Taking versus Taxing: An Analysis of Conscription in a Private Information Economy

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Abstract

Most countries currently man their militaries through conscription (i.e., a draft). Conventional wisdom suggests that, by lowering the budgetary cost of the military, a draft reduces distortionary taxation, especially when military needs are large. We study conscription in a private information economy with heterogeneous civilian and military abilities. We find that voluntary enlistments leave more high-income earners in the civilian sector, leading to a larger tax base. When income taxes are set optimally, voluntary enlistments lead to less distortionary taxation than a draft. Drafts are more distortionary (and less socially desirable) when military needs are large.

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1 Introduction

Governments enjoy the right to take private resources for public use. Takings of labor via conscription (i.e., a military draft) are currently used by the majority of countries to man their militaries.[1] Governments may also raise an army by taxing civilians to finance a market-based voluntary military. The natural and quite enduring question is: should governments favor the market mechanism? Milton Friedman (1967, pp. 202), who advocated for the voluntary army, acknowledged that a volunteer army may require "very high pay in the armed forces and very high tax burdens on those who do not serve." As Mulligan and Shleifer (2005, p. 86) put it, "the draft saves on the cash cost of the military that must be otherwise financed through distortionary taxes." By lowering the budgetary cost of the military, a draft may reduce the needs for distortionary taxation. Although other costs are surely involved, a draft might be the least distortionary way to raise a large army.

This paper analyzes the fiscal advantages and the social desirability of the draft. The novelty is that we study an economy in which individuals differ in their military and civilian abilities, and these abilities are *private information*. The informational asymmetries prevent the government from sorting individuals according to ability. Instead, the government employs two basic policies for acquiring labor: either individuals self-select into the military or the government randomly drafts them. In a voluntary army, the government offers a wage sufficiently high to fulfill the necessary amount of enlistments. In a drafted army, the government may pay soldiers below-market compensation for their service. In either case, the government designs taxes to maximize social welfare subject to a set of constraints. Following Mirrlees (1971), to cover the budgetary costs of the military (whether drafted or not), the government relies on a distortionary nonlinear labor

[1] The U.S. ended the draft in 1973, but conscription is a reality in the majority of countries; see, e.g., Adam (2011), Mulligan and Shleifer (2005), and Poutvaara and Wagener (2007a). A few countries have recently ended conscription, or put in place plans to end it and replace it with voluntary enlistments. Conscription has ended in France (in 2001), Lebanon (in 2007), and Sweden (in 2010); Taiwan and Germany have scheduled conscription to end by 2014. Recruitment policies are said to be in the agenda of many other countries, including Brazil, China, Egypt, Israel, Malaysia, Mexico, Russia, South Korea, Turkey, and the former Soviet republics; see, e.g., Galiani, Rossi, and Schargrodsky (2011), Lokshin and Yemtsov (2008), Gilroy and Williams (2006), and Jehn and Selden (2002).

income tax among the individuals who remain in the civilian sector.

The fundamental observation is that a draft and a voluntary system lead to very different tax bases and that the voluntary system's tax base is more productive. Tax bases differ because volunteers generally have limited opportunities in the civilian labor market.[2] Thus the civilian sector that supports a volunteer army has a tax base with a larger proportion of higher-earning individuals. This more productive tax base raises revenue with fewer distortions than an equally sized, though possibly less expensive, drafted force. The key intuition is that voluntary selection is advantageous for raising revenue. A draft inducts high-income earners. When these high-earning individuals are drafted, the government loses revenue that must be obtained from those who remain in the civilian economy, producing efficiency losses that may exceed those of a voluntary system.

These findings contradict the existence of a trade-off between the foregone and the deadweight costs of conscription. Indeed, a draft is potentially more distortionary when military needs are large. Suppose the drafted military compensates soldiers with a small wage, relative to the wage paid in a volunteer army of the same size. As the size of the army increases two changes take place: more revenue is needed to pay for the additional drafted soldiers and fewer high-income earners remain in the civilian economy. In a volunteer economy, as the size of the army increases, more revenue is needed but the sources of revenue do not decline as much as under a draft. Deadweight losses for the economy are lower under voluntary enlistments because the remaining civilians face lower marginal tax rates.

Using a calibrated version of the model, we find that marginal taxes are generally lower under a voluntary system than under a draft. This is the case even when the elasticity of labor supply with respect to the marginal tax rate is in the upper end of

[2] This implication of the model is consistent with the importance of the business cycle on unemployment and regional variations in unemployment rates for enlistments into the U.S. forces; see Sandler and Hartley (1999, pp. 160-162). This implication is also consistent with the fact that when the military has greater presence in a local labor market, there is a reduced black-white income gap and a larger gender gap; see, e.g., Kriner and Shen (2010, pp. 60-61). Military pay is not the only determinant of enlistment and retention; see, e.g. Hosek et al. (2004). We will examine a variant of our model in which non-pecuniary incentives motivate enlistments in order to capture this aspect of reality.

existing estimates. Moreover, we find that a draft is generally less productive and less socially desirable than a volunteer force. Voluntary service is more socially desirable even once the military compensation of drafted soldiers maximizes social welfare. We also show that volunteer armies are more socially desirable under more redistributive social goals and for civilian ability distributions with thicker tails. These findings are robust to random participation in the volunteer army, where well over half of the enlistments are for non-pecuniary reasons. Finally, we study more sophisticated conscription methods. We allow the government to optimally choose a nonlinear "in-kind" tax for service time. This method fares poorly compared to the income-based taxation, as it does not provide for income redistribution fundamental to social welfare in Mirrleesian economies.

This paper is related to research studying the dichotomy between takings and open market purchases. This question is essential for many regulatory concerns: jury duty (Martin (1972) and Posner (1973)), confiscation and eminent domain (Pecorino (2011) and Shavell (2010)), and industry nationalization (Gordon, Bai, and Li (1999)). In all these settings, the distortionary tax revenues needed for an open market purchase make takings more appealing than the market mechanism. Our contribution is to quantify this tension in the context of conscription.[3] The armed forces are a major employer and defense expenditures are a large government spending category; see, e.g., Warner and Asch (1995, Chapter 6).

This paper complements classical references such as Friedman (1967), Hansen and Weisbrod (1967), and Oi (1967). The traditional argument against the draft focuses on the foregone earnings of higher-earning individuals. These early papers did not examine the tax distortions or redistributive needs of alternative recruitment methods. The importance of the social savings associated with lower tax burdens under a draft continues to be the

[3] Takings are quite common in practice, but they are almost completely neglected in the public finance literature. Mulligan (2008) is one of the few papers that study "in-kind" taxes, with a special focus on conscription. A point of contrast with Mulligan (2008) is that we examine a two-sector private-information economy and allow for nonlinear Mirrleesian taxation. We consider, for example, Mirrleesian taxation of service time in the military. Mulligan (2008), instead, focused on unidimensional sorting. When it considers the tax burden of funding either system (Cf. Section IV.C), it presumes that the marginal cost of raising revenue is the same for both recruitment systems. Our findings emphasize that they may be different, and that this difference is in favor of a voluntary system.

focus of many papers including Garfinkel (1990), Lee and McKenzie (1992), Ross (1994), Warner and Asch (1996), Warner and Negrusa (2005), Siu (2008) and Konstantinidis (2011). These frameworks typically rely on homogeneous agents and the government is assumed to use linear or lum-sum taxes. We consider a private information setting with explicit distributional concerns. In our Mirrleesian framework, the only restrictions on the set of tax instruments available to the government are due to the presence of limited information. Our framework also uses two dimensions of ability. We are thus able to separately discuss civilian and military ability, social costs, and the distributive properties of voluntary enlistments and a draft.

Starting with Angrist (1990), an empirical literature has exploited the random assignment inherent in the draft to learn more about the benefits and costs of military service.[4] Taking this lead, recent theoretical work has investigated the dynamic costs of the draft; see, e.g., Poutvaara and Wagener (2007b) and Lau, Poutvaara, and Wagener (2004). These papers consider a life-cycle general equilibrium framework in which homogeneous individuals are drafted during the first period of their productive life. In these models, the draft distorts human and physical capital investments.[5] Our analysis does not dispute the existence these distortions. We focus on the fact that while the draft may lower the budgetary cost of the military, the taxes that finance it may be more distortionary. Put simply, the literature postulates a trade-off between the reduced opportunity cost of voluntary enlistments and the public financing to entice it. We show is that such a trade-off does not necessarily exist.

The paper unfolds as follows. The basic theory is outlined in Section 2. Section 3 discusses our main quantitative findings. Section 4 contains several extensions to the

[4]This literature has looked at the effect of military service on short- and long-term earnings (Angrist (1990), Angrist, Chen, and Song (2011), and Card and Cardoso (2011)); subsequent educational and health outcomes (Cipollone and Rosolia (2007), Maurin and Xenogiani (2007), Paloyo (2010), Keller, Poutvaara, and Wagener (2010), and Bauer, Bender, Paloyo, and Schmidt (2012); Bedard and Deschenes (2006), Dobkin and Shabani (2009), and Autor, Duggan, and Lyle (2011)); and crime (e.g., Galiani, Rossi, and Schargrodsky (2011)).

[5]College deferments ameliorate the dynamic costs studied by Poutvaara and Wagener (2007b) and Lau, Poutvaara, and Wagener (2004). Card and Lemieux (2001), for example, found that college deferments provided a strong incentive to remain in school during the Vietnam War. Moreover, in Poutvaara and Wagener (2007b) and Lau, Poutvaara, and Wagener (2004), the below-market military compensation is taxed at the same rate as civilian wages, artificially reducing the potential benefits of conscription.

basic framework. Section 5 concludes.

