Thema
UMR 8184
THéorie Économique, Modélisation et Applications

Thema Working Paper n°2012-42
Université de Cergy Pontoise, France

Asymmetric Information and Inefficient Regulation of Firms Under the Threat of Revolution

Paul Maarek
Michael Dorsch
Karl Dunz

UNIVERSITÉ de Cergy-Pontoise
CNRS CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

November, 2012

Asymmetric Information and Inefficient Regulation of Firms Under the Threat of Revolution

Karl Dunz* Michael Dorsch† Paul Maarek‡

November 28, 2012

Abstract

This paper considers the role of asymmetric information in a political agency theory of autocratic economic policy-making. Within the context of a static game, we analyze the strategic interaction between a self-interested elite ruling class, who may extract rent inefficiently through hidden regulations, and an imperfectly informed disenfranchised class, who may choose to revolt. In various models, we identify the Perfect Bayesian Equilibrium (PBE), which we describe in terms of the economy's level of development potential. One model has two-sided uncertainty and a cost of regulation. This model has a PBE such below a threshold development level the elite chose inefficient regulation and above the threshold development level the elite chose the efficient policy. A further extension where the elite own assets allows for a voluntarily transition to democracy.

Keywords: Political transition, Revolution, Asymmetric information, Perfect Bayesian equilibrium

*Department of Economics, The American University of Paris, `kdunz@aup.fr`

†Department of Economics, The American University of Paris, `mdorsch@aup.fr`

‡Department of Economics, Université de Cergy-Pontoise, `paul.maarek@u-cergy.fr`

1 Introduction

Under-developed economies often feature inefficient economic policies such as barriers to entry on entrepreneurs and distortionary regulation of credit and labor markets which deteriorate the level of economic activity (Djankov, La Porta, Lopez-De-Silanes and Schleifer, 2002; La Porta and Schleifer, 2008) and are a source of elite predation (Acemoglu, 2006a,b, 2010). The Arab spring uprisings (and the third wave of democratization more broadly) suggest that inefficient economic regulations may be a source of social conflict, though this source of conflict is absent from most economic models of democratization.

This paper considers the political economy of economic policy in a non-democracy. We model the strategic interaction between a dictatorial elite class, who sets policy to maximize their own utility, and a disenfranchised majority, whose only political power lies in their ability to revolt. The disenfranchised class takes control of economic policy following a revolutionary political transition. The threat of revolution constrains the extent to which the elite can predate the economy, much like the need to stand for re-election mitigates the extent to which elected politicians can extract rent in the democratic political agency literature (Barro, 1973; Ferejohn, 1986).

We consider a novel informational asymmetry in analyzing autocratic economic policy-making under the threat of revolution. When there is a bad economic outcome the disenfranchised do not know the extent to which the dictator's economic policy is responsible. The effect is that the economic return to a revolutionary transition to democratically determined economic policy is uncertain. Thus, the dictator can extract rent from the economy in excess of what he could under a perfectly informed revolutionary threat. If there were perfect information, revolution would never be an equilibrium outcome because the elite would have no incentive to deviate from the efficient policy. With asymmetric information, however, the elite may rationally violate the constraint to extract excess rents, at the cost of provoking revolution with a strictly positive probability. An extension of the model considers elite uncertainty about the cost of revolution and allows the elite to concede democracy. Voluntary democratization does not occur in the basic model, where it is a strategy dominated by choosing the efficient policy. We demonstrate a threshold level of economic development (productive potential of the firms), above which the elite choose the efficient policy and below which they choose distortionary regulation.

We follow a series of papers by Daron Acemoglu in modeling the elite's choice between raising predatory revenue directly through taxation or indirectly through distortionary regulation to benefit elite producers (Acemoglu, 2006a,b, 2010).[1] We suppose that the indirect method of manipulating factor prices cannot be observed by the working class, who hold the revolutionary threat (Dorsch and Maarek, 2012; Dorsch, Dunz and Maarek, 2012). In our model, the distortionary regulation limits the size of non-elite firms, which differentiates our paper from earlier work. The limit on firm size reduces labor demand and therefore wages, which allows the elite producers to earn abnormal profits. Modeling distortionary regulation in this way seems to be a more empirically accurate description of predatory regulatory policy in under-developed economies, where firms are generally smaller (La Porta and Schleifer, 2008).

In our model the incomplete information concerns the maximum possible size of firms (development potential), which determines the potential demand for labor in an unregulated market. Workers' prior beliefs over development potential determine the expected wage they would earn if the dictator's regulatory policy were undone following a revolution. The workers rationally chose to revolt if this expected benefit exceeds the cost of the revolution.[2] When the cost of revolution is high enough there is a separating equilibrium in which the elite choose the efficient policy and the workers do not revolt. When the cost of revolt is low, on the other hand, the revolution constraint is tighter and the payoff for the elite from distortionary regulation may be higher than that from the efficient policy. If the cost of revolution is low enough, there may not be a pure strategy equilibrium. In this case, we identify the set of mixed strategy equilibria, which we characterize in terms of when revolutions are more likely to occur.

Due to the difficulty of interpreting mixed strategy equilibria in the context of political institutional change, we extend the basic model to include: (i) a resource cost associated with

[1] Coate and Morris (1995) provide an analogue to representative democracies.

[2] This differentiates our theory from Acemoglu and Robinson (2001) where there is no uncertainty about the economic benefits for workers of a revolution.

regulating the size of firms and (ii) uncertainty among the elite over the cost of revolution. This extension allows us to identify pure strategy equilibria for the case in which previously equilibrium strategies were mixed. In the extended model we can characterize when the elite choose the efficient policy with reference to a threshold level of economic development potential.

A second extension introduces an asset owned by the elite. This asset is destroyed in a revolt. However, we also introduce the possibility that the elite choose to give up power and democratize the state, in which case, they retain the income from the asset. The resulting equilibria are similar to those in the previous extension. However, depending on the parameter values, the elite above a threshold level of development might choose to democratize rather than implement the efficient policy.

We find the nature of the information asymmetry to be a compelling feature of our model. Incomplete information has, of course, been previously introduced into rationalist models of revolutionary political action (Kuran, 1989; Lohmann, 1994; Ellis and Fender, 2010; Bueno de Mesquita, 2010). This literature typically concentrates on the collective action problem among the disenfranchised class, who are incompletely informed about one another's "type". In these models, revolutions may be triggered by information shocks which facilitate overcoming the collective action problem. By contrast, we consider the working class as a single player in a game against the elite class, where the incomplete information is over the potential state of the aggregate economy. The nature of the information asymmetry in the kind of game we focus on is, therefore, considerably different from how uncertainty has previously been treated in economic models of revolutionary transitions.

Our paper is organized in the following way. The next section describes the basic features of our game-theoretic model, which is presented in its extensive form in the third section. The fourth section demonstrates the game's Perfect Bayesian equilibria, which may include mixed strategies. Two additional sections extend the basic model in the two directions described and characterize the extended games' pure strategy equilibria. A final section concludes with some suggestions for future extensions.

2 Economic Environment

The economic environment is essentially a static version of the model in Dorsch and Maarek (2012). There is a continuum of risk neutral agents consisting of a measure L of workers, a measure θ^h of high-productivity (potential) entrepreneurs, and a measure θ^m of elites who control the political institution and can also run firms. It is assumed that $L > \theta^m + \theta^h$ so that workers are a majority of the population and would set policy if the elite were not in power.

Workers hired by the non-elite entrepreneurs have constant productivity of A^h, while those in elite firms have productivity A^m. We assume $A^h > A^m$, so that workers are more productive in firms run by entrepreneurs than in firms run by members of the elite.[3] In addition, each worker inelastically supplies one unit of labor as long as the wage is above the reservation wage, which we normalize to zero.

