006). ■

Aggregate distortions are a summary measure of how political economy considerations affect the allocation of resources (under government-operated mechanisms). Although Proposition 5 emphasizes the link between aggregate distortions and the marginal tax rate on the highest skill individual, aggregate distortions are interesting precisely because they affect not only the tax faced by the highest type, but the taxes imposed on all types. This point will be clarified in the numerical results presented in Section 6. Note also that while distortions or taxes could in principle be negative, throughout the paper, all the distortions or taxes will be positive.

4.3 Characterization of Best Sustainable and Stationary Best Mechanisms

In this subsection, we provide a number of theoretical results about the behavior of best stationary and best sustainable mechanisms. Somewhat more general versions of all of these results appear in Acemoglu, Golosov and Tsyvinski (2006). We therefore omit the proofs and refer the reader to that paper.

Proposition 6 *The allocation of resources in the best sustainable mechanism is as follows:*

1. *there are aggregate distortions at $t = 0$;*

2. *suppose that $\beta \leq \delta$ and that there exists a steady-state allocation in which the sustainability constraint for the politician does not bind, then the economy asymptotically converges to a steady state without aggregate distortions;*

3. *suppose that $\beta > \delta$, then there are aggregate distortions, even asymptotically.*

This proposition is stated under the assumption in part 2 that there exists a steady state without distortions, that is, a steady-state allocation in which the sustainability constraint, (10) is slack. This is a fairly weak assumption, discussed in greater detail and expressed in terms of primitives in Acemoglu, Golosov and Tsyvinski (2007). In particular, this assumption is satisfied if transferring all resources (raised subject to the individual incentive compatibility constraints, (7)) to the politician is sufficient to ensure that (10) is satisfied as a strict inequality. To simplify the exposition, we do not introduce the additional notation necessary to express this condition.

Part 1 of Proposition 6 illustrates the additional aggregate distortion arising from the sustainability constraints. Intuitively, these distortions result from the fact that as output increases, the sustainability constraint (10) implies that more has to be given to the politicians in power, and this increases the effective cost of production. The constrained efficient allocation creates distortions so as to reduce the level of output in the decentralized equilibrium and thus the amount of rents that have to be paid to the politician. Consequently, the best sustainable mechanism induces aggregate distortions, reducing the level of production in the economy below the level that would prevail without political economy constraints.

The most important results are in parts 2 and 3. Part 2 states that as long as $\beta \leq \delta$, asymptotically the economy converges to an equilibrium where there are no aggregate distortions; even though there will be rents provided to the politician, these will be financed without introducing distortions. This result implies that in the long run there will be "efficient" provision of rents to politicians, that is, individual allocations are undistorted (beyond the requirements necessary to satisfy individual incentive compatibility constraints, (7)), and in particular, there is no marginal tax on the labor supply of the highest type (recall Proposition 5)).

Part 3 of the proposition, on the other hand, states that if the politicians are less patient than the citizens, distortions will not disappear. Since in many realistic political economy models politicians are, or act as, more short-sighted than the citizens, this part of the proposition implies that in a number of important cases, political economy considerations will lead to additional distortions that will not disappear even asymptotically.

Proposition 7 *In the best stationary mechanism distortions never disappear and the allocations are independent of time, given by* $\{c(\theta), l(\theta)\}_{\theta\in\Theta}$*. Moreover, government consumption* x *is such that*

$$\frac{v(x)}{1-\delta} = v\left(\eta \int_{\Theta} l(\theta)\, dG(\theta)\right).$$

This proposition illustrates the contrast between best sustainable and best stationary equilibria. Stationary equilibria do not allow the optimal provision of dynamic incentives to politicians and imply that political economy distortions never disappear, even when $\beta \leq \delta$.

5 Markets Versus Governments: Some Theoretical Results

In this section, we investigate the conditions under which (sustainable) government-operated mechanisms will be preferred to markets. We first present results that apply to both concepts of the market, with both best sustainable and best stationary mechanisms, and under general conditions on utility. In the second part of the section, we present results that apply under additional assumptions and when comparing centralized mechanisms to fully anonymous markets (the equivalent of the Bewley-Aiyagari economy). Finally, in the last part of the section, we provide a comparison of government-operated mechanisms to self-enforcing markets (equivalent to Kehoe-Levine type economies).

5.1 Discount Factors and Institutional Checks

We first provide some simple comparisons between markets and sustainable mechanisms that apply irrespective of which concept of the market we use and whether we focus on best stationary or best sustainable mechanisms. Our first comparative static result states that an increase in the discount factor of the politician ("government"), δ, makes mechanisms more attractive relative to markets. Let $\mathbf{U}^{SM}(\delta)$ be the ex ante expected value of the best sustainable or best stationary mechanism when the politician's discount factor is δ. Let us also refer to the ex ante expected utility under fully anonymous or self-enforcing markets by $\mathbf{U}^{AM}$ (which does not depend on the discount factor δ of the politician).

Proposition 8 *Suppose $\mathbf{U}^{SM}(\delta) \geq \mathbf{U}^{AM}$, then $\mathbf{U}^{SM}(\delta') \geq \mathbf{U}^{AM}$ for all $\delta' \geq \delta$. Moreover, suppose that $\eta = 1$ and $\theta_0 > 0$. Then, as $\delta \to 0$, $\mathbf{U}^{AM} > \mathbf{U}^{SM}(\delta)$.*

Proof. Let $\mathcal{S}(\delta)$ be the feasible set of allocation rules when the politician discount factor is equal to δ (meaning that they are feasible and also satisfy the sustainability constraint either in the case would best sustainable mechanisms or with the best stationary mechanisms). Let $\{c_t(\delta), l_t(\delta), x_t(\delta)\}_{t=0}^{\infty} \in \mathcal{S}(\delta)$ represent the best sustainable mechanism, where $c_t(\delta)$ and $l_t(\delta)$ are vectors of consumption and labor supply levels for different types. Since $\delta' \geq \delta$, $\{c_t(\delta), l_t(\delta), x_t(\delta)\}_{t=0}^{\infty} \in \mathcal{S}(\delta')$—when the discount factor of the politician is δ', the left-hand side of the sustainability constraint is higher, while the right-hand side is unchanged, so $\{c_t(\delta), l_t(\delta), x_t(\delta)\}_{t=0}^{\infty}$ satisfies the sustainability constraint. Therefore, $\{c_t(\delta), l_t(\delta), x_t(\delta)\}_{t=0}^{\infty}$ is feasible and yields expected utility $\mathbf{U}^{SM}(\delta)$ when the politician's discount factor is δ'. This implies that $\mathbf{U}^{SM}(\delta')$ is at least as large as $\mathbf{U}^{AM}$, therefore $\mathbf{U}^{SM}(\delta') \geq \mathbf{U}^{SM}(\delta) \geq \mathbf{U}^{AM}$.

The second part follows from the observation that with anonymous markets, individuals can always achieve the autarchy allocation, thus $\mathbf{U}^{AM} \geq \mathbb{E}_0\left[\sum_{t=0}^{\infty} \beta^t u\left(c^a(\theta_t), l^a(\theta_t) \mid \theta_t\right)\right]$, where c^a and l^a denote the optimal autarchy choices of an agent with type θ. In contrast, with $\eta = 1$ and $\delta \to 0$, the centralized mechanism necessarily leads to a utility of $\mathbb{E}_0\left[\sum_{t=0}^{\infty} \beta^t u(0, 0 \mid \theta_t)\right] < \mathbb{E}_0\left[\sum_{t=0}^{\infty} \beta^t u\left(c^a(\theta_t), l^a(\theta_t) \mid \theta_t\right)\right]$. ■

Notice that Proposition 8 applies irrespective of whether we are looking at best sustainable or best stationary mechanism and also irrespective of whether markets are fully anonymous or involve self-enforcing insurance.

The intuition for this proposition is straightforward: as politicians become more patient, the sustainability constraint becomes easier to satisfy, s centralized mechanisms become more attractive. Moreover, since politicians operating centralized mechanisms are self-interested and unable to commit to policy sequences, not all equilibrium allocations without government intervention can be achieved by a mechanism operated by the government. Consequently, anonymous self-enforcing markets may be preferred to sustainable mechanisms. This contrasts with the typical results in the mechanism design literature (with benevolent governments and full commitment) where market allocations can always be achieved by centralized mechanisms.

