Political Incentives to Privatize

B. Pablo Montagnes[*]   Baur Bektemirov[†]
University of Chicago   University of Chicago

Abstract

What is the boundary of the public sector and the market? What activities should the government undertake versus regulate? How do political incentives distort these boundaries? Political control of publicly owned assets creates an agency problem: re-election uncertainty results in sub-optimal investment. Privatization generates a different set of distortions, as externalities are ignored. Society is thus faced with a trade-off between public failure and market failure. However, the resolution of this trade-off is a political process and generates further distortions. As privatization allows the politician to transfer future money to the present, excessive privatization is often observed. We design a simple model, which allows us to analyze these various distortion arising from public and private ownership and compare the socially optimal allocation of asset ownership to the politically decided allocation of asset ownership. We extend the model to analyze and compare outcomes under different tax regulatory regimes and in presence of borrowing instruments. We study the phenomenon of excessive privatization and taxation distortions and discuss the costs and benefits for the society of allowing politicians to privatize assets.

1 Introduction

The boundary between the public and the private sector is imprecise. Services traditionally thought of as public such as education, criminal justice and waste collection are often provided by private firms. Private markets as varied as alcohol retail, air travel and mining are contested by public enterprise in some economies and not in others. A traditional market failure approach to defining a role for government does not account for the observed variation in public-private provision [**?**]. This fluidity has generated a literature that seeks to characterize the boundary of the government by characterizing the optimal allocation of activities and control rights to between the public and private sectors with references to other features of the economic activity.

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[*]Assistant Professor, Harris School of Public Policy, 1130 E. 60th Street, Chicago, IL 60637

[†]MPP Candidate, Harris School of Public Policy, 1130 E. 60th Street, Chicago, IL 60637

Examining the private provision of public services, the literature on government contracting adopts the framework of the theory of the firm and asks if social welfare is better served by direct government provision (analogous to the make decision) or private outsourcing and contracting (the buy analog). Generally, there have between two conceptual frameworks used to address this question. One approach rooted in transactions costs and incomplete contracting predicts that private provision will dominate when incentives and monitoring are not too costly [?]. Focusing on the problem of hold-up, others have suggested that private provision will dominate when the introduction of incentives does induce too much welfare destroying activity [?,?]. A related strand of the literature has looked at government contracting problems from the perspective of asymmetric information. [?] [EXPAND HERE]

An alternative approach, assumes that channels such as tax policy and corruption mean that the boundary between the private and public sector is porous. In this environment, if transaction costs are sufficiently low then a Coase theorem of sorts holds. Political intrusion into private enterprise (and vice versa) will occur if there are mutual beneficial arrangement to be had. Privatization serves to increase the costs of political instruction by raising transaction costs. Therefore, privatization is appealing for reformists interested in reducing the inefficiencies that accompany political intrusion [?,?].

In this paper, we focus on a set of questions related to the privatization of public assets and focus on hitherto unexamined aspect of privatization: namely, privatization generates a budget windfall. This windfall can in turn generate incentives to over-privatize relative to socially optimal. Previous work on the topic has characterized the optimal ownership or provision of service but has not examined the interaction between the political decision to privatization and the public and private inefficiencies that accompany different ownership structures.

We consider an environment in which both market failure and public failure are present. The asset in question requires investment to produce output in the future. Privatization in our model is a transfer of asset ownership from the public sector to the private sector. Ownership of the asset actually consists of two separate rights: control rights and ownership rights. The control rights constitute the right to make decision regarding the investment and production of the assets. The ownership rights dictate ownership over the flow of revenue associated with the asset.

In order to capture a role for public control, we assume that the production possibly entails an externality. The externality associated with the production is observable but non-verifiable so constitutes a non-appropriable element of production, Private owners of the asset are profit maximizers and only the consider the appropriable elements of production.

While social welfare would be best served by a benevolent social planner in the role of government, we consider the political agency problem that accompanies government control. While politicians may have social preferences, facing electoral uncertainty they discount the future more than is socially optimal and value short-run spending for electoral reasons.

In principal, either public or private ownership may be socially optimal even if there is no channel for politicians to interfere with private provision (through subsidies or taxation) or for private interests to interfere with public provision (through corruptions). Relative to this optimal benchmark, over-privatization occurs because the same political factors than generate inefficiencies under public ownership also influence the privatization decision.

Our main results speak to whether allowing privatization will in fact serve the public interest. If the costs of political control of assets are low, introducing privatization as an option is bad for society: politicians will privatize even when the costs of associated with private ownership are worse than those under their own control. The introduction of a privatization option creates a new political agency problem. If political distortions are high, introducing privatization as option can improve welfare as privatization is socially preferred and pursued by politicians.

In addition to demonstrating the robustness of this phenomena to different assumptions about the political and financial market, we then explore how the social desirability of a privatization option varies with tax and regulatory regimes. We find that, in most cases, an intermediate level of commitment to tax policy best serves social welfare. Full commitment to taxation, allows a politician to use privatization to inefficiently transfer wealth from the future. Too little commitment will lead to expropriation of privatized assets and reduce privatization when it might serve the public interests. One interpretation of this result that we elaborate on is that tax policy and privatization decisions might be best made by separate entities.

While focusing on a richer set of questions, the model focuses on a smaller set of activities. The type of privatization being consider in this model is the sale of government owned revenue-generating assets. These assets includes state owned enterprises such as airlines and liquor stores, infrastructure with user fees such as utilities, airports and toll roads, infrastructure where user fees could be charged such as freeways or government services where payment comes from another level of government such as healthcare.

The approach taken in this paper is closest to the incomplete contracting (GHM cites) and the assignment of rights of control and cash flow. Other scholars (Laffot-Tirole cites) have consider the issue of regulation and public ownership of assets from the asset from asymmetric information and contracting approach which we view as complimentary. Our approach is closest to (Schliefer-Vishny), but we differ from their approach both in our modeling and the question that we address, but share a general framework. In particular, we also consider the separation of control and cash flow rights.

A question to which this work speaks is the effects of political uncertainty on the incentives of politicians to make investment, particularly investments into infrastructure. In a recent paper, **?** demonstrate that future political competition will induce politician to make sub-optimal investments. In their setting, investment decisions are distorted not by discounting, but by a strategic incentives in future elections. [EXPAND HERE].

Additionally our extensions on tax policy formalize much of the intuition regarding

3

political risk. [EXPAND HERE].

We proceed as follows. In section **??**, we describe the details of the model, the main intuitions and some results on optimal benchmarks. In section **??**, we characterize the investment behavior of both public and private owners illustrating that both may deviate socially optimal level. We further demonstrate that depending on initial parameters, either public or private ownership, each with its intended shortcomings, may dominate from the voter's perspective. In section **??**, we then compare the optimal ownership structure to the one would be chosen by a politician and then characterize the factors that drive privatization. We show that over-privatization can occur and characterize when it is most likely and most costly. We then ask how a richer set of options may mitigate or exacerbate the problem over-privatization. Unbundling control rights and cash flow rights, we allow politicians to borrow against the income stream associated with the asset. While a well function borrowing market can mitigate some of the worst over-privatization it does solve the problem. This serve to highlight that the transfer of the bundle of control and cash flow rights is valuable to the politician because it brings with it a commitment to use the asset in a profit maximizing way.

In sections **??**, we present related extensions of the model first showing how various levels of tax commitment power can have qualitative effects on the likely and social desirability of privatization. In particular, we highlight the role of commitment power in connecting tax policy to privatization. Building on these insights, we examine partial privatization as a mechanism that generates commitment for the politician and show how partial privatization can arise as optimal solution to the politician's commitment problem. We then conclude, commenting on the role of institutional arrangements to address the issued raided.

2   Model

The model consist of a representative voter and a politician who must make a decision about the control of a public asset. The asset is valuable as it generates revenue in the future, but it requires short term investment in the present. In addition to generating revenue which can be used for government spending, the asset generates an externality which could be negative or positive. Voters care about the quality of government services which is a function of government spending and the ability of the politician as well as the externality generated by the asset. The politician can decide to privatize the asset in which case the government receives a lump-sum payment equal to the expected profitability of the asset in private hands. If the politician decides to retain control of the asset, she must decide on the level of investment.

The politician values social welfare and enjoys rents from holding office. However, the politician faces an election between the time the asset ownership and investment decisions are made and the time that the asset produces returns in the form of revenue and externality.

The politician values the utility of the representative voter and enjoys benefits from holding office. In addition, the politician enjoys some fixed rents from office. However, the politician faces an election between the time that the asset ownership and investment decision is made and the time that the asset will produce output.

This delay between investment and return creates two distinct distortions between the politician investment decision and the optimal decision from the voter's perspective. The first effect is driven by the politician's desire to win reelection and we term it the *Electoral Effect*. Voters learn about the incumbent's type with the goal of electing the most capable politician in the second period. While they cannot directly observe a politician's type, voters observe the level of public services which is a function of both public spending and politician type. Because voters are better able to observe the level of service than the government investment activity, this creates a career-concerns environment where the incumbent reduces investment in an attempt to jam the learning by citizen by increasing spending. While voters are not fooled in equilibrium, the possibility of jamming creates an incentive to the politician to reduce investment and increase spending.