Only workers and the elite are considered to be strategic players in the game. The elite act as a group to maximize their total payoff. The game described below will give the payoffs to individual workers. However, since all workers are identical, they will make the same choices. Therefore, we will also think of workers as a single player in the game, acting to maximize their total payoff. Notice that this means that we are not considering any coordination problems facing the workers: if one worker revolts then all workers revolt and the revolution will be successful.[4] The entrepreneurs will start businesses if possible and hire the profit-maximizing amount of labor.

In the previous literature there is usually an exogenously given maximum number of workers per entrepreneur. In this paper, we make restrictions on firm size the choice variable for the elite. We normalize units of labor so one worker could be employed per elite firm. The elite choose the maximum number of workers per non-elite entrepreneur, λ, which we interpret as an institutional choice. Rauch (1991), for example, shows that regulation may cause entrepreneurs to move to the informal sector where firms are constrained to be smaller. Smaller firms in the informal sector could also be due to lack of access to resources or public goods.

[3] This assumption is common in the literature; however, the model can be easily solved when the productivities are equal.

[4] Considering an exogenous probability of success, as in Acemoglu *et al.* (2010) and Ellis and Fender (2010) among others, would not change the equilibrium properties.

There could also be institutions that create a cost of entry for middle-class entrepreneurs, or even bar entry explicitly as in Acemoglu (2010) and Dorsch and Maarek (2012). Whatever the case, we consider the limit on firm size as a proxy for these kinds of elite regulation of the private sector.

We assume that the workers have incomplete information about the possible values of λ that the elite could choose. Specifically, we assume that there is a maximum possible value of this parameter, $\bar{\lambda}$, that is known by the elite, but not by the workers, who only know the probability density function, $\rho(\bar{\lambda})$. This $\bar{\lambda}$ can be thought of as describing those features of an economy that affect the capacity constraint of the non-elite firms. Loosely speaking, we think of $\bar{\lambda}$ as summarizing the level of development potential of the economy, which determines the maximum size of non-elite firms. The elite can impose additional institutional or regulatory constraints on firm size by choosing $\lambda < \bar{\lambda}$. The workers are able to infer λ from the equilibrium wage, but are uncertain about whether firms are small because the elite have restricted their size or the economic situation cannot support larger firms.

The payoff to the elite comes from two potential sources. First, they receive profits from the firms they run. This total profit to the elite is $(A^m - w)$ times the amount of labor hired times the measure of the elite producing, where w is the wage rate. Elite producers cannot earn a positive profit if $w \geq A^m$. If this is the case, then the elite earn a payoff from their second source, which is their ability to tax wage income. When $w \geq A^m$, the elite choose a tax rate $0 \leq \tau \leq 1$ and their payoff includes the tax revenue, which is τw times the measure of workers receiving wage w. In principle the elite could receive a payoff from both sources. However, given our assumptions, only one of these will be nonzero in a specific situation.

The payoff to a worker when the elite are in power will be their after-tax wage, $(1 - \tau)w$. The workers can also choose to revolt at a cost of μ per worker. If workers choose to revolt then, since then are a majority, they will choose not to limit the size of firms and not to tax wage income. Therefore, a worker's payoff is $w^* - \mu$ if there is a revolution, where w^* is the wage that would result when $\bar{\lambda}$ is the maximum size of firms. This post-revolution wage is not known to the workers. If the workers revolt then the elite's payoff is zero.

Given the assumption of constant marginal products of labor, there are essentially three different states of the economy, which are characterized by different values of the equilibrium wage. These states are defined by the values of $\bar{\lambda}$, θ^m, and θ^h. One can think of the following characterization of the states of the economy as describing what will happen in a democracy with no constraints of firm size.

The first possibility is that the maximum number of workers that can be hired by the entrepreneurs (both elite and middle-class) is less than the number of workers. In other words,

$$\bar{\lambda} \leq \frac{L - \theta^m}{\theta^h} \equiv \lambda_l. \tag{1}$$

If this is true then the equilibrium wage is zero. Dorsch and Maarek (2012) call this a "tragedy of development". Notice that in this case, any choice of λ by the elite will result in $w = 0$ and, therefore, there will be no tax revenue from a wage tax. This will also be the labor market outcome if there is a revolution and the workers take power. We call this a situation with "low $\bar{\lambda}$" and assume that it occurs with probability $\rho_l \equiv \int_0^{\lambda_l} \rho(\lambda) d\lambda$.

The second possibility is that the marginal employer is an elite entrepreneur, i.e. when

$$\lambda_l \equiv \frac{L - \theta^m}{\theta^h} < \bar{\lambda} \leq \frac{L}{\theta^h} \equiv \lambda_m. \tag{2}$$

In this case the equilibrium wage will be A^m when there are no additional constraints. Notice that it is possible that only a fraction of the elite are in business. All elite firms producing will earn zero profits. So, in this case, the elite's payoff comes from a tax on wage income unless they choose to limit the size of middle-class firms so that the equilibrium wage falls to zero. We call this a situation with "mid $\bar{\lambda}$" and assume that it occurs with probability $\rho_m \equiv \int_{\lambda_l}^{\lambda_m} \rho(\lambda) d\lambda$ (since the equilibrium wage will be A^m in this case).

The final possibility is that all workers can be hired by high-productivity middle-class entrepreneurs. This will be true if

$$\lambda_m \equiv \frac{L}{\theta^h} < \bar{\lambda}. \tag{3}$$

In this situation, the equilibrium wage will be A^h and there will be no elite producers. We call this a situation with "high $\bar{\lambda}$" and assume that it occurs with probability $\rho_h \equiv \int_{\lambda_m}^{\infty} \rho(\lambda) d\lambda$.

It will be convenient to consider inequalities (1), (2) and (3) with $\bar{\lambda}$ replaced by λ. We will call the resulting values of λ low, mid or high, respectively. These result in the different possible equilibrium wages as a function of the choice of λ by the elite. So that if the elite choose low λ then the equilibrium wage is zero, if they choose mid λ then the wage is A^m and if high λ is chosen then the wage is A^h.

All of the above, which is assumed to be common knowledge to workers and the elite, defines an extensive form game with incomplete information. This extensive form is described in the next section along with the notation describing the behavioral strategies of the players.

3 Extensive Form of the Game

We now describe the timing of our extensive form game.

1. Nature chooses $\bar{\lambda}$ with probability density ρ.

2. Elite observe $\bar{\lambda}$ with general information sets denoted by $E(\bar{\lambda})$ or just E_l, E_m, or E_h when $\bar{\lambda}$ is low, mid, or high, respectively.

3. At each information set, elite choose a maximum firm size $0 \leq \lambda \leq \bar{\lambda}$ and tax rate $0 \leq \tau \leq 1$ with the tax rate irrelevant if $\bar{\lambda}$ is low. The values $\lambda(\bar{\lambda})$ and $\tau(\bar{\lambda})$ are the choices of an elite who observe the state of the economy $\bar{\lambda}$, i.e. the behavioral strategy of an elite of type $\bar{\lambda}$. We usually suppress the function notation since it will be clear that we are considering a particular $\bar{\lambda}$. At E_l, the elite's only possible choice is to set a low λ. At E_m, the elite can choose either a low λ or a mid λ with a tax rate τ. At E_h, the elite can choose any of the three types of λ with tax rate for mid λ and high λ. Of course, a strategy choice by the elite can also consist of a mixed strategy.

4. Given the elite's choice of λ and τ, the equilibrium wage, w, is determined and all entrepreneurs demand a profit-maximizing number of workers less than or equal to the maximum (λ for non-elite and 1 for elite).