2 Theory

There is a continuum of individuals of measure one. Each individual is endowed with a civilian and a military ability, θ and m, respectively. Abilities are distributed according to a well-behaved distribution function $\mathbb{F}(\theta, m)$,

$$\int_0^\infty \int_0^\infty \mathbb{F}(d\theta, dm) = 1. \tag{1}$$

The government requires a fraction $R \in (0, 1)$ of the population for the military. We take R as given for several reasons. First, we are not interested in determining the optimal size of the military.[6] Second, in practice, the military typically establishes recruitment quotas rather than other possible targets. Finally, since the government wil not be able to observe ability, the fraction of individuals required for service, along with the distribution $\mathbb{F}(\theta, m)$ and the military production function, is a *sufficient statistic* to examine the effect of alternative recruitment policies on average military quality.

A Voluntary Army. Individuals self-select between working in the civilian sector or joining the military. In the military, and for simplicity, soldiers work for a fixed number of hours, $\bar{h}$.[7] Our benchmark case assumes that military ability is not observed. Thus the government is restricted to compensate soldiers by paying a constant per-hour wage w. As we will see below, both assumptions imply that the participation constraint is type-independent.

While in the civilian sector, individuals supply $h(\theta)$ hours of work. The government

[6] To formulate such a problem, we would need to know the value society places on national defense as well as the military production function and the substitution across inputs, i.e., we would have to specify the patterns of substitution between labor (or labor-types) and capital in the production of military services. These patterns are not easily determined; see Sandler and Hartley (1999, pp. 156-160).

[7] As noted by Sandler and Hartley (1999, p. 156), military employment has distinctive features compared to civilian employment that make the previous assumption desirable. For example, pay, working conditions, and duration of employment for individuals in the armed forces are solely determined by the state. Further, contractual commitments are subject to military discipline, breaches of which can involve severe punishment. These aspects imply less flexibility in military contracts compared to the civilian labor market.

is restricted to setting civilian taxes as a function only of earnings, $y(\theta) = \theta h(\theta)$ since civilian ability is also unobservable. The consumption of an individual with civilian ability θ is given by $c(\theta) = y(\theta) - T(y(\theta))$ with $T(y(\theta))$ as the labor income tax. All individuals have the same separable preferences defined over consumption c and labor supply h, $U(c, h) = u(c) - v(h)$.

Let $V(\theta)$ represent the value of participating in the civilian sector for an individual with civilian ability θ given the tax schedule $T(y(\theta))$. While in the civilian sector, labor supply decisions solve

$$V(\theta) \equiv \max_{h(\theta)} \left\{ u(\theta h(\theta) - T(\theta h(\theta))) - v(h(\theta)) \right\}. \tag{2}$$

This problem is standard.[8] An important property of (2) is that the agent monotonicity condition of Mirrlees (1971) holds: *the gross income $y(\theta)$ and utility $V(\theta)$ for individuals with higher civilian ability are higher than for individuals with lower civilian ability.*

Consider next the *participation constraint.* The utility of individuals who join the military is $u(w\bar{h}) - v(\bar{h})$ where w is the untaxed military compensation. Let $V^v(\theta)$ denote the value an individual with civilian ability θ places on being in an economy that relies on a voluntary army:

$$V^v(\theta) \equiv \max\{V(\theta), u(w\bar{h}) - v(\bar{h})\}. \tag{3}$$

An individual with civilian ability θ would participate in the civilian sector if

$$V(\theta) \geq u(w\bar{h}) - v(\bar{h}), \tag{4}$$

and he would join the military otherwise.

The participation decision (4) can be represented by a cut-off ability $\bar{\theta}(w)$ which partitions the ability distribution into a set of individuals $\theta \leq \bar{\theta}(w)$ who join the military

[8]See, e.g., Mirrlees (1971), Ebert (1992), and Salanie (2003). As these authors, we examine non-stochastic allocations and taxes. Individual randomization is sometimes welfare improving in the presence of indivisibilities in occupational choice; see, e.g., Bergstrom (1986). Random tax schedules have been studied by Stiglitz (1982) and Hellwig (2007).

and a set $\theta > \bar{\theta}(w)$ who participate in the civilian sector. Notice that participation in the military depends exclusively on the civilian ability and not on the military ability, i.e., individuals with civilian abilities below $\bar{\theta}(w)$ would join the military regardless of their military ability m since military compensation cannot depend on their type. Later in this section we provide some remarks about the case when m is observable. The participation decision (4) accommodates the notion that enlisted individuals typically have limited civilian opportunities; see Sandler and Hartley (1999, pp. 160-162) and Kriner and Shen (2010, pp. 60-61). This assumption is not adequate to describe enrollment in military academies or individuals with strong preferences for military service. Commissioned officers are typically in positions of authority that resemble those of upper management in civilian organizations and there are no preferences for service in (4). Later on, we examine a random participation decision to accommodate heterogeneity in preferences for military service. For instance, we consider cases in which a fraction of individuals with high civilian ability opt to join the military for non-pecuniary reasons.

The participation decision (4) effectively reduces the two-dimensional information problem to a one-dimensional problem. Multidimensional screening problems are notoriously difficult to study because they lack a natural order of types. See Rochet and Stole (2003), Basov (2005), and Kleven, Kreiner, and Saez (2009) for general discussions of multidimensional screening problems. See also Jullien (2000) for an analysis that would allow for a less stark participation decision to join the military in private-information economies. Rothschild and Scheuer (2013) is a recent treatment of optimal taxation in the presence of multidimensional heterogeneity and occupational sorting. A central innovation in their paper is to demonstrate that a multi-dimensional information problem collapses into a one-dimensional problem if taxes are not conditioned on the sectoral choice of the individuals; see, e.g., their Lemma 1. Within the civilian economy, taxes are indeed independent of an individual's occupation.

In Rothschild and Scheuer (2013), the social planner is ambivalent about participation in either sector, so long as the occupation decisions are efficient. Participation in the military, however, is important beyond pure allocational efficiency concerns. One might imagine a version of Rothschild and Scheuer (2013), with added constraints on the size of the military sector and the cross subsidization of the civilian sector to the military. Even then, the occupation independence assumption of Rothschild and Scheuer (2013) is inconsistent with casual observation. Military participation confers a number of special tax treatments. For example, military pay earned in combat zones is exempted from taxation; see Siu (2008, p. 1098). More importantly for our purposes, if taxes are independent of an individual's occupation, the distortions associated with an increased tax burden (in the case of a voluntary army) or a higher opportunity cost (in the case of a draft) will be equally shared between the civilian and the military sectors. In this case, the military sector would be 'penalized' by distortions that originate in the civilian economy.

In addition to the participation constraint (4), the government faces a series of *feasibility* constraints. A voluntary army requires

$$R = \int_0^\infty \int_0^{\bar{\theta}(w)} \mathbb{F}(d\theta, dm), \tag{5}$$

where the right-hand-side is the fraction of soldiers who join the military. For instance, (4) and (5) imply that the relevant distribution of ability in the civilian sector is $\mathbb{F}_\Theta(\theta) = \int_{\bar{\theta}(w)}^{\theta} \int_0^\infty \mathbb{F}(d\theta, dm)/(1-R)$.

It is also necessary to cover the budgetary costs of the army. The government's *budget constraint* is

$$w\bar{h}R = \int_0^\infty \int_{\bar{\theta}(w)}^\infty T(y(\theta))\mathbb{F}(d\theta, dm). \tag{6}$$

The left-hand-side represents the cost of the military (i.e., the per-hour wage times the number of hours worked times the number of soldiers) and the right-hand-side is the revenue collected from the workers who remain in the civilian sector.

The *incentive compatibility* constraints are $V_\theta(\theta) = v_h(\theta)h(\theta)/\theta$ and $y_\theta(\theta) \geq 0$, for all $\theta \geq \bar{\theta}(w)$. An exposition of these conditions can be found in Salanie (2003, chapter 4).[9]

[9] The first condition follows from the individual's first order condition whereas the second is a monotonicity and positivity requirement on earnings profiles associated with the second-order condition of the individual problem.

The government maximizes a social welfare function

$$W^v \equiv G(u(w\bar{h}) - v(\bar{h}))R + \int_0^\infty \int_{\bar{\theta}(w)}^\infty G(V(\theta))\mathbb{F}(d\theta, dm), \tag{7}$$

where G is an increasing and concave function. The first term in (7) represents the welfare of soldiers and the second represents the welfare of civilian workers. Social welfare W^v does not directly take into account the quality of the military because the government's goal is to fulfill a quota R.

The government's problem can be partitioned into two parts. First, for a given tax schedule, w is determined from the size requirement (5) since military wages, and hence the term $G(u(w\bar{h}) - v(\bar{h}))R$, are not a choice for the government under voluntary recruitment. Second, given the participation decision and the pricing of military services, the analysis of optimal income taxes is as in Mirrlees (1971). Let $\zeta^u(\theta)$ and $\zeta^c(\theta)$ denote the uncompensated and compensated labor supply elasticities at θ, and let p be the (average) marginal social value of revenue, i.e., the Lagrange multiplier on (6). The next proposition summarizes our previous discussion.

