Public Investment under Autocracy and Social Unrest

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Published as: Gwatipedza, J., & Janus, T. (2019). Public Investment under Autocracy and Social Unrest. Economics & Politics, 31(1), 112-135.

Abstract

This paper studies the determinants of public investment under autocracy. The optimal investment level balances rent extraction with increasing the future tax base and preventing social unrest. The citizens balance their time between producing and protesting. The labour supply is downward distorted. The public investment level suffers three downward distortions and a fourth, potentially upward distortion. The joint distortions can generate moderate to large efficiency losses. Empirically we show that government spending in autocracies varies more and is less related to tax collections than in democracies. Additionally, it responds to democratization pressure.

Keywords: political instability; social unrest; autocracy; public investment

JEL: D72, D78, O43

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1. Introduction

Many countries, such as China, Germany, and South Korea, industrialized under autocracy. Other autocracies, such as Egypt and Zimbabwe, either stagnated or developed along an unstable path. In this paper, we study the determinants of public goods provision under autocracy. Why do some autocracies invest more in infrastructure, contract enforcement, and other public goods?

In order to address this question, we study a two-stage strategic game. In the first stage, the government chooses public investment. In the second stage, the citizens divide their time between producing and protesting against the regime. In the subgame perfect Nash equilibrium (SPNE), the public investment level balances rent extraction with increasing the future tax base and decreasing social unrest. The citizens balance their time between producing and protesting. The labour supply is downward distorted and the public investment level suffers three downward distortions and a fourth, potentially upward distortion. The labour distortion reflects that the protest sector is socially unproductive. The downward investment distortions reflect that the government (a) cannot appropriate the entire social return to public investment; (b) may be ousted prior to tax collections, which makes it myopic; (c) faces a downward-distorted labour supply, which decreases the capital return. The fourth distortion reflects that public investment changes the labour allocation. If the substitution elasticity between capital and labour in the production function is less than one, public investment increases the return to producing relative to protesting, which decreases social unrest and increases the regime's survival probability. If the substitution elasticity exceeds one the opposite happens, which discourages public investment. When we simulate the model, we find that the distortions can generate moderate to large efficiency losses.

Section 2 reviews the related literature. Section 3 presents the model and characterizes the efficient and SPNE outcomes. Section 4 presents some empirical evidence. Section 5 concludes.

2. Related Literature

The paper relates to the literatures on redistributive conflict and the economics of autocracy (Acemoglu and Robinson 2001, Bueno de Mesquita et al. 2003, Bates 2008). Grossman (1991, 1995) studies conflicts between autocratic regimes and their citizens. In Grossman (1991), the government hires soldiers to reduce the number of protesters as well as repress the protesters. In Grossman (1995), it pays a wage subsidy to increase the return to producing relative to protesting. In contrast to these papers, which study the use of redistributive policy instruments, we study the use of public investment as a political-survival technique. Additionally, we study a model with two production inputs and generalize the aggregate production function. The two departures together imply that, unlike in Grossman's papers, the citizens' ability to protest can increase efficiency. Particularly, if the substitution elasticity between capital and labour is less than one, the regime can prefer to increase investment in order to decrease the protest level.

Acemoglu and Robinson (2001) study a dynamic game where the ruling elite cannot commit to future transfers and the citizens might rebel when the opportunity cost is low. Vargas (2011) extends the model and assumes that the elite cannot commit not to expropriate the poor. The poor then rebel when either their opportunity cost is low or they are afraid of being expropriated. Both models assume endowment incomes and that the opportunity cost of rebelling is exogenous. Our model endogenizes output and the opportunity cost of protesting. Olson (1993) and McGuire and Olson (1996) argue that a dictator that expects to remain in power

extracts less rent than a sequence of myopic dictators that do not internalize that rent extraction erodes the future tax base. In our model, political myopia also undermines the investment incentive, but the government can influence its own myopia level by investing in the economy. We also show that myopic regimes can invest more than long-lived autocracies. Myerson (2010) asks how the government's temptation to expropriate affects private investment. In contrast, we study the interaction of two commitment problems. First, the government cannot commit not to tax the citizens after they have worked. Second, the citizens cannot commit not to overthrow the government after it has invested in the economy. Azam et al. (2009) study an opportunistic government that conceals its nature by acting benevolently. Once it preys on the private sector, it destroys the production incentive. In contrast, we study a two-sector, perfect-information model with political replacement risk. Dixit (2010) studies the optimal design of bureaucracies in autocratic and democratic regimes. Our model abstracts from internal governance issues and focuses on the interactions between the government and the citizens. Besley and Kudamatsu (2008), Buena de Mesquita et al. (2003) and Padró I Miquel (2007) argue that autocratic leaders depend on parties, economic elites, and other social groups that can depose them. Although the elite in our paper is not accountable to another social group, its public investment determines the size of the protest sector and its survival probability. In this sense, it is accountable for its decisions.

Acemoglu (2005) asks how strong and weak autocracies affect economic efficiency. The government's *economic* strength is the citizens' cost of hiding output from tax collectors. The government's *political* strength is the citizens' cost of replacing it. If the government is very strong the high-taxation threat disincentives private investment. When the government is weak, its inability to tax the citizens disincentives the government from investing. Intermediate strength

levels balance incentives and increase efficiency. In our model the tax parameter, τ, which is the maximum tax rate that the government can collect, can be interpreted as its economic power. Our parameter $\mu > 0$, which translates the citizens' protest effort into their probability of overthrowing the government, can be interpreted as an inverse measure of the government's political power (Acemoglu 2005).[2] The main difference between the papers is that the production function in Acemoglu's (2005) paper is a Cobb-Douglas function and the citizens first produce and then they decide whether to rebel. In our model, the citizens divide their time between producing and protesting against the regime and the substitution elasticity between capital and labour can depart from one. When the elasticity is less than one, the government can use public goods to increase the citizens' return to producing instead of protesting, which creates an upward investment distortion. Myopic regimes can therefore invest more than long-lived regimes as they try to decrease their replacement risk (Olson 1993).

3. Public Investment under Autocracy and Social Unrest

In this section, we model the public investment decision of an elite-controlled autocratic regime in a sequential move game. Section 3.1 defines the assumptions. Section 3.2 defines the first-best solution. Section 3.3 defines the SPNE. Section 3.4 discusses the factor market distortions in the SPNE. Section 3.5 simulates the model. Section 3.6 discusses its comparative statics. Section 3.7 discusses extensions and alternative model versions.

[2] Although we treat the economic and political strength parameters as exogenous, one of their key determinants may be the government's ability to monopolize the use of force. We are very grateful to a referee for pointing this out.

3.1 Assumptions

There is a continuum population of size one. The government is controlled by an infinitesimally small elite that supplies a public good input to production. The citizens then combine their labour input with the public good in a neoclassical production function with total factor productivity (TFP) $\theta > 0$. Although we abstract from private capital, we could alternatively have assumed that the government can expropriate the private capital stock. The private capital it does not expropriate would then be contained in the capital it supplies in equilibrium.

In the first stage of the game, the government invests $G \geq 0$ in public goods. In the second stage, the citizens allocate $(1-l) \in [0,1]$ labour units to producing and l labour units to protesting. For example, they can demonstrate, strike, or rebel.[3] The aggregate production function is

$$y = \theta f(1-l, G), \tag{1}$$

where $f(0,G) = f(1-l,0) = 0$, $f_1^{'}, f_2^{'} > 0, f_{11}^{''}, f_{22}^{''} < 0, f_{12}^{''} > 0$. The elite's political survival probability – the probability that it survives the protest - is $q = q(\mu, l) \in [0,1]$, $q_l^{'} < 0$, $q_\mu^{'} < 0$, $q_{l\mu}^{''} < 0$. In this expression μ is the protest technology that translates the protest effort l into the survival probability q. The value of this technology parameter might depend on the citizens' knowledge about political organization and social movement techniques, access to communication networks and infrastructure, and international supporters. The assumptions that

[3]The individual protestors might be incentivized by expected future rewards, justice-, altruistic-, and ideological motives, as well or social expectations and peer effects (McAdam et al. 2001).

$q_l^{'} < 0$, $q_\mu^{'} < 0$ and $q_{l\mu}^{''} < 0$ imply that more effort and better technology decrease the regime's survival probability and that better protest technology increases the marginal effort effect.