5. Workers observe the equilibrium wage, w, and any tax rate, τ with general information sets denoted by $W(w, \tau)$ or just W_l, $W_m(\tau)$, or $W_h(\tau)$ for the three possible equilibrium

wages, 0, A^m, or A^h, respectively. Although workers do not observe the elite's choice of λ, they can deduce it from the equilibrium wage. We sometimes suppress the dependence on τ and write W_l, W_m and W_h for these information sets when there is no ambiguity about the value of τ.

6. At each information set, workers choose a probability of revolt, $0 \leq r(w, \tau) \leq 1$. Again suppressing τ, we denote these probabilities by r_l, r_m, and r_h, corresponding to the information sets W_l, W_m and W_h.

7. The following summarizes the payoffs in the three possible states of the economy, i.e. $\bar{\lambda}$ is low, mid, or high, in terms of the pure strategies of the elite and workers. Note that the first expression in each cell is the elite's payoff and the second is the payoff to a worker. Remember that the workers do not know $\bar{\lambda}$ and so their expected payoff depends on their beliefs about $\bar{\lambda}$ and the strategy choice of the elite.

   (a) $\bar{\lambda}$ is low:

Workers

Elite	$r = 0$	$r = 1$
low λ	$A^m\theta^m$, 0	0, $-\mu$

   (b) $\bar{\lambda}$ is mid:

Workers

Elite	$r = 0$	$r = 1$
low λ	$A^m\theta^m$, 0	0, $A^m - \mu$
mid λ, τ'	$\tau' A^m L, (1 - \tau')A^m$	0, $A^m - \mu$

   (c) $\bar{\lambda}$ is high:

Workers

Elite	$r = 0$	$r = 1$
low λ	$A^m\theta^m$, 0	0, $A^h - \mu$
mid λ, τ_m	$\tau_m A^m L, (1 - \tau_m)A^m$	0, $A^h - \mu$
high λ, τ_h	$\tau_h A^h L, (1 - \tau_h)A^h$	0, $A^h - \mu$

If workers revolt ($r = 1$) then the elite receives zero and workers receive the equilibrium wage that would result with $\bar{\lambda}$ minus the cost of revolting μ. This depends on whether nature has chosen $\bar{\lambda}$ to be low, mid or high and is a random variable from the workers' point of view. In these three possible cases, a worker's payoff when revolting is $-\mu$, $A^m - \mu$, or $A^h - \mu$, respectively. When the workers do not revolt, they receive the after-tax wage, which now depends on the λ (and tax rate τ) chosen by the elite. This results in payoffs of 0, $(1-\tau)A^m$, or $(1-\tau)A^h$, depending on whether the elite have chosen λ to be low, mid, or high, respectively. When λ is low, the elite's payoff is their profit from running firms, $A^m\theta^m$ (remember that $\lambda^e \equiv 1$), since there can be no wage tax revenue. If λ is mid or high then the elite's payoff is $\tau A^m L$ or $\tau A^h L$, respectively, where τ is the chosen tax rate which can be different in these two cases. Also, notice that when λ is mid then some elite can be producing. However, any elite producing earns zero profits in this case since $w = A^m$. So all of the elite's payoff comes from taxing labor in this case.

4 Perfect Bayesian Equilibria

A Perfect Bayesian Equilibrium (PBE) of this game also requires specifying the players' beliefs about where they are in each information set. In general, the workers' beliefs would be given by $p(\bar{\lambda}|w, \tau)$, i.e. a probability density of the workers' beliefs about $\bar{\lambda}$ conditional on w and τ. This would give the workers' probability density over nodes at their information set $W(w, \tau)$. However, the only payoff-relevant properties of this density are the probabilities assigned to $\bar{\lambda}$ being low, mid and high, which can depend on the observed wage of either 0, A^m, or A^h. So workers' beliefs can be represented by three triples of probabilities, p^i_j, where p^i_j is the probability that workers believe that $\bar{\lambda}$ is low ($j = l$), mid ($j = m$) or high ($j = h$) when they observe that the wage is $0(i = l)$, $A^m(i = m)$, or $A^h(i = h)$. In addition, for all i we must have $p^i_l + p^i_m + p^i_h = 1$ with each $p^i_j \geq 0$. When workers observe $w = A^h$ they know that $\bar{\lambda}$ must be high and the elite must have chosen a high λ. Therefore, beliefs must have $p^h_h = 1$ with $p^h_l = p^h_m = 0$. When workers observe $w = A^m$ then they know that $\bar{\lambda}$ cannot be low, i.e. $p^m_l = 0$ and $p^m_m + p^m_h = 1$. When workers observe $w = 0$ then they know nothing about $\bar{\lambda}$ and so there are no additional restrictions of the probability vector $p^l \equiv (p^l_l, p^l_m, p^l_h)$. Technically, these beliefs should also depend on the tax rate when relevant.

Definition 1 *A PBE for this game gives a choice of (actually a probability distribution over) $\lambda(\bar{\lambda})$ and a tax rate $\tau(\bar{\lambda})$ (if the chosen λ is not low) at each elite's information set, $E(\bar{\lambda})$; a choice by the workers of a probability of revolting, $r(w, \tau)$, at each of their information sets, $W(w, \tau)$; and workers' beliefs, $p(\bar{\lambda}|w, \tau)$ at each of their information sets, such that*

- *at every information set, the given behavioral strategy is a best reply for that player given that player's beliefs at that information set and the strategies of the other player; and*
- *the beliefs of a player are consistent with Bayes' rule given the strategies and prior probabilities ρ whenever possible.*

We find PBE for all possible combinations of parameter values, but first we show several properties that a PBE must have. We start by describing the only possible τ chosen at E_h along with a high λ that is consistent with a PBE. To do this we first describe the workers' best replies at an information $W(A^h, \tau)$. If workers observe $w = A^h$ then they know that $\bar{\lambda}$ must be high and that the elite have chosen a high λ. Therefore, $p^h_h = 1$ and the workers know that if they revolt they can get a wage of A^h with no taxes. So the workers' best reply will be given by:

$$\left\{ \begin{array}{l} r(A^h, \tau) = 0 \\ r(A^h, \tau) \in [0, 1] \\ r(A^h, \tau) = 1 \end{array} \right\} \Leftarrow \left\{ \begin{array}{l} (1-\tau)A^h > A^h - \mu \\ (1-\tau)A^h = A^h - \mu \\ (1-\tau)A^h < A^h - \mu \end{array} \right\} \quad (4)$$

In other words, when workers observe the high wage they will revolt with positive probability only if the tax rate τ is greater or equal to $\frac{\mu}{A^h}$. Note that if $\mu > A^h$ then the workers will never revolt.

This implies that in a PBE if the elite choose a high λ they will also choose a tax rate of $\tau_h \equiv \min\{1, \frac{\mu}{A^h}\}$ since a higher tax results in a revolt that yields zero to the elite and lower rates will yield lower revenue. This means that the only relevant choice in E_h associated with choosing a high λ is to also choose τ_h. This yields payoffs to the elite of either 0 if there is a revolt or $\tau_h A^h L = \mu L$ if there is no revolt. Worker's receive a payoff of $A^h - \mu$ whether or not they revolt.

Actually, the workers will never revolt if the elite choose (high λ, τ_h) at a PBE. If workers were to revolt with some positive probability (which is a weakly best reply for them) then the payoff to the elite would be less than μL when they choose (high λ, τ_h) at E_h. However, the elite could then achieve a payoff arbitrarily close to μL by choosing a tax rate slightly less than τ_h, which would cause all workers not to revolt. Therefore, there cannot be a PBE where the elite choose (high λ, τ_h) at E_h and the workers revolt with a strictly positive probability at $W(A^h, \tau_h)$. This proves the following.