The second effect, the *Political Impatiences Effect*, is driven by the incumbent's uncertainty about being retained. Our assumption is that while in office the politician's preferences are a combination of the general social welfare plus some office rents. When not in office, we assume that a politician gets some fixed utility that we normalize to zero. One could think of the politician valuing social welfare as an altruist when in office and discounting social value completely when not in office. Alternatively, the politician may value the general welfare because a higher social welfare allows her to pursue her policy goals more effectively and to help her win reelection. However, when not in power the politician can no longer affect policy and thus does not value social welfare or social welfare is no longer of value to the politician in terms of achieving other goals or gaining reelection. The essential element for the *Political Impatiences Effect* to be present is that the politician values social welfare more when in office than out-of-office. This combined with uncertainty about the political environment causes the political to discount the future more than is socially optimal. Other than the politician discounting the future due to the uncertainty of being in office, we assume no other discounting.[1]

Both the Electoral and the Political Impatience effects distort the politicians investment decision away from the voter in the same way: The politician under invests in the asset relative to the voter's preference.

If instead of retaining control the politician privatize the asset, a different set of distortion arise. A private owner seeks to maximize the profitability of a project and only values the market appropriable returns and ignores the externalities associated with production. However, unlike a politician, he behaves as a long-lived owner. In private hands, the ownership of the asset does not change unless the private owner decides to sell the asset and thus private owners internalize the long-term value. Even if a particular private owner of an asset does hold the asset forever, he will still want to maximize the value of the asset by making

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[1]This assumption is without loss of generality with respect to the questions we address.

profit maximizing decisions. While private owners have the same time horizon as voters, they do not value the externality and may over or under produce relative to the optimal.
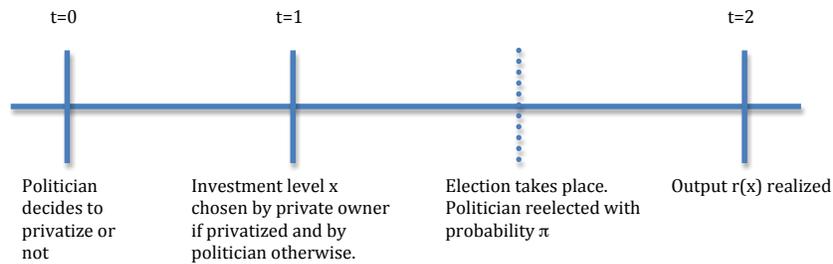
figure.pdf

Figure 1: Sequence of Events

2.1   Timing, Investment Costs and Returns

The model proceeds over three periods, let $t \in \{0, 1, 2\}$ denote the period. In period 0, the politician decides to privatize the asset or not and in later extension how much to borrow. In period 1, the owner of the asset decides on the level of investment. Between periods 1 and 2, voters observe the level of government service and decide whether to retain the incumbent through an election. In period 2, the asset produces revenue and externalities that depends on the amount invested and the game ends. Let x denote both the level and the cost of investment.[2]

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[2]We can assume any weakly convex cost function, but the exposition is much clear with simple linear costs of 1.

The output of the asset consists of two components. The first is the market appropriable return of the asset: for a fixed investment of x the asset returns $R(x)$ units of revenue in the second period, where the technology exhibits decreasing returns to scale with $R' > 0, R'' < 0, R(0) = 0$ and $R'(x) \to \infty$ as $x \to 0$. The market appropriable returns are the only element of production that a private owner considers when making an investment decision and when valuing the asset. If the politician does not privatize, these market returns become revenue for the government. In addition to the market appropriable returns, we assume that the asset generates non-appropriable output $S(x)$. This non-appropriable return that can generally be thought of as standard economic externalities. If these are negative externalities such as with pollution, then we assume that $S' < 0$ and $S'' < 0$. If these are positive externalities such as increases in the value of neighboring properties due to investment, the we assume that $S' > 0$ and $S'' < 0$. To ensure interior solutions, we assume that $R'(0) + S'(0) > 1$

2.2   Voter Utility

In periods 1 and 2, the voters experience government services that depend on the level of government spending and the quality of the office holder. In period 2, the voter also experiences the externality (positive or negative) generated by the asset. Let Let ν_t denote the quality of the politician in office at period t. We assume that government revenue raised through taxes are fixed and generate flow of revenue, B_t in each period. Apart from the borrowing against the asset consider later, we assume no borrowing or saving on the part of the government.

We can now describe voter utility in each period if the politician retains control. Let E_t^G denote the level of government services experienced in period t under retained control. In period 1, government services is equal to the quality of the politician plus the first period budget minus investment.

$$E_1^G = \nu_1 + B_1 - x \tag{1}$$

In period 2, the level of services experienced is equal to the budget plus the revenue generated by the asset in addition to the quality of the second period politician and the externality generated by the asset.

$$E_2^G = \nu_2 + B_2 + R(x) + S(x) \tag{2}$$

If instead the asset is privatized, the government sells the asset in the first period, but does not need to invest and receives no revenue from the project. Let Q denote the amount the government receives for selling the asset. We assume a perfectly competitive market for asset control and so the value of the asset is equal to the expected profit of the asset, $Q = R(x) - x$ where the level of investment will be decided by the private owner and will be

7

anticipated by the politician.[3] Let E_t^P denote the level of government services experienced in period t under privatization. In period 1, government services are equal to the quality of the politician plus the first period budget and the the windfall from privatization

$$E_1^P = \nu_1 + B_1 + Q = \nu_1 + B_1 + R(x) - x \tag{3}$$

In period 2, the level of services experienced is equal to quality of the politician and the externality generated by the asset under private control, but the only revenue is that from the budget.

$$E_2^P = \nu_2 + B_2 + S(x) \tag{4}$$

From the perspective of the voter, the optimal level of investment does not depend on ownership, $E_1^G + E_2^G = E_1^P + E_2^P$. Let $x_F B$ denote the optimal level of investment from the voter's perspective and note that it is defined by the following first order conditions:

$$S' + R' - 1 = 0 \tag{5}$$

As we will demonstrate in the next section, the actual level of investment under private and public control will vary from this optimal benchmark in different ways suggesting that there will be a trade-off between privatization and retained public control.

3   Investment Behavior

In previous section, we characterized the socially optimal level of investment from the perspective of the voter and discussed how the incentives of both public owners and private owners would cause them to invest at different levels. In this section, we formally characterize the first period investment decisions that arise under different allocation of control rights and establish two basic facts about investment under public and private ownership. First, each ownership structure induces a deviation from the social optimum. Second, depending on the electoral environment and the size of the externality, public ownership can dominate private ownership and vice versa. If a politician is sufficiently likely to be reelected and reelection is not too sensitive to first period spending, then public ownership dominate private ownership. However, these comparison between ownership structures serve only as benchmarks. The actual decision to privatize lies with the politician and we compare her choice of ownership

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[3]This can be relaxed. If the market for control is less than perfect then the government will receive a proportion of expected profit less than 1. As social welfare in the model is invariant to distribution, this will have no effect on welfare, but will strictly reduce the appeal of privatization from the perspective of the politician.

structure to the socially optimal structure in subsequent sections.

3.1   Voter Preferences, Beliefs and Reelection

The level of spending experienced by the voters is a function of the size of the budget, the level of investment and the competence of the politician. Between periods 1 and 2, the the level of investment and budget are fixed, but the voters can choose to either retain the incumbent of type ν_I or select a challenger. Note that as investment level is chosen and fixed before the voters make a decision on whom to elect, they only condition their decision on the expected type of the politician. For notational simplicity, we assume that the expected type of the challenger is a fixed known value ν_c and the incumbent type is unknown and distributed symmetrically on $\left[-\frac{\xi}{2}, \frac{\xi}{2}\right]$ with some cumulative distribution function F. We assume that the expected challengers type lies within the support of the incumbents types so that the election result is not deterministic. An expected challenger of type $\nu_c < 0$ is associated with an incumbency advantage with the incumbent having a type higher than the challenger more than half the time. Similarly, a challenger of type $\nu_c > 0$ corresponds to a disadvantage for the incumbent. As we will demonstrate, the challenger quality will correspond to degree of political impatiences that the incumbent exhibits. [CITATIONS FOR Persson and Tabellini, Ashworth, Ashworth and BDM, etc.]

Voter can only observe total government services and if the asset is retained by the politician they assume that first period services are a function of the budget, politician quality and the level of investment, $E_1^G = B_1 - x + \nu_I$. In the second period, government services depend on the quality of the politician as well as the budget, the externality and the revenue generated by the asset. Only the first of these components is something that the voter can affect through his vote choice. Voters update their believe of the politician based the observed spending in the first period and their beliefs about the level of spending. Conditional on their experience of government services, voters re-elect the politician if her expected type is higher than the challenger's expected competence ν_c

3.2   Investment under Political Control

In order to determine the amount of a investment that a politician will make, we first suppose that the voter believes that the politician will choose level of investment equal to x^*. We will determine the politician's actual investment decision and then impose consistent beliefs upon the voter in order to derive the equilibrium level of investment.

Given such a belief that the politician will invest x^*, the voter who observes spending E_1^G and knows budget B_1 will have the following estimate of the incumbents type:

$$\hat{\nu}_I = E_1^G - B_1 + x^* \tag{6}$$

where E_1^G is the observed level of spending equal to $B_1 - x + \nu_I$. The politician will be re-elected if the voter's update belief about his type is greater than the expected type of the challenger that is if $\hat{\nu}_I \geq \nu_C$, (i.e. $\nu_I \geq \nu_C + x - x^*$.)