Perhaps more interesting are the implications of institutional checks and balances on politicians. In our model, these institutional checks are represented by the parameter η. A lower η implies more strict limits on the amount of resources that the politician in power can divert for his own consumption.

Proposition 9 *Suppose* $\mathbf{U}^{SM}(\eta) \geq \mathbf{U}^{AM}$, *then* $\mathbf{U}^{SM}(\eta') \geq \mathbf{U}^{AM}$ *for all* $\eta' \leq \eta$. *Moreover, as* $\eta \to 0$, $\mathbf{U}^{SM}(\eta) > \mathbf{U}^{AM}$.

The proof of this proposition is similar to that of Proposition 8 and is omitted. It states the intuitive result that better institutional controls on politicians make mechanisms more desirable relative to markets. This proposition also shows that electoral accountability and other institutional controls on politicians are *complementary*. Institutional checks on politicians combined with electoral accountability would make centralized mechanisms more attractive relative to anonymous markets, which fail to provide the same degree of insurance and risk sharing across individuals.

5.2 The Effects of Risk Aversion: Governments versus Fully Anonymous Markets

We now investigate the impact of risk aversion on the trade-off between markets and sustainable mechanisms, focusing on stationary mechanisms, fully anonymous markets, and quasi-linear preferences. This enables us to obtain sharp results concerning how the trade-off between governments and markets changes with the degree of risk aversion. We then see how these results change when some of these assumptions are relaxed. Recall that with quasi-linear preferences, individuals maximize

$$\mathbb{E}\sum_{t=0}^{\infty}\beta^t u\left(c_t^i - g\left(\frac{l_t^i}{\theta_t^i}\right)\right). \tag{12}$$

As noted above, this removes income effects on labor supply in autarchy. We will see how income effects change the comparison between markets and governments in Section 6. Recall that with quasi-linear utility and fully anonymous markets the optimal labor supply choices of an individual of type $\theta_i^t = \theta_j$ for some $j \in \{0, 1, \ldots, N\}$ will satisfy $\bar{c}_j = \bar{l}_j$ such that

$$\frac{1}{\theta_j} g'\left(\frac{\bar{l}_j}{\theta_j}\right) = 1.$$

We denote the market equilibrium by $\left\{\bar{c}_j, \bar{l}_j\right\}$, and write the utility of an individual explicitly conditional on the utility function of agents being u as $\mathbf{U}^{AM}(u)$. Let us also denote the probability that an individual will have type θ_j by π_j (with $\pi_j > 0$ for all j and $\sum_{j=0}^{N} \pi_j = 1$). Then, we can write:

$$\mathbf{U}^{AM}(u) = \frac{1}{1-\beta}\sum_{j=0}^{N}\pi_j\left[u\left(\bar{l}_j - g\left(\frac{\bar{l}_j}{\theta_j}\right)\right)\right],$$

where we have used the fact that since there exists an invariant distribution of skills, $G(\theta)$, in each period, ex ante each individual has a probability π_j of being type j in every period.

The restriction to stationary mechanisms implies that instead of the general sustainability constraint (10), the stationary sustainability constraint, (11), applies, which, in this case, can be written as

$$\frac{v(x)}{1-\delta} \geq v(\eta Y), \tag{13}$$

where Y denotes total output. Since individual allocations will also be stationary (given the stationarity of payments to politicians and the assumption of private histories), the incentive compatibility constraints can be written as

$$c_j - g\left(\frac{l_j}{\theta_j}\right) \geq c_{j-1} - g\left(\frac{l_{j-1}}{\theta_j}\right) \tag{14}$$

for all $j = 1, 2, ..., N$.

Recall also that if a utility function $\tilde{u}$ is an increasing concave transformation of another one, u, then $\tilde{u}$ represents more risk-averse preferences than u. Let $\{c_j(u), l_j(u), x(u)\}$ be a solution when the utility function is u, and define

$$b_j \equiv c_j(u) - g\left(\frac{l_j(u)}{\theta_j}\right)$$

and

$$\bar{b}_j \equiv \bar{c}_j - g\left(\frac{\bar{l}_j}{\theta_j}\right).$$

Before proving this proposition, we need the following straightforward lemma:

Lemma 1 $l_t^i \leq \bar{l}_t^i$.

This lemma simply states that labor supply of all individuals (and therefore for all types) will always be (weakly) lower under a sustainable mechanism than in the market equilibrium. The proof of this lemma is standard and is omitted.

Proposition 10 *Let us restrict attention to the stationary mechanisms where $x_t = x$ for all t. Let $\tilde{u} = h(u)$ where $h(\cdot)$ is increasing and concave. Suppose $\mathbf{U}^{SM}(u) \geq \mathbf{U}^{AM}(u)$, then $\mathbf{U}^{SM}(\tilde{u}) \geq \mathbf{U}^{AM}(\tilde{u})$.*

Moreover, let u_0 be linear and suppose that $\eta > 0$ and $\delta < 1$. Then $\mathbf{U}^{SM}(u_0) < \mathbf{U}^{AM}(u_0)$.

Proof. Denote the solution to the program with utility functions u by $\left\{c_t^i(u), l_t^i(u), x_t(u)\right\}$, and recall that the market equilibrium is $\left\{\bar{c}_j, \bar{l}_j\right\}_{j=0}^N$. Also denote the set of allocation rules that are feasible for the stationary mechanism design problem when the utility function is u by $\mathcal{S}(u)$. Note that (14) implies that if $\{c_j(u), l_j(u), x(u)\} \in \mathcal{S}(u)$ is a solution to this program (which is the same for all individuals of type θ_j, so we suppress reference to individual i), then $\{c_j(u), l_j(u), x(u)\} \in \mathcal{S}(\tilde{u})$, since both individual allocations remain feasible and (13) is still satisfied. We say that an allocation is u-preferred to another, if when preferences are given by u, the first allocation is feasible (sustainable) and gives greater ex ante utility. We will show that if $\{c_j(u), l_j(u), x(u)\}$ is u-preferred to $\{\bar{c}_j, \bar{l}_j\}$, then $\{c_j(u), l_j(u), x(u)\}$ is $\tilde{u}$-preferred to $\{\bar{c}_j, \bar{l}_j\}$. This implies that since the solution to the second-best program with utility function $\tilde{u}$, $\{c_j(\tilde{u}), l_j(\tilde{u}), x(\tilde{u})\}$, is by definition $\tilde{u}$-preferred to $\{c_j(u), l_j(u), x(u)\}$, it must also be $\tilde{u}$-preferred to $\{\bar{c}_j, \bar{l}_j\}$.

In fact, it is sufficient to prove that when $\{c_j(u), l_j(u), x(u)\}$ is u-indifferent to $\{\bar{c}_j, \bar{l}_j\}$, then $\{c_j(u), l_j(u), x(u)\}$ is $\tilde{u}$-preferred to $\{\bar{c}_j, \bar{l}_j\}$. So let us focus on this case where by hypothesis, we have

$$\sum_{j=0}^{N} \pi_j u(b_j(u)) = \sum_{j=0}^{N} \pi_j u(\bar{b}_j). \tag{15}$$

Now, we would like to prove that for any concave $h(\cdot)$, we have

$$\sum_{j=0}^{N} \pi_j h(u(b_j(u))) \geq \sum_{j=0}^{N} \pi_j h(u(\bar{b}_j)). \tag{16}$$

To accomplish this, let us define two new random variables $B_j \equiv u(b_j(u))$ and $\bar{B}_j \equiv u(\bar{b}_j)$. From (15), these two variables have the same mean. If, in addition, B_j second-order stochastically dominates $\bar{B}_j$ (which is then a mean-preserving spread of B_j), then (16) follows for any concave h, and this would prove the desired result.

Therefore, for the first part of the proposition we only have to prove that B_j second-order stochastically dominates $\bar{B}_j$. To do this, recall the following equivalent characterization of second order stochastic dominance: if B_j and $\bar{B}_j$ have the same mean and their distribution functions intersect only once (with that of B_j cutting from below), then B_j second-order stochastically dominates $\bar{B}_j$.