If the elite survives the protest, it chooses a revenue-maximizing tax rate $\tau < 1$. The tax parameter can be interpreted as the output share that the elite can extract from the citizens.[4] In order to ensure that the elite can finance the initial investment, we also assume that it has a stock of wealth or access to international capital markets. The citizens' expected payoff is

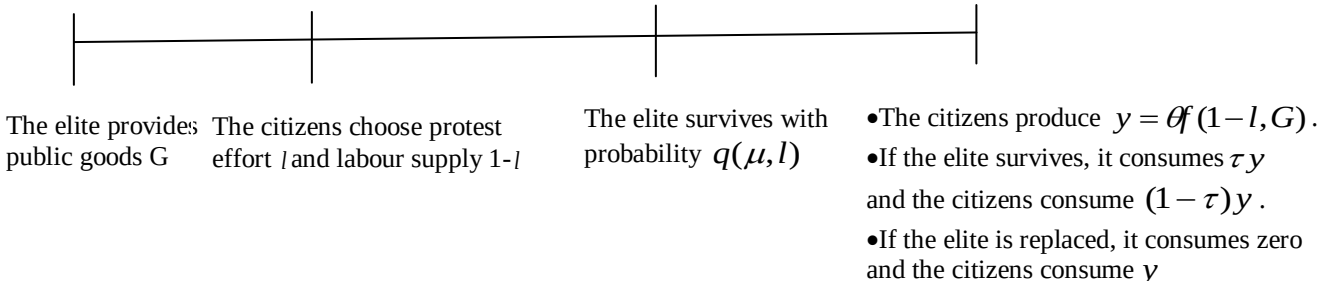
$$u^c(l, G, \mu, \tau, \theta) = \left(1 - q(\mu, l)\tau\right)\theta f(1-l, G), \tag{2}$$

where $q(\mu, l)\tau$ is the expected tax rate. The elite's expected payoff is

$$u^e(l, G, \mu, \tau, \theta) = q(\mu, l)\tau\theta f(1-l, G), \tag{3}$$

Figure 1 summarizes the timing of the game.

Figure 1: The timing of the game



[4] For instance, if the citizens can hide output at a unit cost $c < 1$, the revenue-maximizing tax rate is $\tau = c$.

3.2 Efficient solution

The efficient solution maximizes output minus the public investment cost:

$$\max_{l,G} \theta f(1-l,G) - G,$$

which implies that,

$$l = 0, \tag{4}$$

$$\theta f_2^{'}(1,G) = 1. \tag{5}$$

Since the protest sector is technically a rent-seeking sector, the first-best protest effort is zero. The social marginal return to capital equals the social marginal cost $(\theta f_2^{'}(1,G) = 1)$.

3.3 SPNE

In order to characterize the SPNE, we use backward induction. In the second stage of the game, the citizens take the public investment level as given and solve

$$\max_{l}(1-q(l)\tau)\theta f(1-l,G),. \tag{6}$$

which implies that

$$\underbrace{-q_l'\tau\theta f(1-l,G)}_{\substack{\text{marginal tax saving + rent}\\ \text{appropriation from protesting}}} = \underbrace{(1-q\tau)\theta f_1'(1-l,G)}_{\text{foregone labor income}}. \tag{7}$$

Equation (7) equates the marginal expected tax saving from increasing protest effort (on the left-hand side) with the marginal decline in expected after-tax earnings due to reducing the labour supply (on the right-hand side). The second-order condition is

$$\underbrace{(1-q\tau)\theta f_{11}''}_{<0} - \underbrace{q_{ll}''}_{?}\underbrace{\tau\theta f(1-l,G)}_{>0} + \underbrace{2q_l'\tau\theta f_1'}_{<0} \equiv u_{ll}''^{c} < 0. \tag{8}$$

The second-order condition is satisfied if the protest effort does not decrease the elite's survival probability at a rapidly increasing rate, that is, if q_{ll}'' exceeds a negative lower bound. We assume that this is the case. If we apply the implicit function theorem to (7), we can calculate the citizens' reaction function, l_G', that is, the marginal effect of public investment on the protest effort, as

$$l_G' = \frac{\overbrace{(1-q\tau)\theta f_{12}''}^{>0} + \overbrace{q_l'\tau\theta f_2'}^{<0}}{\underbrace{u_{ll}''^{c}}_{<0}} < 0 \Leftrightarrow (1-q\tau)\theta f_{12}'' + q_l'\tau\theta f_2' > 0. \tag{9}$$

In the following, we refer to condition (9) as the *complementarity condition*. If the complementarity condition is satisfied, public investment increases the citizens' marginal return to producing relative to protesting, that is, $(1-q\tau)\theta f_{12}'' + q_l'\tau\theta f_2' > 0$, and their protest effort decreases. The condition is satisfied if the degree of input-complementarity between capital and

labour is large enough that $(1-q\tau)\theta f_{12}^{''} > -q_l^{'}\tau\theta f_2^{'} > 0$. Intuitively, public investment increases both the marginal product of labour, since $f_{12}^{''} > 0$, and output, since $f_2^{'} > 0$. The former effect increases the opportunity cost of protesting, but the latter effect increases the tax revenues that the citizens can appropriate (or avoid paying) if they protest. In order for the protest level to decrease, the increase in the marginal product of labour has to exceed the increase in the return to protesting. The condition is equivalent to saying that the substitution elasticity between capital and labour, $(f_2^{'}/f)/(f_{12}^{''}/f_1^{'})$, is less than one: if we substitute (7) into (9) we get that

$$l_G^{'} = \frac{q_l^{'}}{u_{ll}^c}\tau\theta\left(-f(f_{12}^{''}/f_1^{'}) + f_2^{'}\right) < 0 \Leftrightarrow (f_2^{'}/f)/(f_{12}^{''}/f_1^{'}) < 1 \quad . \tag{10}$$

Next, we proceed to the first game stage. In the first stage, the elite solves

$$\max_G q(l^*(G))\tau\theta f(1-l(G),G) - G, \tag{11}$$

where $l(G)$ is the solution to (7). The optimal investment level solves

$$\underbrace{q_l^{'}l_G^{'}\tau\theta f}_{\text{Rent protection}} + \underbrace{\tau q\theta(f_2^{'} - f_1^{'}l_G^{'})}_{\text{Rent increase}} = \underbrace{1}_{\text{Marginal cost}} \quad . \tag{12}$$

where $l_G^{'}$ is the citizens' reaction function in (9) or, equivalently, (10).

Condition (12) equates the elite's marginal benefit and cost from investing in the economy. We call the first term on the left-hand side the marginal *rent protection* benefit. This is

because, whenever the complementarity condition is satisfied ($l_G^{'} < 0$), public good provision decreases the number of protesters. The likelihood of regime survival, therefore, increases by $q_l^{'} l_G^{'} > 0$. The second term on the left-hand side is the marginal *rent increase*: as long as the elite survives the protest (which happens with probability q) it receives the additional revenues $\tau\theta(f_2^{'} - f_1^{'} l_G^{'})$, where $f_2^{'}$ is the direct output gain from investing (holding the labour force constant) and $-f_1^{'} l_G^{'}$ is the output gain from reallocating the labour force, which is positive if $l_G^{'} < 0$. In the optimum, the sum of the marginal rent-protection and rent-increase benefits equals the marginal cost of the public good. If we substitute (7) into (12), we can restate the elite's first-order condition as

$$\theta\left\{\underbrace{\tau q f_2^{'}(1-l,G)}_{\substack{\text{MR given the} \\ \text{labor allocation}}} \underbrace{-f_1^{'} l_G^{'}}_{\substack{\text{MR from labor} \\ \text{reallocation}}}\right\} = \underbrace{1}_{MC}, \tag{13}$$

where, after multiplying through by the productivity level, the first term in brackets is the expected marginal revenue from public investment given the labour allocation. The second term is the marginal revenue from labour reallocation.

Finally, the elite's second-order condition, the second derivative of (11),

$$\theta\left(\underbrace{q_l^{'} l_G^{'} \tau f_2^{'}}_{?} + \underbrace{\tau q\left(-f_{21}^{''} l_G^{'} + f_{22}^{''}\right)}_{?} + \underbrace{f_{11}^{''} l_G^{'} l_G^{'}}_{<0} - \underbrace{f_{12}^{''} l_G^{'}}_{?} - \underbrace{f_1^{'} l_{Gl}^{''} l_G^{'}}_{?} - \underbrace{f_1^{'} l_{GG}}_{?}\right) \equiv u_{GG}^{''e} < 0, \tag{14}$$

where l'_G and l''_{GG} can be substituted and computed from (9), has to hold. Altogether, equations (7) and (13) define the SPNE solutions for protest effort l and public investment G. Equations (1)-(3) define the implied output y and the expected payoffs u^c and u^e.

3.4 The factor distortions in the SPNE

Comparing (7) and (13) with the efficient solution (4)-(5) shows that both the labour supply and the public investment level are distorted. The labour supply is downward distorted because the rent-seeking protest sector absorbs a share of the labour force $l > 0$. The public investment level, on the other hand, suffers from four distortions:

(i) *Imperfect appropriation*: Due to the fact that the revenue-maximizing tax rate is $\tau < 1$, the elite cannot appropriate the marginal social return to capital. The imperfect-appropriation effect decreases public investment.

(ii) *Elite myopia*: The protest decreases the regime's survival probability to $q < 1$, which makes the regime myopic. The myopia effect also decreases public investment.

(iii) *Labour misallocation*: The allocation of labour to the protest sector decreases the social return to public investment, that is the growth in the tax base. This is because whenever $l > 0$ $\theta f'_2(1-l, G) < \theta f'_2(1, G)$ (recall that $f''_{12} > 0$). The labour misallocation effect further decreases the public-investment level.

(iv) *Labour* re*allocation:* The elite's ability to influence the labour allocation through public investment, that is, the fact that $l_G^{'}$ is generally non-zero, can either increase or decrease the public investment. level. If $l_G^{'} > 0$ - equivalently, the substitution elasticity between capital and labour exceeds one - the desire to reallocate the workers discourages investment and reinforces the first three downward investment distortions. If, instead, the complementarity condition is satisfied (such that $l_G^{'} < 0$ and the substitution elasticity is less than one), the labour reallocation incentive creates an *upward* investment distortion.