Given the voter's conjecture about the level of investment, the politician believes she will be re-elected with probability:

$$Pr(\nu_I \geq \nu_c + x - x^*) = 1 - Pr(\nu_I < \nu_c + x - x^*) = 1 - F(\nu_c + x - x^*) \qquad (7)$$

Given such a believe, the politician choose x to maximize her total expected utility::

$$\underbrace{B_1 - x}_{\substack{\text{First Period} \\ \text{Spending}}} + \underbrace{(1 - F(\nu_c + x - x^*))}_{\text{Reelection Probability}}[\underbrace{B_2 + (R(x)}_{\substack{\text{Second Period} \\ \text{Spending}}} + \underbrace{\gamma}_{\substack{\text{Second Period} \\ \text{Office Rent}}} + \underbrace{S(x)}_{\substack{\text{Second Period} \\ \text{Externality}}}] \qquad (8)$$

where γ represents the additional benefits of holding office. The first order conditions for this problem defines the level of investment as a function of the voter's conjecture and the primals of the model. The first order conditions are sufficient for any weakly convex distribution function F and are:

$$-1 - F'(\nu_0 + x - x^*)[\gamma + B_2 + (R(x) + S(x))] + (1 - F(\nu_0 + x - x^*))(R'(x) + S'(x)) \qquad (9)$$

A particular distribution that satisfies our sufficiency condition is the uniform distribution and we assume such a distribution for what remains. Therefore, politician's types are distributed:

$$F(X) = \frac{X - (-\frac{\xi}{2})}{\frac{\xi}{2} - (-\frac{\xi}{2})} = \frac{1}{\xi}(X + \frac{\xi}{2})$$

with $F'(X) = \frac{1}{\xi}$. Substituting into the first order condition we arrive at the following:

$$-(R(x) + S(x)) + (\frac{\xi}{2} - \nu_0 + x^* - x)(R'(x) + S'(x)) = \xi + \gamma + B_2 \qquad (10)$$

In order for the investment decision to be a sequential equilibrium, the beliefs of the voter must be consistent and so $x^* = x$. The level of investment under government control, $x_G(\gamma, \xi, \nu_C, B_2)$, that satisfies this condition is a function of the level of uncertainty about his type, the second period office benefits and the expected type of the challenger and is defined by the following condition:

$$-(R(x_G) + S(x_G)) + (\frac{\xi}{2} - \nu_c)(R'(x_G) + S'(x_G)) = \xi + \gamma + B_2 \qquad (11)$$

We can immediately derive predictions about how politically controlled investment will vary according to the parameters of the model. Our first result speaks to the *Electoral Effect* on investment. As the benefits of being in office increases so to does the incentive to obfuscate the voters updating. While the voter is not fooled in equilibrium, the temptation to boost short term spending by reducing investment nonetheless increases as the benefits of holding office increases resulting in lower levels of investment.

Proposition 1. *The level of investment under political control, x_G is strictly decreasing in benefits to office, γ and second period fixed revenues, B_2.*

Proof. This and all subsequent proofs are found in appendix A. □

A separate effect on investment is *Political Impatiences.* As politician become less sure about being reelected, their calculus of the trade-off between investing in future or spending today is altered. One way to demonstrate this effect is to alter the quality of the challenger. As the quality of the expected challenger increases, the probability that the incumbent is reelected decreases as does their weight on the future returns to investment.

Proposition 2. *The level of investment under political control is strictly decreasing in the expected quality of the challenger, ν_c.*

[ADD RESULTS ON ξ]

Once investments are made, the probability of reelection is:

$$1 - F(\nu_0 + x^* - x^*) = 1 - F(\nu_0)$$

Note that as the voter holds consistent beliefs, they are able to back out the effect of investment on government services. As a result, the probability of reelection does not depend on the level of investment. To facilitate analysis later, we introduce the following notation that incorporates this insight. Let $\pi(\nu_C) = 1 - F(\nu_C)$ denote the probability of reelection as a function of the challenger type.

Both of these effects are in the same direction and in total, the politician under-invests relative to the social optimum, a result we formalize in proposition **??**.

Proposition 3. *The level of investment under political control is strictly less than the socially optimal level of investment.*

3.2.1   Observable Investment Decision

As mentioned, one of the mechanisms driving down investment under political control is the temptation to boost short term spending in order to increase the voter's assessment of

the incumbent. If we instead assumed that voters could observe spending would we will still observe under-investment. The answer is yes and illustrates that the *Electoral* and *Political Impatience* effects act independently of each other.

Consider a variation of this model when the voters observe both the level of expenditure E_1^G and investment made x. Then they have complete information about politician's type $\nu_I = E_1^G - B_1 + x$ and will re-elect her if $\nu_I \geq \nu_c$, i.e. the probability of re-election is equal to $\pi(\nu_C)$. The politician must maximize

$$B_1 - x + \pi(\nu_C)[\gamma + B_2 + R(x) + S(x)]$$

Optimal $\hat{x_G}$ satisfies

$$\pi(\nu_C)(R'(\hat{x_G}) + S'(\hat{x_G})) = 1$$

Comparing this condition with (**??**), we can verify that $x_G < \hat{x_G}$. If the voters can observe the level of investment, the politician will face the same re-election chances but will invest more. However, as the next proposition establish the level of investment is still less than the socially optimal level.

Proposition 4. *If investment is observed by the voter, the level of investment under political control is strictly less than the socially optimal level of investment, but strictly higher than the level of investment when investment is not observable.*

Proposition 5. *Under political control with observable investment, investment in the asset does not depend on revenue or the returns to office.*

Previously, B_2 and γ only factored into the politician's investment decision via the effect of spending on reelection. As reelection is fixed, we have effectively shut down the channel by which these parameters affect investment. However, the main qualitative results regarding investment under political control relative to the social optimal level of investment still hold.

3.3   Investment under Privatization

If the asset is privatized, the private firm faces the same timing as under public ownership making an investment x in period 1 and obtaining returns $R(x)$ in period 2. However, private owners only care about the market appropriable returns and ignore the externality. Thus in private hands, the firm maximizes profit by choosing investment level x:

$$-x + R(x) \tag{12}$$

The resulting level of investment satisfies the following first order conditions:

$$R'(x) = 1 \tag{13}$$

We denote this level of investment, x_P. Comparing equation (**??**) to (**??**), it is immediately apparent that in the presence of a negative (*resp.* positive) externality, the firm overproduces (*resp.* underproduces) relative to the first best.

In addition to privatizing the asset and transferring the control rights of the investment, the government may be able to regulate the production of the output. We might imagine that for a variety of activities it is easy to monitor the output and thus tax it. Taxation has a variety of effects. First and most directly it affects the firm's investment decision. Thus, the level of output can be indirectly controlled by the tax level. We will consider the secondary effects of taxation on the profits of the firm and the revenue stream they create in the next section. To see how the direct effects manifest, let τ denote the tax rate (if positive) or the subsidy rate (if negative) that the government may impose. When faced with tax rate τ, the firm chooses investment level x to maximize after-tax profits:

$$-x + (1 - \tau)R(x) \tag{14}$$

The resulting level of investment satisfies the following first order conditions:

$$R'(x) = \frac{1}{1 - \tau} \tag{15}$$

and we denote the solution with taxation $x_{PT}(\tau)$. The investment level is clearly decreasing in τ. If we do not restrict τ to be positive, than it is easy to implement the first best by imposing a pigouvian tax that sets $x_{PT}(\tau)$ equal to the social optimal. However, just as the decision to privatize will be made by the politician, the tax rate will also be set by the politician. Thus, either due to restriction on the tax rate or political interference x_{PT} need not equal x_{FB}.

3.4   Socially Optimal Privatization

Having described how investment decisions vary with ownership structure, we characterize the optimal allocation of control rights from the voter's perspective: weighing the public failure of under-investment against the private failure to take into account the externality. Assuming that indifference between public and private ownership is decided in favor of retained public control, privatization is preferred by the voter if and only if $E_1^P + E_2^P > E_1^G + E_2^G$ where we substitute the appropriate equilibrium choices of investment by the public and private owners (for notational simplicity, we suppress the arguments of $x_G(\gamma, \xi, B_2)$):

$$\underbrace{B_1 + (R(x_P) - x_P) + B_2 + S(x_P)}_{\substack{\text{Utility under} \\ \text{Privatization}}} > \underbrace{B_1 + -x_G + B_2 + R(x_G) + S(x_G)}_{\substack{\text{Utility under} \\ \text{Public Control}}} \tag{16}$$

Which can be re-written as

$$\underbrace{(R(x_P) - x_P) - (R(x_G) - x_G)}_{\substack{\text{Gains in Profitability} \\ \text{under Privatization}}} > \underbrace{S(x_G) - S(x_P)}_{\substack{\text{Differnce in Externality} \\ \text{under Government Control}}} \tag{17}$$

The left-hand sides of equation **??** represents the gains in profitability from moving from a government owner to a private owner. Since x_P is the unique maximizer of profit, the difference between profit under private control and public control is weakly positive and generically strictly positive. The right-hand side is a measure of the gains in the externality under government control. While the gains in profit under private control are always positive, it is possible that the value of the externality is higher under private control if the externality associated with the asset is positive and the public underinvestment problem is severe enough. In fact, for either a positive or a negative externality if the politician sufficiently discounts the future or is influenced by electoral concerns than the underinvestment problem can dominate and privatization willl be preferred.

While future benefits from office, uncertainty about incumbent quality and the quality of the challenger all contribute to public failure, we characterize the preferences of voters in terms of the latter. The quality of the challenger serves as parameterization of the overall probability of winning: for a fixed level of γ, ξ and B_1 a higher level of challenger quality, ν_c reduces the incumbents chance of winning. As ν_c varies from the lower bound of incumbent quality $\left(-\frac{\xi}{2}\right)$ to upper bound $\left(\frac{\xi}{2}\right)$, the probability of reelection varies monotonically and continuously from 1 to 0. Consequently, the level of investment under public control varies from the social optimal (when reelection is assured) to 0 as the probability of reelection reaches 0. While variation in γ and B_2 have a similar monotonic effect on the investment level, the level of investment does not vary over the range of socially optimal to zero as we vary these parameters. As noted in Proposition XXX, the relationship between ξ and investment depends on the sign of ν_c. Therefore it is simplest if we state our results in terms of the expected challenger quality.