Now consider the incentive compatibility constraint between types j and $j-1$. This constraint can either be binding or slack. First, suppose that it is binding, which means that

$$c_j - g\left(\frac{l_j}{\theta_j}\right) = c_{j-1} - g\left(\frac{l_{j-1}}{\theta_j}\right). \tag{17}$$

Now consider function

$$K(\theta) \equiv \bar{l}_j - g\left(\frac{\bar{l}_j}{\theta_j}\right) - \bar{l}_{j-1} + g\left(\frac{\bar{l}_{j-1}}{\theta}\right) - g\left(\frac{l_{j-1}}{\theta}\right) + g\left(\frac{l_{j-1}}{\theta_j}\right)$$

(we use $\bar{l}_j$ instead of $\bar{l}(\theta_j)$ for brevity). Since under fully anonymous markets, individuals of type θ_j maximize $u(l - g(l/\theta_j))$ and choose $\bar{l}_j$, we must have

$$K(\theta_j) = \bar{l}_j - g\left(\frac{\bar{l}_j}{\theta_j}\right) - \bar{l}_{j-1} + g\left(\frac{\bar{l}_{j-1}}{\theta_j}\right) \geq 0.$$

Moreover,

$$K'(\theta) = -\frac{\bar{l}_{j-1}}{\theta^2} g'\left(\frac{\bar{l}_{j-1}}{\theta}\right) + \frac{l_{j-1}}{\theta^2} g'\left(\frac{l_{j-1}}{\theta}\right) \leq 0,$$

since $\bar{l}_{j-1} \geq l_{j-1}$ by Lemma 1, and g is concave, so g' is an increasing function. Since $K(\theta_j) \geq 0$, $K'(\theta) \leq 0$ and $\theta_{j-1} \leq \theta_j$, we have $K(\theta_{j-1}) \geq 0$. Now substituting for $g(l_{j-1}/\theta_j)$ from (17) which holds by hypothesis and rearranging, we obtain

$$\bar{l}_j - g\left(\frac{\bar{l}_j}{\theta_j}\right) - \bar{l}_{j-1} + g\left(\frac{\bar{l}_{j-1}}{\theta_{j-1}}\right) \geq c_j - g\left(\frac{l_j}{\theta_j}\right) - c_{j-1} + g\left(\frac{l_{j-1}}{\theta_{j-1}}\right).$$

Recalling the definition of b and $\bar{b}$, we conclude that

$$\bar{b}_j - \bar{b}_{j-1} \geq b_j - b_{j-1}. \tag{18}$$

Next, suppose that the incentive compatibility constraint between j and $j-1$ is slack at time t, this implies $b_j = b_{j-1}$, so (18) is again satisfied.

Now, this observation combined with (15) implies that there exists some k such that

$$\begin{aligned} b_j &\geq \bar{b}_j \text{ for all } j \leq k \text{ and} \\ b_j &\leq \bar{b}_j \text{ for all } j > k, \end{aligned}$$

Since $u(\cdot)$ is strictly monotonic, the same applies to the ranking of B_j and $\bar{B}_j$. This implies that for all $\{\pi_j\}_{j=0}^N$, B_j second-order stochastically dominates $\bar{B}_j$, and this completes the proof for the first part.

For the second part, note that $\eta > 0$ and $\delta < 1$ imply that $x > 0$, while with linear (risk neutral) preferences, the fully anonymous market achieves the first-best, thus the best stationary mechanism necessarily yields lower ex ante utility than markets. ■

This proposition yields an important and intuitive result; it shows that when individuals become more risk averse, then they also become more willing to tolerate the costs of centralized mechanisms.

5.3 The Effects of Risk Aversion: Governments versus Self-Enforcing Markets

The previous subsection showed that with quasi-linear preferences, greater risk aversion makes government-operated mechanisms more desirable relative to fully anonymous markets. In this subsection, we show that this is no longer true with self-enforcing markets. First, recall that in this subsection, we will focus on self-enforcing markets, *without any private information.*

Therefore, correspondingly, the mechanisms in question will also not feature private information (and thus no individual incentive compatibility constraints) and can condition on the entire past history of individuals (though this does not have any bearing on the main results presented here). The main difference between government-operated mechanisms and self-enforcing markets, summarized in program (4)-(6), is that with governments there is no need for the no-deviation constraint (6), since governments can enforce allocations. This individual constraint will be replaced by a sustainability constrainet for the politician in power ((19) below).[15] Therefore, the best sustainable mechanism is now a solution to the following maximization problem:

$$\mathbf{U}^{SM} = \max_{\left\{c_t\left(\theta^t\right), l_t\left(\theta^t\right), x_t\right\}_{t=0}^{\infty}} \mathbb{E}\left[\sum_{t=0}^{\infty} \beta^t u\left(c_t\left(\theta^t\right), l_t\left(\theta^t\right) \mid \theta_t\right)\right]$$

subject to the resource constraint

$$\int c_t\left(\theta^t\right) dG^t\left(\theta^t\right) + x_t \leq \int l_t\left(\theta^t\right) dG^t\left(\theta^t\right),$$

for all t and for all $\theta \in \Theta$, and the sustainability constraint of the politician

$$\sum_{s=0}^{\infty} \delta^s v\left(x_{t+s}\right) \geq v\left(\eta \int l_t\left(\theta^t\right) dG^t\left(\theta^t\right)\right). \tag{19}$$

Notice that the main difference between this program and (8) is twofold. First, the individual incentive compatibility constraints, captured by (7), are absent, since individual types are observed. Second, there is no longer a restriction to private histories, thus allocation rules are functions of entire past histories of individuals, represented by $\left\{c_t\left(\theta^t\right), l_t\left(\theta^t\right)\right\}_{t=0}^{\infty}$ rather than $\left\{c_t\left(\theta\right), l_t\left(\theta\right)\right\}_{t=0}^{\infty}$. It is also straightforward to specify the best stationary mechanism, which will involve replacing (19) with the equivalent of (11).

The main result in this subsection is provided in the next proposition. Suppose that utility functions are given either by the quasi-linear form (2) or the separable form (3) introduced in Section 2. Whenever we refer to a utility function u in this subsection, this is taken to be a function of the form $u : \mathbb{R}_+ \to \mathbb{R}$ corresponding to either (2) or (3). Moreover, given such utility function, let $\mathbf{U}^{AM}(u)$ denote the ex ante utility under self-enforcing markets and $\mathbf{U}^{SM}(u)$ the ex ante utility under best sustainable mechanisms. Finally, let $\mathcal{N}(u)$ denote a (open) "neighborhood" of the utility function u in the space of continuous, increasing and concave utility functions with the sup metric.

[15] We could introduce some weaker individual rationality constraints under governments, for example requiring that $\mathbb{E}\left[\sum_{t=0}^{\infty} \beta^t u\left(c_t\left(\theta^t\right), l_t\left(\theta^t\right) \mid \theta_t\right)\right] \geq 0$. Such constraints are typically redundant and have no effect on the results presented here.

Proposition 11 *Suppose that $\delta < 1$, $\beta < 1$, and $\eta > 0$. Let u_0 denote linear (risk-neutral) preferences and u_∞ denote logarithmic preferences. Suppose that $\theta_0 = 0$, so that the lowest productivity individual cannot supply any labor. Then there exists a neighborhood $\mathcal{N}_0(u_0)$ of linear preferences and a neighborhood $\mathcal{N}_\infty(u_\infty)$ of log preferences such that for all $u \in \mathcal{N}_0(u_0)$ or for all $u \in \mathcal{N}_\infty(u_\infty)$, $\mathbf{U}^{AM}(u) > \mathbf{U}^{SM}(u)$. Moreover, for δ sufficiently large, there exists $u \notin \mathcal{N}_0(u_0) \cup \mathcal{N}_\infty(u_\infty)$ such that $\mathbf{U}^{AM}(u) < \mathbf{U}^{SM}(u)$.*

Proof. Let us first define a first-best allocation as one in which there is full consumption smoothing. The solution to the maximization (4) in Section 3 is typically not a first-best allocation, but will be so under some special circumstances. In particular, when $u = u_0$, since the allocation of risk does not matter, the value of the maximization problem in (4) will be the same as in the case with full consumption smoothing. In this case, no allocation can be better than the solution to (4). Since $\delta < 1$ and $\eta > 0$, the centralized mechanism must involve $x_t > 0$ for some t, thus it must be worse than the self-enforcing market equilibrium. This establishes that $\mathbf{U}^{AM}(u_0) > \mathbf{U}^{SM}(u_0)$. From the Berge's Maximum Theorem for metric spaces (see, e.g., Aliprantis and Border, 1999, Acemoglu, 2008, Appendix A), $\mathbf{U}^{AM}(u)$ is continuous in u, thus the same conclusion holds for any u in an open neighborhood $\mathcal{N}_0(u_0)$ of u_0. Moreover, the above argument shows that $\mathcal{N}_0(u_0)$ can be chosen independent of δ and η.