3.5 CES Example

In order to estimate how large the distortions can be in practice, we simulate the model with specific functional forms. Thus, we assume that the political survival function is[5]

$$q(l) = 1 - \mu l,\ \mu \in (0,1) \tag{15}$$

and that the production function is the constant-elasticity-of-substitution (CES) function

$$y = \theta\left(\lambda(1-l)^{(\sigma-1)/\sigma} + (1-\lambda)G^{(\sigma-1)/\sigma}\right)^{\sigma/(\sigma-1)},\ \sigma > 0, \tag{16}$$

[5] In order to get a micro-foundation for (15), assume that the elite is ousted if its randomly determined military or political strength, ρ, which is defined as the level of protest effort that it can resist, is less than the actual protest level. If ρ is uniform on $[0,1/\mu]$, then, $q(l) = pr(\rho \geq l)$. $= 1 - F(l) = 1 - \mu l$.

where $\lambda \in (0,1)$ is the relative importance of the labour input – or what Arrow at al. (1961) call the distribution parameter – and $\sigma > 0$ is the substitution elasticity between capital and labour. When $\sigma = 1$, equation (16) becomes the Cobb-Douglas or unit-elastic function $y = \theta(1-l)^{\lambda} G^{1-\lambda}$. When $\sigma < 1$ the inputs are complements. As $\sigma \to \infty$ they become perfect substitutes. The complementarity condition ($l_G^{'} < 0$) is satisfied if and only if $\sigma < 1$.

In order to choose the parameters, we draw on the evidence as follows:

- We set $\tau = 0.50$ to allow the government to collect 50% of GDP. This is perhaps a high estimate, but the tax policy can include all policy distortions designed to favour the elite, including direct and indirect taxes, subsidies, public monopolies, financial regulations like directed lending, inflation taxes, the allocation of import quotas, dual exchange rate systems, discriminatory land access, biases in local public investment, and other redistributive policies.

- Given that $q(l) = 1 - \mu l$, we set $\mu = 0.75$. This implies that, if the entire non-elite population challenges the regime, it has 25% survival probability. If half the population challenges the regime, it has 62.5% survival probability.

- The TFP level is arbitrary as we can normalize the output units. Hence, we let it vary along the horizontal axis and plot the endogenous outcomes on the vertical axes in the figures below.[6]

[6] Under the functional form assumptions, $q_{ll}^{"} = 0$, so the citizens' second-order condition (8) always holds. Since the elite's second-order condition (14) remains analytically intractable, we substitute the solutions for l and $q = 1 - \mu l$ into the elite's payoff function (3) and check that it is increasing and concave in the simulations.

• The distribution parameter λ is 2/3, which ensures that, if the agents use a Cobb-Douglas production function, the labour share of income is 2/3 and the capital share is 1/3 (Gollin 2002). As the substitution elasticity departs from one – which is the Cobb-Douglas case - the income shares of capital and labour change. In order to see this, assume that the economy is competitive and that the marginal return to capital is r. Then the capital share in income is

$$rG/y = \theta f_2' G/\theta f(1-l,G) = \left(G/(1-l)\right)^{(\sigma-1)/\sigma} \Big/ \left(2+\left(G/(1-l)\right)^{(\sigma-1)/\sigma}\right).$$

When the substitution elasticity is $\sigma < 1$, higher capital-labour ratios $\left(G/(1-l)\right)$ decrease the income share of capital. Intuitively, when the relative supply of capital increases and capital is a poor substitute for labour, the market return to capital decreases. When $\sigma > 1$, conversely, higher capital-labour ratios increase capital's income share. If the substitution elasticity is $\sigma = 0.8$, for example, doubling the capital-labour ratio decreases the income share of capital by 0 to 16% depending on the initial capital-labour ratio.[7] This is consistent with Gollin (2002), who finds that poor countries tend to have higher income shares of capital, though much of the difference disappears after correcting for self-employed income.

• Finally, the simulation requires us to choose a range for the substitution elasticity σ. In a rare study of a country panel that includes developing as well as developed countries (a total of 82 countries from 1960-87), Duffy and Papageorgiou (2000) estimate that the substitution elasticity

[7] If $x = \left(G/(1-l)\right)$, the ratio of capital shares is $\dfrac{(2x)^{-1/4}\Big/\left(2+(2x)^{-1/4}\right)}{x^{-1/4}\Big/\left(2+x^{-1/4}\right)} = \dfrac{2^{3/4}+(2x)^{-1/4}}{2+(2x)^{-1/4}} \in (0.84,1)$

between capital and either labour or human capital-augmented labour may range from 0.8 for the poorest quarter of countries to 1.10 for the wealthiest quarter. However, Antras (2004) shows that in time-series where the factor shares in income tend to be relatively stable over time (which is true for most countries or at least most developed countries (Golin 2002)), estimating CES functions with Hicks-neutral technical change like the one in Duffy and Papageorgiou (2000) tends to force the estimated substitution elasticity to be one. Under the alternative assumption that the labour and capital-augmenting technology levels grow at constant, but potentially different rates, Antras (2004) estimates that the US post-WWII substitution elasticity might have been below 0.5. More generally, Diamond et al. (1978) show that, if one allows for arbitrarily flexible factor-biased technological change, it is impossible to distinguish the substitution elasticity from technological innovations in the time-series. Due to these difficulties in choosing a plausible elasticity range for the CES function, we simulate the model for a relatively low-elasticity scenario where $\sigma = 0.6$ - and therefore the complementarity condition is satisfied – and a relatively high-elasticity scenario where $\sigma = 1.10$ and the complementarity condition fails. The results for intermediate elasticities are intermediate between the results for the extremes.

The simulation equations come from substituting (16) into (5) to determine the first-best public investment solution and into (7), (10) and (13), to determine the protest level and public investment in the SPNE. After calculating $\boldsymbol{I}, \boldsymbol{I}_G^{\cdot}$, G, and $u_{ll}^{\prime\prime c}$ based on (7)-(9) and (13), we can compute output y and the political-survival probability q from (15)-(16) and the elite and citizen payoffs from (2)-(3). Finally, we compute the efficiency level in the different scenarios as output minus the cost of goods provision

$$E \equiv y - G. \tag{17}$$

Expression (17) is an efficiency measure in the sense that it equals the sum of the elite and citizen utilities and the economy's value added. However, one could argue that a *welfare* measure should weigh the citizens' utility more than the elite's payoff.

Results

Figure 2 compares the results for protest effort, public investment, output, and efficiency in the SPNE with the efficient solutions when $\sigma = 0.6$ and $l_G^{'} < 0$, that is, the complementarity condition is satisfied. Figure 3 presents the results when $\sigma = 1.10$ and $l_G^{'} > 0$. In both figures, as the TFP level increases along the horizontal axis, public investment, output, and efficiency increase. In Figure 2, the increase in public investment decreases the protest level because the opportunity cost of protesting increases relative to the rent-seeking return. The opposite happens in Figure 3.

The factor market and output distortions range from moderate to large. In Figure 2, the distortions decrease with the TFP level. In the least productive economy (when $\theta = 1$) close to half of the population protests. The government only supplies 0.05/0.34≈15% of the efficient public investment level. The output level is 0.12/0.62 ≈19% of the efficient level. Efficiency $(y - G)$ is 0.08/0.30 ≈ 27% of its first-best value. Since the distortions are largest for the least productive economies, the results suggest that autocratic rule in poor countries increases poverty, not only by redistributing resources to elites but also by decreasing output. In contrast, the most productive autocracies ($\theta \approx 8$) are close to efficient. Nonetheless, the elite still appropriates 50% of output (since $\tau = 0.50$), which is far more than it spends.

In Figure 3, the distortions increase with the TFP level. For the most productive economy (when $\theta \approx 8$), while only 6.5% of the population protests, the government only supplies

22% of the first-best public investment level. Nonetheless, the high substitution elasticity allows the labour input to substitute for the public good and the economy still produces 57% of the first-best. It achieves a 75% efficiency level. The inconclusive elasticity-estimation literature that we discussed above, however, suggests that the substitution elasticity we use to generate Figure 3 ($\sigma = 1.10$) may be a high estimate. Most countries may better fit the Figure 2 scenario ($\sigma < 1$).

Figure 2: Protest effort, public investment, output, and efficiency. $\tau = 0.5$, $\mu = 0.75$, $\lambda = 0.67$, $\sigma = 0.6$. SPNE vs. efficient solution.