Proposition 6. *There exists $\bar{\nu}_V(\gamma, \xi, B_1)$ such the voter prefers privatization if and only if $\nu_c > \bar{\nu}_V$.*

Proposition **??** states if the politician sufficiently discounts the future than the voter strictly prefers the level of investment under private control than under continued public control. Whether or not the politician's preference for privatization corresponds with the voter's depends upon the benefits and costs to privatization for the politcian which we expand upon in the next section.

14

4 Privatization Decisions

4.1 Asset Sale

A politician faces a trade-off between selling the asset for windfall and losing control and retaining control, foregoing the windfall, but being able to address the level of the externality. Privatization is appealing for the politician as she is able to spend the proceeds in period 1 which she values more than spending in period 2 due to the electoral uncertainty. As stated, we assume that the market for control of the asset and the politician is able to recoup the full market value of the asset, so the value of the asset is $Q = R(x_p) - x_p$. This is obviously one extreme of the possible prices that the politician could get for the asset. Most of our results regarding the desirability of the privatization will be framed in terms of over-privatization relative to the social optimal. An alternative interpretation of these results consistent with the model is that politicians are willing to accept lower prices for assets than is socially desirable. Assuming that the politician gets the highest prices simply frames the results in terms of *likelihood* of over-privatization rather than *quality* of privatization.

While the politician values the transfer of the value of the asset from the future to the present due to her discounting, it could also be appealing for electoral reasons. The windfall from the asset could allow the politician to boost short run spending and further affect the voter's belief about her quality. We rule out this second effect by assuming that privatization is observed by voters and thus they update their belief about the resources available for government services from B_1 to $B_1 + Q$. If politicians are able to secretly privatize asset, the appeal of privatization would strictly increase and as we are interested in establishing over privatization assuming public observability biases us away from finding the result.

Under public privatization, voters update their belief about spending levels and are able to perfectly infer the politician's type. As before, the politician is reelected with probability $\pi(\nu_c)$ and the value of privatization to the politician is:

$$\underbrace{R(x_{pr}) - x_p}_{\text{Market Value of Asset}} + B_1 + \pi(\nu_c)[B_2 + \gamma + \underbrace{\eta R(x_p)]}_{\text{Externality Under Private Control}} \tag{18}$$

In preceding sections, we established the social optimal level of investment and compared how investment decisions vary with ownership structure. We also characterized the optimal level of privatization from the voter's perspective. Our approach now is to characterie the political privatization choice and to compare it to the socially optimal ownership structure. Under various institutional assumptions, we can characterize when there will be excessive or under privatization by politicians and how costly the decision to privatize is relative to the social optimum.

We begin by noting that under both privatization and retained control, the reelection rate faced by the incumbent is the same value $\pi(\nu_c)$. As with the voter, simply comparing utilities under each regime for gives us the condition under which privatization is pursued by the politician:

$$\underbrace{B_1 + (R(x_P) - x_P) + \pi(\nu_c)(B_2 + \gamma + S(x_P))}_{\substack{\text{Utility under} \\ \text{Privatization}}} > \underbrace{B_1 + -x_G + \pi(\nu_c)(B_2 + \gamma + R(x_G) + S(x_G))}_{\substack{\text{Utility under} \\ \text{Public Control}}} \tag{19}$$

which can be also be written as:

$$\underbrace{(R(x_P) - x_P) - (R(x_G) - x_G)}_{\substack{\text{Gains in Profitability} \\ \text{under Privatization}}} > \pi(\nu_c) \underbrace{(S(x_G) - S(x_P))}_{\substack{\text{Difference in Externality} \\ \text{under Government Control}}} + \underbrace{(\pi(\nu_c) - 1)R(x_G)}_{\substack{\text{Delayed value of revenue} \\ \text{under Government Control}}} \tag{20}$$

As before, the left-hand sides of equations (**??**) represent the gains in profitability from moving from a government owner to a private owner and the right-hand side the gains to public ownership. However, these gains are discounted by the politician. Comparing the politician's weighing of privatization to public control, we see that she discounts public control more than the voter. As result, the politician will never prefer public ownership when the voter does not and we can establish that under-privatization will never occur.

Proposition 7. *Whenever voters prefer privatization so does the politician.*

This distortion or wedge is driven by two distinct differences in the preferences. First, while both the politician and the voter value gains in the profitability of the asset, their relative value of the trade-off between profitability and the externality is different. Since the politician discounts the future, she is willing to accept greater decreases in welfare for increased revenue than the voter. Second, the politician values the transfer of revenue that would have accrued to the government from the future to the present. The voter is indifferent between revenue in the present and the future as he does not discount the second period. These distortion contribute to our second result which suggests that over-privatization will occur when the degree of public failure is great enough. We characterize over-privatization relative to the overall probability of winning which is parameterized by the expected strength of the challenger.

Proposition 8. *There exists $\bar{\nu}_{POL}(\gamma, \xi, B_1)$ such the politician prefers privatization if and only if $\nu_c > \bar{\nu}_{POL}$.*

Proposition 9. *The politicians prefers to privatize for lower values of political certainty then does the voter. That is $\bar{\nu}_{POL} < \bar{\nu}_V$.*

[DRAW PICTURES USING PARAMETRIZATION AND DISCUSS]

16

4.2   Borrowing

As has been noted, one of the principal meachanisms by which privatization is prefered by the policitican is through the transfer of wealth from the future to the present. An alternative mechanism for transferring wealth between periods is to borrow against the future revenues generated by the asset. We assume that the politician is able to borrow against the future revenue generated by the asset, but only against this revenue. In period 0, before making the investment, she has access to a completely competitive lending market, but cannot make binding commitments with regards to the amount of investment that she will undertake. As the amount borrowed will influence the investment decision of the politician, the lending market takes this into account when making a loan and does not lend the politician more than will be recouped by the revenue generated by the asset in period 2.

By explaining the robustness of our results to an alternative means of transferring wealth between periods, we highlight that privatization also provides the politician with commitment to use the asset in the profit maximizing manner. To focus on the moral hazard issue that exists between politicians and lenders, we assume the politicians investment decision is observed by voters. As discussed this effectively shuts down the incentive for the politician to manipulate spending and therefore the reelection probability is fixed and only depends on the probability that the challenger is better than the incumbent. So the reelection rate is invariant to level of investment and borrowing and remains$\pi(\nu_c)$.

For a fixed loan amount, L, the politician chooses investment level x to maximize her expected utility noting that revenue generated by the asset will only flow to government coffers once the loan amount as been repaid:

$$L + B_1 - x + \pi(\nu_c)[S(x) + Max\{0, R(x) - L\}]$$ (21)

The problem in equation **??** is generally not concave or differentiable so the standard first order approach is not valid. However, the politician will either be facing an investment decision where the loan is small enough such that it does not affect the marginal investment decision or large enough such that she expects no revenue from the project in the second period as loan repayment will take all of the generated income for all relevant levels of investment. We will first establish the range of investment levels that a politician would feasibly make by considering extreme levels of the loan. We will then show that the solutions to these extremes are the only possible solutions to the problem. Thus, we can restrict ourselves to comparing the value of the politician's problem with these two solutions. We will then note that the politician's utility is increasing in the size of the loan. Therefore, the politician will seek to maximize the size of the loan. Finally, we will characterize the largest loan that is consistent with full repayment by the government and therefore the size of the loan that will be implemented.

The lowest possible loan that the politician could receive is $\underline{L} = 0$ and the politician

faces his standard problem without borrowing:

$$B_1 - x + \pi(\nu_c)(S(x) + R(x) + \gamma + B_2) \tag{22}$$

This loan of 0 provides the politician with the highest incentives to invest as she is able to recoup all the financial rewards of the asset in the second period. We label the unique solution to this problem $\bar{x}$ (we suppress its argument ν_c) and note that it is the most the politician would ever invest. For investments greater than $\bar{x}$, the return to investment is negative regardless of the loan amount.

We now want to consider a loan amount large enough such that the politician knows that the entire income stream from the project will be for paying back the loan. Facing such a loan, the politician will not consider the revenue generated by the project when making an investment decision. If $\bar{L} > R(\bar{x})$, the revenue generated by the project will be insufficient to pay back the loan as all feasible investment levels ($x \leq \bar{x}$) generate income below $\bar{L}$. Put another way, for all feasible investment levels $Max\{0, R(x) - \bar{L}\} = 0$ and the politician chooses investment level x to maximize:

$$\bar{L} + B_1 - x + \pi(\nu_c)(S(x) + \gamma + B_2) \tag{23}$$

This loan amount provides the lowest possible incentive to investment and we label the unique solution to this problem $\underline{x}$.

Having established that a feasible investment must be in the range $[\underline{x}, \bar{x}]$, we now show that any optimal solution must in fact be one of these two extremes. That is any solution must be in the set $\{\underline{x}, \bar{x}\}$.