Next suppose that individuals have logarithmic preferences. Then the autarchy payoff is $-\infty$, since $\theta_0 = 0$. This implies that the no-deviation constraint (6) is always slack and thus a first-best allocation can be achieved. By the same argument, this gives higher ex ante welfare than any centralized mechanism, that is, $\mathbf{U}^{AM}(u) > \mathbf{U}^{SM}(u)$. Again by the continuity of $\mathbf{U}^{AM}(u)$, there exists a neighborhood $\mathcal{N}_\infty(u_\infty)$ for which this is true, and again this neighborhood can be chosen independent of δ and η.

Finally, since $\beta < 1$, there exists $u \notin \mathcal{N}_0(u_0) \cup \mathcal{N}_\infty(u_\infty)$ such that the first-best allocation cannot be achieved. Moreover, for δ close to 1, the cost of providing incentives to a politician goes to zero. Consequently, since $\mathcal{N}_0(u_0)$ and $\mathcal{N}_\infty(u_\infty)$ can be chosen independent of δ, for some $u \notin \mathcal{N}_0(u_0) \cup \mathcal{N}_\infty(u_\infty)$ a centralized mechanism must be preferred to the self-enforcing market allocation. ■

Note that although the proposition was stated for u_∞ corresponding to logarithmic preferences, any preferences where $\lim_{c \to 0} u(c) = -\infty$ would lead to the same results.

The most important result in this proposition is that risk-aversion has a non-monotonic effect on the comparison between markets and governments. Markets are preferred at very low and very high levels of risk aversion. This is different from the conclusion in the previous subsection because with self-enforcing markets high levels of risk aversion not only increase the demand for insurance but also relax the no-deviation constraint (6). The proof of Proposition 11 also makes it clear that the focus on the best sustainable mechanism plays no role in this result. Therefore the following corollary is immediate.

Corollary 2 *All of the results in Proposition 11 apply when* $\mathbf{U}^{SM}(u)$ *is taken to be the ex ante utility from the best stationary mechanism with the utility function given by* u*.*

The general conclusion from these results is that the impact of risk aversion on the comparison of markets to governments depends on how successful markets are in allocating risks. With fully anonymous markets as in the previous subsection, markets have no ability to provide risk sharing. With self-enforcing markets, this is no longer the case and the degree of risk sharing provided by self-enforcing markets will be a function of the risk aversion of the agents. Consequently, in the next section, we will see that a similar non-monotonic effect of risk aversion on the comparison of markets versus governments will arise in the context of fully anonymous markets when we move away from quasi-linear preferences.

6 Numerical Investigation

In this section, we undertake a numerical investigation of the models presented so far. Our purpose is to illustrate some of the theoretical results derived in the previous two sections and also to study some further results that are theoretically ambiguous (for example, the effect of risk aversion when preferences are not quasi-linear). We start by providing a number of comparisons that illustrate the theoretical results derived so far.

6.1 Parameterization

We choose parameters of the models primarily for illustration (and with an eye to simplify the computation) rather than attempting a careful calibration. We consider two specifications of utility functions in our simulation. The first one is a special case of the *quasi-linear* utility function used in the proof of Proposition 10 above:

$$u(c,l) = \frac{1}{1-\sigma}\left(c - \frac{l^{\phi}}{\phi}\right)^{1-\sigma}.$$

As noted above, the quasi-linear utility function is particularly useful because it removes the effect of the extent of risk aversion on labor supply levels (in the absence of insurance). We take the baseline utility function in this class of preferences to be constant elasticity of substitution (CES), both because of the relative tractability and familiarity of these functions.

The second specification assumes a *separable* utility function as in much of the theoretical and applied work in macroeconomics and public finance. In this case also we take the benchmark utility function to be CES:

$$u(c,l) = \frac{c^{1-\sigma}}{1-\sigma} - \frac{l^{\phi}}{\phi}.$$

Here σ is the coefficient of relative risk aversion, and $1/(\phi - 1)$ is the elasticity of labor supply. These preferences are commonly used in the macroeconomics and public finance literatures. We choose the discount factor for agents $\beta = 0.9$. In our benchmark parameterization, we choose the coefficient of relative risk aversion parameter as $\sigma = 1/2$, so that there is less risk aversion than with the log utility function. We also choose an intermediate level of labor supply elasticity, $\phi = 2$.

We assume that utility of the politician (government) is given by:

$$v(x) = \frac{x^{1-\sigma_g}}{1-\sigma_g},$$

which takes an identical form to those of the individuals. In this specification, σ_g is the inverse of the elasticity of intertemporal substitution (though σ_g is also the degree of risk aversion, politicians do not face risk, but have non-smooth consumption profiles, so the main role of σ_g is regulate the attitudes of the politician towards non-smooth consumption profiles). For the baseline, we choose $\sigma_g = 1/2$ and $\delta = 0.9$ to parallel that of the citizens. We choose the degree of institutional controls $\eta = 1$ and then show how imposing greater controls on politicians changes allocations and the comparison of markets and governments.

We also assume that skills are distributed over $N = 10$ levels within the interval $\Theta = [\theta_l, \theta_h]$. We suppose that each skill level has the same probability of realization. In the benchmark analyses we set $\theta_l = 0.38$ and $\theta_h = 0.84$. The end points θ_l and θ_h are chosen mainly for convenience of computation. Having 10 distinct skill levels is sufficient for generating smooth profiles of the marginal labor taxes (wedges) for the individuals. We have also conducted experiments with higher number of shocks without a significant difference in the results. Our computational method is non-recursive. We solve a constrained optimization problem in which we assume that at time T there is convergence to a steady state. All experiments that follow refer to comparison with the benchmark case.

One of the main objects of interest for us is the structure of taxes faced by different types. As in the standard Mirrlees (1971) framework, these are implicit taxes or wedges between the marginal utility of consumption and the marginal disutility of labor. More specifically, these taxes/wedges are defined as

$$\tau(\theta) = 1 + \frac{u_l\left(c(\theta), l(\theta)\right)/\theta}{u_c\left(c(\theta), l(\theta)\right)},$$

and their variation over different types will give a sense of the progressivity of the tax system. Recall that these taxes depend on *aggregate distortions*. In particular, we know from Mirrlees (1971) that the marginal tax on the highest type should be equal to 0. However, this is no longer the case in the presence of political economy distortions and Proposition 5 showed that that the labor tax on the highest type, here $\tau(\theta_h)$, is equal to the aggregate distortions due to political economy frictions. We will see below that these aggregate distortions will also affect the taxes faced by other types.

Finally, in most of the computations, we will focus on the ex ante welfare gap between governments (best sustainable or stationary mechanisms) and markets denoted by:

$$\Delta = \mathbf{U}^{SM} - \mathbf{U}^{AM},$$

where $\mathbf{U}^{SM}$ denotes utility achieved by the best sustainable mechanism and $\mathbf{U}^{AM}$ denotes the utility achieved under market allocations.[16]

6.2 Governments and Welfare

Our first step is to explore numerically how preferences and constraints on the politician/government affect the allocations that are achieved by centralized mechanisms. Since changes in the discount factor of the government δ, institutional constraints η, and a measure of government's elasticity of intertemporal substitution σ_g^{-1} do not affect the allocations that are achieved under market arrangements (either in the case of fully anonymous or self-enforcing markets), we can conduct most of our analysis without explicitly comparing markets and governments. Another purpose of this section is to illustrate the results of Propositions 8 and 9. In our benchmark specification, we assume that current skills, the θ_t's, and past histories are private information, as discussed in Section 4. We report the analysis for the *separable* preferences. The results with *quasi-linear* preferences are similar and are not reported to economize on space. We also focus on the best sustainable mechanisms. For the best stationary mechanisms, qualitative results

[16] We do not report consumption-equivalent measures of welfare, since our computations are stylized, so we do not wish to place too much emphasis on the quantitative extent of welfare losses from different arrangements.