Proposition 1 *(i) For a given tax schedule, there exists a unique military wage $w > 0$ that fulfills the quota (5). The military wage w is increasing in the recruitment quota R.*

(ii) For a given military wage w, and for all $\theta > \bar{\theta}(w)$, the first-order condition for the optimal tax rate at a civilian income $y(\theta)$ satisfies

$$\frac{T_y(y(\theta))}{1 - T_y(y(\theta))} = \left(\frac{1 + \zeta^u(\theta)}{\zeta^c(\theta)}\right) \frac{u_c(c(\theta))}{\theta \mathbb{F}_\Theta(d\theta)} \int_\theta^\infty \left[1 - \frac{G_V(V(s))u_c(c(s))}{p}\right] \left(\frac{1}{u_c(c(s))}\right) \mathbb{F}_\Theta(ds). \tag{8}$$

Proof. (i) Recall that $V(\bar{\theta}(w)) = u(w\bar{h}) - v(\bar{h})$. Assuming differentiability, $\bar{\theta}_w(w) = u_c(w\bar{h})\bar{h}/V_\theta(\bar{\theta}(w))$, which is positive. Let $\Xi(w) \equiv \int_0^{\bar{\theta}(w)} \mathbb{F}_\Theta(d\theta)$, with $\Xi(0) = 0$ and $\Xi(\infty) = 1$. By continuity, there is a wage that satisfies $\Xi(w) = R$. By monotonicity, this wage is unique and increasing in R. The proof of (ii) is omitted; the derivation and interpretation of the marginal taxes has been treated in several places, notably by Saez (2001). ■

Proposition 1(i) simply notes that a voluntary army is always feasible, provided that there is enough revenue to pay for it. Moreover, to voluntarily attract a larger fraction of individuals into the military sector, the military must compensate them at higher rates. An interpretation of Proposition 1(ii) is unnecessary but it is useful to highlight the aspects that are specific to our problem.[10] First, since individuals have the option of joining the military, the lower tail of the distribution of civilian ability is truncated. Second, marginal taxes in (8) only depend on the marginal distribution of civilian ability $\mathbb{F}_\Theta(\theta)$. Thus the distribution of military ability can be conditioned upon to determine marginal taxes in the civilian economy. This point allows us to separately study civilian and military outcomes. The reason for these simplifications is that selection into the voluntary army takes place independently of military ability, as per (4). Such separation, though, is not exclusive to our benchmark formulation. Later in this section we assume that military ability is fully observable. Since the value of being in the military will not influence the optimal tax in the civilian sector beyond its effects on the participation constraint, the distribution of military ability can also conditioned upon to formulate the optimal taxes in the civilian sector.

One way to examine the importance of the tax distortions is to consider the Lagrange multiplier p:

$$p = \frac{\int_{\bar{\theta}(w)}^{\infty} G_V(V(s))\mathbb{F}_\Theta(ds)}{\int_{\bar{\theta}(w)}^{\infty} \left(\frac{1}{u_c(s)}\right) \mathbb{F}_\Theta(ds)}. \tag{9}$$

This multiplier measures the (average) marginal social value of revenue for the government. Notice that (9) takes into account the individuals who have joined the military. Their decision effectively eliminates the lower tail of the distribution of civilian earnings and this lowers the value of p (compared to a case with $\bar{\theta}(w) = 0$). Thus, as the fraction of individuals who join the military increases, the marginal social value of additional revenue declines.

[10]Essentially, the shape of marginal taxes depends on three terms: the labor supply elasticity since an elastic labor response implies lower marginal taxes, the skill distribution since the aggregate distortion of taxation depends on the population affected by the marginal tax at each level, and the preferences for redistribution implicit in the welfare function; see, e.g., Salanie (2003) and Saez (2001).

A Military Draft. Suppose now that a draft lottery selects individuals into the army. Individuals are no longer required to satisfy the participation constraint (4). Instead, soldiers are randomly selected from the population. In a fair draft, the budget constraint for the government is

$$w^d \bar{h} R = \int_0^\infty \int_0^\infty T^d(y(\theta))(1-R)\mathbb{F}(d\theta, dm), \tag{10}$$

where w^d represents the per-hour wage paid to draftees and $T^d(y(\theta))(1-R)$ is the revenue collected from individuals with income $y(\theta)$ who have not been drafted into service. Notice that w^d is exogenous and differs from the compensation in the volunteer military, w. In the quantitative section we will treat w^d as a choice variable for the government.

The value an individual with ability θ places on being in a draft economy is

$$V^d(\theta) \equiv [u(w^d \bar{h}) - v(\bar{h})]R + V(\theta)(1-R), \tag{11}$$

where the value function $V(\theta)$ is equivalent to (2) with the tax function $T^d(y(\theta))$. This value function applies to the fraction $(1-R)$ of individuals who participate in the civilian sector. In other words, a draft in (11) imposes a "tax" of R on civilians. Finally, conditional on not being drafted, work decisions satisfy the optimality conditions obtainable under a volunteer military with $\bar{\theta}(w) = 0$.

The social welfare function is given by

$$W^d \equiv G(u(w^d \bar{h}) - v(\bar{h}))R + \int_0^\infty \int_0^\infty G(V(\theta))(1-R)\mathbb{F}(d\theta, dm), \tag{12}$$

which shall be maximized subject to (10) and the appropriate incentive compatibility conditions.

Let $T_y(y(\theta), p, \bar{\theta}(w))$ denote a marginal tax rate that satisfies (8) as a function of $(y(\theta), p, \bar{\theta}(w))$, and let p^d be the Lagrange multiplier on the budget constraint (10).

Proposition 2 *Under a draft, the first-order condition for the optimal tax rate at a civilian income $y(\theta)$ satisfies $T^d_y(y(\theta), p^d, 0) = T_y(y(\theta), p, \bar{\theta}(w))$, for all $\theta \geq 0$.*

Proof. Notice that the relevant distributional terms in (10) and (12) can be written as in (6) and (7) with $(1-R)\mathbb{F}(d\theta, dm)$. In (8), however, the term $(1-R)$ in the numerator and in the denominator would simply cancel since the draft is fair. ■

The intuition behind the previous proposition is that a fair draft does not alter the distribution of ability in the civilian sector relative to the given distribution $\mathbb{F}(d\theta, dm)$. There are, however, important differences between the income tax needed to finance a volunteer military and that needed to finance a drafted military. First, under the draft, there is a mass of individuals with $\theta \leq \bar{\theta}(w)$ who will now participate in the civilian sector. Similarly, the mass of individuals with civilian ability $\theta > \bar{\theta}(w)$ is smaller under a draft than under the volunteer military since a fraction R is taken from civilian activities. Second, the total budgetary cost of the drafted military can be lowered by reducing the compensation of soldiers, w^d. We will discuss these differences in our numerical analyses below.

Finally, notice that there should be differences in the value of a marginal social value of revenue, $p^d \neq p$. In particular,

$$p^d = \frac{\int_0^\infty G_V(V(s))\mathbb{F}_\Theta(ds)}{\int_0^\infty \left(\frac{1}{u_c(s)}\right)\mathbb{F}_\Theta(ds)}, \tag{13}$$

which, in contrast to (9), integrates over the entire domain of civilian ability. This implies that the marginal social value of revenue for the government is higher under a draft than under a volunteer army. The reason is that a fair draft and a voluntary system alter the distribution of civilian earnings in different ways.

Overall performance under both systems. We next characterize important aspects of the overall performance of volunteer and drafted economies and armies. Let Y^v denote the average gross income of civilians under volunteer enlistments. That is, $Y^v \equiv \mathbb{E}[y(\theta)|\theta > \bar{\theta}(w)]$. In turn, the average gross income of civilians under a draft is $Y^d \equiv \mathbb{E}[y(\theta)]$. Likewise, let M^v denote the average quality of the voluntary army, $M^v \equiv \mathbb{E}[m\bar{h}|\theta \leq \bar{\theta}(w)]$. The average quality of a drafted army is $M^d \equiv \mathbb{E}[m\bar{h}] = \mathbb{E}[m]\bar{h}$. Higher moments of military outcomes can be defined in similar ways.

To compare M^v with M^d it is crucial to understand the *association* between civilian and military abilities in the population. There are multiple ways to describe bivariate dependence between random variables. The weakest concept of dependence that we can use here is that of *positive quadrant dependence in expectation.*[11] This concept requires that

$$\mathbb{E}[m|\theta \leq \hat{\theta}] \leq \mathbb{E}[m], \tag{14}$$

for $\hat{\theta} > 0$; negative dependence is defined similarly. The idea in (14) is simply that knowing that civilian ability is low (i.e., $\theta \leq \hat{\theta}$) increases the chances of seeing low values of m in the population.

The next proposition characterizes the relative civilian and military performance of a voluntary army and a draft.

Proposition 3 *(i) For a given recruitment quota R and a given tax schedule, the average gross income of the civilian sector is higher under a volunteer military than under a draft. That is, $Y^v \geq Y^d$.*

(ii) Suppose civilian and military abilities are positively (resp. negatively) associated. Then, for a given recruitment quota R and a given tax schedule, the average quality of a voluntary army is lower (higher) than that of a drafted army. That is, $M^v < (\geq) M^d$.

Proof. (i) Individuals who voluntarily serve in the military have low civilian ability. Thus those who remain in the civilian sector invariably have higher ability that those who serve in the army. As a consequence of the agent monotonicity condition, i.e., $y_\theta(\theta) \geq 0$, we have that $\mathbb{E}[y(\theta)|\theta > \bar{\theta}(w)] \geq \mathbb{E}[y(\theta)]$. The proof of (ii) follows from (14) with $\hat{\theta} = \bar{\theta}(w)$. ■

The key implication of Proposition 3(i) is that the tax base under a volunteer system is larger than under a draft. Just as the draft takes the "wrong" people in terms of civilian opportunity cost, it also takes the "wrong" people for the purposes of low-distortion rev-

[11]A stronger concept of dependence is that of positive likelihood dependence. That concept implies that we are more likely to observe civilian and military abilities take larger values together and smaller values together than any mixture of these. See Balakrishnan and Lai (2009) for a discussion of these concepts.

enue generation. This result is a consequence of self-selection and the agent's monotonicity requirement.

Proposition 3(ii) shows that a voluntary army need not be desirable from a military productivity point of view. If civilian and military abilities are positively associated in the population, those who voluntarily serve will have low military ability. Thus, as in *adverse selection* models, the average quality of the military will be lower than the average quality of a randomly selected sample.