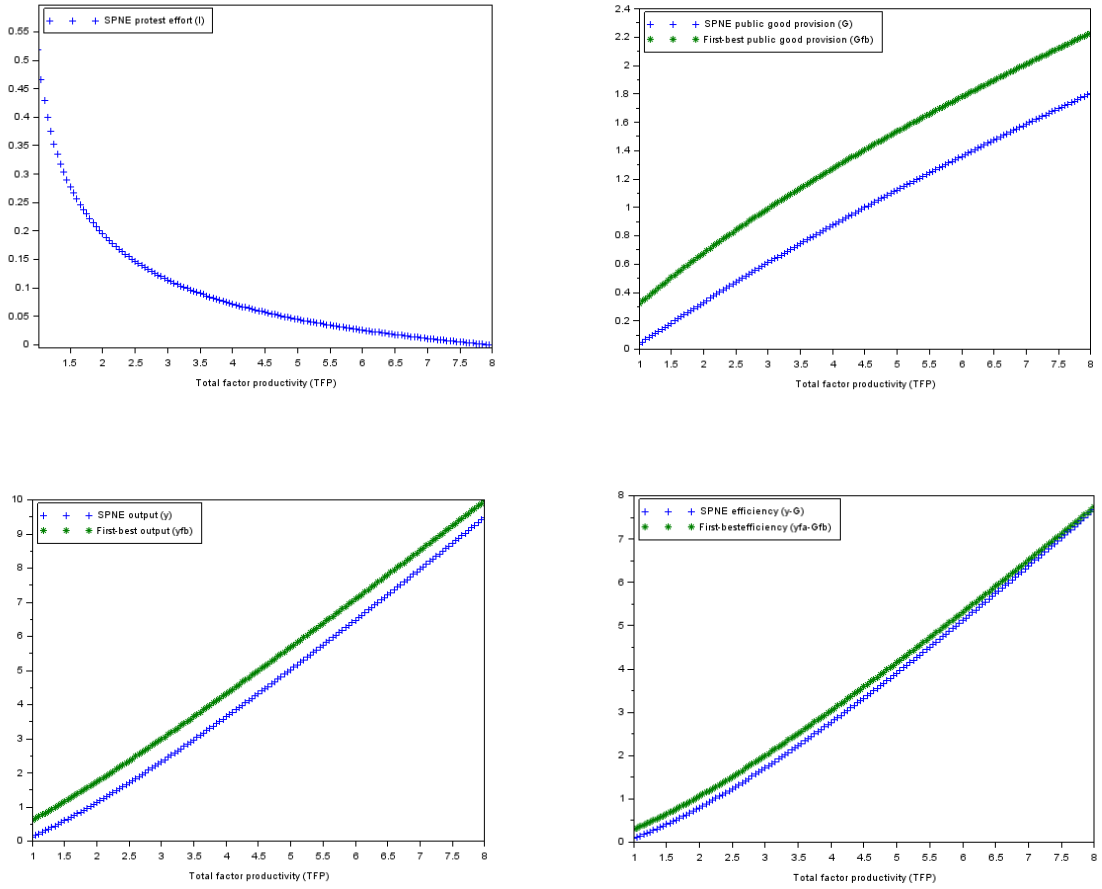
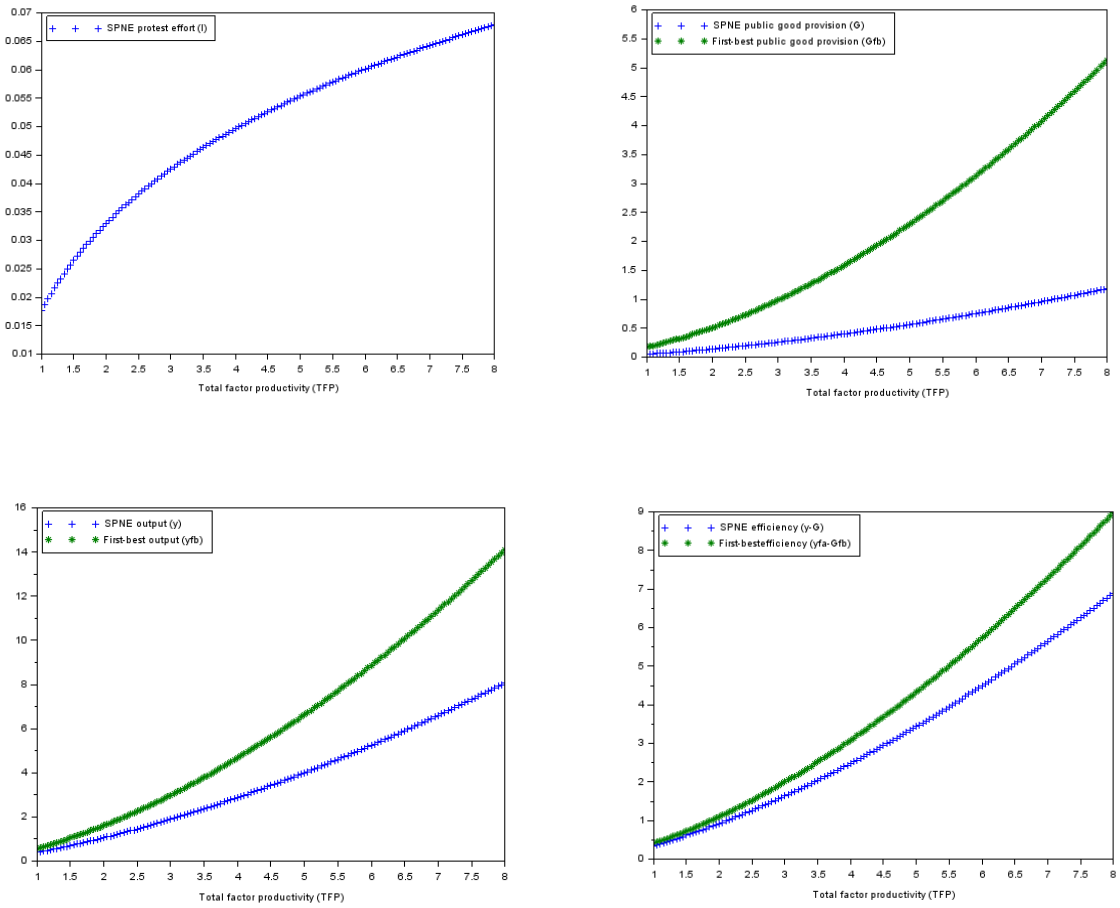


Figure 3: Protest effort, public investment, output, and efficiency. $\tau = 0.5$, $\mu = 0.75$, $\lambda = 0.67$, $\sigma = 1.10$. SPNE vs. efficient solution.



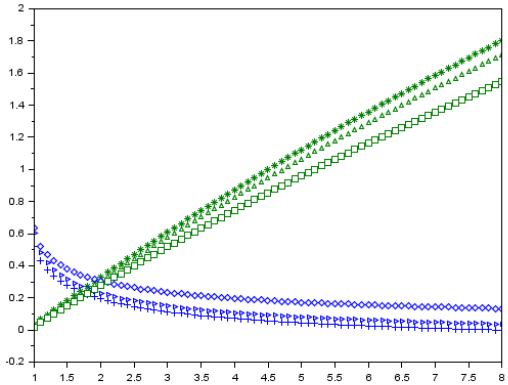
3.6 Comparative Statics

In the appendix we show that unless we restrict the functional forms (as we did in Section 3.5) the comparative statics for protest effort and public investment with respect to the exogenous parameters, that is, the signs of $l_x^{'}$ and $G_x^{'}$ for every $x \in X = \{\theta, \tau, \mu\}$, are ambiguous.[8] The reason is that in two-stage games with continuous actions, the comparative statics can depend on third derivatives that are not constrained by the first-and second-order conditions. In order to, nonetheless, demonstrate that functional form restrictions can generate empirically testable

[8] Since the capital-labour substitution elasticity is only constant in the CES case, we do not treat it as a parameter.

predictions Figure 4 reproduces the low-elasticity case in Figure 2, which seems more empirically plausible than the high-elasticity case (Antras 2004). First, we reproduce the solutions for protest and public investment in Figure 2. Second, we increase the protest technology to $\mu = 0.8$. Third, we retain $\mu = 0.8$ and increase the tax rate to $\tau = 0.55$. In both cases, protest increases and public investment decreases. The effects of the protest technology reflect that the citizens' return from protesting relative to producing increases, which increases the equilibrium protest level and the labour misallocation and myopia effects on investment. Thus, investment decreases. The effects of the tax rate reflect that, on one hand, the imperfect-appropriation effect on investment decreases: the fact that the regime can collect a larger output share increases its investment incentive. On the other hand, the fact that the citizens anticipate the higher tax rate increases protest, which increases the labour misallocation and myopia effects. The net investment effect is negative.

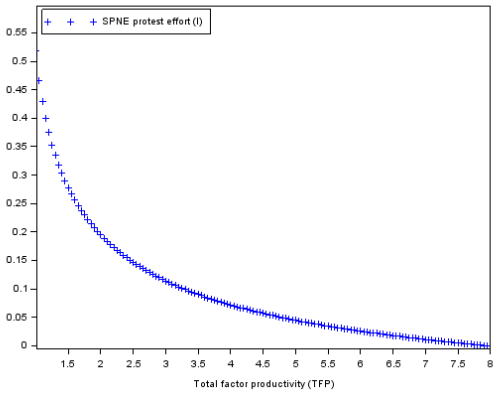
Figure 4: Protest effort and public investment: Effects of protest technology and tax capacity when $\sigma = 0.6$ and $\lambda = 0.67$. + and * depict protest effort and public investment when $\tau = 0.5$ and $\mu = 0.75$; > and ^ set $\mu = 0.8$ and $\tau = 0.5$; ◊ and □ set $\mu = 0.8$ and $\tau = 0.55$.