Proposition 1 *At a PBE, if the elite choose high λ at E_h then they also choose the tax rate $\tau_h \equiv \min\{1, \frac{\mu}{A^h}\}$. Furthermore, at such a PBE, when workers observe a wage equal to A^h they will not revolt, i.e. $r_h = 0$.*

Next, we show that the elite will never choose a mid λ when $\bar{\lambda}$ is high at a PBE. Suppose to the contrary that the elite choose mid λ with tax rate τ at E_h. At $W(A^m, \tau)$, workers will revolt with positive probability if and only if $(1-\tau)A^m \leq p_m^m A^m + p_h^m A^h - \mu$ or $\tau \geq \frac{\mu - (A^h - A^m)p_h^m}{A^m}$ since $p_h^m = 1 - p_m^m$ in this case. This last inequality gives the highest tax rate at which there will be no revolt. Also note that p_h^m by Bayes' Rule depends on the ρ_i and the strategies the elite have chosen at E_h and E_m. Therefore, the elite's highest (conditional) payoff possible when mid λ is selected at E_h is to also choose $\tau = \frac{\mu - (A^h - A^m)p_h^m}{A^m}$. The elite's payoff by doing this will be at most $\frac{\mu - (A^h - A^m)p_h^m}{A^m} A^m L = \mu L - (A^h - A^m)p_h^m L$. Since the elite can attain a payoff of μL by selecting (high λ, τ_h) at E_h, they will never select a mid λ at E_h, which would imply that $p_h^m > 0$ and result in a payoff less than μL.

Combining this with the earlier result and the fact that a wage of A^m will not occur when $\bar{\lambda}$ is high gives

Proposition 2 *At a PBE, the probability that the elite choose a (mid λ, τ) at E_h is zero. Furthermore, this implies that $p_h^m = 0$ and therefore $p_m^m = 1$ at all PBE, i.e. when workers observe a wage of A^m they must believe that $\bar{\lambda}$ is mid.*

This implies that, at $W(A^m, \tau)$, workers will not revolt if $(1-\tau)A^m > A^m - \mu$ or $\tau < \frac{\mu}{A^m}$. Define $\tau_m \equiv \min\{1, \frac{\mu}{A^m}\}$, which will be the tax rate if mid λ is chosen by the elite at E_m at a PBE. So we have

Proposition 3 *At a PBE, if the elite choose a mid λ at E_m then they will also choose a tax rate $\tau_m \equiv \min\{1, \frac{\mu}{A^m}\}$. Furthermore, as above, the workers will not revolt at $W(A^m, \tau_m)$.*

Finally, we describe what consistency with Bayes' Rule implies about the workers' beliefs, p^l, at W_l. To do this let q_j^i, where $i, j \in \{l, m, h\}$ denote the probability that the elite choose a λ that is {low, mid, high} [j is l, m, or h] when they know $\bar{\lambda}$ is {low, mid, high} [i is l, m, or h]. The triple q^i describes the elite's mixed strategy at its information set E_i. Recall that $q_l^l = 1$ since when $\bar{\lambda}$ is low the elite can only choose a low λ. Then we have

$$\begin{aligned} p_l^l &= \frac{\rho_l}{\rho_l + \rho_m q_l^m + \rho_h q_l^h}, \\ p_m^l &= \frac{\rho_m q_l^m}{\rho_l + \rho_m q_l^m + \rho_h q_l^h}, \text{ and} \\ p_h^l &= \frac{\rho_h q_l^h}{\rho_l + \rho_m q_l^m + \rho_h q_l^h}. \end{aligned} \tag{5}$$

The following gives the PBE for various possible values of the parameters. There are 3 cases that describe all of the possible sets of parameters (up to a set of measure zero given by a set of equalities). We also describe the additional possible PBE that arise at the boundary of each case.

Case 1: $\theta^m A^m < \mu L$

At E_l, low λ is the only possible choice for the elite. At E_m, choosing (mid λ, τ_m) yields a payoff of μL to the elite since the workers know $\bar{\lambda}$ is mid if they observe a wage of A^m and will therefore not revolt if the tax rate is τ_m. At E_h, the elite choose (high λ, τ_h) as shown above. Since the elite are choosing different policies in each state, we have a separating equilibrium and the workers know the state by observing the wage. The given policies make not revolting a best reply in each of the workers' information sets. So these policy choices by the elite and the workers not revolting with beliefs given by $p_l^l = p_m^m = p_h^h = 1$ is a pure strategy PBE in this case.

Note that this is also a PBE when $\theta^m A^m = \mu L$. However, in that case, there could also be mixed strategy PBE where the elite could choose a low λ with positive probability at any information set since their payoff is the same. This would require that the workers' beliefs be different since if the wage was zero the workers would not know the state. The beliefs at W_l, which are given by (5) at a PBE would be determined by the mixed strategy used by the elite and Bayes' Rule. [It would still be the case that $p_m^m = p_h^h = 1$.] Any mixed strategy that resulted in beliefs for which not revolting at W_l is a best reply would be part of a PBE.

Case 2: $\theta^m A^m > \mu L$ and $\mu > \rho_m A^m + \rho_h A^h$

The second inequality in this case says that the cost of revolting is greater than the expected wage using the prior probabilities of the different states, i.e. the probabilities of whether $\bar{\lambda}$ is low, mid or high. Note that if the expected wage was high enough, i.e. greater than $\theta^m A^m$, there would be no PBE in this case.

With $\theta^m A^m > \mu L$, the elite will do better by choosing low λ at E_m and E_h if the workers do not revolt at W_l. If the elite choose low λ at every information set then the workers will always observe a wage of zero. Therefore, the workers must believe that the probability of a given state is just the probability that nature chooses that state, i.e. for all $i, p_i^l = \rho_i$.

Given the second inequality involving μ, the workers will therefore never revolt at W_l. Therefore, we have a PBE where the elite are always choosing low λ, the workers always observe a wage of zero and never revolt. The beliefs must be $p^l = \rho$ with p^m and p^h arbitrary since all information sets where the workers observe a nonzero wage are off the equilibrium path. Actions by workers at these other information sets must be optimal given the beliefs and the first constraint on μ guarantees that the elite will not want to deviate from choosing a low λ. These features define the pure strategy PBE in this case.

Notice that this is also a PBE when $\mu = \rho_m A^m + \rho_h A^h$. However, in this case, there would also be mixed strategy PBE of the form given in the next case.

Case 3: $\theta^m A^m > \mu L$ and $\mu < \rho_m A^m + \rho_h A^h$

In this case there is no pure strategy PBE as in the previous two cases. To see this suppose that the workers do not revolt at W_l. Then the elite will want to choose low λ at every information set. Then the workers' beliefs must be $p^l = \rho$ and the second constraint on μ implies that the workers will revolt at W_l so that the elite would receive a payoff of zero. If the workers are revolting at W_l then the elite can do better by choosing (mid λ, τ_m) at E_m and (high λ, τ_h) at E_h, which both yield a payoff of μL to the elite. If this is the elite's strategy then the workers will know that $\bar{\lambda}$ is low when the wage is zero and will therefore not want to revolt at W_l. Therefore, there is no pure strategy choice at W_l that is part of a PBE.

So there must be a PBE with the workers choosing a mixed strategy at W_l. For this to be true, we must have the expected payoff of revolting being equal to the expected payoff of not revolting when the workers observe a wage of zero. In other words, the workers' beliefs at W_l must be such that

$$\mu = p^l_m A^m + p^l_h A^h.$$

Using (5) gives

$$\mu = \frac{\rho_m q^m_l A^m + \rho_h q^h_l A^h}{\rho_l + \rho_m q^m_l + \rho_h q^h_l}$$

or

$$(A^h - \mu)\rho_h q^h_l = \mu\rho_l - (A^m - \mu)\rho_m q^m_l. \tag{6}$$

Note that $A^m > \mu$ by the first inequality constraint in this case and the assumption that $\theta^m < L$.