Observable military ability. We have assumed that the government cannot observe military abilities. While this is an extreme assumption, especially given the large battery of physical and ability tests individuals undertake prior to their enlistment, our central findings are not likely to change if we consider the opposite side of the spectrum. That is, if we assume that the government can fully observe military ability.

If military ability is observable, an individual with military ability m earns $m\bar{h}$ in the army and the participation constraint (4) is $V(\theta) \geq u(m\bar{h}) - v(\bar{h})$. Since $V(\theta)$ is increasing, there is a cut-off civilian ability $\tilde{\theta}(m)$ which partitions the ability distribution into a set of individuals $\theta \leq \tilde{\theta}(m)$ who join the military and a set $\theta > \tilde{\theta}(m)$ who participate in the civilian sector, with $\tilde{\theta}_m(m) > 0$. The size requirement for the voluntary army is $R = \int_0^\infty \int_0^{\tilde{\theta}(m)} \mathbb{F}(d\theta, dm)$, which has the same interpretation as (5), and the budgetary costs of the army is

$$\mathbb{E}[m|\theta \leq \tilde{\theta}(m)]\bar{h}R = \int_0^\infty \int_{\tilde{\theta}(m)}^\infty T(y(\theta))\mathbb{F}(d\theta, dm), \tag{15}$$

where $\mathbb{E}[m|\theta \leq \tilde{\theta}(m)]$ is the average compensation for the voluntary army under observable military ability. In contrast to our benchmark case, voluntary participation in the military now depends on military ability.

Let $\tilde{Y}^v \equiv \mathbb{E}[y(\theta)|\theta > \tilde{\theta}(m)]$ denote the average gross income of civilians under voluntary enlistments when military ability is perfectly observable; the average quality of the voluntary army is $\tilde{M}^v \equiv \mathbb{E}[m\bar{h}|\theta \leq \tilde{\theta}(m)]$. Since the overall performance under a draft is not affected by whether military ability is observable or not, it is not difficult to see that

Proposition 3(i) remains unchanged: when military abilities are fully observable, average gross income of the civilian sector is higher under a volunteer military than under a draft, i.e., the average gross income of the civilian sector satisfies $\tilde{Y}^v \geq \mathbb{E}[y(\theta)] \equiv Y^d$. This means that the larger tax base tax under a volunteer system is still present under fully observable military abilities. Likewise, as in Proposition 3(ii), comparisons in terms of average quality in the military depend on the association between civilian and military abilities in the population, i.e., on whether $\mathbb{E}[m|\theta \leq \tilde{\theta}(m)]$ is larger or smaller than $\mathbb{E}[m]$. If abilities are "strongly" positively associated, comparative advantage implies that those individuals who voluntarily enlist have low civilian ability and also low military ability. In effect, if civilian and military abilities are "strongly" positively associated, the average quality of a voluntary army will be lower than that of a drafted army.[12]

Some additional remarks. Proposition 3, and the previous analysis under perfectly observable military ability, cannot be directly extended to a utility comparison between the draft and a voluntary army since $V^v(\theta)$ and $V^d(\theta)$ depend on the tax schedules and the military compensations. A comparison of after-tax (net) civilian incomes also depends on these factors. Since the government sets marginal taxes taking into account the marginal loss in social welfare relative to the average loss in social welfare (i.e., the ratio $G_V(V(s))/p$), it is likely that the marginal taxes will be lower under a voluntary system. We will next explore these scenarios numerically.

In our benchmark case, the marginal distribution of civilian abilities is given by $\mathbb{F}_\Theta(\theta) = \int_{\bar{\theta}(w)}^{\theta} \int_0^{\infty} \mathbb{F}(d\theta, dm)/(1-R)$. Under perfectly observable military ability, the marginal distribution of civilian abilities satisfies $\tilde{\mathbb{F}}_\Theta(\theta) = \int_{\tilde{\theta}(m)}^{\theta} \int_0^{\infty} \mathbb{F}(d\theta, dm)/(1-R)$. Both distributions represent truncations of the given distribution $\mathbb{F}(\theta, m)$ in (1), which is

[12]The only difference in the case of observable military abilities is that the notion of positive association needs to be slightly strengthened. One relevant notion of association in this case is positive association according to the *monotonic quadrant dependence function*. Consider a pair of random variables (X, Y) and let x_p denote the p-th quantile of X. The strength of the association between X and Y can be measured with the difference function $L_{Y,X}(p) \equiv \mathbb{E}[Y|X > x_p] - \mathbb{E}[Y]$. Positive values of this function indicate a tendency for values of X larger than x_p to be associated with large values of Y. The function $\mu_{Y,X}(p) \equiv L_{Y,X}(p)/\mathbb{E}[Y|Y > y_p] - \mathbb{E}[Y]$ is the *monotonic quadrant dependence function.* This function compares the improvement in prediction of Y from knowing that X is big to the improvement in prediction from knowing that X is small; see, e.g., Balakrishnan and Lai (2009) To apply this concept, notice that R acts as the R-th quantile of the distribution of abilities.

the relevant distribution under a fair draft. In both instances, the nature of selection into the military (i.e., advantageous or adverse) depends on properties of $\mathbb{F}(\theta, m)$ such as the association between θ and m in the population. The type of selection into a voluntary army can be empirically tested. In a companion paper, Birchenall and Koch (2015), we have tested for the possibility of adverse selection in the U.S. Army during World War II, when both voluntary enlistments and a democratic draft were in place. We compared the relative performance of draftees vs. volunteers, using selection tests in the style of Chiappori and Salanie (2001). These tests rely on the (conditional) correlation between an individual's choice to volunteer and the individual's performance while in the army, which in our case is the probability of receiving high military honors. We concluded that, on the whole, selection was advantageous. That is, those who volunteered for the U.S. Army were more likely to win high honors for valor than were drafted men. Since this analysis is discussed in a separate paper, we instead focus on the civilian burdens associated with alternative recruitment methods.

Notice also that regardless of the information available to the government, only individuals with low civilian abilities join the army voluntarily. Later on, in Section 4, we consider a random participation model in which preferences for military service are central for voluntary enlistments. Finally, notice that we have abstracted from considering externalities from military service. The military provides substantial positive externalities in terms of professional training, national security, rule of law, and even in less direct ways such as innovation. Considering these externalities or even determining the optimal military size requirement for the government is outside the scope of this paper.

3 Quantitative findings

This section reports the results of a quantitative comparison of volunteer and drafted economies for armies of various sizes.

Parametrization. Our choice for functional forms and parameters relies on the existing literature on optimal income taxation. As we remarked after Proposition 1, knowledge of the marginal distribution of civilian ability, $\mathbb{F}_\Theta(\theta)$, is sufficient to determine marginal income taxes and all other civilian outcomes. (A marginal distribution $\tilde{\mathbb{F}}_\Theta(\theta)$ would also be sufficient to study the civilian economy when military abilities are observable, as we just noted.) We employ a lognormal distribution with mean and variance $(2.757, 0.5611)$, specified by Mankiw, Weinzierl, and Yagan (2009) to fit the distribution of wages (i.e., civilian ability) from the March Current Population Survey (CPS) of 2007.[13]

We use individual preferences of the form

$$U(c,h) = \frac{c^{1-\gamma} - 1}{1-\gamma} - \frac{\alpha h^\sigma}{\sigma}, \tag{16}$$

with a coefficient of risk aversion of $\gamma = 1.5$ and with a Frisch elasticity of labor supply of $1/(\sigma - 1) = 0.5$. The parameter α specifies the value of nonmarket productive time for the individual. We assume that $\alpha = 2.55$ to obtain an average of 40 hours of work per week in the civilian sector, per Mankiw, Weinzierl, and Yagan (2009).

We use a social welfare function $G(V)$ given by

$$G(V) = -\frac{\exp\{-\xi V\}}{\xi}, \tag{17}$$

where ξ measures the degree of preference for equity. Higher values of ξ represent greater concern for equity. When $\xi \to 0$, $G(V) = V$ and we obtain a *utilitarian* case. We consider $\xi = 0$ and $\xi = 1$.

Military wages. Wages for the voluntary army w are endogenous. To determine the compensation for the drafted army we consider three scenarios. First, we assume that $w^d = w$. This implies that the total cost of the military is the same regardless of the recruitment method. Second, we assume that $w^d = (1 - R)w$. This assumption lowers the cost of the army but it preserves the amount of revenue that needs to be raised from

[13] This ignores the fact that those currently employed by the military are counted as receiving "civilian wages" and are thus included in this parameterizations. We performed several robustness checks with adjusted lower-ends of the ability distribution, and the distributional consequences were the same. We rely on an iterative procedure and assume a dense grid over the distribution of productivity. The bins begin at \$4.76, and are fifty cents wide. The bins continue until \$109.76, the 99.97th percentile. This allows for military sizes from zero to forty percent of the population.

the civilian sector. Third, we examine a wage-setting rule that maximizes social welfare, (12). In some instances we consider $w^d = 0$, which assumes that drafted soldiers receive no compensation at all.

Utilitarian case. First consider the utilitarian case, i.e., $\xi \to 0$ in (17). We are interested in two *social* outcomes: (i) the marginal social value of revenue p and p^d, which measure how valuable revenue is from a social point of view, and (ii) the social welfare functions W^v and W^d. We are also interested in two *individual* outcomes: (i) average tax rates $T(y(\theta))$ and $T^d(y(\theta))$, which measure the tax burden for different individuals, and (ii) value functions $V^v(\theta)$ and $V^d(\theta)$, which measure individual welfare, i.e., who gains the most from each recruitment method.