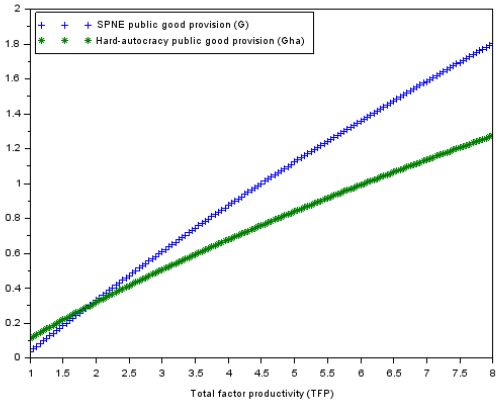


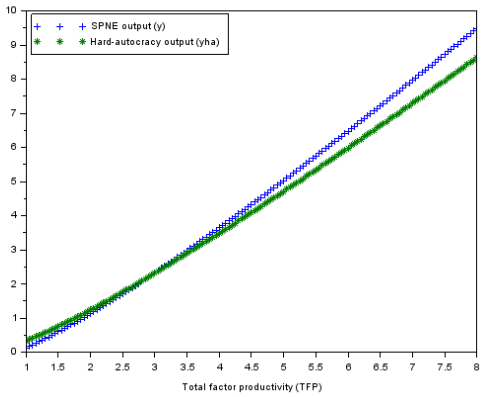
In Figures 5 and 6 we consider the effects of a non-marginal increase in the protest technology μ from an initial value of zero to the $\mu = 0.75$ value that we used to produce Figures 2-3. The idea is that many social movements, such as democratization and civil rights movements appear to arise suddenly, but once they arise, they instantly become large. Examples include the Arab Spring movements around 2011-13 and the democratization movements in Eastern Europe in the early 1990s (Kuran 1989, 1991). With $\mu = 0$, the labour allocation is efficient and the regime is not myopic, but it does not have a labour-reallocation incentive to invest either. The only investment distortion is the imperfect-appropriation effect because $\tau < 1$. We call the $\mu = 0$ cases "hard autocracy" since protest effort is ineffective.

Figures 5-6 reproduce Figures 2-3 (where $\mu = 0.75$) and overlay the results when $\mu = 0$. In the low-elasticity case in Figure 5, the labour misallocation and myopia effects dominate the labour-reallocation incentive at low TFP levels, which decreases investment and efficiency. At higher TFP levels, the dominance ranking switches and the regime invests more when the protest parameter is high. Myopic regimes achieve more efficient outcomes than stable autocracies (Alesina and Tabellini 1990, Olson 1993). Figure 6 shows that this is never the case – protest always decreases investment and efficiency – when the substitution elasticity between capital and labour exceeds one. This is because, in that case, the labour-reallocation incentive is negative $(l_G^{'} > 0)$. Thus, the negative myopia, labour-misallocation, and labour-reallocation effects on investment reinforce one another and create a triple downward distortion compared to the hard-autocracy case.

Figure 5: Protest effort, public investment, output, and efficiency. $\tau = 0.5$, $\mu = 0.75$, $\lambda = 0.67$, $\sigma = 0.6$. SPNE vs. "hard autocracy."







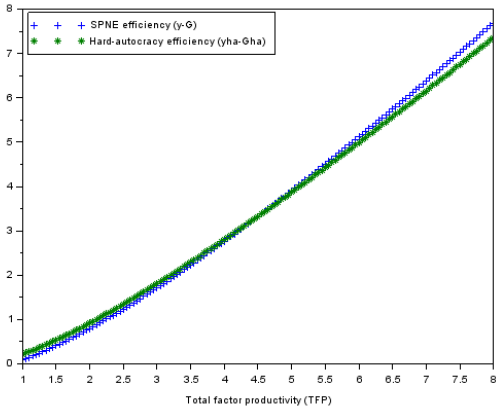
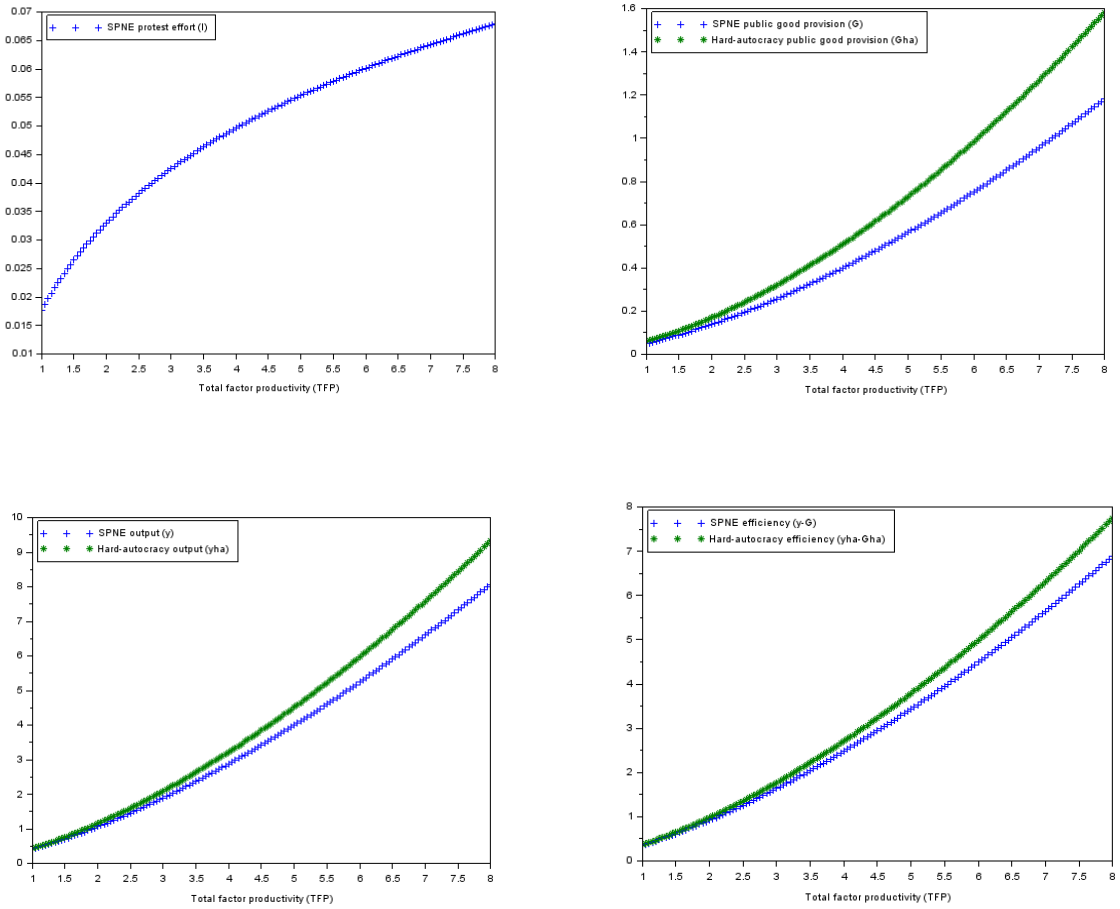


Figure 6: Protest effort, public investment, output, and efficiency. $\tau = 0.5$, $\mu = 0.75$, $\lambda = 0.67$, $\sigma = 1.10$. SPNE vs. "hard autocracy."



3.7 Extensions

In the online appendix, we discuss other model formulations and extensions, such as allowing the elite to commit to the tax rate and to repress the protesters, assuming that the elite must bribe the military in order to prevent a coup, and dynamic extensions, such as allowing the TFP level to increase exogenously. The last extension could potentially help to explain catch-up growth under autocratic regimes, such as the history of several Asian economies. In the following, we summarize our most developed analyses (see Sections 1-2 in the online appendix), which allow the citizens to use output against the regime and allow the citizen to migrate and, thereby, utilize

their "exit" as well as their 'voice" option against the regime (Hirschman 1970).[9] We believe that output effects can be important because political protest activity depends on capital and intermediate inputs as well as effort. The exit option is likely to be relevant when private agents can either join the informal sector or migrate in order to escape taxation. Many developing countries have large diaspora. The Zimbabwean crisis that we study in Section 4.4 created extensive internal and international migration (Hammar et al. 2010).

When the citizens can use output as opposed to just protest effort against the regime, on one hand, the labour misallocation problem decreases because the citizens get additional benefits from producing. On the other hand, the government's knowledge that increasing output undermines its political control undermines its investment incentive. Qualitatively, in a model where economic growth undermines the autocratic regime, we might expect somewhat opposite conclusions compared to a model where the government tries to "create jobs" in order to placate the citizens. Which concern is most important is an empirical question.

In order to model an exit option, we assume that the citizens can migrate abroad where they earn a constant labour return. In this three-sector model, since the international labour return is constant, the diaspora provides an elastic labour supply. When the government provides more public goods, migrants return home to join the production sector (where the marginal product of labour increases) but also the protest sector (where the conflict "prize," that is, the contestable output increases). As in the first extension, therefore, public goods provision becomes a double-edged sword for the government. Compared to our original model without an exit option, the government's investment incentive tends to fall because investing increases protest and the

[9] We are very grateful to an anonymous referee for proposing the study of an output-dependent protest technology and an exit options for the citizens.

labour supply is smaller than before. On the other hand, the total number of protesters is smaller, which decreases the myopia effect. Additionally, investing always increases the labour supply.

Finally, Dal Bó and Dal Bó (2011) study the effect of relative international price changes on conflict in a two-sector open economy with an additional "appropriation sector". They show that the effect of relative price shocks depends on whether the appropriation sector is more labour intensive than the economy as a whole. Although our model is different (we study a two-sector closed economy with public investment) our assumption that the protest sector is more labour-intensive than the production sector might similarly affect our results. In the online appendix, Section 3 allows the protesters to use public goods as well as effort against the regime, although we do not examine, similarly to Dal Bó and Dal Bó (2011), how changes in the relative public goods intensity of the protest sector affect the equilibrium and comparative statics.