This equation gives the constraint on the elite's mixed strategies at E_m and E_h, which are defined by the the probabilities of choosing low λ, q^m_l and q^h_l, at these information sets, that make the workers indifferent between revolting and not revolting at W_l. These probabilities must be such that the workers' expected wage under democracy conditional on observing a zero wage is equal to the cost of revolting. In general, (6) implies that the elite are choosing mixed strategies when they know $\bar{\lambda}$ is mid and when they know it is high. However, it is also possible that the elite only mix at one of these information sets.

For example, (6) is satisfied by

$$q_l^m = 0 \text{ and } q_l^h = \frac{\mu\rho_l}{(A^h - \mu)\rho_h}, \tag{7}$$

which says that the elite choose a mid λ at E_m and mix between a low λ with probability q_l^h and a high λ (with tax rate τ_h) at E_h.

Alternatively, (6) is also satisfied by

$$q_l^h = 0 \text{ and } q_l^m = \frac{\mu\rho_l}{(A^m - \mu)\rho_m}, \tag{8}$$

which says that the elite choose a mid λ at E_h and mix between a low λ with probability q_l^m and a mid λ (with tax rate τ_m) at E_m.

In order for the above mixed strategies to be optimal at E_m and E_h it must be that a low λ yields the same expected payoff as (mid λ, τ_m) at E_m and the same expected payoff as (high λ, τ_h) at E_h. In other words, we must have

$$(1 - r_l)\theta^m A^m = \tau_m A^m L = \mu L \text{ and } (1 - r_l)\theta^m A^m = \tau_h A^h L = \mu L. \tag{9}$$

Both of these constraints give

$$r_l = \frac{\theta^m A^m - \mu L}{\theta^m A^m} \tag{10}$$

as the probability the workers will revolt when they observe a wage of zero. Notice that, perhaps surprisingly, this probability of a revolt does not depend on the prior probabilities of the various states, ρ_i. However, these probabilities do affect whether this case or the previous case, in which there is no probability of a revolt, occurs. For example, higher ρ_m or higher ρ_h, other things being equal, make this case more likely than the previous case and therefore can cause a jump in the equilibrium probability of a revolt from zero to some positive value.

Equations (6) and (10) define mixed strategies for the elite and workers that are part of a PBE in this case. Substituting a solution to these equations into (5) gives the workers' beliefs at W_l. When the workers observe a mid λ they know that $\bar{\lambda}$ is mid and will not revolt if and only if $\tau \leq \tau_h$. When workers observe a high λ they know that $\bar{\lambda}$ is high and do not revolt if and only if $\tau \leq \tau_h$. Since the elite choose tax rates τ_h when they choose a mid λ and τ_h when they choose a high λ, there will be no revolt when the wage is above zero. These features define a PBE in this case.

The following summarizes the three possible PBE of the game.

1. When the cost of revolt and the economic return of taxation relative to elite productivity is high , i.e. $\theta^m A^m < \mu L$, there is a pure strategy PBE in which there is no revolution and all elite types choose taxation if possible.

2. When elite productivity is high relative to the revenue from taxation (i.e. $\theta^m A^m > \mu L$) and the cost of revolt is sufficiently high (i.e. $\mu > \rho_m A^m + \rho_h A^h$), there is a pure strategy PBE in which there is no revolution and all elite choose factor price manipulation.

3. When elite productivity is high relative to the revenue from taxation (i.e. $\theta^m A^m > \mu L$) and the cost of revolt is sufficiently low (i.e $\mu < \rho_m A^m + \rho_h A^h$), there are only mixed strategy PBE in which workers choose to revolt with positive probability of revolution and some elites choose to restrict firm size with positive probability.

We find it worthwhile to point out some interesting features of our model with reference to the relevant literatures in economics and political science. First, note the inequality that differentiates cases 2 and 3 is the expected post-revolution wage relative to the cost of revolting ($\rho_m A^m + \rho_h A^h$ -vs- μ). The uncertainty surrounding the net benefit of revolt differentiates our theory from previous work that concentrates on how the cost of revolt fluctuates with the business cycle. Second, note that the equilibrium mixed strategy of workers in case 3 suggests a random element to the outbreak of revolutions, consistent with the models of Kuran (1989, 1991). Finally, note that the motivation for workers to revolt in our model is *not* redistributive, as in the classic economic models of democratization (Acemoglu and Robinson, 2001, 2006). In our model, the incentives to revolt are found in the workers' opinion concerning economic institutions.

The equilibrium mixed strategy of the elite. however, in case 3 is more difficult to interpret since it is unclear what exactly it means for the elite to mix between different limits on firm size. A possible interpretation of the q_l^i given by (6) is that it represents the fraction of the elites in E_i choosing a low λ. So, all elites choose a pure strategy; however, not all of them observing the same type of information choose the same strategy. For example, q_l^h is the fraction of all elites observing a high $\bar{\lambda}$ who choose a low λ. The other $1 - q_l^h$ of elites observing a high $\bar{\lambda}$ would choose not to restrict firm size. This interpretation is not completely satisfactory since it is unclear what determines whether an elite observing a high $\bar{\lambda}$ chooses to restrict firm size or not. The next section enriches the basic model in a way that yields pure strategy PBE in all cases.

5 Pure Strategy Equilibrium

In this section we add two features to the model that result in pure strategy PBE always existing. First, we make the cost of revolution, μ, unknown to the elite. This implies that there is always a probability of revolt, unlike in the previous model in which the elite can choose a tax rate that makes the probability of revolt zero. This uncertainty is not enough to guarantee pure strategy PBE. Therefore we add a second feature, namely a cost for the elite of restricting firm size. Limiting firms to a size below their potential requires more regulation and costly monitoring. When are model is enriched with both of these features there are pure strategy PBE for all parameter values.

It seems more realistic that the elite do not know the workers' cost of revolt. Things like the cost and ease of coordination or the extent of the workers' distrust of the elite, which can be included in the cost of revolt, are clearly better known to the workers than to the elite. Formally, we assume that the elite only know the probability distribution function,

$$F(x) \equiv \int_0^x f(\mu) d\mu \tag{11}$$

giving the probability that $\mu \leq x$. We will assume that $F(0) = 0$ so that $\mu > 0$ with probability one. In addition, we will assume that $F(A^m) = 1$, which guarantees that elite with mid or high $\bar{\lambda}$ will choose a tax rate less than 1 when they choose not to restrict firm size.

Workers know the value of μ. So, we now have to index the workers' information sets by his type μ. Therefore, $W(w, \tau, \mu)$ now represents an information set of the workers. At such an information set, the workers will revolt only if $p_m A^m + p_h A^h - \mu \geq (1-\tau)w$, where p_m and p_h give the conditional probability given w that the workers believe that the equilibrium wage will be A^m or A^h, respectively, after a revolt.

We suppose that the cost of regulating firm size is strictly increasing in the difference between the productive capacity of non-elite firms and the size of firms that is desired by the elite. That is, the regulatory cost is higher the more the elite restrict firm size below $\bar{\lambda}$. We capture this regulatory cost of limiting firms to λ when the economy is characterized by $\bar{\lambda}$ by a strictly increasing continuous function $c(\bar{\lambda} - \lambda)$. Assume that $c(0) = 0$ so that if the elite impose no restriction on firms there is no regulatory cost.