Marginal social value of revenue.– Figure 1 plots p, the marginal social value of revenue for a volunteer army, against similar values for a draft economy, p^d. The figure varies military size from $R = 0$ to $R = 0.40$ and considers the three wage-setting mechanisms for w^d previously discussed. When the value of p^d is large, the marginal social value of additional revenue is large. This means that the government is more willing to distort the economy in order to raise revenue. At $R = 0$, $p = p^d$ trivially. As Figure 1 suggests, however, p is smaller than p^d regardless of the wage-setting mechanism.

These results are consistent with our introductory remarks and with (9) and (13). Under a voluntary system, the tax base is larger and the redistributive needs in the civilian economy are lower. This reduces the marginal social value of revenue. In fact, p actually falls as the size of the army grows. This is because as the army requires more soldiers, it takes them from the bottom of the earnings distribution. The civilian economy that is left behind has richer tax payers and suffers from less earnings inequality. When the drafted army pays high wages, i.e., $w^d = w$, the value of p^d is larger than for lower wages, i.e., $w^d = 0$, because the government has larger expenses and larger redistributive needs. That is, under $w^d = 0$, the social marginal value of revenue is indeed lower than under $w^d = w$. However, p^d at $w^d = 0$ is still larger than p as long as $R > 0$ because a voluntary army transfers resources to all inframarginal soldiers.

Social welfare.– There are broader consequences to paying a drafted army low wages.

Lowering the military wage increases the *forgone earnings cost* of the draft. Figure 2 plots the average welfare of volunteer armies and drafted armies under the assumption that the government sets the military wage w^d to maximize the social welfare function, W^d. For completeness, we also consider the previous wage-setting rules.

Three results are clear: first, optimally setting the military wage in the draft economy provides greater social welfare than when the military wage is set at the value of the volunteer economy, i.e., $w^d = w$. The former economy is an unconstrained version of the latter, so this is a trivial result. Second, despite these gains, the volunteer economy is still better on average than either of the draft economies. In fact, having low military wages, $w^d = w(1 - R)$, fairs worst. There are budgetary gains from lowering military wages, and thus relaxing the tax burden on the civilian sector. Those gains, however, are small compared to the welfare loss due to the forgone earnings. The intuition for these differences is that to lower the social cost of the draft, the compensation given to soldiers w^d must be large since high military wages yield higher consumption value for draftees (i.e., a high military wage provides *partial insurance* against the draft).

Figure 2 also plots the ratio of the optimal draft economy military wage and the volunteer wage. The third result is that the optimal military wage exceeds the volunteer military wage. Starting at 1.7 times the volunteer wage, this mark-up falls as the military size grows. As the military size grows, agents face a larger chance of being drafted, so it makes sense to transfer resources to that state by increasing the military wage.

Individual tax burden.– Figure 3 plots the average tax rates for the volunteer and drafted economies against the cumulative distribution of civilian ability. We plot two military sizes: two and a half percent and seventeen percent, though the patterns we describe are consistent with those for the other military sizes we considered. The differences in the marginal social value of revenue correspond to differences in marginal taxes; see (8). In particular, since $p^d > p$, the draft leads to the larger marginal taxes, and thus steeper average tax curves evident in Figure 3. For low ability agents, a draft leads to a more negative average tax, i.e., a larger net transfer from the government. The average tax contribution of high-income earners is larger under the draft than under the voluntary system, even at lower military wages.[14] These average tax curves cross, leaving some individuals with a larger net subsidy from the government with a draft. The crossing of the average tax curves has important consequences for individual welfare differences.

Individual welfare.– Figure 4(a) plots the difference between the individual welfare of an economy with a drafted army versus one with a voluntary army, by civilian ability, and by military size. The vertical axis plots the percent consumption equivalent to $V^v(\theta) - V^d(\theta)$ (i.e., divided by the marginal utility and level of consumption). If this value is positive, then the agent prefers the voluntary army. If it is negative, the draft is preferred. The level values correspond to the amount of consumption in the volunteer economy that an agent would give up to avoid the level of utility he would have in a drafted economy. The first of the other two axes represents the military size required in the economy, i.e., the fraction of the economy's agents required for service. The second axis indexes the individual's ability in the civilian economy.

For armies of all sizes the individual welfare differences exhibit a V-shape. At one extreme, the individuals with the highest civilian ability are better off with a voluntary army since they are able to exploit their comparative advantage. At the other extreme, the individuals with the lowest civilian ability, those who would join the military, prefer the voluntary army as it keeps them from their low-productivity civilian jobs in the event these individuals are not drafted.

For some individuals, a draft is preferred. These are the agents for whom volunteering for the military is near-marginal. In theory, the marginal individual who decides to participate in the military is indifferent between a voluntary system and a drafted one. These near-marginal individuals have valuable civilian options. This is why the left-side of the V slopes down as agent ability grows: the civilian options grow more lucrative,

[14] We can make the previous argument a little bit more precise in the following sense. Suppose that $w^d = w(1-R)$ and $p = p^d$. The first assumption implies that $\int_0^\infty T^d(y(\theta))\mathbb{F}_\Theta(d\theta) = \int_{\bar{\theta}(w)}^\infty T(y(\theta))\mathbb{F}_\Theta(d\theta)$, whereas the second assumption implies that $T_y^d(y(\theta))$ and $T_y(y(\theta))$ are differential equations that only differ in their initial condition; see Proposition 2. Since average taxes are represented by solutions of a differential equation (8), and because of the existence and uniqueness theorem for differential equations, one and only one integral curve passes through each point. That is, $T^d(y(\theta))$ and $T(y(\theta))$ cannot cross. It follows that $T(y(\theta)) > T^d(y(\theta))$ for all $\theta \in [\bar{\theta}(w), \infty)$. Under a budget neutral draft with equal value of a marginal unit of public funds, the tax burden of high-ability civilians is higher under a draft than under a voluntary system.

making the voluntary army relatively less attractive. Because the military earnings are close to the civilian options, the difference $V^v(\theta) - V^d(\theta)$ comes down to the average taxation. Thus the low marginal gains from volunteer enlistments and the lower average taxes make the draft preferred for some.

Figures 4(b) and 4(c) plot the individual welfare difference between a volunteer economy and one with a draft, for alternative military wage-setting mechanism. The distributional consequences are essentially the same as in Figure 4(a): we get V-shaped utility differences, which leaves near-marginal agents better off with a draft economy when the military needs are small. This shows that the distributional consequences of the drafted military are not tied to the size of military compensation.[15]

Our findings are not just qualitatively instructive, but also quantitatively important. For example, when the military is five percent of the population, the average consumption equivalent is 4.3 percent of consumption. The mean masks a larger cross-sectional difference between agents: the median agent would give up ten percent of civilian consumption in the economy with a voluntary army to avoid a draft. The magnitude of this difference should not be surprising, as the draft represents a five percent chance of consuming one quarter in the military of what he would have made in the civilian sector.

Sensitivity. The numerical findings to this point rely upon utilitarian welfare. Next we employ a social welfare function with higher preferences for equity. As in Tuomala (1984), we set $\xi = 1$ in (17). Table 1 presents the results of this and our other robustness and sensitivity checks. In terms of welfare differences, the results are stronger than before. That is, the volunteer military is better on average, and for all individuals. This can be seen in the final column of Table 1, which reports the fraction of the population that prefers a draft.

Table 1 also reports the average tax functions for the same two military sizes as

[15]Konstantinidis (2011) studied a political economy model of conscription with unidimensional abilities and lump sum taxation. In Konstantinidis (2011), there is a medium-income constituency of civilians who favor conscription. Low- and high-income individuals always find the voluntary army to be preferable, for the same reasons outlined here. Numerically, Konstantinidis (2011) showed that this "middle-class 'pocket' of pro-conscription civilians" is larger in a more egalitarian societies. In Konstantinidis (2011), however, tax burdens and redistributive needs are not explicitly taken into account as taxation is lump-sum.

above, at the 5th and 95th percentile in the ability distribution. The average tax function does not cross with stronger preference for redistribution, as opposed to the utilitarian case. Here, the average taxes with the draft are larger (i.e., less negative) for the lower productivity agents than in the voluntary army. The stronger redistribution motives remove any potential for some agents to be better off with a draft.

The labor supply elasticity is a key parameter in our model. We increase the labor supply elasticity to 3 ($\sigma = 1.33$), while targeting average hours worked consistent with the U.S. data ($\alpha = 0.64$). The deadweight losses of a voluntary army are the largest here due to the distortionary costs of taxation. This specification provides the draft its largest group of advocates yet, over 12 percent. This recedes as the military grows to its larger size. A more responsive labor supply increases the potential gains from a draft, but it is limited to small militaries.

While our focus has been on the bottom of the productivity distribution, the optimal tax literature has focused at the top, e.g. Saez (2001). For a second specification test, we directly adopt Mankiw, Weinzierl, and Yagan's (2009) distribution of abilities, which appends a Pareto tail with coefficient 2 to the top of the wage distribution. A Pareto tail can be seen as a distribution of civilian ability with a higher fraction of high-earning individuals. The simulation results can be found in Table 2. The Pareto tail leads to much lower (negative) average taxes for the low ability agents. This relative difference, however, is not enough to make those low ability agents prefer the draft. This results in a Pareto preference for the voluntary army.[16]

In addition to this, we studied simulations with another four civilian ability distributions: the first two adjust the mean of the civilian ability distribution (plus and minus ten percent), while the second two adjust the standard deviation of the civilian ability distribution (also plus and minus ten percent). The results are reported in Table 2. In practice, nothing changes; voluntary armies are still preferred by the vast majority of agents in the economy. Varying the ability distribution does lead to differences in redistribution, as is evident in the average taxes for the fifth and ninety-fifth percentile in the

[16]A distribution focused on older individuals, or those without physical disabilities, might similarly exhibit thicker tails. The consequences of changes to the ability distribution appear limited.

ability distribution. These taxes are less burdensome with the volunteer economy.

