Essays on Corruption

A DISSERTATION

SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL

OF THE UNIVERSITY OF MINNESOTA

BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

Advisor: Larry E. Jones

June 2009

Acknowledgements

I would like to thank my advisor Professor Larry E. Jones for his encouragement and advice during the long writing process of this dissertation. I also would like to thank Professor V.V. Chari for patiently listening to my presentations at the Chari-Jones workshop, giving invaluable suggestions to improve my work. I thank Professor José-Víctor Ríos-Rull for encouraging me to think more critically with his questions and comments. I thank Professor Raymond D. Duvall for giving insightful comments about my research.

Parts of this dissertation have been presented at various conferences and seminars. For their suggestions and comments, I would like to thank Kenneth Binmore, Francesca Carapella, Roozbeh Hosseini, Facundo Piguillem, Evşen Türkay, and the members of the Chari-Jones Workshop, as well as the participants at the III Guanajuato Workshop for Young Economists, the Third Annual Graduate Student Conference at Washington University in St. Louis, the 6th Midwest International Economic Development Conference, the 2009 European School on New Institutional Economics, and the 13th Annual Conference of the International Society for New Institutional Economics. The chapter titled "Self-selection of Politicians and Corruption" is written with Evşen Türkay.

The Department of Economics at the University of Minnesota is blessed with the best staff! They have not only made my life so much easier by taking care of all the bureaucratic processes related to my studies, but also offered me their moral support and encouragement on a daily basis. I especially thank Catherine Bach and Kara Kersteter for all they have done for me from the time I took preliminary exams to the time I was on the job market. I would like to thank Dr. Simran Sahi for her patience and understanding during my training as an instructor. I learned so much about teaching from her! I am grateful for her moral support as well as professional mentorship.

I would like to thank the Research Department at the Federal Reserve Bank of Minneapolis for hosting me in the past four years. The work environment they provided helped me be more productive. I thank very much to Dr. Warren Weber for allowing me to have a work space at the Fed and staff members Barbara Drucker, Vicki Reupke, and Wendy Stier for their kindness.

As anyone who has ever written a doctoral dissertation would agree, continuous moral support by family and friends is very important during this long and exhausting process. I consider myself very lucky to have many loving and supportive people in my life, who provided me with an unbelievable amount of encouragement and support. First of all, I would like to thank my parents Nevin Tarhan and R. Engin Tarhan for all they have done for me from the moment I

was born. Without their continuous support, both material and emotional, and unconditional belief in me this dissertation could not have been written. They allowed me to chase my dreams and be myself. I am proud to be their daughter.

Doktora tezi yazan herkesin kabul edeceği üzere, bu uzun ve yorucu süreçte aile ve arkadaşların sürekli manevi desteği çok önemli. Hayatımda bana inanılmaz derecede cesaret ve destek veren birçok sevgi dolu insana sahip olduğum için kendimi çok şanslı hissediyorum. Her şeyden önce, doğduğum andan itibaren benim için yaptıkları her şey için annem Nevin Tarhan ve babam R. Engin Tarhan'a teşekkür ediyorum. Hem maddi, hem manevi olarak verdikleri destek olmasa ve koşulsuz olarak bana inanmasalardı bu tez yazılamazdı. Hayallerimin peşinden gitmeme ve kendim olmama izin verdiler. Onların kızı olduğum için gurur duyuyorum.

I have the most beautiful family in the world! I am grateful to the members of my family who showered me with so much love and support. Without their continuous encouragement, pursuing a PhD would have been much harder. For their boundless affection and pride in me, I am indebted to my grandparents Necla Taşcı and Dursun Taşcı. I thank my uncles Çetin Taşcı, Metin Taşcı, and Tekin Taşcı and my aunt Emine Taşcı for all they have done to make me feel happy and special during my short visits to Turkey. For bringing joy and laughter to my life even during the hardest times, I thank my beloved cousins

Can Taşcı, Işın Taşcı, and Aylin Taşcı. I love them as my own siblings.