The elite's payoff is now reduced by the regulatory cost of achieving their chosen λ. This means that the elite will choose the λ that results in their desired outcome and has the lowest regulatory cost. Therefore, if $\bar{\lambda}$ is already of the desired type (i.e. low, mid or high) then the elite will chose $\lambda = \bar{\lambda}$ and incur no cost. If the elite want to limit firm size then they will pick the highest λ consistent with the desired equilibrium wage. In other words, if the elite want to restrict firm size to a low λ they will pick λ_l and if they want to restrict to a mid λ they will pick λ_m.

When the elite are uncertain about the value of μ, Propositions 1-3 do not directly apply. It will no longer be true, as in Propositions 1 and 3, that elite with high $\bar{\lambda}$ and mid $\bar{\lambda}$ can prevent revolution by choosing a conciliatory tax rate. When μ is uncertain for the elites, that is not possible. In the extended model, the payoff-maximizing tax rates are associated with a strictly positive probability of revolt.

However, we demonstrate below that one implication of these propositions continues to hold. Namely, elites at E_e and E_h who choose not to restrict firm size have the same expected payoff. We also show that Proposition 2 still holds when the elite are uncertain about the value of μ and there is a regulatory cost associated with restricting firm size.

First, consider an elite at an E_h. Remember that when the wage is A^h the workers know that $\bar{\lambda}$ is high and therefore $p_h = 1$ at any $W(A^h, \tau, \mu)$. This implies that workers revolt at such information sets whenever $\mu \leq \tau A^h$ and therefore the elite choosing a high λ will face a probability of a revolt of $F(\tau A^h)$. So at an $E(\bar{\lambda})$ with $\bar{\lambda}$ high, the elite's expected payoff of choosing $(\bar{\lambda}, \tau)$ is $[1 - F(\tau A^h)]\tau A^h$. This means the elite's maximum expected payoff when they do not restrict firm size and choose a tax rate of τ is given by

$$\max_{\tau}[1 - F(\tau A^h)]\tau A^h L. \tag{12}$$

We assume that F is such that this problem has a unique maximum and denote the tax rate that solves this problem by τ_h.

Now consider an elite at an E_m and assume that when workers observe a wage of A^m they believe that $\bar{\lambda}$ is mid, i.e. $p^m_m = 1$. [We will show that this is in fact true.] Therefore, workers will revolt if $\mu \leq \tau A^m$ and the probability of revolt facing an elite is $F(\tau A^m)$. So such an elite's maximum expected payoff when they do not restrict firm size and choose a tax rate of τ is given by

$$\max_{\tau}[1 - F(\tau A^m)]\tau A^m L. \tag{13}$$

Let τ_m be the tax rate that solves this problem.

Note that problems (12) and (13) are equivalent to the following problem.

$$\Pi^* \equiv L \max_{x}[1 - F(x)]x. \tag{14}$$

In this formulation of the elite's problem, x can be interpreted as the amount of tax the elite extract per worker. We assume that F is such that this problem has a unique solution, which we denote x^*.[5] The assumption that $F(A^m) = 1$ guarantees that the solution will be less than A^m. Therefore, the solution to (13) will be $\tau_m \equiv \frac{x^*}{A^m}$ and the solution to (12) will be $\tau_h \equiv \frac{x^*}{A^h}$.

Therefore, if $p^m_m = 1$ then elite at an E_m and E_h will have the same expected payoff, Π^*, if they choose not to restrict firm size. The condition $p^m_m = 1$ will be satisfied if elite with a high $\bar{\lambda}$ never select a mid λ. We next show that this is true as in Proposition 2.

Suppose the elite at E_h choose a mid λ with tax rate τ. In this case, workers observing a

[5] A sufficient condition for this is $xf'(x) > -2f(x)$ for all x between 0 and A^m, which is satisfied by a uniform distribution.

wage of A^m will revolt if $(1-\tau)A^m < p^m_m A^m + p^m_h A^h - \mu$ or, equivalently if $\mu < \tau A^m + (A^h - A^m)p^m_h$, since $p^m_m + p^m_h = 1$. Therefore such an elite's expected payoff is $[1 - F(\tau A^m + (A^h - A^m)p^m_h)]\tau A^m L$ and their maximum payoff associated with a mid λ is

$$\max_{\tau}[1 - F(\tau A^m + (A^h - A^m)p^m_h)]\tau A^m L. \tag{15}$$

Note that this has the form

$$L \max_{x}[1 - F(x + a)]x, \tag{16}$$

where $a > 0$. Since F is increasing, the maximum value of (16) will be less than the solution to (14). This means that if a positive measure of elite with a high $\bar{\lambda}$ choose a mid λ, so that $p^m_h > 0$, then the payoff of an elite at E_h choosing not to restrict firm size will have a higher expected payoff than an elite at E_h who chooses a mid λ. So, at a PBE, no elite will choose a mid λ at an E_h. Therefore, Proposition 2 holds in our extended model. This also implies that the previous argument showing that elites with both mid and high $\bar{\lambda}$ have the same payoff, Π^*, applies.

The value Π^* will be now be used to characterize the different types of PBE. At each PBE each type of worker and elite will choose a pure strategy, unlike in the previous section where there are only mixed strategy PBE for certain parameter values. Workers will choose to revolt at $W(w, \tau, \mu)$ iff $\mu <$ expected wage after a revolt minus $(1-\tau)w$, where the expected wage depends on the workers' conditional beliefs about the true value of $\bar{\lambda}$. These conditional beliefs are given by Bayes' Rule and the elite's strategy in the PBE. The elite with a low $\bar{\lambda}$ will choose to make no change. The elite at $E(\bar{\lambda})$ with $\bar{\lambda} > \lambda_l$ will choose either not to restrict firm size by selecting $\lambda = \bar{\lambda}$ with tax rates τ_m if $\bar{\lambda}$ is mid or τ_h if $\bar{\lambda}$ is high, or choose to restrict firm size by selecting $\lambda = \lambda_l$. The following describes when each of these strategies is chosen.

First, we define notation for the worker's expected wage after a revolt conditional on observing a wage of zero. In general this depends on which elite choose λ_l. However, given our assumption it will be sufficient to have an expression giving the expected wage after a revolt when only elite with $\bar{\lambda} < \ell$ choose to restrict firm size to λ_l. For all $\ell \geq \lambda_l$, this will be

$$\mathbf{E}w(\ell) \equiv \left(\int_{\lambda_l}^{\min\{\ell,\lambda_m\}} \rho(\lambda) A^m d\lambda + \int_{\lambda_m}^{\max\{\ell,\lambda_m\}} \rho(\lambda) A^h d\lambda \right) / \left(\int_0^{\ell} \rho(\lambda) d\lambda \right).$$

Our characterization will also depend on the following function. Define

$$\Pi(\ell) \equiv [1 - F(\mathbf{E}w(\ell))] \, \theta^m A^m - c(\ell - \lambda_l). \tag{17}$$

This function gives the expected payoff of an elite at $E(\ell)$ choosing to restrict firm size by selecting λ_l assuming that all types of elite with $\bar{\lambda} \leq \ell$ also choose λ_l and all types of elite with $\bar{\lambda} > \ell$ choose not to restrict firm size. $F(\mathbf{E}w(\ell))$ is the fraction of worker types who will revolt, i.e. have a cost of revolt less than the expected wage, when they observe a wage of zero and have equilibrium beliefs that all types of elite with $\bar{\lambda} \leq \ell$ choose a low λ. Note that $\Pi(\lambda_l) = \theta^m A^m$ and Π is a decreasing continuous function.