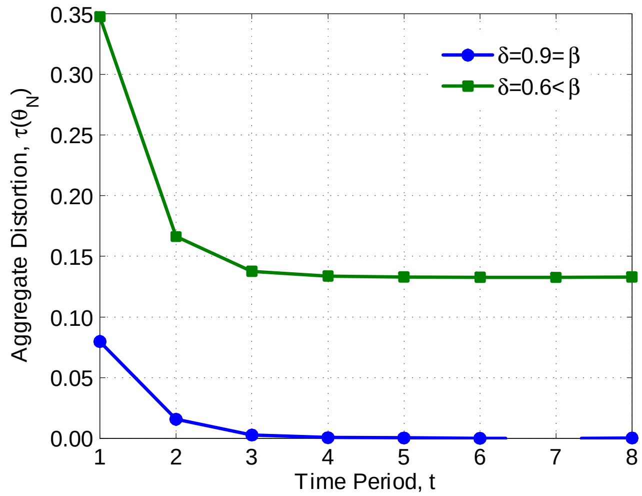

Figure 1: The evolution of aggregate distortions for $\delta = \beta = 0.9$ and for $\delta = 0.6 < \beta = 0.9$.

are similar to the steady state results in the best sustainable mechanims, with the important exception that the aggregate distortions are positive for all values of δ (recall Proposition 4).

6.2.1 Effects of the Government's Discount Factor

We start with the impact of the government's (politician's) discount factor δ on the size of the aggregate distortions. Figure 1 shows the dynamics of the aggregate distortions over time for various parameters of δ.

Consistent with Proposition 6, initial distortions are positive for all δ, but when the discount factor of the government is equal to the discount factor of the individual agents, the aggregate distortions and the tax on the highest type tend to zero (in fact, in this example, the reach zero in four periods). This is shown by the lowest curve in the figure. However, for the lower value of δ, aggregate distortions are higher and do not disappear, even in the long run. The figure shows that when $\delta = 0.6$, the steady-state level on aggregate distortion (and thus the marginal tax on the highest type) will be approximately 15 percent. This is intuitive and consistent with Proposition 6. With a lower discount factor, the government does not value future consumption streams as highly and thus a higher amount of rents is required to satisfy the politician's sustainability constraint. Consequently, rents accruing to the politician (government) are higher when δ is lower. Figure 2 illustrates this point by showing rents as the fraction of GDP for $\delta = 0.6$ are an order of magnitude greater than the rents that arise when $\delta = \beta = 0.9$ (the same pattern applies when we look at the level of rents). Another noteworthy feature is that for $\delta = \beta = 0.9$ only a very small fraction of GDP (less than 1%) is paid out to the politician as rents. This shows that, despite the strong powers vested in the government, the appropriate incentives can be provided to the politician in power by transferring to him only a small fraction of GDP.

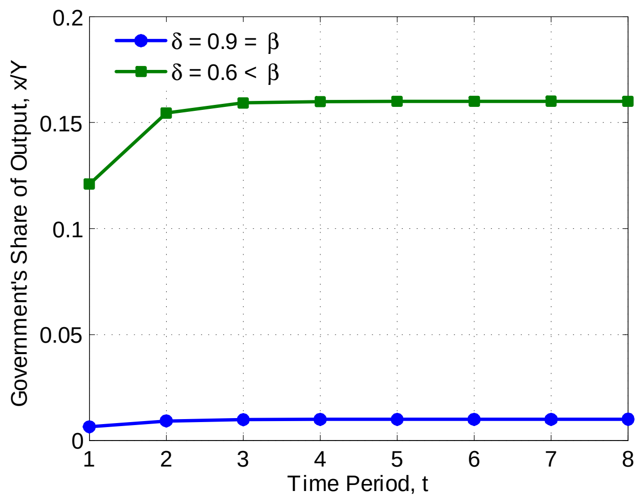

Figure 2: The evolution of government rents as a fraction of output, x_t/Y_t, for $\delta = \beta = 0.9$ and for $\delta = 0.6 < \beta = 0.9$.

Higher aggregate distortions typically imply that individual marginal taxes $\tau(\theta)$ must also be higher. In Figure 3, we plot steady state taxes for various types. By definition (i.e., Proposition 5), the marginal tax rate on the highest type is equal to the aggregate distortion. Figure 3 shows how the marginal tax rate on different types compares to that on the highest type. The figure shows that, as expected, the marginal tax on the highest type is the same as the steady state aggregate distortion depicted in Figure 2. In contrast, lower types face higher marginal taxes than the highest type, since such distortions are necessary to provide incentives for information revelation (see, e.g. Mirrlees, 1971). An interesting pattern that emerges from this figure is that the overall shape of the tax schedule and the degree of progressivity of taxes appears to be relatively independent of the discount factor of the politicians and thus of the extent of political economy distortions.

Finally, Figure 4 presents the difference in welfare in the best sustainable mechanisms ($\mathbf{U}^{SM}$) and in the fully anonymous markets described in Section 3.1 (U^{AM}). Consistent with Proposition 8, markets dominate governments for lower δ. For higher δ, the reverse is true and

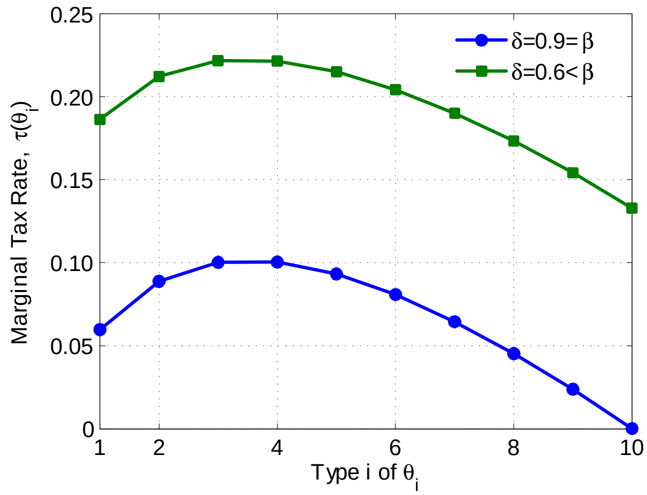

Figure 3: Steady state taxes for $\delta = \beta = 0.9$ and for $\delta = 0.6 < \beta = 0.9$.

governments are preferred to markets. The comparison of welfare with self-enforcing markets of Section 3.2 is similar, and is omitted.

6.2.2 Effects of Institutional Checks

We now study implications of institutional checks and balances imposed on politicians which are represented by the parameter η. A lower value of η means that a politician can expropriate less resources, and thus it becomes easier to satisfy the sustainability constraint of politicians. To save space, we omit the figures for the behavior of the rents to the government x for various values of η, but simply note that as η increases, the amount of rents in the steady state increases significantly. However, the marginal tax on individual agents does not change by a significant amount. The reason for this appears to be that even in the benchmark parameterization, given the relatively high discount factor of politicians, political economy distortions and the amount of resources accruing to politicians are limited (recall Figure 2). Consequently, changes in η lead to only small changes in marginal tax rates.

Figure 5 illustrates the result in Proposition 9 by comparing welfare under the best sustainable mechanism and under fully anonymous markets. As η increases, there are fewer checks on politicians and government-operated mechanisms become less attractive.