Dünyanın en güzel ailesine sahibim! Ailemin bana bu kadar çok sevgi ve destek veren üyelerine müteşekkirim. Sınırsız sevgileri ve benimle hep gurur duydukları için anneannem Necla Taşcı'ya ve dedem Dursun Taşcı'ya teşekkürü bir borç bilirim. Dayılarım Çetin Taşcı, Metin Taşcı ve Tekin Taşcı'ya ve yengem Emine Taşcı'ya, Türkiye'ye yaptığım kısa ziyaretlerde beni mutlu etmek ve kendimi özel hissettirmek için yaptıkları her şey için teşekkür ederim. En zor zamanlarda hayatıma neşe ve kahkaha katan sevgili kuzenlerim Can Taşcı, Işın Taşcı ve Aylin Taşcı'ya teşekkür ederim. Onları kendi kardeşlerim gibi seviyorum.

Unfortunately, my grandfather Lütfü Tarhan could not live to see me receive my PhD. I am sure he would have been very proud of me. He was a person of great character and perseverance. I can only hope to live up to his ideals.

Ne yazık ki dedem Lütfü Tarhan doktoramı aldığımı göremedi. Eminim görse benimle çok gurur duyardı. Çok güçlü karakterli ve azimli bir insandı. Bir gün onun ideallerine ulaşmayı umut ediyorum.

During the past six years, my dear friends and colleagues became my new family in Minneapolis. We have shared and gone through so much together. Without these supportive and compassionate people, my life would have been much harder during my PhD studies. First of all, I would like to thank Evşen Türkay, who has been closer than a sister to me. She has given me a lot of moral support and encouragement in the past six years and been a source of laughter and happiness in my life. I am looking forward to enriching our friendship with co-authorship in the future. I am grateful to have Stefania Marcassa and Michael W. Walrath as my friends and thank them for all they have generously done for me over the years. For their support, encouragement, and friendship, I thank Ioanna Grypari, Wen-Tai Hsu, Ayça Özdoğan, and Unnikrishnan Pillai. I hope to remain friends with them for years to come.

There are many other people that have made pursuing a PhD in economics at the University of Minnesota a rewarding experience for me. I thank them all for sharing their time and expertise with me. Their kindness will always be remembered and appreciated.

Last but not least; I would like to acknowledge myself. I have gone through a lot of hardship during my years as a graduate student. Yet, I did not quit. I learned a lot about life and about myself during this process. I know, better than ever, that I can face any difficulty life might bring my way in the future. I am proud of myself for all the hard work and the long days and nights I put in this dissertation; and for my perseverance and courage at times when it was much easier to quit than to go on; and for always finding ways to progress and grow up as an individual.

Dedication

I dedicate this dissertation to my beloved parents:

Nevin Tarhan and R. Engin Tarhan.

Bu tezi çok sevdiğim annem ve babam

Nevin Tarhan ve R. Engin Tarhan'a

ithaf ediyorum.

Abstract

This dissertation is comprised of two papers. In the first one, titled ”Public Investment and Corruption in an Endogenous Growth Model,” I provide an endogenous growth model with Ramsey taxation that is consistent with empirical findings regarding public investment, corruption, and economic growth. In the model, government maximizes the weighted average of consumers’ utility and its own utility coming from expropriation of tax revenues. The weight determines the benevolence of the government. I show that a self-interested government sets a higher public-to-private-capital ratio than a benevolent one in order to increase the before-tax returns to private investment and hence increase tax revenues that can be expropriated. However, after-tax returns to private investment are lower and hence the growth rate is lower. Another result is that self-interested governments choose a high level of non-productive public investment, which provides a channel for the government to expropriate tax revenues for its private gain, thereby inflating total public investment. In the second paper, titled ”Self-selection of Politicians and Corruption,” I, together with my coauthor Evşen Türkay, build a citizen-candidate model, in which agents are heterogenous with respect to their honesty and they choose whether to become entrepreneurs or run for politics. We characterize the subgame perfect equilibrium of the model and analyze the effects of changing exogenous parameters, such as politicians’ salaries, entrepreneurial profits and campaigning costs, on the equilibrium outcome.