4. Evidence

4.1 Public expenditure variation

The model predicts that, depending on the balance of the positive and negative investment distortions, we could observe a wide variation in public investment levels across autocracies. Table 1 presents the summary statistics for PPP-adjusted government shares in GDP in the Penn World Tables Versions 7.1 and 8.0 together with non-PPP adjusted shares from the World Development Indicators (WDI) for democracies and autocracies.[10] The data covers 1950-2016. Although our model only compares autocratic and efficient outcomes, we use democratic outcomes as a proxy for the unobserved efficient outcomes in the data, under the assumption that

[10] We drop a few observations where the government shares exceed 100%.

democratically elected regimes are more constrained and accountable. Therefore, they should generate smaller distortions.

The reason that we consider two versions of the Penn Tables is that Version 7.1 subtracts health and education expenditures that are attributable to individuals on the basis that they represent private rather than public consumption. Thus, Version 7.1 might capture infrastructure, law enforcement, and other public expenditures that increase labour productivity more precisely. The PPP-adjusted data allows us to compare the "quantities" of public goods provided and ensure that high government shares do not reflect high public sector salaries, the creation of unproductive public sector jobs, and other ways political elites can appropriate and distribute rents. Finally, we use the "polity2" scores provided by the Polity IV project to distinguish democracies and autocracies. The polity2 score falls in [-10,-1] for autocracies and in [1,10] for democracies.[11]

Table 1 suggests that the average size of the public sector is comparable across democracies and autocracies. However, the PPP-adjusted data shows that the standard deviation is 75-80% larger in autocracies. Figure 7 and inspecting the percentiles suggests that the distribution for autocracies has a slightly thicker left tail and a significantly thicker right tail. The greater variation suggests that political economy concerns can distort investment in both directions.[12]

[11] See http://www.systemicpeace.org/polityproject.html

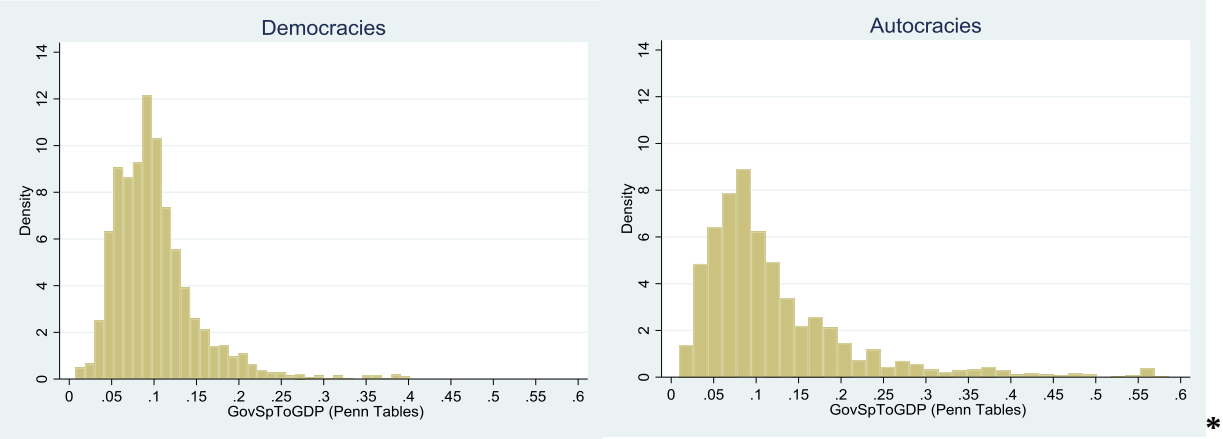
[12] Some of the autocratic economies with the largest government shares are socialist or quasi-socialist economies where a state-led economic-development strategy might explain the large public sector. Even so, the government can choose the public investment level strategically to increase its payoff.

Table 1: Government GDP shares in democracies and autocracies

	Obs	Mean	Std Dev	Min	Max
Penn World Tables V. 7.1					
Democracies	3,263	0.10	0.05	0.01	0.40
Autocracies	2,956	0.12	0.09	0.01	0.59
Penn World Tables V. 8.0					
Democracies	3,350	0.18	0.08	0.02	0.96
Autocracies	2,798	0.22	0.14	0.02	0.93
World Development Indicators (WDI)					
Democracies	3,686	0.16	0.05	0.03	0.55
Autocracies	2,640	0.15	0.08	0.00	0.85

Note: Data for Government shares comes from the Penn World Tables, Versions 7.1 and 8.0 and the World Development Indicators.

Figure 7: Government GDP Shares (Penn Tables V. 7.1)



*

4.2 Tax capacity and public expenditures

Although the comparative statics are ambiguous, if the functional forms we used to generate Figure 4 are empirically plausible, greater tax capacity should decrease the public investment incentive due to the protest it creates. In that case, we should expect a negative relationship between tax capacity and public investment. Table 2 reports the correlations between tax revenues (as a share of GDP) and government shares in GDP in the WDI dataset. Although the

correlation is positive rather than negative – the positive correlation might reflect that governments need to finance public expenditures– it is smaller for autocracies.[13]

Table 2: Correlations between revenue shares and government shares in GDP

	Observations	Correlation
Democracies	2,320	0.68
Autocracies	759	0.37

Note: The data comes from the World Development Indicators ..

4.3 Public expenditures and protest technologies

Figure 4 suggests that better protest technologies should decrease investment. However, Figure 5 shows that such technology increases can also increase investment by creating a labour-reallocation incentive. In this section, we estimate the empirical effects of protest technologies on public investment in a panel of autocracies. A positive relationship would suggest that the substitution elasticity between capital and labour is, on average, below one, and that the labour-reallocation incentive for public investment is empirically relevant.

In order to measure empirical changes in protest technologies, we use the change in the average polity2 democracy score in regional neighbours. For example, democracy improvements in sub-Saharan Africa outside of Zimbabwe should make it easier for protesters in Zimbabwe to challenge their regime - for example, by teaching the protesters new social movement techniques and supporting them economically and politically. Acemoglu et al. (2014), similarly, use

[13] Apart from the political-economy concerns we emphasize, counter-cyclical fiscal policies might explain the imperfect correlation between taxes and spending. If this were the case, however, arguably, we should have found a higher correlation among autocracies given that most autocracies are developing countries. Developing countries have historically conducted pro-cyclical fiscal policies (Talvi and Vegh 2005).

regional democracy changes to predict domestic democratization and many countries historically democratized during regional democratization "waves" (Huntington 1993) as opposed to independently. We estimate the following equation:

$$\Delta G_{jt} = \alpha + \beta \Delta \mu_{j(t-1)} + \gamma_j + z_t + \rho_j t + \varepsilon_{jt}, \quad (18)$$

where ΔG_{jt} and $\Delta \mu_{j(t-1)}$ are the change in the government share in GDP in country j in year t and the lagged change in the average polity2 score in the country's regional neighbours. Although the polity2 scores range in [-10,10] we drop observations where polity2=0 as they indicate periods without an effective government. We consider six regions: sub-Saharan Africa, North Africa and the Middle East, Latin America, Asia, Eastern Europe, and Western countries. γ_j and z_t are country and year fixed effects, $\rho_j t$ is a country-specific time-trend, and ε_{jt} is the error term. We estimate a panel of autocracies (that is, observations with a polity2 score in [-10,-1]) that covers 1960-2009. The dependent variable is the change in the government share in the Penn Tables Version 7.1.

A potential complication is that oil and similar fossil fuel exporters appear to rely on transfers as much as public investment to counter social unrest (Game III 2011, Jones 2012)[14] and our model does not allow for transfers. Therefore, we omit fossil fuel exporters from the

[14] For example, Game III (2011, p. 85) argues that "…since the current [Arab Spring] uprisings began, only Libya among the major oil exporters (Algeria, Iraq, Kuwait, Libya, Qatar, Saudi Arabia, and the United Arab Emirates) has faced a serious challenge. Buoyed by high oil prices, the other oil exporters have been able to head off potential opposition by distributing resources through increased state salaries, higher subsidies for consumer goods, new state jobs, and direct handouts to citizens."

main regressions and estimate them separately. In order to identify the fuel exporters in the sample, we use an indicator variable from Janus and Riera-Crichton (2018) that equals one when a country's average fossil fuel export share in GDP from 1970-2006 exceeded its import share and 2% of GDP.[15]

Table 3 presents the summary statistics. Table 4 presents the estimates for non-fuel exporters. Column (1) implies that a 1-point increase in neighbours' average democracy score on the 20-point polity2 scale is associated with 0.4 percentage point increase in the government's GDP share. The positive coefficient suggests that the labour-reallocation incentive to invest when the protest technology improves is empirically relevant.

In column (2), we interact the change in neighbour democracy with an indicator for poor countries. The indicator equals one when PPP-adjusted GDP per capita in the Penn Tables is below the median. The estimates suggest that the investment effect of foreign democracy improvements are concentrated in wealthier autocracies. At low TFP levels, the negative myopia and labour-misallocation effects of better protest technologies might outweigh the labour-reallocation incentives they create for governemnts as in Figure 5.