6.2.3 Effects of the Government's Elasticity of Substitution

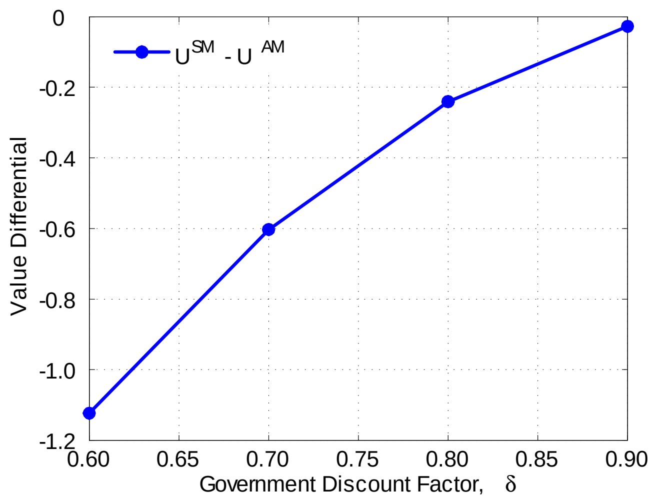

Figure 4: Difference in welfare under government-operated mechanisms and anonymous markets for various values of the government discount factor, δ.

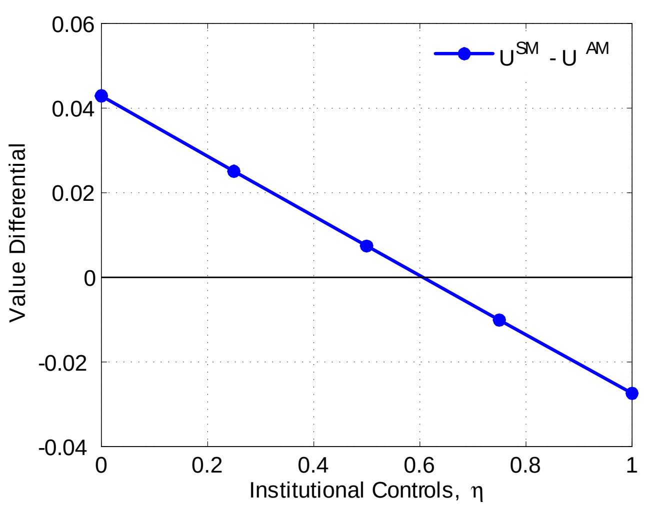

Figure 5: Difference in welfare between government-operated mechanisms and anonymous markets for various values of institutional checks, η.

In this section we explore another important determinant of the tradeoff between markets and governments—the elasticity of intertemporal substitution of the government σ_g. We considered a range of σ_g from 0 to 0.75. Figure 6 plots the rents accruing to the politician for various levels of σ_g (as a fraction of GDP). Two important results can be seen here. First, when the government's utility is linear (or is close to linear), it can tolerate highly non-smooth profiles of consumption. Consequently, government consumption is equal to zero for a number of periods and then increases sharply as shown by the case in which $\sigma_g = 0$. For high levels of σ_g, politicians receive smoother rents over time. As σ_g becomes even higher, the sustainability constraints can be satisfied with lower rents, since being replaced becomes increasingly costly for politicians.

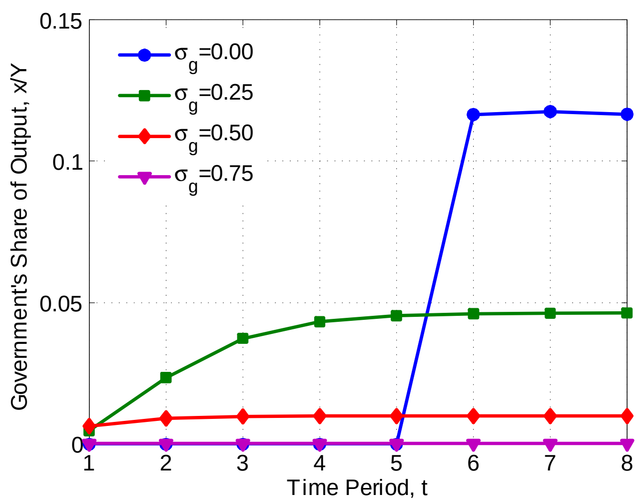

Figure 6: The evolution of the payment to the government as a fraction of output, x_t/Y_t, for various levels of the elasticity of substitution, σ_g.

We summarize the effects of changing σ_g in Figure 7, where we plot the difference in the welfare of the best sustainable mechanisms ($\mathbf{U}^{SM}$) and the fully anonymous markets described in Section 3.1 ($\mathbf{U}^{AM}$). The main result here is that as σ_g increases, the provision of insurance via governments becomes less and less costly as it becomes easier to provide incentives to it.

6.3 Risk and Risk Aversion

One of the central goals of these paper is to explore how the trade-off between market allocations and government regulation changes as a function of risk aversion and the extent of risks in the economy. We start from the presumption that private markets without government

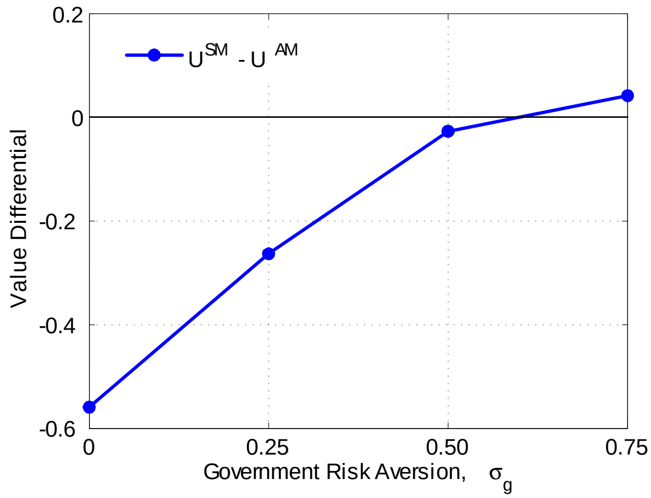

Figure 7: Difference in welfare in the case of governments versus markets for various σ_g

interventions may be unable to achieve efficient allocations due to imperfect enforcement of private contracts. The central feature of both fully anonymous and self-enforcing markets is that individuals never transfer any resources to others unless it is in their ex-post interests. At the same time, due to idiosyncratic uncertainty, all individuals would be better off if they were able to make such transfers ex ante. A potential advantage of the government is that it can implement such ex post transfers, but on the negative side, it introduces political economy distortions. We now investigate how the extent of risk aversion affects these costs and benefits.

We now present a number of quantitative exercises illustrating how changes in the coefficient of relative risk aversion σ affect the trade-off between governments and markets. Our starting point is Proposition 10, which established that greater relative risk aversion makes government-operated mechanisms more attractive relative to fully anonymous markets, when preferences are quasi-linear.

6.3.1 Best sustainable equilibria with quasi-linear preferences

Proposition 10 was stated for the best stationary mechanism. Figure 8 shows that the main result in Proposition 10 also holds for the best sustainable mechanism. This figure plots the difference in welfare in the best sustainable mechanisms ($\mathbf{U}^{SM}$) and in the fully anonymous markets ($\mathbf{U}^{AM}$). For very low levels of risk aversion, markets are preferred to governments, but as the degree of risk aversion increases, government-operated mechanisms provide greater ex ante welfare than fully anonymous markets

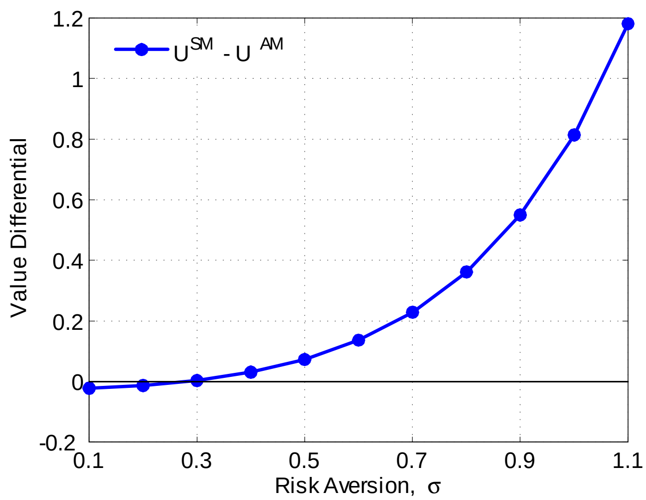

Figure 8: Difference in welfare between best sustainable mechanisms and fully anonymous markets with quasi-linear preferences and for various levels of the degree of relative risk aversion, σ.