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Chapter 1

Public Investment and Corruption in an Endogenous Growth Model

1.1 Introduction

This paper studies the relationship between political corruption and public investment, and how economic growth in the long run is affected by this relationship. Political corruption, as defined by *Transparency International*, is the abuse of entrusted power by political leaders for private gain, with the objective of increasing power or wealth. Given this definition, a benevolent government, whose sole purpose is to promote consumers' welfare, would never engage in corrupt activities. Hence, it is important to relax the assumption of a benevolent government in order to understand the link between political corruption, public investment, and growth. To this end, I write an endogenous growth model with a non-benevolent government deciding how much public investment to undertake. In the model I assume public investment to be financed through income taxes. Collecting taxes and deciding how to use the tax revenues give the government an opportunity to engage in corrupt activities for its own benefit. Using the model, I study the choices of the government and the behavior of consumers as a response to government policies, all depending on how benevolent the government is.

In the model the government is assumed to maximize a weighted average of consumers' welfare and its own welfare coming from expropriated tax revenues. The weight on consumers' welfare determines how benevolent the government is. If the weight on consumers' welfare is zero, then the government is totally self-interested, and if the weight is one then the government is totally benevolent. The weight can be any number between 0 and 1, implying that the government can be partially benevolent. I show when the government is self-interested, the amount of productive public investment is low but the amount of expropriated tax revenues is high.

The government is assumed to be constrained by a period-by-period budget, which implies an upper bound on total embezzlement by the government at any period. This results in a dilemma for the corrupt politicians: they can either steal as much as they can at any period, leaving only a small amount of funds for the financing of the public capital, or they can invest in public capital so as to increase the productivity of private capital, and hence income, in the future. Increased income implies higher income tax revenues and more funds to embezzle in the future. Therefore, each type of government chooses an optimal growth rate through its policies that balances the cost of deferring expropriation of funds today and the benefit of increased tax revenues that can be embezzled in the future. This optimal growth rate is determined by the public-to-private capital ratio. I argue that a self-interested government chooses a higher public-to-private-capital ratio than a benevolent government and that this results in lower economic growth in the long run.

The model predicts low productive public investment and low growth in countries with self-interested governments. When testing the predictions of the model against data, benevolence of a government will be thought of as the degree of lack of corruption in that country. Hence, a self-interested government in the model will be a counterpart of a highly corrupt government in the data. While the model distinguishes between productive public investment and expropriated tax revenues, it is hard to do so in the data. Expropriated tax revenues are recorded as part of government budget and affect several entries in the government budget. However, authors such as Tanzi and Davoodi (1997) and Keefer and Knack (2007) claim that most of the corrupt activities of governments are recorded as public investment[1]. Treating expropriated tax revenues as part of public investment in accordance with these studies, the model predicts that high levels of total public investment would be observed in countries with high corruption.

To the best of my knowledge, this paper is the first attempt to explain the interrelationship between political corruption, public investment, and economic growth through a model that analyzes the behavior of different types of government. Haque and Kneller (2008) undertake an empirical study to see the effects of corruption on public investment and economic growth. They find that corrup-

[1]See next section for a more detailed discussion.

tion raises the level of public investment but lowers the returns to it, making it ineffective in promoting economic growth, which is consistent with the results of my model.

1.1.1 Background and Related Literature

The effect of public investment on growth has been debated extensively in the literature. Starting with Barro (1990), many researchers have tried to capture the effect of public investment on growth; however, a consensus on the empirical evidence has never been reached. There are studies claiming that public investment is not important for economic growth (e.g. Easterly and Rebelo (1993)) while others maintain that public investment has a substantial positive effect on growth (e.g. Aschauer (1989)). There are yet other papers which assert that only certain types of public investment are productive and that the effect of these on growth are different from the effect of non-productive public investment. For example, Devarajan, Swaroop, and Zou (1996) find that current expenditure has a positive effect on economic growth whereas capital spending of governments has a negative relationship on growth. They argue that developing countries have over-invested in public capital at the expense of current spending.

The link between corruption and public investment has been explored mainly empirically. Tanzi and Davoodi (1997), for example, maintain that corrupt governments choose a higher public investment share of aggregate income. They claim that political corruption is often tied to capital projects. This is because the decisions regarding the budget and composition of capital are highly discretionary. Lack of competition in undertaking big capital projects and the difficulty in assessing the real cost and value of these projects make them a tool for corruption. The authors also argue that corruption reduces the productivity of public capital. Similarly, Keefer and Knack (2007) show that observed levels of public investment, as fractions of national income or of total investment, are higher in corrupt countries. These empirical findings are consistent with what my model predicts.