Consider an arbitrary loan $\widehat{L}$ and investment level $\widehat{x}$ and denote the value to the politician for such a loan and investment: $V(\widehat{x}|\widehat{L})$. We will show that $\widehat{x}$ is dominated by either $\underline{x}$ or $\bar{x}$. If $\widehat{x} \in (\underline{x}, R^{-1}(\widehat{L})]$, it would be dominated by $\underline{x}$. To see this, note that $V(\underline{x}|\widehat{L}) - V(\widehat{x}|\widehat{L}) = \pi(\nu_c)S(\underline{x}) - \underline{x} - [\pi(\nu_c)S(\widehat{x}) - \widehat{x}]$ which is strictly positive as $\underline{x}$ is the unique maximizer of $\pi(\nu_c)S(x) - x$. Similarly for investment level $\widehat{x} \in [R^{-1}(\widehat{L}), \bar{x})$, $V(\bar{x}|\widehat{L}) - V(\widehat{x}|\widehat{L})$ is strictly positive. In either case, the solution to the politician's borrowing investment problem is either $\underline{x}$ or $\bar{x}$ or both.

Because the politician discounts period 2 revenue relative to period 1, the politician's utility is increasing in the period 0 loan amount and she will seek the largest possible loan. However, the lender will lend only up until an amount that he expects to be paid back. Thus if the investment level is x, the lender will be willing to make any loan in $[0, R(x)]$. Clearly investment level $\bar{x}$ supports a larger loan. However, as the loan amount increases the incentive to invest less increases and the politician will be tempted to switch from investing $\bar{x}$ to $\underline{x}$. To find the largest possible loan that the politician will qualify for (and therefore the amount she will borrow), we need to find the largest loan L that is consistent with investment level $\bar{x}$. That is the largest loan that is incentive compatible with an investment

level $\overline{x}$.

Our task is to find the highest L such that $V(\overline{x}|L) \geq V(\underline{x}|L)$ and therefore $\overline{x}$ is one of the solutions to the problem. For $L = 0$, $V(\overline{x}|0) > V(\underline{x}|0)$ and for $L' \geq \bar{L}$, $V(\overline{x}|L') < V(\underline{x}|L')$. Define $D(L) = V(\overline{x}|L) - V(\underline{x}|L)$, by above $D(\underline{L}) < 0$ and $D(\bar{L}) > 0$. As $D(L)$ is linear in L, it is both continuous and monotone, so by the mean value theorem there exists L^* such that $D(L^*) = 0$ which implies $V(\overline{x}|L^*) = V(\underline{x}|L^*)$ and for $L > L^*$, $V(\overline{x}|L) < V(\underline{x}LB)$.

At L^* both investment levels $\overline{x}$ and $\underline{x}$ are solutions, but only investment level $\overline{x}$ supports repayment of the loan. We will assume that if indifferent, the politician will invest $\overline{x}$.[4]

Because the size of the loan is structured so that politician has a marginal incentive to value increased output, the level of investment with borrowing is the same as without borrowing and social welfare under political control is unaffected. However, because the politician has transferred wealth from period 2 to period 1, the politician strictly prefers public control with borrowing to public control without.

Overprivatization and Borrowing

When borrowing is allowed, the politician has more options when controlling the asset. While borrowing allows for some of the fiscal transfer effects of privatization, we will see that there are still conditions under which privatization will dominate public control.

This occurs because privatization entails a transfer of control and this allows the politician to commit to a level of investment that would not otherwise be credible if the politician retained control. This establishes that in addition to the benefit in transferring revenue between periods, another distinct advantage of privatization is that it allows the politician to commit to profit and thus asset value maximizing decision.

As shown in the previous section, the politician's utility increases with the amount of loan she can borrow. If the asset remains under public control, the politician will borrow L^* and invest the same level as in the case without borrowing. This unambiguously increases the benefits of retaining public control. We will proceed by showing that over-privatization will occur, albeit less often than in the previous case. As before the politician compares her utility under privatization and retained control:

$$\underbrace{B_1 + (R(x_P) - x_P) + \pi(\nu_c)(B_2 + \gamma + S(x_P))}_{\substack{\text{Utility under} \\ \text{Privatization}}} > \underbrace{B_1 + L^* - x_G + \pi(\nu_c)(B_2 + \gamma + R(x_G) - L^* + S(x_G))}_{\substack{\text{Utility under} \\ \text{Public Control}}}$$

$$(24)$$

which can be also be written as:

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[4]For example, all else equal the politician would prefer not to default on the loan if in office.

19

$$\underbrace{(R(x_P) - x_P) - (R(x_G) - x_G)}_{\substack{\text{Gains in Profitability} \\ \text{under Privatization}}} > \underbrace{\pi(\nu_c)(S(x_G) - S(x_P))}_{\substack{\text{Difference in Externality} \\ \text{under Government Control}}} + \underbrace{(\pi(\nu_c) - 1)(R(x_G) - L^*)}_{\substack{\text{Delayed value of revenue} \\ \text{under Government Control}}} \quad (25)$$

However, since the loan must leave some residual incentive for the politcian $(R(x_G) - L^*) > 0$ and so the last term $(\pi(\nu_c) - 1)(R(x_G) - L^*)$ although greater than before remains negative. Consequently, while the wedge between voter and politician is smaller it still exists and over-privatization still occurs. We formalize these results in the following propositions, beginning with the result that politician will sometimes prefer privatization.

Proposition 10. *If the politician is able to borrow, there exists $\bar{\nu}_{Borrow}(\gamma, \xi, B_1)$ such the politician prefers privatization if and only if $\nu_c < \bar{\nu}_{Borrow}$*

Borrowing is beneficial, however, as politician's privatize less often:

Proposition 11. *If the politician is able to borrow, she prefers to privatize for for higher values of political certainty then she does without borrowing. That is $\bar{\nu}_{Borrow} > \bar{\nu}_{POL}$.*

Nonetheless, the reduction in privatization still allows for the possibility of over-privatization.

Proposition 12. *If the politician is able to borrow, she still prefers to privatize for lower values of political certainty then does the voter. That is $\bar{\nu}_{Borrow} < \bar{\nu}_V$.*

It is also the case that conditional on retaining public control, a politician's utility is strictly larger when he or she can borrow. Conditional on occurring, the social cost of privatization remains the same. Therefore, allowing borrowing is weakly preferable for the social planner.

We conclude that the absence of adequate borrowing instruments may force privatization to occur where political control would be optimal. Thus, better functioning capital markets will reduce over-privatization cases particularly when the social losses from over-privatization are highest. The logic is not one of competitive outside options, instead the introduction of a borrowing market reduces the appeal of socially inefficient privatization.

5 Taxation

Until this point we have assumed a stark regulatory environment: either the government retains full control of the asset or completely relinquishes control. While there are environments in which technology constraints might make it difficult to observe and regulate the economic activity, the government often has on hand a variety of regulatory instruments.

Here we consider the implication of using taxation of the output as a regulatory control and explore a set of related questions. First, under a variety of assumptions about commitment, we ask how a politician will set taxes or subsidies recognizing that taxation effects revenue, investment decisions and ultimately the value of the asset. Second, how does it influence the decision to privatize? Does a change in the legal environment or technology that allows for taxation necessarily make privatization more appealing? Finally, we ask how further regulation changes the social calculus of privatization. [DISCUSSION OF POLITICAL RISK]

In order to facilitate direct comparison of the different regimes, we impose a bit more structure on the problem. This allows us to directly parametrize the degree of the externality and the level of political uncertainty and to focus on the level of taxes and subsidies that will arise. Instead of assuming a general form for output in the second period we let $R(x) = 2\sqrt{x}$ and $S(x) = \eta 2\sqrt{x}$, where $\eta \in (-1, \infty)$. Where we interpret η as a measure of the externality; negative when η is negative and vice versa. The sum of the market appropriable and non-appropriable output is $R(x) + S(x) = (1 + \eta)2\sqrt{x}$. We also now assume a simple fixed reelection rate π that does not depend on the primals and focus on π as a parameter of interest. This is done to simplify comparisons between the level of the externality and political market. Of course, the underlying parameters that influence π might be of interest. Given such a parameterization, the optimal level of investment from the voter's perspective is $x_{FB}(\eta) = (1+\eta)^2$ and the level of investment under political control is $x_G(\pi, \eta) = (\pi + \pi\eta)^2$.

While a variety of regulatory mechanism could in practice be used, we think focusing on taxes illuminates the main trade-offs. Additionally, taxation is a widely used mechanism. Finally, given our distinction between the appropriable market returns and non-appropriable externalities associated with the asset, we think focusing on an instrument that conditions only on the appropriable element of production is most consistent with the assumptions of the model.

Unlike a privatization decision which entails a transfer of control rights, a politician may lack commitment to tax the asset at an agreed rate. A private buyer will anticipate the politician's ability, or lack there of, to commit to taxation when making an investment decision and purchasing the asset. Highlighting the role of commitment, we consider three levels of commitment that a politician may have when setting tax rates. With full commitment, the politician is able to set long-lasting tax rates at the time the asset is privatized. In this environment, tax policy is set taking into account its effects on investment, revenue and output as well as on the market value of the asset. Relaxing the politician's level of commitment, we next consider an environment where taxation is set prior to the investment decision by the firm, but after the sale of the asset. Here, tax policy is set by accounting for its effect on investment, but not on asset value. Finally, we consider an environment where the politician selling the asset has no ability to commit to taxation rates, and taxes are set after investment decisions have been made and the asset purchased.

Our results are clear: Taxation is lower with increased commitment and commitment is valuable for a politician as it increases both expected revenue, output and the value of the asset. Much as privatization allows the politician to commit to the most profitable use of

the asset, an ability to commit to reduced taxation is valuable to a politician. This suggests that instruments that allow for commitment will be valuable to the politician and in the section that follows we explore an instrument that potentially provides this commitment: partial privatization. When an asset is partially privatized and the government relinques control, but retains partial rights to the cash flow of the asset. Partial privatization solves two commitment problems: the politician is able to commit to investment decision by ceding control and to commit to lower taxation by retaining interest in the cash flow of the asst.