4 Extensions

Random participation. So far, the participation decision focused exclusively on pecuniary incentives. In reality, individuals enlist due to non-pecuniary motives (i.e., patriotism and an affinity for the military lifestyle).[17] We next consider non-pecuniary motives in a version of the model with random participation, as in Rochet and Stole (2002).

Suppose that the utility of individuals who join the military is $u(w\bar{h}) - v(\bar{h}) + \eta$, where η is an additive utility of military service (or, equivalently, the disutility of staying in the civilian sector). We assume that individuals are heterogeneous in η and that η is randomly distributed with a cumulative distribution function $\Phi(\theta, \eta)$. We assume that η and m are independent.

Individuals will now join the military for pure pecuniary reasons (as in the basic model) but also due to non-pecuniary motives. The participation decision is such that the probability that an individual with civilian ability θ stays in the civilian sector is $\Pr\{(\theta, \eta)|V(\theta) \geq u(w\bar{h}) - v(\bar{h}) + \eta\}$. Trivially, the probability that an individual with civilian ability joins the military is $\Pr\{(\theta, \eta)|V(\theta) < u(w\bar{h}) - v(\bar{h}) + \eta\}$. Notice that the previous probabilities are still independent of the military ability m, as in our benchmark model.

Participation in the civilian sector is based on a threshold. Let $\pi(\theta) \equiv V(\theta) - [u(w\bar{h}) - v(\bar{h})]$ denote the pure pecuniary difference between the civilian and the military utility for an individual with civilian ability θ. (For convenience, we dropped the terms w and $\bar{h}$ from the function $\pi(\theta)$.) The probability that such an individual stays in the civilian economy is

$$\Phi(\theta, \eta) \equiv \Pr\{(\theta, \eta)|\pi(\theta) \geq \eta\}.$$

[17] A recent study of participation and retention in the U.S. military suggest that non-pecuniary incentives play an important role in these decisions. In their study of information technology (IT) workers in and out of the military, Hosek et al. (2004) found that the recruitment into the U.S. military of these specialized workers held steady in spite of growing civilian market opportunities in the late 1990s. Likewise, "taste" for military service plays a central role in the econometric model of recruitment and retention estimated by Hosek and Mattock (2003).

That is, those with a utility η lower than $\pi(\theta)$ choose to remain in the civilian sector. The density of individuals with civilian ability θ in the civilian sector is

$$\hat{\mathbb{F}}_\Theta(\theta) \equiv \int_0^{\pi(\theta)} \mathbb{F}_\Theta(\theta)\Phi(\theta, d\eta). \tag{18}$$

Notice that $\hat{\mathbb{F}}_\Theta(\theta)$ differs from the distribution in our benchmark case. In the benchmark case, this density function was degenerate whereas here some high-ability civilian individuals may opt to join the military for non-pecuniary reasons. We use the updated distribution $\hat{\mathbb{F}}_\Theta(\theta)$ to obtain marginal tax rates and other outcomes following the same steps as in our benchmark specification.

We assume that η is independent of θ. We further assume that η is normally distributed with mean zero and variance σ_η^2. In order to examine the importance of pecuniary versus non-pecuniary motives, we examine different values of σ_η^2. In particular, let σ_π^2 be the variance of $\pi(\theta)$ in the population. (Since θ is heterogeneous in the population, $\pi(\theta)$ is also heterogeneous.) We assume that $\sigma_\eta^2 = k\sigma_\pi^2$. Thus, k represents how much more or less disperse the non-pecuniary motive is relative to the pecuniary motive.

Two extreme cases are illustrative. First, if $k = 0$, we return to the baseline model. Second, if k is large, e.g., as $k \to \infty$, the decision to participate becomes independent of the pecuniary motive; agents enlist half of the time and remain in the civilian sector the other half. Since η and θ are independent, the resulting distribution will be identical to the distribution under a draft. To see this equivalence, notice that the independence between η and θ implies that (18) becomes $\hat{\mathbb{F}}_\Theta(\theta) \equiv \mathbb{F}_\Theta(\theta)\Phi(\pi(\theta))$. For large values of k, $\Phi(\pi(\theta))$ will tend to a one half for all civilian ability types.[18] Half of the population enlists in the military, independent of θ. The budgetary cost, and thus the tax schedule, depends upon the wage paid by the military, just as it does with a draft.

The logic of the previous equivalence is the following. In the draft, nature decides who joins the military. When preferences are the only driver for enlistments (and these

[18] This can be demonstrated by taking the usual normal distribution partial and cumulative densities, and taking the limit as their variance goes to infinity. The partial density converges to zero, while the cumulative density conveges to 0.5.

preferences are independent of civilian ability), the decision to join is also "as if" nature determines who serves. Thus the government may set the military wage to zero, and still recruit a sufficiently large military. For the purposes of optimal taxation, a "pure" random participation is essentially the same as a draft. Obviously, since the motivation to enlist in this case is driven by preferences, the welfare aspects of the analysis are quite different.

Figure 5 plots the military participation and the marginal social value of government revenue for the random participation model. The horizontal axes vary the values of k, from near zero to eighty percent of the standard deviation of $\pi(\theta)$. The starting point is the case where the military wage would draw seventeen percent of the population in the baseline model. As expected, at the lowest values of $k \approx 0$, the military size is approximately the same as it would be in the baseline model.

The mass of individuals who enlist in the random participation model, and would also in the baseline model, is annotated in the graph as "pecuniary enlistment." The individuals who enlist due to non-pecuniary motives are identified as the residual from total enlistments. As the figure shows, the amount of pecuniary enlistment shrinks as k grows because a larger fraction of them draw ηs that keep them out of the military. The incidence of non-pecuniary enlistment grows as the standard deviation of υ grows. The fraction of individuals who enlist in spite of their civilian opportunity costs, relative to those who do so because more limited opportunity cost, grows as the standard deviation of η grows.

As k varies, so does the size and cost of the resulting military, though the wage in the military does not change. To compare the voluntary army against the corresponding draft and baseline volunteer economies, we also plot the marginal social values of government revenue under these two systems with a military of the same size. Figure 5 shows that as the (relative) variance of η grows, the marginal social value of government revenue increases for both the draft and volunteering with random participation. Even with random participation, however, the opportunity cost of revenue is lower under a volunteer system than under a draft. For the largest value of k under study here, well over half of those who enlist would not enlist in the baseline model. In spite of this large volume of enlistment motivated by non-pecuniary reasons, the voluntary system is supported by taxation that is less distortionary than a draft.

Our findings thus suggest that the differences in efficiency between the draft and the voluntary military do not originate in the stark participation decisions of the baseline model.

An optimal conscription tax. Next we consider a more sophisticated recruitment system based on an optimal "in-kind" tax. We assume that the government taxes individuals' productive time directly and uses this time input in the production of government-related activities.[19]

Let $H(y(\theta))$ denote the number of hours a typical individual with reported civilian income $y(\theta)$ must spend in the army, i.e., a conscription tax. As before, this conscription tax depends on the individual's earnings because abilities are private information. Individuals take this tax schedule as given. Let $V^c(\theta)$ represent the value function for an individual with civilian ability θ in an economy with a conscription tax. Let $\ell(\theta) \equiv h(\theta) + H(\theta h(\theta))$ denote the total labor supply of an individual with ability θ. The first term, $h(\theta)$, is the number of hours supplied to the civilian sector and the second, $H(y(\theta))$, the hours in the military.

Analogous to (2), labor supply decisions solve

$$V^c(\theta) \equiv \max_{h(\theta)} \left\{ u(\theta h(\theta)) - v(\ell(\theta)) \right\}. \tag{19}$$

From the first order condition that solves (19) and the envelope theorem, $V^c_\theta(\theta)$ can be written as

$$V^c_\theta(\theta) = v_h(\ell(\theta)) h(\theta)/\theta. \tag{20}$$

A conscription tax is *feasible* if the number of man-hours provided by soldiers equals

[19]The government does not directly compete with the civilian labor market. As in *jury duty*, individuals are required to serve as members of a jury from time to time. As the use of money was rare, "in-kind" taxation including compulsory service in public works and defense was the common mode of taxation in ancient times; see, e.g., Salanie (2003, p. 2).

the given requirement R. That is,

$$\bar{h}R = \int_0^\infty \int_0^\infty H(y(\theta))\mathbb{F}(d\theta, dm). \tag{21}$$

A separate feasibility condition is

$$\int_0^\infty \int_0^\infty c(\theta)\mathbb{F}(d\theta, dm) = \int_0^\infty \int_0^\infty \theta h(\theta)\mathbb{F}(d\theta, dm), \tag{22}$$

which equalizes total consumption with total earnings. A point to notice from the previous constraints is that there is no monetary compensation for military service. For instance, the cost of the army is not present in (22). Individuals have the option of working additional hours in the civilian sector to compensate for the time devoted to military service.

As before, the optimal conscription tax must be *incentive compatible*. The incentive compatibility requirements are given by (20) and $y_\theta(\theta) \geq 0$ for all $\theta \geq 0$. The derivation of these conditions is analogous to the case of income taxes treated before.

The government's social welfare function is

$$W^c \equiv \int_0^\infty \int_0^\infty G(V^c(\theta))\mathbb{F}(d\theta, dm), \tag{23}$$

which shall be maximized subject to the the incentive-compatibility constraint (20) and the feasibility constraints (21) and (22).