The intuition for this result is identical to that of Proposition 10. The level of labor supply and output in fully anonymous markets are independent of the degree of risk aversion. As a result, the best sustainable mechanism, which provides a significant amount of risk sharing, become increasingly preferred to markets as the extent of risk aversion increases. Furthermore, we also find that higher risk aversion leads to lower output under the best sustainable mechanism and thus to lower rents for politicians (not shown). This feature will contrast with the results for the case of separable utility functions.

6.3.2 Comparison with separable preferences

With more general preferences, the monotonic relationship between the welfare under governments and under fully anonymous markets may no longer hold. In particular, with separable preferences, as the degree of relative risk aversion increases, the output under both fully anonymous market and the government increases due to the "income effects" on labor supply. This has two consequences. First, the increase in output necessitates higher rents for politicians, making government-regulated mechanisms less attractive. Second, greater output when risk aversion is higher plays the role of "self-insurance" in fully anonymous markets. These two effects combined imply that for high levels of risk aversion markets may generate higher ex

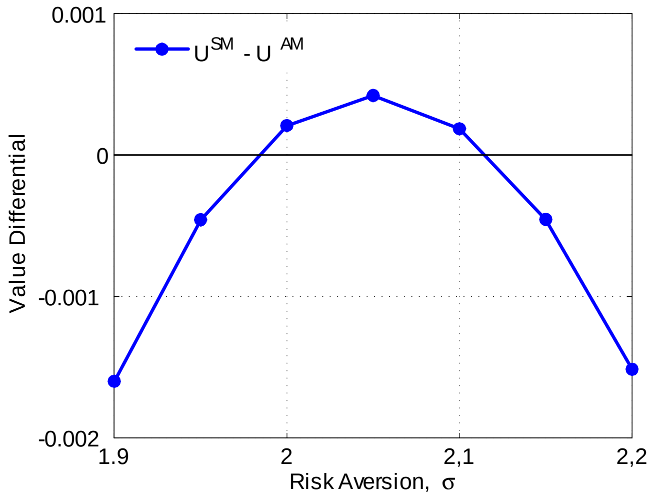

Figure 9: Difference in welfare between best sustainable mechanisms and fully anonymous markets with separable preferences for various levels of the degree of relative risk aversion, σ.

ante utility than government-operated mechanisms. Figure 9 illustrates this pattern and plots the difference in welfare in the best sustainable mechanisms ($\mathbf{U}^{SM}$) and in the fully anonymous markets ($\mathbf{U}^{AM}$). We start with the risk neutral agent case in which markets are preferred. As risk aversion increases, the demand for insurance increases and governments become preferable to markets. However, as the degree of risk aversion increases further, markets start dominating governments again. Consequently, the welfare difference between governments and markets has an inverse U-shape; for the intermediate level of risk aversion, government provision of insurance dominates market provision.

Figure 10 provides a further intuition for the inverse U-shaped pattern in Figure 9. It plots the levels of output under the best sustainable mechanism and under fully anonymous markets as a function of the degree of risk aversion, σ. Higher σ leads to higher labor supply and output under both systems. With the government in charge of the allocation of resources, higher output necessitates higher rents for politicians, which is shown in Figure 11. In contrast, without the government, higher output implies better self-insurance.

6.3.3 Governments versus self-enforcing markets

We now illustrate the comparison between government-operated mechanisms and self-enforcing risk-sharing arrangements discussed in Section 3.2. Recall from Proposition 11 that the relationship between risk aversion and the advantage of governments over markets is non-

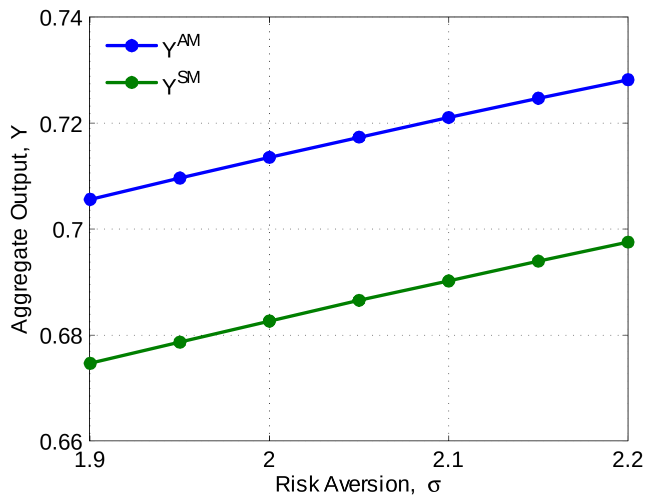

Figure 10: Output under governments and markets with separable preferences and as a function of the degree of relative risk aversion, σ.

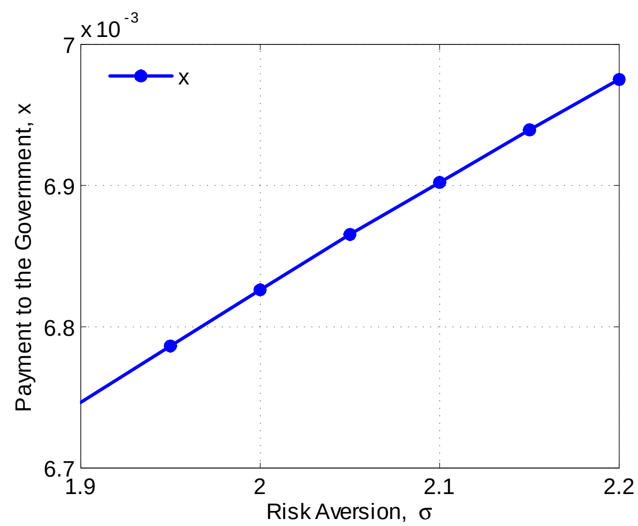

Figure 11: Government rents with separable preferences and as a function of the degree of relative risk aversion, σ.

monotonic. This is because as risk aversion increases, the utility that individuals can obtain on their own, if excluded from the market, falls rapidly, making it possible to sustain self-enforcing equilibria on with better insurance.

The following numerical example illustrates this intuition in a simple manner. We consider the CES preferences used in the benchmark parametrization. Generally, the equilibria in the self-enforcing economies are difficult to characterize since the allocations are highly history dependent. Since our main purpose is not to provide a comprehensive analysis of risk-sharing in such economies, but to illustrate our main propositions and provide an intuition for the result, we choose a more special economy with two perfectly negatively correlated types, following Kocherlakota (1996). Thus, we assume that the economy consists of two groups of agents with observable, perfectly negatively correlated shocks that take values θ_l or θ_h with equal probability. A simple adaptation of the arguments from Kocherlakota (1996) shows that the distibution of the allocations in this case is not history dependent, and depends only on the current realizations of agents' shock θ. This significantly facilitates the computation of equilibrium welfare under self-enforcing markets. For comparison, we look at the best stationary mechanism under governments. It turns out that for $\beta = \delta = 0.9$, the first-best allocations are sustainable in the self-enforcing markets, so we choose $\beta = \delta = 0.8$ for simulations.

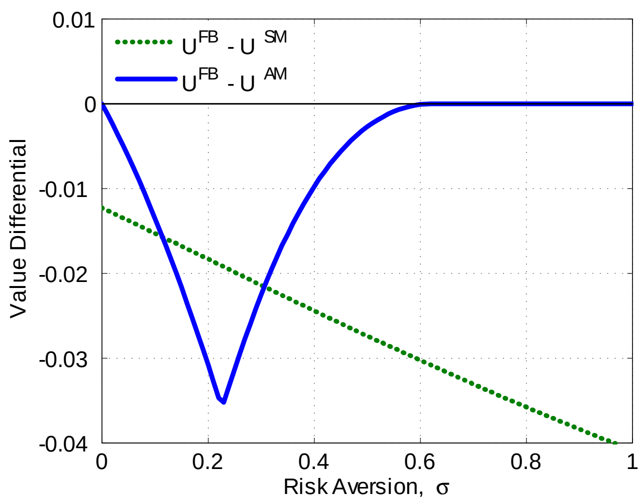

Figure 12: Welfare levels under best sustainable mechanisms and self enforcing markets for various values of the degree of relative risk aversion, σ.