While commitment is valuable from the perspective of the politician, it has ambiguous effects on social welfare. The introduction of taxation when privatization was not to occur otherwise is socially costly. However, if privatization (in particular over-privatization) were to occur otherwise, the introduction of taxation can (but will not always) ameliorate market failures and improve social welfare.

As discussed in section **??**, taxation is on the appropriated output of the asset $R(x)$. The tax rate is denoted by τ and we assume that taxation is bounded above by 1 as no firm would sell any output for taxation above the value of the good. In the first instance, we place no restriction on the lower value of τ. In particular, we allow τ to be negative, in which case it should be interpreted as a subsidy. It is easy to see that the optimal level of taxation is simply the pigovian solution of $\tau = -\eta$ at which point the firm will be provided with incentive equal to societies. We will compare taxation to this benchmark as we consider the various levels of taxation commitment.

Full Commitment

In this section, we assume that the decision to privatization and the tax rate are set in period 0. The tax rate is persistent, and thus the firm takes into account the announced tax rate when making its investment decision in period 1 and its purchasing decision in period 0. Let τ_{fc} denote the full commitment tax rate. If the asset is privatization, the private firm solves $(1 - \tau_{fc})2\sqrt{x} - x$, invests $x_{PT}(\tau_{fc}) = (1 - \tau_{fc})^2$, produces $R(x_{PT}(\tau_{fc})) = 2(1 - \tau_{fc})$ and enjoys profit of $(1 - \tau_{fc})^2$.

When setting tax policy, the politician conditions on privatization occurring and considers the effects of the tax rate on profit and tax revenue in addition to output. Thus, she sets the tax rate τ that maximizes:

$$\underbrace{(1 - \tau_{fc})^2}_{\text{Profit/Value of Asset}} + \underbrace{\pi\eta(2 - 2\tau_{fc})}_{\text{Externality value of Production}} + \underbrace{\pi\tau_{fc}(2 - 2\tau_{fc})}_{\text{Tax Revenue}}$$

To insure that this is a concave problem, we will assume that $\pi > \frac{1}{2}$. The tax rate that maximizes the politician's utility under full commitment is $\tau_{fc} = \frac{\pi - \pi\eta - 1}{2\pi - 1}$ and $x_{PT}(\tau_{fc}) = [\frac{\pi(1+\eta)}{2\pi - 1}]^2$.

22

Note that the tax rate decided politically is always less than the socially optimal pigovian tax rate. In fact, the tax rate is so far from the pigovian rate that privatization with full tax commitment is always worse from a welfare perspective than public control. This is true even if privatization would have dominated public control without taxation. In other words, when the politician has full control over taxation at the time of privatization, privatization will always result in lower social welfare than public control.

Result 1. *Under full tax commitment, privatization is never socially optimal.*

Why has the introduction taxation made privatization worse? By allowing the politician to tax or subsidize, she is able to affect investment behavior and indirectly the value of the asset. While a subsidy is only socially valuable if there is a positive externality ($\eta > 0$), a politician will agree to a subsidy as long as $\eta > \frac{\pi-1}{\pi}$. Thus for values of $\eta \in (\frac{\pi-1}{\pi}, 0)$ when the output generates a negative externality, the politician will be willing to grant a subsidy. This is valuable to the politician as the subsidy which is paid in the future, increases the present value of the asset which increases the value of privatization. While this logic is clearest when $\eta < 0$, it extends throughout to cases when $\eta > 0$.

To see why public ownership remains socially optimal even as π declines and public failure increases, recall that the distortion in taxation is growing in proportion to the size of public failure. As public failure increases, privatization gets even worse as taxes are further distorted. Without taxation, output under privatization never depends on the political environment. However with full commitment, taxation introduces a contagion between the political landscape and private market behavior.

While privatization with full taxation is *never* desirable from a social perspective, it is *always* desirable from the politician's perspective for precisely the same reason it is socially undesirable. The politician is able to finely control the private market behavior and to transfer revenues from the future to the present.

Result 2. *Under full tax commitment, privatization is always preferred by the politician.*

Results (**??**) and (**??**) imply that under full commitment, we will always observe over-privatization, but this does not necessarily imply that the introduction of taxation with full commitment is socially undesirable.

To demonstrate how the introduction of full commitment taxation can have an ambiguous effect of social welfare, we consider the cases with references to figure **??** and table **??** where we assume a exogenous upper bound on the subsidy equal to XXX. Without taxation, the politician retains public control in region A. Since public control is always better than privatization with full commitment, the introduction of full commitment taxation is welfare harming in this region. In regions $B = B' \cup B''$ and C, privatization occurs with or without taxation but the welfare implications are ambiguous. In region B', the subsidy offered by the politician moves the private sector closer to the optimal than unsubsidized private sector, so welfare improves. In region C, the subsidy offered by the politician is too large and moves

the private sector further away from optimal production, and welfare is lower. In region B'', the politician actually implements a tax. Since an unregulated private firm over-produces in this region and politicians always under-tax, the introduction of an tax moves production towards the optimal and improves welfare.
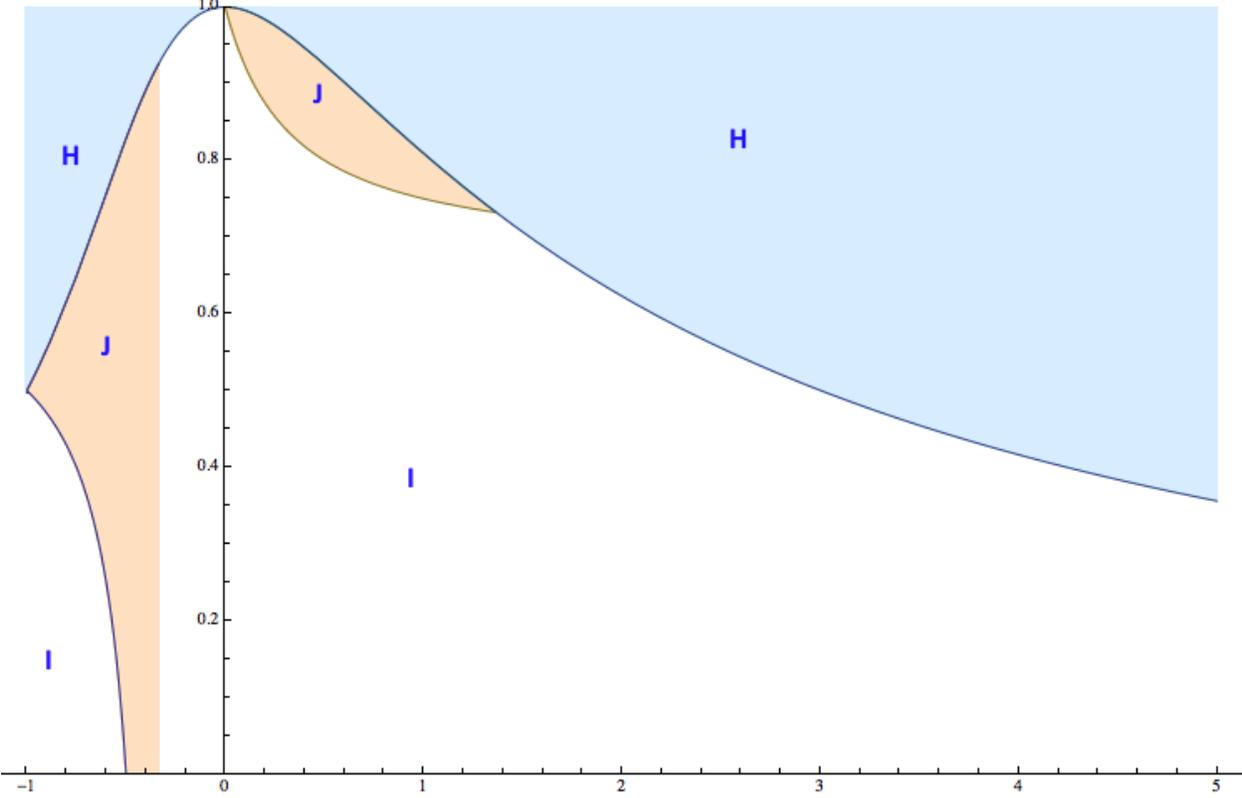

Figure 2: Welfare Implications of Introduction of Full Commitment Taxation

	Before	After	Social welfare change
A	Public	Private	decline
B	Private	Private	improvement
C	Private	Private	decline

Table 1: Change in social welfare and ownership structure after allowing tax with full commitment

Result 3. *The introduction of full commitment taxation has an ambiguous effect on welfare.*

Partial Commitment

We relax the politician's ability to commit to taxation by changing the timing of the tax rate decision. We now assume that the tax rate is set after the asset has been sold. While the politician still considers the effect of taxation on the firm's investment decision, she no

longer considers the effect of taxation on the value of the asset. This has a qualitative effect on the tax rate, the welfare implications of taxation and the appeal of privatizations to the politician.