Let $T_y^d(y(\theta), p^d, V^d(\theta))$ denote a marginal tax rate for a draft economy as a function of $(y(\theta), p^d, V^d(\theta))$. Let p^c be the Lagrange multiplier on the feasibility constraint (22). The first-order condition for the optimal conscription tax at a civilian income $y(\theta)$ satisfies

$$\theta H_y(y(\theta), p^c, V^c(\theta)) = \frac{T_y^d(y(\theta), p^d, V^d(\theta))}{1 - T_y^d(y(\theta), p^d, V^d(\theta))}, \text{ for all } \theta \geq 0. \tag{24}$$

Expression (24) bears a similar interpretation as $T_y(y(\theta))$.[20] One difference is that

[20]Its derivation is analogous to that of the income tax and hence it is available upon request. For example, notice that the first order condition for an income tax is: $\theta u_c(c(\theta))(1 - T_y(\theta)) = v_h(h(\theta))$.

there is no direct budgetary cost of conscription and hence there is no need to raise tax revenues to pay for the army. For instance, the cost of the army is not present in (22). Individuals have the option of working additional hours in the civilian sector to compensate for the time devoted to military service. A second difference is the inability to transfer time in the case of conscription. While revenues can be transferred across the population, time is an endowment that cannot be transferred. Redistributive goals are more limited under a conscription tax than in the baseline model.

We study the optimal conscription tax numerically following the same steps of the previous methods. We employ the baseline parametrization: utilitarian welfare, lognormal productivity distribution, and the initial individual preference parameters. Figure 6 plots the difference between average welfare in economies with (i) a voluntary army vs. a draft army, and (ii) a voluntary army and a conscripted army: essentially, how much better on average is a voluntary army versus some alternative. The stark inferiority of the conscription tax is readily apparent. The reason for this large difference is that the economies studied here value redistribution. Since conscription taxes are an in-kind tax denominated in hours, this tax does not allow for any income redistribution. Their inability to provide redistribution leads to low consumption, and thus low levels of utility, among the low civilian ability agents. Figure 7 plots the average time tax paid, by agent ability for two military needs: 2.5 and 17 percent. The plot is essentially flat along the dimension of agent ability. This means that, for a given military need, all agents essentially must serve the same amount of time. The optimal conscription time tax is effectively a lump sum time tax. The simulated marginal conscription rates are on the order of 1×10^{-3}.

5 Concluding remarks

The main point of this paper has been to show that, contrary to conventional wisdom, a draft has a limited power to lower the tax distortions tied to the budgetary cost of the

The first order condition for a conscription tax is $\theta u_c(c(\theta)) = v_h(\ell(\theta))(1 + \theta H_y(y(\theta))$. Equalizing both expressions gives the value of $\theta H_y(y(\theta))$ as a function of marginal income taxes.

military. Using a Mirrleesian approach and a two-sector economy, we found that a draft reduces the tax base because some high-income earners are inducted into the army. This reduction in the tax base increases marginal taxes and the distortions associated with taxation in the civilian sector. We found that the efficiency losses of the draft are higher at large military sizes.

We considered additional costs. In general, we found that a volunteer force leads to a more productive civilian economy and is more socially desirable; this result was robust to a series of alternative specifications. Some individuals do prefer a draft because draft economies may redistribute more income in the civilian sector. The size of this minority varies across specifications and declines as military needs increase. Although low military compensations under a draft lower the budgetary cost of the military, we found that such compensation is undesirable as these wages are the only form of insurance under a draft. We also considered a less stark random participation decision, where agents join the military for non-pecuniary reasons. The results under random participation are fully consistent with the baseline results. Further, we considered an optimal conscription tax. We found that this third option fares worst, as it does not allow for income redistribution fundamental to social welfare in Mirrleesian economies.

Our model was purposefully simple. In order to examine the many competing trade-offs associated with alternative recruitment methods, we abstracted from many additional margins that may be important for military recruitment in reality. For example, we have also abstracted from potential gains in training once in the army as well as other dynamic considerations. We leave these explorations for future work.

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Figure 1: Utilitarian social welfare, log-normal wage distribution, alternate wage settings

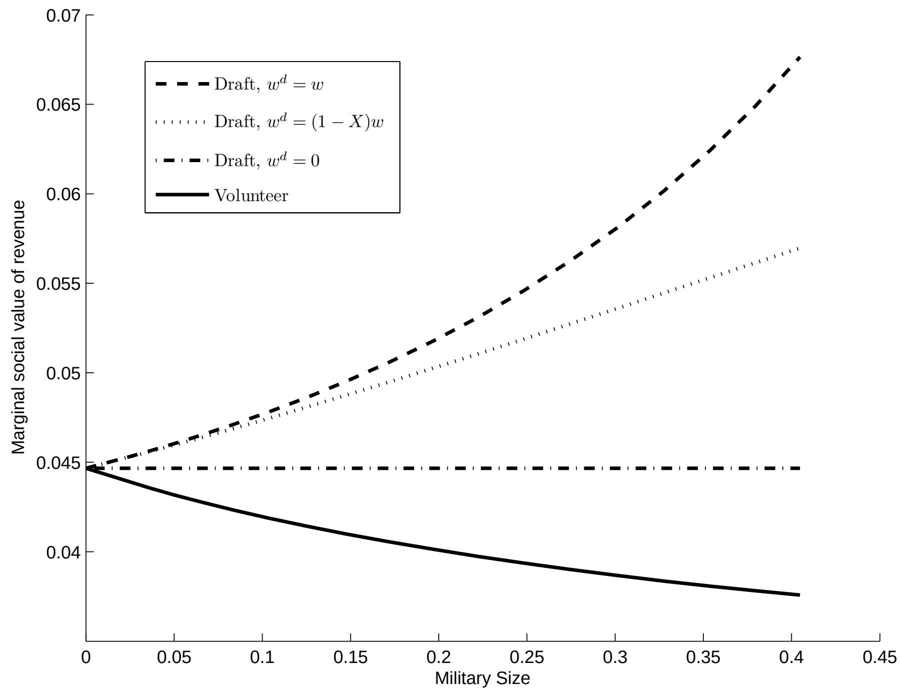


Figure 2: Utilitarian social welfare, log-normal wage distribution

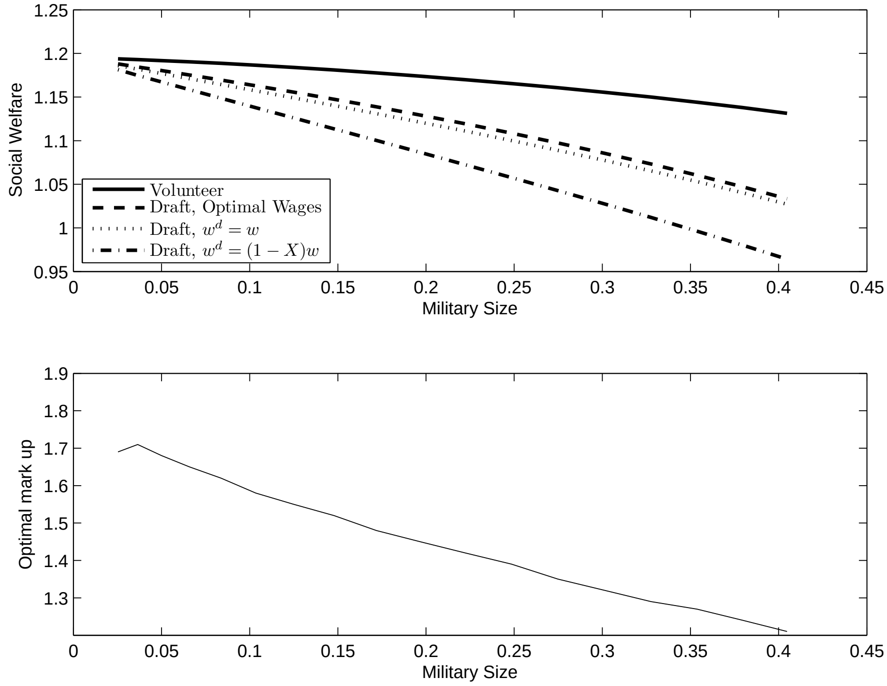


Figure 3: Utilitarian social welfare, log-normal wage distribution

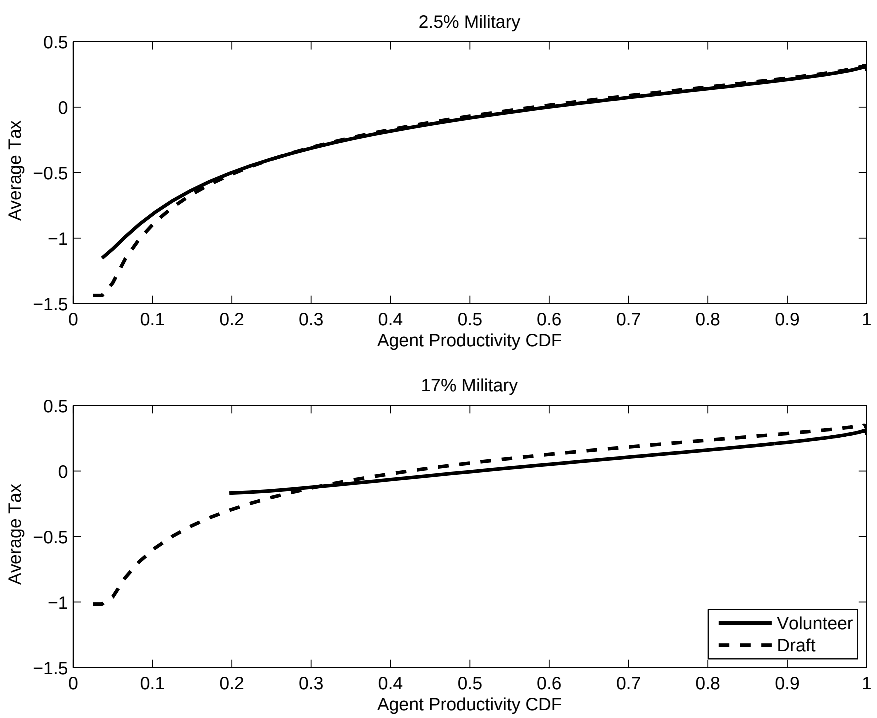
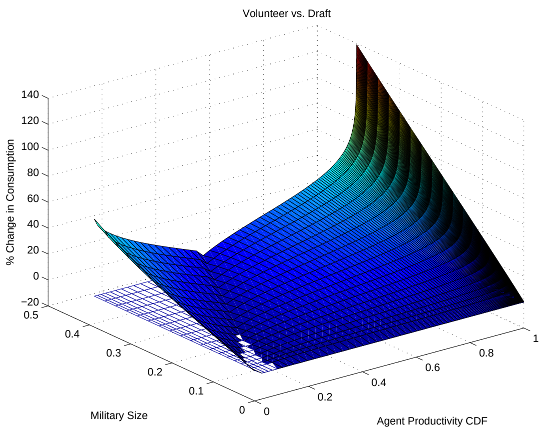
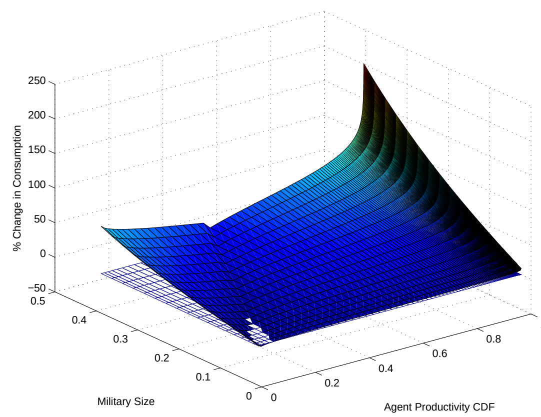