In Figure 12 the solid line shows the difference in welfare between the first-best and self-enforcing markets and the dotted line represents the difference in welfare between the first-best and the best sustainable mechanism. When individuals are risk neutral, there is no need for insurance and the first-best level of welfare is achieved. Similarly, for high degrees of risk averion, the utility of autarchy is so low that first-best allocations can be achieved in the self-enforcing market equilibrium. Consequently, in these cases, self-enforcing markets provide greater ex ante welfare than governments. However, for intermediate values of the coefficient of relative risk aversion, σ, there is a significant welfare loss from the lack of commitment in private markets, and when these exceed the political economy distortions, governments are preferred. In the figure, this happens when the dotted curve is above solid curve.

6.4 Effects of Risk and Inequality

The previous section kept the uncertainty that agents face constant and analyzed how the degree of risk aversion of agents affects the allocations under governments and various types of market arrangements. The riskiness of the economy may change as the variances of the idionsyncratic shocks (or the extent of inequality) increases.

In the computations that follow, we leave the parameters as in our benchmark case, but change θ_l and θ_h in the distribution of skills (and keeping the mean level of skills constant). First, we compare welfare under governments with welfare under fully anonymous markets. To save space, we report the results only for the separable preferences. The results with quasi-linear preferences are similar. Figure 13 shows the difference in the welfare of the best sustainable mechanisms ($\mathbf{U}^{SM}$) and the fully anonymous markets ($\mathbf{U}^{AM}$). First, consider with the case in which the variance of the shocks is zero. In that case, the government provides no benefits (since there is no demand for risk sharing) but extracts resources. Therefore, the level of welfare with government-operated mechanisms is strictly lower than under fully anonymous markets. As the variance of the skills increases, there is demand for greater redistribution (i.e., ex ante welfare maximization requires greater redistribution). This increases the value of government-operated mechanisms relative to markets, which are more constrained in the amount of redistribution they can deliver. Interestingly, in contrast to the results in the previous subsection, there does not appear to be an inverse U-shaped pattern in this numerical comparison of markets to governments as we vary the amount of risk in the economy.

The welfare comparisons are quite different if we compare welfare achieved under governments with the equilibrium utility in self-enforcing markets. Figure 14 shows this comparison. In that figure, the solid line shows the difference in welfare between the first-best and self en-

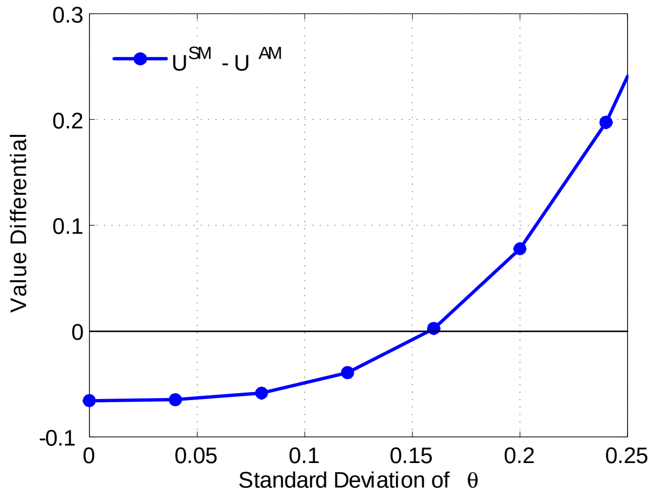

Figure 13: Difference in welfare between best sustainable mechanisms and fully anonymous markets for various levels of the standard deviation of the distribution of skills.

forcing markets and the dotted line represents the difference in welfare between the first-best and the best sustainable mechanism. Notice the same distinct U-shaped relationship between the welfare of government-operated mechanisms relative to markets and uncertainty as we saw in Figure 12 between the same welfare differential and the degree of risk aversion. The intuition for the result is the same as in that case. When uncertainty is very high, the outside option of agents is very low, and the outcomes approaching the first-best allocations can be sustained (see Krueger and Perri, 2006).

7 Concluding Remarks

In this paper we provided a first attempt to answer one of the central questions of economic analysis—whether market-based allocations are preferred to allocations regulated by governments. The starting point of our analysis is that risk-averse agents demand insurance or redistribution, but in pure market environments the extent of the redistribution will be limited, because agents cannot be forced to make transfers once their types (for example, there income levels) are realized. Ex post redistribution or insurance payments require third-party enforcement, typically provided by the government.

The standard approach in public finance and in much of economics is to presume that governments can be considered as benevolent and time-consistent social planners, enforcing

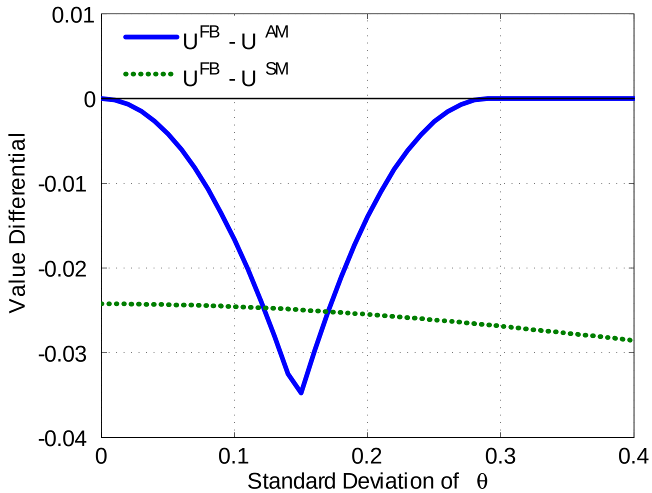

Figure 14: Welfare levels under best sustainable mechanisms and under self-enforcing markets for various values of the standard deviation of the distribution of skills.

contracts or making redistributions to improve welfare. If so, given sufficient instruments government-operated allocation mechanisms would always (at least weakly) dominate markets. At the very worst, as pointed out by Oscar Lange (1940), the government can always replicate market allocations. Our analysis is motivated by the observation that once we recognize that governments (politicians) are also self-interested, government-operated resource allocation mechanisms will involve costs that are not present in market allocations. For example, politicians need to be paid rents so that they abide by the implicit rules and follow the prescribed policies and allocation rules. In such an environment, there is a meaningful trade-off between markets and governments: government-operated mechanisms can provide better insurance, but only at the cost of introducing political economy distortions and rents for politicians.

We showed theoretically that in such an environment either markets or governments can lead to higher ex ante welfare. We also proved a number of results on various factors affecting the comparison of markets to governments that apply irrespective of the exact conception of how government mechanisms are operated and how markets are organized. For example, higher discount factors for politicians and better institutional controls on politician behavior tend to make governments better relative to markets. We also provided additional results for the specific cases in which markets are assumed to be fully anonymous (thus unable to provide any insurance) and in which markets can provide self-enforcing insurance. We finally provided a number of numerical results to illustrate the main results. These results also showed how the degree of the progressivity of taxes depends on the risk aversion of individuals, the extent of risk (inequality) faced by individuals, the intertemporal elasticity of substitution and discount factor of politicians, and the extent of institutional controls on politicians.

Our analysis is a first step in the comparison of markets and governments and remains limited in many aspects. First, our modelling of political economy is quite stylized. We used a classic Barro-Ferejohn model of electoral accountability as our workhorse model of political economy. One may want to think about more detailed modeling of the political economy institutions in our context. We provide one such extension in Acemoglu, Golosov and Tsyvinski (in progress) where instead of the unitary ruler we consider resources being allocated by various parties. Clearly, the political institutions in reality are much richer than in either of these papers. Future research may focus on endogenous elections, conflict between (potentially, endogenously formed) groups, and other more detailed analysis of the political economy institutions. Second, our paper has not addressed another classical side of the markets versus governments debate of Hayek-Lange, which concerns the efficiency of different resource allocation mechanisms in terms of their communication requirements. Segal (2007) provides a very promising direction of research on this topic. Finally, our notion of the markets in this paper is simplistic. We focused only on two particular cases of the markets. Future research should focus on a more detailed modeling of markets such as allowing more opportunities for risk sharing.

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