There have been many empirical studies trying to document a relationship between corruption and economic growth, especially after the well-known paper of Mauro (1995). Mauro (1995) maintains that corruption leads to lower economic growth and there are several studies confirming this paper's findings. (e.g. Tanzi and Davoodi (1997), Mauro (1997)) My results are consistent with these papers; high corruption and low growth go hand in hand.

1.1.2 Contribution of This Paper

This paper contributes to the literature on public investment and growth, corruption and growth, and corruption and public investment. Most of the work done in these areas are empirical and lack a theoretical basis. However, in order to fully understand the economic mechanism and provide policy suggestions it is important to have a model that captures the way benevolent and self-interested governments act. This paper provides such a model and therefore fills a theoretical gap in the literature. Within an optimal fiscal policy framework this paper explains the interdependency of public investment, corruption and growth.

This paper also contributes to the literature on optimal fiscal policy with linear taxes. Virtually all previous work in this literature assumes government to be benevolent. Jones, Manuelli, and Rossi (1993) extend the basic literature to endogenous growth models and Azzimonti-Renzo, Sarte, and Soares (2003) consider optimal choices of government in an environment with public capital. Contrary to these works, this paper allows the government to be self-interested and compares the behavior of self-interested and benevolent governments.

1.1.3 The Road Map

The rest of the paper is organized as follows: In Section 2, the model setup is introduced and competitive equilibrium is defined. Competitive equilibrium outcomes are for given government policies; however, the aim of this paper is to endogenize government policies. For this reason, another equilibrium concept, namely Ramsey equilibrium, is employed. Ramsey equilibrium outcomes include policy selections by the government and private allocations as best response to government policies. Competitive equilibrium outcomes are used to characterize Ramsey equilibrium, following Chari and Kehoe (1999). Next, balanced growth path allocations are characterized. These allocations depend on the type of the government, hence the relationship between public investment, corruption, and long-run growth can be studied. In Section 3, some empirical implications of the model are explained. These implications are consistent with previous empirical work described in the literature review above. However, not all empirical implications of the model have been studied before. Therefore I use the data set from Easterly and Rebelo (1993) to compare the results of the model with the data. In section 4, I describe the data I use and show that those implications of the model are also consistent with the data. Section 5 concludes.

1.2 The model

1.2.1 Setup

In order to study the relationship between public investment and growth, an endogenous growth model with public capital is used. In this economy, there are a continuum of identical infinitely-lived individuals and a government. Each individual is born with an initial capital endowment of k_0. To keep the model simple, it is assumed that there is no labor market. There is a single nonstorable consumption good which is valued by the consumers. The representative individual maximizes her present discounted utility from consumption, where the discount rate $\beta \in (0, 1)$:

$$\sum_{t=0}^{\infty} \beta^t u(c_t) \tag{1.1}$$

Individuals rent capital, k, to firms and earn capital income at rate r, and pay income taxes at rate τ to the government. Therefore, their budget constraint is:

$$c_t + k_{t+1} - (1 - \delta_k)k_t = (1 - \tau_t)r_t k_t \qquad \forall t \tag{1.2}$$

where δ_k is the depreciation rate for private capital. Hence, given representative individual's initial capital endowment, k_0, sequence of rates of return to private capital, $\{r_t\}_0^{\infty}$, and sequence of tax rates, $\{\tau_t\}_0^{\infty}$, the representative consumer's problem can be written as:

Consumer's Problem

$$\max_{c_t, k_{t+1}} \sum_{t=0}^{\infty} \beta^t u(c_t)$$

subject to

$$c_t + k_{t+1} - (1 - \delta_k)k_t = (1 - \tau_t)r_t k_t \qquad \forall t$$

$$c_t \geq 0, \quad k_{t+1} \geq 0 \qquad \forall t$$

There are two factors of production in this economy: private capital and public capital. Each firm produces output, y_t, according to the following technology:

$$y_t = f(k_t, g_t) = Ak_t(\frac{g_t}{K_t})^{\alpha} \qquad \forall t \tag{1.3}$$

where $A > 0$, $0 < \alpha < 1$, g_t is the public capital stock, and K_t is the aggregate private capital stock. Individual private capital stock k and aggregate private capital stock K are differentiated to capture the effect of *congestion* on the marginal productivity of private capital. As the aggregate capital stock increases, public capital available per unit of private capital decreases, thereby reducing the marginal productivity of private capital. As argued in Barro and Sala-i Martin (1992), this functional form of production function refers to the case when public goods are rival but not excludable. According to these authors this type of public goods includes highways, water and sewer systems, airports and harbors, courts, and even national defense and police.