Divorcing the asset sale from the taxation decision removes the channel by which a politician transfers income from the future (via tax policy) to the present (via the asset sale). In particular, taking into account the firm's response the politician chooses τ_{pc} to maximize:

$$\underbrace{\pi\eta(2 - 2\tau_{pc})}_{\text{Externality value of Production}} + \underbrace{\pi\tau_{pc}(2 - 2\tau_{pc})}_{\text{Tax Revenue}}$$

This is the same problem as before, but without the profit component. The solution to this problem is $\tau_{pc} = \frac{1-\eta}{2}$ and unlike the full commitment scenario, the tax rate under partial commitment does not depend on the probability of being in office and only on the externality.

The tax rate under partial commitment is higher that the tax rate under full commitment as we have removed an incentive for reducing taxation while maintaining all other incentives. However, the tax rate is also higher that the optimal pigovian tax rate.

Result 4. *Under partial commitment, the tax rate is higher than the tax rate under full commitment and higher than the pigovian tax rate.*

The tax rate is higher because the politician having sold the rights to the cash flow of the asset does not directly take them into account when setting the tax rate. The tax rates effects on output are considered as much as the politician values the externality and the tax revenue. Thus, output and profit are both lower with partial commitment relative to full commitment and to the social optimal.

This distortion in taxation policy is sufficient to make privatization under partial commitment unappealing from the social welfare perspective unless the public failure is too

Result 5. *Under partial tax commitment, welfare is weakly higher under privatization if $\pi \leq XXX$ and strictly higher if the inequality holds strictly.*

Unlike full commitment, privatization is not a dominant choice for the politician under partial commitment.

Result 6. *Under partial tax commitment, privatization is weakly preferred by the politician if $\pi \leq \frac{\sqrt{5}+1}{4}$ with strict preference if the inequality is strict.*

Results **??** and **??** imply that whether over-privatization occurs no longer depends on the degree of the externality. In the partial commitment environment, over-privatization depends only on the political landscape.

The positive predictions and welfare implications of an introduction of partial commitment taxation relative to an environment without taxation are more complicated than in the full commitment environment. We again consider the cases this time with reference to figure **??** and table **??**.
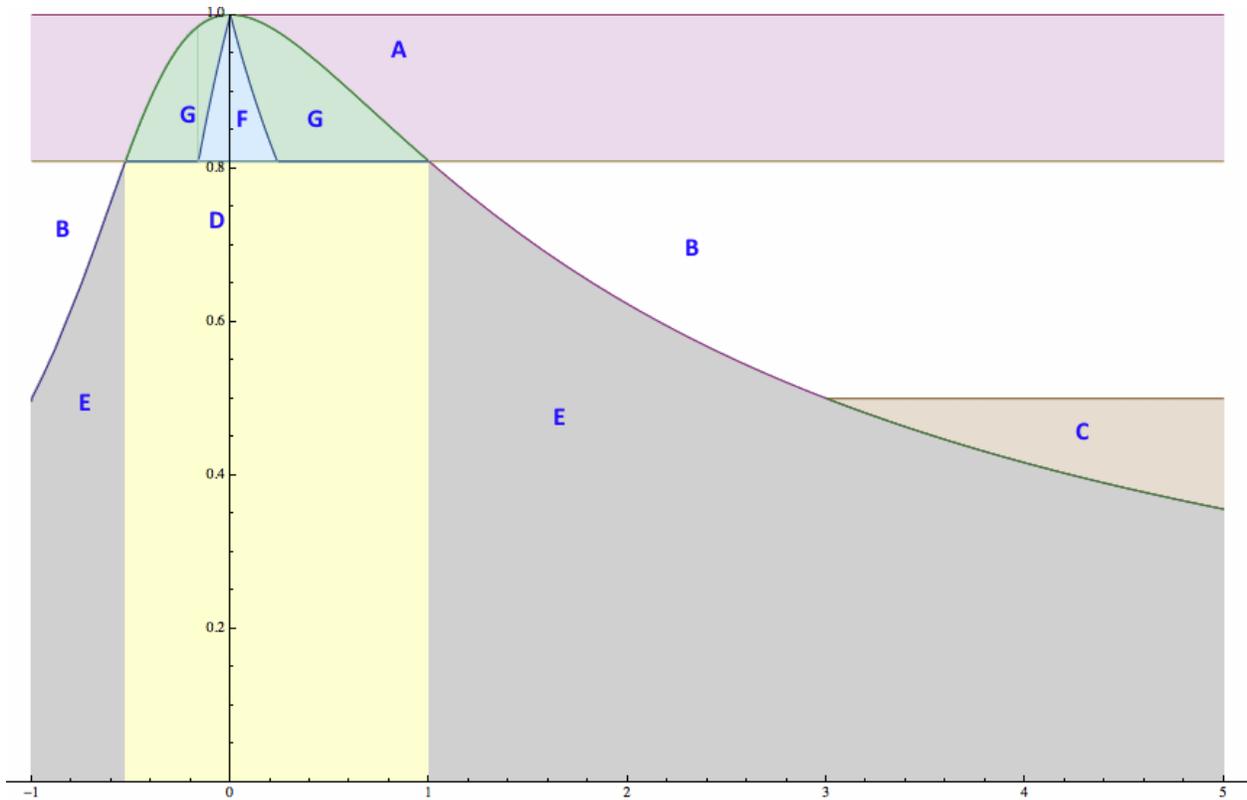

Figure 3: Welfare Implications of Introduction of Partial Commitment Taxation

In regions A, B and C, the politician retains public control without taxation. With the introduction of partial commitment taxation, public control continues to be retained in region A and welfare is unchanged. In region B and C, partial commitment taxation moves the political decision towards privatization. In region C, the subsidy offered is sufficient to move private production closer to the optimal than public production and welfare improves. In region B, the tax/subsidy implement is insufficient and public control continues to dominate private control from the social perspective and so welfare declines.

In regions D and $E = E' \cup E''$ privatization occurs with or without taxation. In region D, the politician over-taxes relative to the pigovian optimal because he ignores the effects of taxation on the appropriable output of the firm and so welfare is lower. In region E', this tax changes to a subsidy. While the subsidy is less than the optimal pigovian level, it nonetheless moves private production towards the optimal and improves welfare. In region E'', over-taxation continues to result in underproduction, but as the cost of the externality increases this underproduction dominates the overproduction that occurs without taxation and welfare improves.

	Before	After	Social welfare change
A	Public	Public	no change
B	Public	Private	decline
C	Public	Private	improvement
D	Private	Private	decline
E	Private	Private	improvement
F	Private	Public	decline
G	Private	Public	improvement

Table 2: Change in social welfare and ownership structure after allowing tax with partial commitment

In regions, F and G the introduction of partial commitment taxation moves the political decision from privatization to retained public control. This occurs because the commitment problem that the politician faces when setting the tax rate reduces the value of the asset enough that privatization is no longer appealing. In region G, this improves welfare as in this region over-privatization was occurring absent taxation. In region F, moving public control actually reduces welfare and we see the first instance of what could be called under-privatization.

The comparison of the positive and welfare effects of moving from full commitment to partial commitment taxation are much simpler. Figure **??** and table**??** outline the relevant cases moving from full commitment to partial commitment in taxation. In region A, moving to partial commitment changes the political choice to public control. As public control is always better than privatization with full commitment, welfare improves. In region B and C, privatization occurs in either regime. In region B, the distortion introduced by not considering the effects of taxation on firm profits dominates and welfare is lower under partial privatization, In region C, the distortions under full commitment are greater and welfare improves.

	Before	After	Social welfare change
A	Private	Public	improvement
B	Private	Private	decline
C	Private	Private	improvement

Table 3: Change in social welfare and ownership structure after moving from partial commitment to full commitment

No Commitment

If a politician has no ability to commit to taxation then tax rates will be set or readjusted in period 2. Whomever is in power in period 2 will face a private firm that has already made an investment and the output of the firm will be fixed. Let $\bar{x}_{pt}$ denote this level of investment.
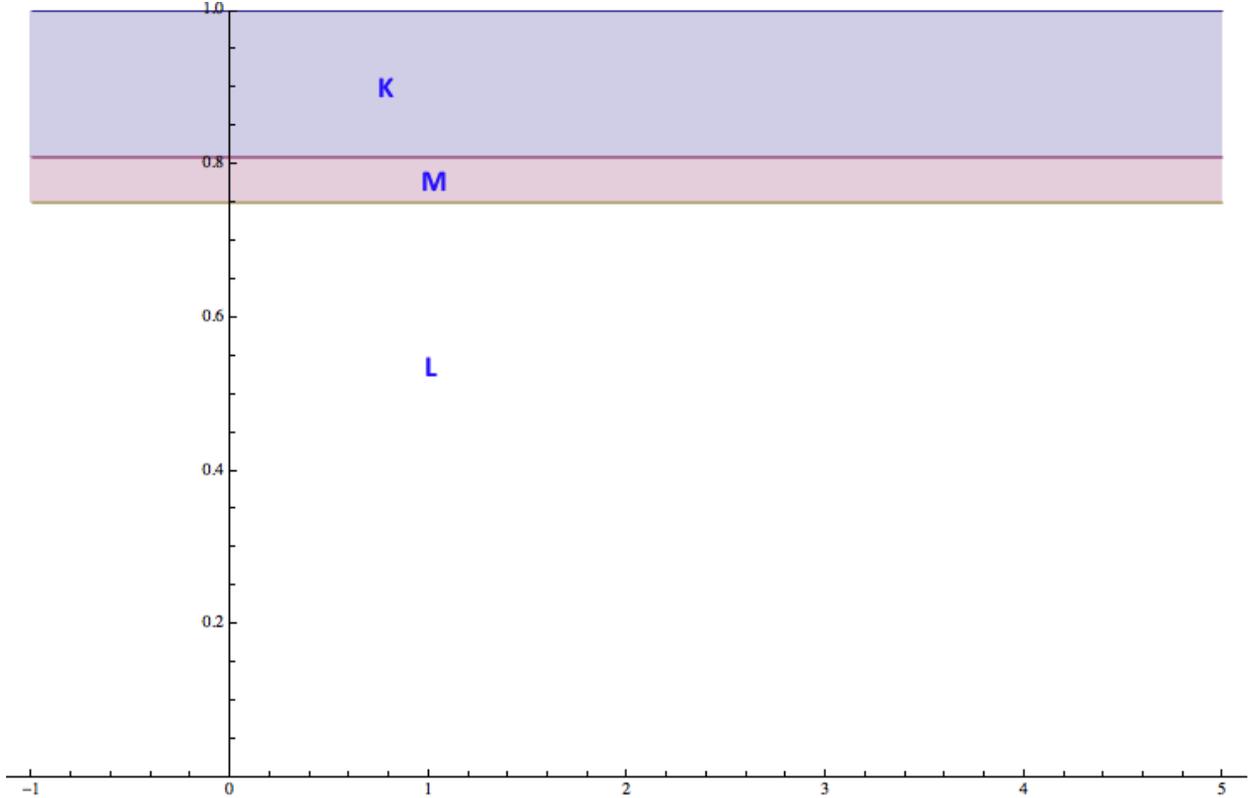
Figure 4: Welfare Implications of Changing from Full to Partial Commitment