In column (3), we estimate the relationship between changes in government spending and the probability of democratic transitions. A democratic transition is defined as a year-on-year change from a strictly negative to a strictly positive polity2 score (Brückner and Ciccone 2011). If autocratic regimes use public expenditure to stay in power, increases in public spending should decrease the democratization probability. The estimates imply that a percentage point increase in the government share in GDP is associated with about 0.7 percentage points decrease in the

[15] The fuel exporters are: Angola, Azerbaijan, Bolivia, Cameroon, Egypt, Gabon, Indonesia, Iran, Iraq, Mexico, Nigeria, Oman, Saudi Arabia, Sudan, Syria, Tunisia, Venezuela, and Yemen.

democratization probability. For comparison, the mean democratization probability in the data is about 3 percent. Column (4) shows that controlling for the change in neighbour democracy and its two-year lagged value produces a similar coefficient. Additionally, Column (4) suggests that the "direct" effect of increases in neighbour democracy is about 5 percentage points. In contrast, the indirect and offsetting effect via increases in government spending is only (when we combine the Columns (1) and (4) estimates) $(0.4)(0.007)\approx 0.28$ percentage points. Thus, the spending response appears too small to protect the average autocracy from democratization pressure.

Table 5 presents the results for fuel exporters. In this sample, regional democracy changes are insignificantly related to government spending changes and government spending changes are insignificantly related to the democratization probability. This suggests that fuel exporters might address democratization pressure with other policy instruments, such as transfers or repression (Ross 2001, Game III 2011).

Table 3: Summary Statistics

Variable	Obs	Mean	St.dev.	Min	Max
Δ(G/Y)	1,704	0.00	0.02	-0.22	0.23
Δ Neighbour democracy	1,888	0.14	0.55	-1.76	7.75
Dem. transition dummy	1,864	0.03	0.17	0	1
Neighbour democracy	1,888	-2.04	3.44	-7.75	9.76
Fuel exporter dummy	1,888	0.31	0.46	0	1
Ln(real PPP GDP/Cap)	1,713	5.33	1.60	1.95	10.21

Table 4: Regional Democratization, Government Spending, and Democratization (Non-Fuel Exporting Economies)

	(1)	(2)	(3)	(4)
Estimation Method	LSDV	LSDV	LSDV	LSDV
Dependent variable	Δ(G/Y)(t)	Δ(G/Y)(t)	Democratic transition	Democratic transition
ΔNeighbor Dem(t-1)	0.399*	0.589**		0.053**
	[0.201]	[0.262]		[0.026]
ΔND*I(low GDP/CAP)		-0.429*		
		[0.241]		
I(low GDP/CAP)(t-1)		-0.57		
		[0.983]		
Δ(G/Y)(t-1)			-0.007**	-0.007**
			[0.003]	[0.003]
Neighbour Dem (t-2)				0.051***
				[0.015]
Observations	1,202	1,202	1,193	1,193
R-squared	0.09	0.09	0.23	0.26
Number of countries	55	55	55	55
Pr (ΔNghbor Dem+I(poor)=0)		0.39		
Country dummies	Y	Y	Y	Y
Year dummies	Y	Y	Y	Y
Country time trends	Y	Y	Y	Y

Note: Country fixed effects estimates with robust standard errors clustered at the country-level in brackets.* significant at 10%; ** significant at 5%; *** significant at 1%.Δ denotes the annual change, (G/Y) is the government-spending-to GDP ratio in the Penn World Tables Version 7.1., which includes PPP-adjusted government spending on collective goods but excludes government-provided individual health care and education spending (which is counted as part of private consumption in PWT Version 7.1). Neighbour democracy is the average polity2 democracy score democracy score for other countries in the same region (North Africa and the Middle East, sub-Saharan Africa, Asia, Eastern Europe, Latin America, and the group of Western countries). Fuel exporters are the countries whose average export share of fuels in GDP from 1970 to 2006 exceeded the average import share and two percent of GDP.

Table 5: Regional Democratization, Government Spending, and Democratization (Fuel Exporting Economies)

	(1)	(2)	(4)	(5)
Estimation Method	LSDV	LSDV	LSDV	LSDV
Dependent variable	Δ(G/Y)(t)	Δ(G/Y)(t)	Democratic transition	Democratic transition
ΔNeighbor Dem(t-1)	-0.023	-0.618		-0.005
	[0.235]	[0.550]		[0.009]
ΔND*I(low GDP/CAP)		1.168		
		[0.720]		
I(low GDP/CAP)(t-1)		-0.54		
		[0.805]		
Δ(G/Y)(t-1)			0	0
			[0.001]	[0.001]
Neighbour Dem (t-2)				0
				[0.008]
Observations	495	495	496	496
R-squared	0.06	0.07	0.19	0.19
Number of countries	16	16	17	17
Pr (ΔNghbor Dem+I(poor)=0)		0.13		
Country dummies	Y	Y	Y	Y
Year dummies	Y	Y	Y	Y
Country time trends	Y	Y	Y	Y

Note: Country fixed effects estimates with robust standard errors clustered at the country-level in brackets.* significant at 10%; ** significant at 5%; *** significant at 1%.Δ denotes the annual change, (G/Y) is the government-spending-to GDP ratio in the Penn World Tables Version 7.1., which includes PPP-adjusted government spending on collective goods but excludes government-provided individual health care and education spending (which is counted as part of private consumption in PWT Version 7.1). Neighbour democracy is the average polity2 democracy score democracy score for other countries in the same region (North Africa and the Middle East, sub-Saharan Africa, Asia, Eastern Europe, Latin America, and the group of Western countries). Fuel exporters are the countries whose average export share of fuels in GDP from 1970 to 2006 exceeded the average import share and two percent of GDP.

In Table 6 we replace the PPP-adjusted government share with the government share in the World Development Indicators (WDI). For brevity, we focus on non-fuel exporters. The estimates are less significant but qualitatively similar to the ones in Table 3, Column (1). Since the WDI data also reports the military spending share in GDP, we can also test whether autocratic governments increase military spending (in order to increase repression) rather than public investment. Columns (2)-(3) do not suggest that this is the case. Finally, Column (4) uses the PPP adjusted government share from Version 8.0 of the Penn Tables, where the government

share includes health and education spending assignable to individuals. The results remain insignificant but qualitatively similar.

Table 6: Regional democratization Effects on Alternative Spending Measures (non-Fuel exporters)

	(1)	(2)	(3)	(3)
Estimation Method	LSDV	LSDV	LSDV	LSDV
Dependent variable	Δ(G/Y)(t)	Δ(G/Y)(t) Non-military	Δ(G/Y)(t) military	PPP Δ(G/Y)(t)
Fuel exporter	N	N	N	N
ΔNeighbor Dem(t-1)	0.244	0.372	-0.145	0.403
	[0.287]	[0.283]	[0.111]	[0.328]
Observations	804	804	896	1,048
R-squared	0.117	0.124	0.126	0.095
Number of countries	49	49	52	47
Country dummies	Y	Y	Y	Y
Year dummies	Y	Y	Y	Y
Country time trends	Y	Y	Y	Y

Note: Country fixed effects estimates with robust standard errors clustered at the country-level in brackets.* significant at 10%; ** significant at 5%; *** significant at 1%.Δ denotes the annual change, (G/Y) is the government-spending-to GDP ratio from the Penn World Bank's World Development Indicators dataset. (G/Y) non-military and (G/Y) military are the non-military and military spending components. PPP Δ(G/Y)(t) is the PPP adjusted government spending share in the Penn World Tables Version 8.0. Neighbour democracy is the average polity2 democracy score democracy score for other countries in the same region (North Africa and the Middle East, sub-Saharan Africa, Asia, Eastern Europe, Latin America, and the group of Western countries). Fuel exporters are countries whose average export share of fuels in GDP from 1970 to 2006 exceeded the average import share and two percent of GDP.

4.4 Zimbabwe's output collapse from 1998-2008

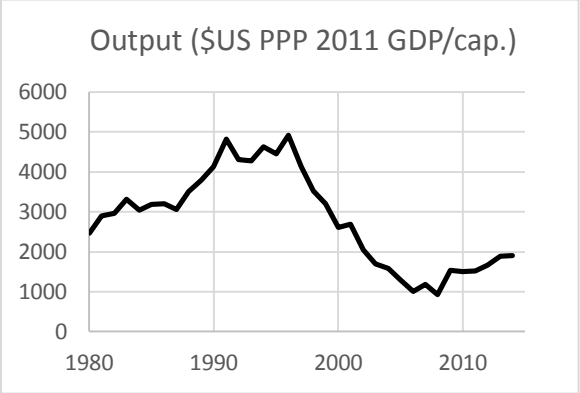
The evidence in the previous section suggested that, on average, better protest technologies increase public investment in autocracies. However, Figure 5 and Table 4 Column (2) suggest that the effect might be income-dependent. In this section, we study a poor (and presumably low-TFP) economy where popular protests increased myopic behaviour by the ruling elite instead of increasing public investment: Zimbabwe from 1998 to 2008.