Case 1: $\theta^m A^m \leq \Pi^*$

At all $E(\bar{\lambda})$ with $\bar{\lambda} \leq \lambda_l$, low λ is the only possible choice for the elite. For the other elite types, this case says that Π^* is larger than what such elite would obtain by choosing a low λ. Therefore, at $E(\bar{\lambda})$ with $\lambda_l < \bar{\lambda} \leq \lambda_m$, the elite choose $(\bar{\lambda}, \tau_m)$ and at $E(\bar{\lambda})$ with $\bar{\lambda} > \lambda_m$, the elite choose $(\bar{\lambda}, \tau_h)$.

This gives essentially the same kind of PBE as in the case where $\theta^m A^m < \mu L$. All elite choose not to restrict firm size and the workers know the state by observing the wage. Here, the regulatory cost leads to the elite keeping $\bar{\lambda}$ unchanged. In the previous section there was a zero probability of revolt. Here, except when $w = 0$, there is always a positive probability of revolt. Furthermore, elite with mid and high $\bar{\lambda}$ get the same expected payoff, Π^*, and face the same probability of revolt, $F(x^*)$. However, as in the previous section, elite with mid $\bar{\lambda}$ will have a higher tax rate, $\tau_m = x^*/A^m$, than elite with high $\bar{\lambda}$, who will select a tax rate of $\tau_h = x^*/A^h$.

Case 2: $\Pi^* < \theta^m A^m$ **and** $\Pi^* < \Pi(\ell)$ **for all** $\ell > \lambda_l$

The second condition implies that all elite with $\bar{\lambda} > \lambda_l$ have a higher payoff if they restrict firm size to λ_l than if they choose no restrictions on firm size with the payoff-maximizing tax rate. This is analogous to the second case in the previous section, where all elite also choose a low λ. However, in the previous section workers never revolt while here there is a positive probability of revolt.

Case 3: $\Pi^* < \theta^m A^m$ **and** $\Pi^* \geq \Pi(\ell)$ **for some** $\ell > \lambda_l$

Since Π is a decreasing continuous function with $\theta^m A^m = \Pi(\lambda_l) > \Pi^* \geq \Pi(\ell)$ for some ℓ, there exists a $\lambda^* > \lambda_l$ such that $\Pi(\lambda^*) = \Pi^*$. For all types of elite with $\bar{\lambda} < \lambda^*$ their payoff when choosing λ_l is greater than their payoff from not restricting firm size, which is Π^*. All types of elite with $\bar{\lambda} > \lambda^*$ have a higher payoff when not restricting firm size than if they choose λ_l, which yields less than $\Pi(\lambda^*)$ since the regulatory costs of such elites is larger than for the type with $\bar{\lambda} = \lambda^*$.

This case corresponds to the case in the previous section that had no pure strategy PBE. However, here we have all players choosing pure strategies at every information set. All types of elite in economies below some level of development (i.e. $\bar{\lambda} < \lambda^*$) choose to restrict firm size, while types with more developed economies choose not to restrict firm size. In effect, from the point of view of the workers this is like selecting a particular type of mixed strategy satisfying the analogue of the constraint (6). The λ^* defines a fraction of elite with mid $\bar{\lambda}$ that restrict firm size. If this fraction is less than one then all types of elite with high $\bar{\lambda}$ do not restrict firm size. The fraction of types of elite with high $\bar{\lambda}$ that restrict firm size is strictly positive only if the fraction of types of elite with mid $\bar{\lambda}$ that restrict firm size is one. These fractions of these two types of elite restricting firm size determines the workers' expected post-revolution wage when they observe a wage of zero. In equilibrium this expected wage must be such that the probability of revolt faced by the elite makes the type of elite with λ^* indifferent between restricting firm size and not restricting firm size.

Our model predicts a negative correlation between the level of development and bad regulation (i.e. restrictions on firm size). Assuming a given prior, increasing $\bar{\lambda}$ increases the cost of limiting firm size in order to lower wages and extract rent. When the level of development reaches a particular threshold level, elite switch from inefficient regulation (restricting firm size) to the efficient policy of taxation. This is consistent with much of the empirical evidence, such as Djankov *et al.* (2002), that finds entry costs to start a business are 108% of per capita GDP for the lowest quartile of development and only 41% for the third quartile of development.

6 Elite Asset Income and Democratization

In this section we assume that the elite have assets that yield a payoff of B and allow them to voluntarily democratize giving the workers political power. The elite's asset is destroyed in a revolution and cannot be obtained by the workers. However, the elite retain this asset income if they democratize. Therefore, if the elite choose to democratize then their payoff is B. If the elite choose to restrict firm size and there is no revolt then they receive the payoff given in the previous section plus B. As before, if there is a revolt then the elite receive zero. Everything else is the same as in the previous section.

Before describing the equilibria in this new situation, note that adding asset income to our baseline model with no incomplete information about μ will not result in the elite choosing to democratize in any equilibrium. This is because when there is no revolt democratization is dominated by other possible choices of the elite. Democratization yields the elite a payoff of B, while choosing taxation will give them that asset income plus the tax revenue μL without any risk of revolt in the baseline model. The inclusion of asset income would change the equilibrium probability that workers revolt in this case; however, none of the other parts of the equilibria described in Section 4 would change.

Including asset income does change the equilibria when there is incomplete information about μ. The following describes how the results in the previous section differ with the addition of asset income for the elite.

First consider the elite's problems at E_h and E_m when they do not restrict firm size. (14) shows that these two problems are equivalent with their common maximum value defined to be Π^*. With income from an asset, this problem becomes

$$L \max_x [1 - F(x)](x + \frac{B}{L}). \tag{18}$$

We again assume that this has a unique solution, which we will now denote by x_B. Furthermore, to guarantee that the solution is greater than zero we assume that $Bf(0) < L$. Call the maximum value of (18), $\Pi_B \equiv [1 - F(x_B)](x_B L + B)$, which will now be the common payoff of the elite at E_m and E_h if they do not restrict firm size. The argument in the previous section showing that Proposition 2 applies is also true with an asset income. Therefore, it will still be the case that $p_m^m = 1$ and no elite at E_h will choose a mid λ. So, elites who do not restrict firm size at both mid and high $\bar{\lambda}$ will have the same payoff, Π_B, in the case where they have asset income.

Also note that the tax rates chosen by the elite will now be different than in the case without asset income. At E_m, the elite will now select $\tau_m \equiv \frac{x_B}{A^m}$ and at E_h they will select $\tau_h \equiv \frac{x_B}{A^h}$.

The function, $\Pi(\ell)$, defined by equation (17) is modified in the obvious way to include the asset income. It still represents the expected payoff of an elite at $E(\ell)$ choosing to restrict firm size by selecting λ_l assuming that all types of elite with $\bar{\lambda} \leq \ell$ also choose λ_l and all types of elite with $\bar{\lambda} > \ell$ choose not to restrict firm size. Note that $\Pi(\lambda_\ell) = \theta^m A^m + B$ and Π is a decreasing continuous function.

We use this function to describe the PBE in the same way as earlier. However, the definitions of the cases will now be slightly different to take into account the possibility that the elite can now choose to democratize.

Case 1′: $\theta^m A^m + B \leq \Pi_B$

This is the analogue of case 1 in the previous section. With the chosen tax rates and expected payoffs modified as above, this case is otherwise unchanged. All types of elites choose not to restrict firm size and the workers know the state by observing the wage.

Case 2′: $\Pi_B < \theta^m A^m + B$ **and** $\max\{B, \Pi_B\} < \Pi(\ell)$ **for all** $\ell > \lambda_l$

This is the analogue of case 2. The second inequality implies that all elite prefer to restrict firm size to λ_l rather than either democratizing or imposing a tax.