The politician in office will consider investment and output fixed and only consider the direct effect of the tax rate on tax revenue. This differs from the partial commitment environment where output was a function of taxes and the full commitment environment where the value of the asset was an indirect function of the tax rate. In particular, the politician sets τ_{nc} to maximize:

$$(\eta + \tau_{nc})R(\bar{x_{pt}}) \tag{26}$$

This is trivially maximized by setting the tax to highest possible rate, $\tau_{nc} = 1$. Anticipating the full appropriation of revenue, a firm will choose to not invest in period 1 and the value of the asset in private hands will be zero. Thus, if a politician is not able to commit to taxation (that is not able to commit to not fully expropriating output) then a politician will never privatize.

While a complete lack of commitment and the ability to fully expropriate the private production are extreme assumption. It does suggest that the commitment problem can make privatization difficult. Recognizing that full expropriation (100% taxation) is uncommon, we might impose a exogenous upper bound $\bar{\tau}$ on taxation and appeal to some unmodelled aspects of the political taxation process. The firm will invest in period 1 anticipating future taxation at $\bar{\tau}$ and set investment $x_{pt}(\bar{\tau}) = (1-\bar{\tau})^2$ and the expect value of the asset in period

28

0 will be $(1 - \bar{\tau})^2$.

Two interesting phenomena are immediately apparent from the relation between $\bar{\tau}$ and the value of the asset. First, the value of the asset in private hand and thus the likelihood of privatization are decreasing in $\bar{\tau}$. Thus, in the no commitment environment, as the government gains the ability to regulate and control the private sector, it is less likely to transfer assets to the private sector. The new technology creates an opportunity for expropriation that is too hard to resist. Gaining an ability to regulate and tax creates political risk if not accompanied by commitment.

Second, if politicians differ in their ability to set high taxes then politicians will have different values of privatization. We might imagine that due to ideological reasons or connections to industry that parties have different taste for high tax. What is interesting is that it is possible that free market parties that favor lower taxation may be able to derive less value from the sale of assets. Consider two parties: low tax and high tax. The low tax party is able to commit to a maximum taxation rate of τ_L which is strictly less that the maximum taxation rate of the high tax party τ_H. If the low tax party is in power, the expected tax rate in period two is $\pi\tau_L + (1-\pi)\tau_H$ and if the high tax party is in power the expected tax rate in period two is $\pi\tau_H + (1-\pi)\tau_L$. Expected taxation is lower at the time of privatization when the low tax party is in power if and only if $\pi > \frac{1}{2}$. If we are expecting a transition of government, $\pi < \frac{1}{2}$, than the high tax party might be able to commit to lower future taxation and extract an higher value for the asset.

An alternative specification that generates a similar dynamic is to assume that a party is only able to commit to taxation levels if it stays in power. In this setting, the asset will always be more valuable when the high tax party is in power. Both parties will commit to the same politically optimal taxation and implement it if reelected, but the high tax party will have lower tax in expectation.

5.1 Partial Privatization

So far we've considered privatization as a bundle of cash flow and decision rights. In private hands, a owner makes all decision regarding investment and retains all profit. Of course, much as a revenue bond allowed a politician to retain decision rights while transferring cash flow rights, it is possible to transfer control rights and a portion of cash flow rights. [5] Much as selling the control rights offered the politician the ability to commit to a profit maximizing use of the asset, retained cash flow rights introduce an incentive for the politician to consider the effects of taxation on profitability and therefore generate commitment. This commitment is not without costs as the retained cash flow rights reduce the value of the asset sale in the present (which the politician values) for cash flow in the future (which the politician discounts). As we will show, there is an optimal trade-off between the gain in

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[5]This can be accomplished by issuing two classes of shares. Shares with both cash flow and control rights can be sold to the private market while retaining a share of the cash flow rights.

commitment and the delay in revenue.

In environments without taxation or with full commitment to taxation, partial privatization has no value as there are no benefits to be gained. We therefore analyze the partial commitment environment. We assume that privatization always entails a transfer of control rights, but possibly a fraction of cash flow rights. Let $s \in [0,1]$ denote the portion of the cash flow rights of the asset that is sold to the private market.

Under partial commitment, politicians considered the direct effect of the tax rate on tax revenue as well as indirect effect on output which in turn affects tax revenue and the level of the externality. If cash flow rights are retained, the politician now considers the effect of taxation on profitability as well but not as much as under full commitment (unless the retained cash flow share is 1).

From the firm's perspective profit is equal to $s[(1 - \tau)R(x) - x]$. Maximizing a share of the profit is equivilent to maximize total profit $((1 - \tau)R(x) - x)$, and so the firm makes the same investment decision as under full privatization: $x_{PT}(\tau) = (1 - \tau)^2$ and and total output is $R(x_{PT}(\tau)) = 2(1 - \tau)$ and profit is $(1 - \tau)^2$.

As tax rates are set after the sale of the asset, but before the investment decision is made, the politician chooses the tax rate that maximizes his value of the externality plus tax revenue and the public retained share of the profitability:

$$\eta \underbrace{2(1 - \tau)}_{\text{Output}} \underbrace{\tau \underbrace{2(1 - \tau)}_{\text{Output}}}_{} + \underbrace{(1 - s)}_{\text{Retained Share}} \underbrace{(1 - \tau)^2}_{\text{Profit}} \qquad (27)$$

$$\underbrace{\quad}_{\text{Externality}} \underbrace{\quad}_{\text{Tax Revenue}}$$

Solving for the maximum gives the following tax rate which depends on the share privatized in addition to the externality: $\tau_{PRT}(\eta, s) = 1 - \frac{\eta+1}{s+1}$. Substituting this tax rate gives us investment level $x_{PT}(\tau_{PRT}(\eta, s)) = (\frac{\eta+1}{s+1})^2$, Revenue of $2(\frac{\eta+1}{s+1})$ and profit of $(\frac{\eta+1}{s+1})^2$.

When deciding on the share s to privatize, the politician anticipates the tax rate that will be implemented as well as the private owners reaction to the tax rate and maximizes:

$$\underbrace{s}_{\text{Shares Sold}} \underbrace{(\frac{\eta+1}{s+1})^2)}_{\text{Value of Shares}} + \pi[\eta \underbrace{2(\frac{\eta+1}{s+1})}_{\text{Output}} + (1 - \frac{\eta+1}{s+1}) \underbrace{2(\frac{\eta+1}{s+1})}_{\text{Output}})] + \underbrace{(1 - s)}_{\text{Retained Share}} \underbrace{(\frac{\eta+1}{s+1})^2]}_{\text{Profit}} \qquad (28)$$

$$\underbrace{\quad}_{\text{Externality}} \underbrace{\quad}_{\text{Tax Revenue}}$$

The asset share that maximizes this is $s = \frac{1-\pi}{1+\pi}$ and the politician's utility equal to $\frac{(\eta+1)^2(\pi+1)^2}{4}$. Our first result is that the politician will always prefer partial privatization to full privatization or public control (that is we have an interior solution).

Result 7. *The politician prefers to partial privatize relative to full privatization or retained control.*

Our second result speaks to an alignment of interest of sorts. When partial privatization is pursued by the politician, it is always preferred to retained control by the voter.

Result 8. *The voter always prefers partial privatize to retained control.*

6   Conclusion

In this paper, we considered a model of asset ownership in the presence of public and private failure. While social welfare may be better served by public or private provision, the windfall that accompanies privatization creates a further distortion between the preferences of politicians and society and generates over-privatization. While better functions capital markets can mitigate the worst of the over-privatization it does not eliminate it. This is because privatization brings with it a commitment to use the asset in its most profitable manner. The introduction of taxation can actually exacerbate the problems associated with privatization as tax policy creates a link between the public failure and market behavior.

The policy implication of our model are first that privatization should be permitted only in the presence of well-function borrowing markets. In absence of this, we would expect over-privatization to occur more frequently and with greater cost. Second, tax policy and privatization decisions should be divorced from one another. This can be accomplished by ceding taxation power over formerly government owned assets to higher levels of government. Finally, if taxation and privatization decision can be uncoupled, the model suggest that partial privatization may be a way to avoids some of the pitfalls associated with co-mingling of taxation and privatization policy.