In the early post-independence period in the 1980s, Zimbabwe grew rapidly, developed its industrial and mining sectors, and the broadly-supported government expanded public goods and services provision (Potts 2006, Barry et al. 2009, Eriksen 2011). In the 1990s, however, the economy stagnated. In 1991, the government initiated a structural adjustment program that

decreased public expenditures and subsidies. In 1992, the economy was struck by a major drought, which was followed by a minor drought in 1995 (Chavunduka and Bromely 2010, Makina 2010). In 1997, thousands of independence-war veterans rose up demanding land and manufacturing plants. The regime responded by redistributing farms to the political elite and promising large one-time payments and pensions to the veterans (Potts 2006, Barry et al 2009, Eriksen 2011). On 14 November, in the face of a weak economy, increasing fiscal commitments, and contagion from the Asian crisis via South Africa, the Zimbabwean dollar collapsed. The regime then redistributed commercial and financial institutions, acquired large stakes in private firms, and cut education, health, and housing expenditures. Youth militias attacked farmers and the opposition. Manufacturing output and investment plummeted. In 2000, the government expropriated land under the Fast Track Land Reform Program (Potts 2006, Makina 2010, Eriksen 2011).

In 1999, the opposition formed the Movement for Democratic Change (MDC) and in 2008 the government and the MDC reached an uneasy power-sharing agreement (Alexander and McGregor 2013). The economy then started to recover. Figure 8 shows that PPP-adjusted income per capita declined from almost $5,000 in 1996 to $934 in 2008. Zimbabwe's history during this period suggests that political-replacement threats can also encourage myopic rent grabbing. This is consistent with Figure 6 or the results in Figure 5 at the lowest TFP levels.

Figure 8: Income per capita in Zimbabwe



Source: Penn World Tables V. 8.0

5. Conclusion

This paper has studied the determinants of public investment when an autocratic government invests in public capital and the citizens divide their time between producing and protesting. The labour supply is downward distorted because a fraction of the citizens protests instead of producing. The public investment level is downward distorted as the government can only collect a fraction of the marginal social investment return, it is myopic, and the labour supply is downward distorted. Nonetheless, there can also exist a government incentive to invest in order to persuade the citizens to return to the production sector. The key requirement is that the substitution elasticity between capital and labour is less than one. The paper's numerical simulations suggest that the joint distortions can generate moderate to large efficiency losses. Empirically we show that government spending in autocracies varies more and is less related to tax collections than in democracies. Additionally, it responds to democratization pressure. We conclude that autocratic rule can generate significant public expenditure and labour supply distortions.

Acknowledgements

We are very grateful to Avinash Dixit, whose discussions at the University of Wyoming in 2007 inspired this paper, as well as Ed Barbier, Rik Chakraborti, Darlington Sabasi, Sherrill Shaffer, Jay Shogren, Klaas van't Veld, and seminar participants at the University of Wyoming.

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Appendix:

Proof that without specific functional forms, the comparative statics are ambiguous

Define the parameter set $X = \{\theta, \tau, \mu\}$ and write the equilibrium conditions (7), (13), and (8)-(9)

$$h(X, l(G(X), X), G(X)) \equiv -q_l' \tau \theta f(1-l, G) - (1-q\tau)\theta f_1'(1-l, G) = 0 \quad \text{(a1)}$$

$$j(X, l(G(X), X), G(X)) = \theta\left(\tau q f_2'(1-l, G) - f_1' l_G'\right) - 1 = 0 \quad \text{(a2)}$$

$$l_G' = \left(\frac{-h_G'}{h_l'}\right) = \left(\frac{q_l' \tau f_2' + (1-q\tau) f_{12}''}{(1-q\tau) f_{11}'' - q_{ll}'' \tau f + 2 q_l' \tau f_1'}\right) \quad \text{(a3)}$$

For a marginal change in parameter $x \in X$,

$$\begin{bmatrix} h_l^{'} & h_G^{'} \\ j_l^{'} & j_G^{'} \end{bmatrix} \begin{bmatrix} dl \\ dG \end{bmatrix} = \begin{bmatrix} -h_x^{'} \\ -j_x^{'} \end{bmatrix}$$

By Cramer's rule

$$dl = \begin{vmatrix} -h_x^{'} & h_G^{'} \\ -j_x^{'} & j_G^{'} \end{vmatrix} \Big/ \begin{vmatrix} h_l^{'} & h_G^{'} \\ j_l^{'} & j_G^{'} \end{vmatrix} = \frac{j_x^{'} h_G^{'} - h_x^{'} j_G^{'}}{h_l^{'} j_G^{'} - j_l^{'} h_G^{'}} \tag{a4}$$

$$dG = \begin{vmatrix} h_l^{'} & -h_x^{'} \\ j_l^{'} & -j_x^{'} \end{vmatrix} \Big/ \begin{vmatrix} h_l^{'} & h_G^{'} \\ j_l^{'} & j_G^{'} \end{vmatrix} = \frac{j_l^{'} h_x^{'} - h_l^{'} j_x^{'}}{h_l^{'} j_G^{'} - j_l^{'} h_G^{'}} \tag{a5}$$

where:

$h_l^{'} = \theta\left[(1-q\tau) f_{11}^{"} - q_{ll}^{"} \tau f + 2q_l^{'} \tau f_1^{'} \right] < 0$ signed by the citizens' second-order condition (SOC)

$j_G^{'} = \theta\left[\tau q f_{22}^{"} - f_{12}^{"} l_G^{'} - f_1^{'} l_{GG}^{"} \right] < 0$ signed by the elite's SOC

$j_l^{'} = \theta\left[\tau q_l^{'} f_2^{'} - \tau q f_{21}^{"} + f_{11}^{"} l_G^{'} - f_1^{'} l_{Gl}^{"} \right]$

$h_G^{'} = \theta\left[-q_l^{'} \tau f_2^{'} - (1-q\tau) f_{12}^{"} \right]$

$$l''_{GI} = \frac{h_l\left(q''_{ll}\tau f'_2 - 2q'_l\tau f''_{21} - (1-q\tau) f'''_{121} - q'_l\tau f''_{12}\right) + h_G\left(-(1-q\tau) f'''_{111} - q'''_{lll}\tau f - 3q'_l\tau f''_{11} + 3q''_{ll}\tau f'_1\right)}{(h'_l)^2}$$

$$l''_{GG} = \frac{h_l\left((1-q\tau) f''_{122} + q'_l\tau f''_{22}\right) + h_G\left((1-q\tau) f'''_{112} - q''_{ll}\tau f'_2 + 2q'_l\tau f''_{12}\right)}{(h'_l)^2}.$$

We prove the claim in 6 steps:

1) In (a4-5) the terms h'_l, h'_G, h'_x, $x \in X = (\theta, \tau, \mu)$, contain no third derivatives.

2) j'_G and j'_x, $x \in X = (\theta, \tau, \mu)$, do not contain q'''_{lll}.

3) j'_l is linear in q'''_{lll}: $\frac{\partial j'_l}{\partial q'''_{lll}} = -\theta f'_1 \frac{\partial l''_{Gl}}{\partial q'''_{lll}} = \theta f'_1 \frac{h_G \tau f}{(h'_l)^2}$.

4) Step 3 implies that q'''_{lll} variations in $(-\infty, \infty)$ cause j'_l variations in $(-\infty, \infty)$. Steps 1 and 2 imply that q'''_{lll} changes do not affect any of the other terms in the *dl* and *dG* expressions in (a4-5).

5) To get

$$dl = \frac{j'_x h'_G - h'_x j'_G}{h'_l j'_G - j'_l h'_G} \equiv \frac{n}{d} > 0,$$

choose q'''_{lll} and in turn j'_l such that

$$n = d \Leftrightarrow$$

$$j_x' h_G' - h_x' j_G' = -h_l' j_G' - j_l' h_G' \Leftrightarrow$$

$$j_l' = \frac{j_x' h_G' - h_x' j_G' - h_l' j_G'}{-h_G'}.$$

To get $dl < 0$, choose q_{lll}''' and j_l' such that

$$n = -d \Leftrightarrow$$

$$j_x' h_G' - h_x' j_G' = h_l' j_G' + j_l' h_G' \Leftrightarrow$$

$$j_l' = \frac{j_x' h_G' - h_x' j_G' - h_l' j_G'}{h_G'}$$

6) To get

$$dG = \frac{j_l' h_x' - h_l' j_x'}{h_l' j_G' - j_l' h_G'} \equiv \frac{\hat{n}}{\hat{d}} > 0,$$

choose q_{lll}''' and in turn j_l' such that

$$\hat{n} = \hat{d} \Leftrightarrow$$

$$j_l^{'} h_x^{'} - h_l^{'} j_x^{'} = h_1^{'} j_G^{'} - j_l^{'} h_G^{'} \Leftrightarrow$$

$$j_l^{'} = \frac{(h_l^{'} j_x^{'} + h_1^{'} j_G^{'})}{(h_x^{'} + h_G^{'})}$$

To get $dG < 0$ choose $q_{lll}^{'''}$ and in turn $j_l^{'}$ such that

$$\hat{n} = -\hat{d} \Leftrightarrow$$

$$j_l^{'} h_x^{'} - h_l^{'} j_x^{'} = -h_1^{'} j_G^{'} + j_l^{'} h_G^{'} \Leftrightarrow$$

$$j_l^{'} = \frac{(-h_l^{'} j_x^{'} + h_1^{'} j_G^{'})}{(h_x^{'} - h_G^{'})} . \blacksquare$$