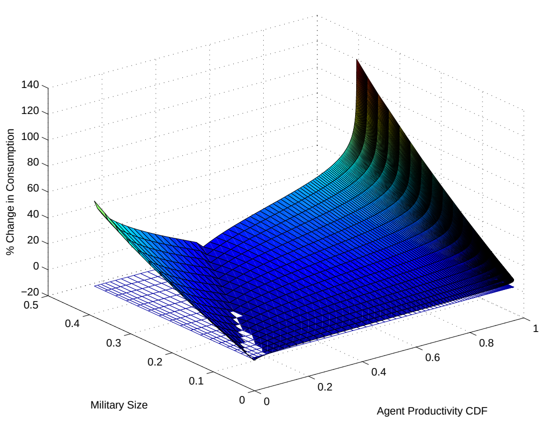
Figure 4: Utilitarian welfare, log-normal wage distribution, alternate draft wages



(a) $w^d = w$



(b) $w^d = (1 - X)w$



(c) Optimal military wages

Figure 5: Volunteering with random participation versus a draft: Utilitarian social welfare, log-normal wage distribution

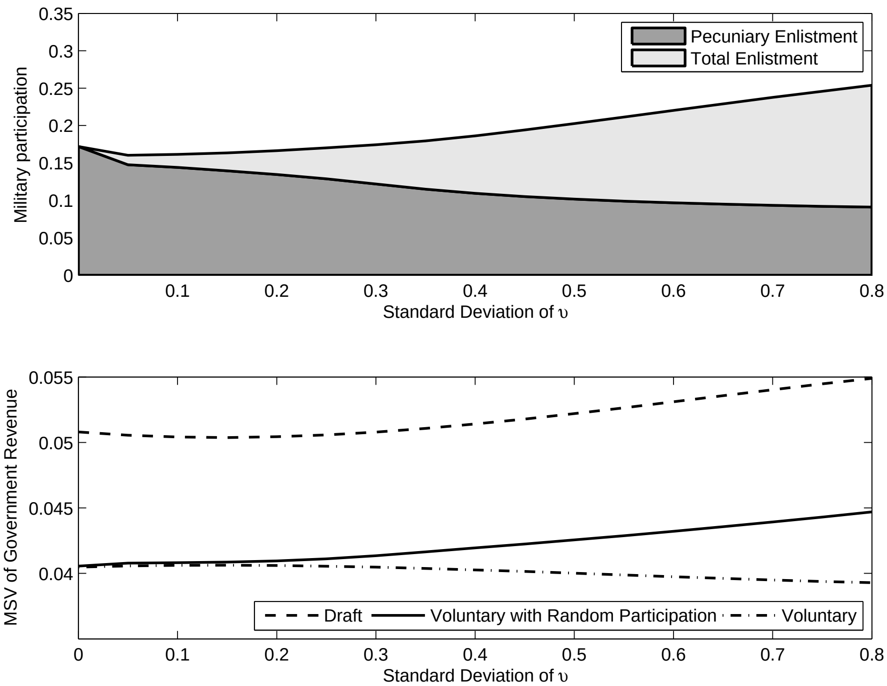


Figure 6: Utilitarian social welfare, log-normal wage distribution

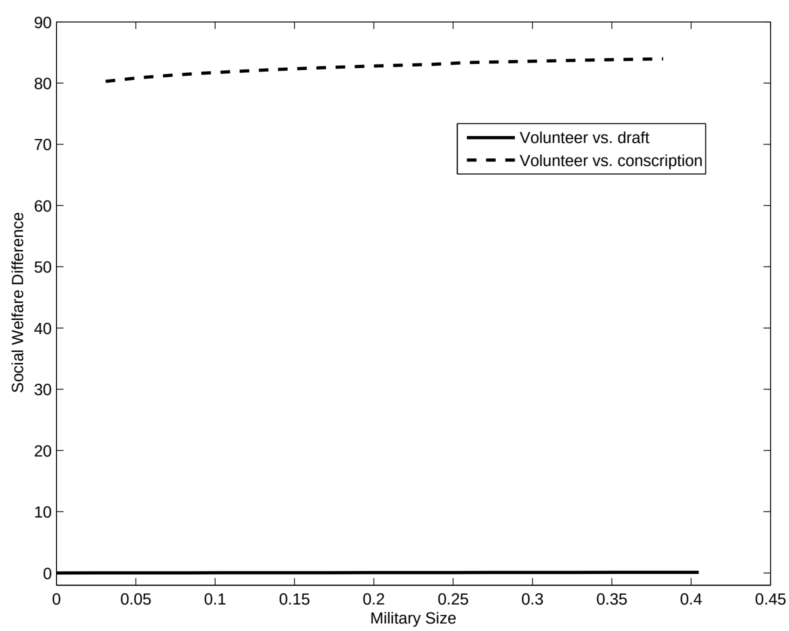


Figure 7: Conscription ("time tax") with utilitarian social welfare, log-normal wage distribution

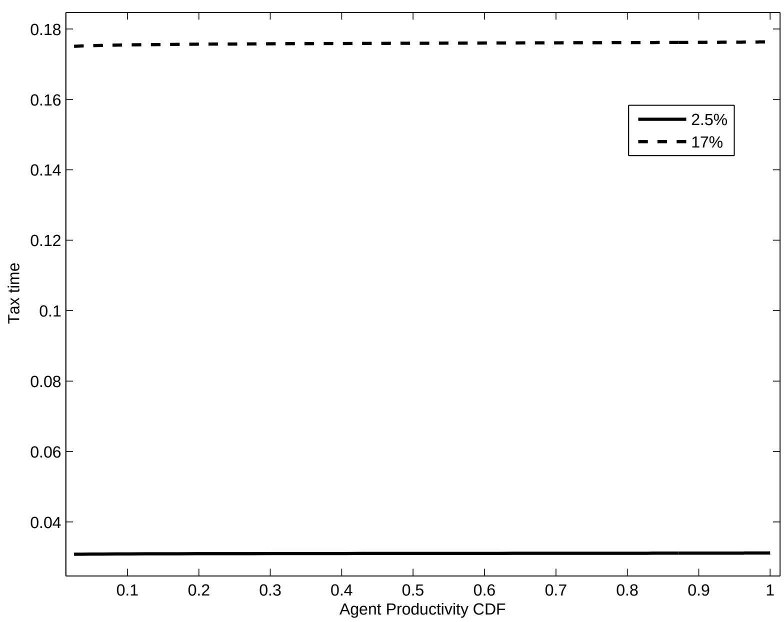


Table 1: Robustness results for alternative model specifications

	Military size	Average tax at ability percentile: 5th Draft	5th Volunteer	95th Draft	95th Volunteer	% Who Prefer Draft
A. Baseline results	2.5	−1.34	−1.08	0.26	0.25	5.84
	17	−0.96	–	0.31	0.25	0
B. Social Welfare Function	2.5	−8.78	−9.02	0.41	0.41	0
($\xi = 1$)	17	−6.94	–	0.47	0.42	0
C. More elastic	2.5	−1.21	−0.82	0.17	0.16	12.5
labor supply	17	−0.69	–	0.21	0.15	2.49

Table 2: Robustness results for alternative civilian ability distributions

	Military size	Average tax at ability percentile: 5th Draft	5th Volunteer	95th Draft	95th Volunteer	% Who Prefer Draft
A. Pareto tail on the ability distribution	5	−12.45	−7.31	0.34	0.32	0
	18	−10.23	–	0.40	0.32	0
B. Increase mean ability ten percent	2.5	−1.26	−0.98	0.26	0.25	6.70
	17	−0.89	–	0.31	0.25	1.90
C. Decrease mean ability ten percent	2.5	−0.83	−0.83	0.24	0.24	2.25
	17	−0.53	–	0.29	0.25	3.53
D. Increase standard deviation of ability ten percent	2.5	−0.60	−0.60	0.29	0.29	2.25
	17	−0.36	–	0.33	0.29	3.53
E. Decrease standard deviation of ability ten percent	2.5	−0.82	−0.67	0.22	0.21	7.81
	17	−0.52	–	0.28	0.22	0