Case 3′: $\Pi_B < \theta^m A^m + B$ **and** $\max\{B, \Pi_B\} \geq \Pi(\ell)$ **for some** $\ell > \lambda_l$

This is analogous to case 3 where there is a (potentially partial) separately equilibrium in which elite types with $\bar{\lambda} <$ some λ^* choose to restrict firm size to λ_l and the other elite choose not to restrict. Now it is possible that the elite will prefer to democratize rather restrict firm size. The cutoff λ^* is determined by $\Pi(\lambda^*) = \max\{B, \Pi_B\}$. All elite with $\bar{\lambda} < \lambda^*$ choose λ_l.

If $\Pi_B > B$ then then all elite with $\bar{\lambda} > \lambda^*$ choose not to restrict firm size. If $\Pi_B < B$ then then all elite with $\bar{\lambda} > \lambda^*$ choose to democratize. If $\Pi_B = B$ then all elite with $\bar{\lambda} > \lambda^*$ are indifferent between not restricting firm size and democratizing.

Therefore our model, depending on the parameter values, allows for democratic transitions either by the elite abandonning power or by a worker revolution. This contributes the theoretical literature concerning political transition. In Acemoglu and Robinson (2001) the elite's only source of income is from an asset that is lost if a revolt occurs. In this dynamic game, after observing that the revolution constraint is violated the elite can credibly democratize and a revolt never occurs. In Ellis and Fender (2010), Bueno de Mesquita (2010) or Kuran (1989), political transitions are only possible if a revolt occurs. Our model, by contrast, provides a unified framework where both types of transitions are possible equilibria in a one-shot game.

7 Conclusion

This paper has introduced incomplete information into a political economy model of economic policy in a non-democracy along the lines of Dorsch and Maarek (2012). Our model is a static two-player game with incomplete information where the uncertainty is about the potential size of firms, which we interpret as representing the level of development or productive potential of the economy. In our basic model, we show that it is possible that there are no pure strategy equilibrium in certain situations. We consider an extension in which the elite are also uncertain about the cost of revolt to the workers. The extended model with two-sided uncertainty also includes a regulatory cost of restricting the size of firms, which is increasing in the amount by which firm size is reduced. This enables us to show that a pure strategy PBE always exists in the extended model. These equilibria have the property that there exists a level of development such that if the level observed by the elite is less than this amount then the elite choose distortionary regulation while if they know the level of development is higher then they choose the efficient policy.

Recent empirical findings in the political science literature demonstrate that the "third wave" of democratization (since 1970s) seems to have been driven by distributive conflicts to a lesser extent than the previous waves (Houle, 2009; Haggard and Kaufman, 2012; Teorell, 2012). To the extent that transitions are motivated by institutional factors rather than distributive factors, our model provides a point of departure for further theoretical work on democratization that is not driven by distributive conflict. Furthermore, the most recent episodes of revolutionary democratization have occurred in countries with under-employed and highly educated work forces (Campante and Chor, 2012). Our model, with its emphasis on development capacity and distorting regulation sheds light on these episodes.

Since we are thinking of the parameter $\bar{\lambda}$ as representing the level of development of an economy it would be useful to consider a repeated game where is parameter evolved over time and/or was endogenously determined. This would allow one to examine how the institution choice of the elite evolved over time. One can get a rough sense of what might happen in this situation by examining how the equilibrium changes in our model as the expectation of the probability distribution ρ increases. This would place more weight on states of the economy with higher equilibrium wages, which would increase the expected wage of the workers after a revolution and thus make revolts more likely. This would make the first case in each of our models less likely, other things being equal. Therefore, one would expect to see more equilibria where the elite choose the efficient policy as the productive potential of the economy increases. This is similar to our interpretation of the equilibrium with the threshold level in our extended model. However, it would be useful to have a more explicit dynamic model with such a results.

Another possible extension that might be interesting is to consider a game where the middle-class entrepreneurs are also strategic players. This would make the model similar to Acemoglu (2010) where he has two competing groups of elites, but no workers. One could ask questions like when and/or whether the middle-class will support the elite against the workers or support the workers in a revolt against the elite. In the basic model in this paper, the middle-class would prefer to have restrictions that limit the wage to A^m (or less) since they make no profits when λ is high and the wage is A^h. So they would seem likely to support the elite to prevent a revolution when $\bar{\lambda}$ is high. However, when $\bar{\lambda}$ is low (or mid) the middle-class would do better under democracy than under the elite with a restriction on firm size. So, in such cases, it appears that the middle-class might support the workers against the elite. It would be interesting examine this issue of coalition formation more precisely in our model.

References

Acemoglu, D. (2006a) Modeling inefficient institutions, in *Advances in Economic Theory and Econometrics: Proceedings of the 2005 World Congress of the Econometric Society* (Eds.) R. Blundell, W. Newey and T. Persson, Cambridge University Press, Cambridge.

Acemoglu, D. (2006b) A simple model of inefficient institutions, *Scandinavian Journal of Economics*, **108**, 515–546.

Acemoglu, D. (2010) Institutions, factor prices and taxation: Virtues of strong states?, *American Economic Review*, **100**, 115–119.

Acemoglu, D. and Robinson, J. (2001) A theory of political transitions, *American Economic Review*, **91**, 938–963.

Acemoglu, D. and Robinson, J. (2006) *The Economic Origins of Dictatorship and Democracy*, Cambridge University Press, Cambridge.

Acemoglu, D., Ticchi, D. and Vindigni, A. (2010) A theory of military dictatorships, *American Economic Journal: Macroeconomics*, **2**, 1–42.

Barro, R. (1973) The control of politicians: An economic model, *Public Choice*, **14**, 19–42.

Bueno de Mesquita, E. (2010) Regime change and revolutionary entrepreneurs, *American Political Science Review*, **104**, 446–466.

Campante, F. and Chor, D. (2012) Why was the Arab world poised for revolution? Schooling, economic opportunities, and the Arab Spring, *Journal of Economic Perspectives*, **26**, 167–188.

Coate, S. and Morris, S. (1995) On the form of transfers to special interests, *Journal of Political Economy*, **103**, 1210–1235.

Djankov, S., La Porta, R., Lopez-De-Silanes, F. and Schleifer, A. (2002) The regulation of entry, *Quarterly Journal of Economics*, **117**, 1–37.

Dorsch, M., Dunz, K. and Maarek, P. (2012) Macro shocks, regulatory quality, and costly political action, *Université de Cergy-Pontoise Working Paper*.

Dorsch, M. and Maarek, P. (2012) Inefficient predation, information, and contagious institutional change, *Université de Cergy-Pontoise Working Paper*.

Ellis, C. and Fender, J. (2010) Information cascades and revolutionary regime transitions, *Economic Journal*, **121**, 763–792.

Ferejohn, J. (1986) Incumbent performance and electoral control, *Public Choice*, **50**, 5–25.

Haggard, S. and Kaufman, R. (2012) Inequality and regime change: Democratic transitions and the stability of democratic rule, *American Political Science Review*, **XX**, xxx–xxx.

Houle, C. (2009) Inequality and democracy: Why inequality harms consolidation but does not affect democratization, *World Politics*, **61**, 589–622.

Kuran, T. (1989) Sparks and prairie fires: A theory of unanticipated political revolution, *Public Choice*, **61**, 41–74.

Kuran, T. (1991) Now out of never: The element of surprise in the East European revolution of 1989, *World Politics*, **44**, 7–48.

La Porta, R. and Schleifer, A. (2008) The unofficial economy and economic development, *Brookings Papers on Economic Activity*, **9**, 275–352.

Lohmann, S. (1994) Information aggregation through costly political action, *American Economic Review*, **84**, 518–530.

Rauch, J. (1991) Modeling the informal sector formally, *Journal of Development Economics*, **35**, 33–47.

Teorell, J. (2012) *Determinants of Democratization: Explaining Regime Change in the World, 1972-2006*, Cambridge University Press, Cambridge, UK.