Note that this production function implies constant returns to private capital as long as the government maintains a constant congestion of public services, i.e. a constant $\frac{g}{K}$ ratio. However, the aggregate production function

$Y_t = AK_t(\frac{g_t}{K_t})^\alpha$ exhibits diminishing returns to aggregate private capital K for given public capital stock g, and this is due to congestion.

This environment is similar to the one in Barro (1990) except that in the production function public services appear as stock variable, whereas in Barro (1990) they are treated as flow variable. Also, public services are assumed to be subject to congestion in this setup.

The government is allowed to be non-benevolent and is assumed to maximize a weighted average of consumers' welfare and the utility it gets from expropriated resources:

$$\sum_{t=0}^{\infty} \rho^t \{(1-\theta)u(C_t) + \theta v(E_t)\} \tag{1.4}$$

where $\rho \in (0,1)$ is the rate of time preference of the government, $\theta \in [0,1]$ is the type of the government, and E is the expropriation by the government.

Here θ denotes the degree of government's benevolence. If $\theta = 0$, the government is totally benevolent and maximizes consumers' utility. If $\theta = 1$, the government is totally self-interested and maximizes the amount of resources it can divert from productive uses. The parameter θ is allowed to take on any value between 0 and 1, implying that the government can be partially benevolent. The type of the government is determined exogenously and does not change over time.

The degree of benevolence of a government can depend on many institutional, sociological, historical, and economic factors. Studying these factors is outside the scope of this paper, and hence, the type of the government will be treated as exogenously given. Moreover, indices measuring the extent of corruption show that there is persistence in the extent of corruption over time[2]. Corrupt countries tend to stay corrupt. Similarly, clean economies persistently stay free of corruption[3]. Hence, θ for any country will be taken as constant over time.

Note that the government's time preference, ρ, is allowed to be different than that of the consumers, β. This is to capture the idea that governments usually have a shorter lifespan than consumers due to elections, coups, revolutions, etc. The government levies distortionary income taxes to finance public investment but it can expropriate part of the tax revenues for its own consumption. Hence, the government budget constraint at any time t can be written as:

$$E_t + g_{t+1} - (1 - \delta_g) g_t = \tau_t r_t K_t \tag{1.5}$$

where E is the amount of expropriation and δ_g is the depreciation rate of public capital. It is assumed that the government has a technology that converts tax revenues into public good. Also, it is assumed that $g_{t+1} \geq 0$ in every period. This implies that the maximum amount that can be expropriated at any time t equals total tax revenues at that period plus existing public goods net of depreciation.

A government policy is a sequence of tax rates, public capital levels, and amount of expropriation for all $t \geq 0$. It is denoted by $\Pi = \{\tau_t, g_{t+1}, E_t\}_{t=0}^{\infty}$.

[2]For example, Corruption Perceptions Index values in 1995 and 2006 have a correlation coefficient equal to 0.93. See Appendix B for details.

[3]See Mauro (2004) for two models with multiple equilibria that explain the persistence phenomena and its effects on economic growth.

Finally, feasible allocations are described by the resource constraint:

$$C_t + K_{t+1} - (1-\delta_k)K_t + g_{t+1} - (1-\delta_g)g_t + E_t = AK_t\left(\frac{g_t}{K_t}\right)^{\alpha} \quad (1.6)$$

where C is the aggregate consumption in the economy.

1.2.2 Competitive Equilibrium

Competitive equilibrium describes the choices of consumers and firms as best response to government policies. Private agents' optimal choices along with the feasibility constraint and the government budget constraint are used to characterize the competitive equilibrium allocations and prices.

Competitive Equilibrium. For a given government policy $\Pi = \{\tau_t, g_{t+1}, E_t\}_{t\geq 0}$, and initial public and private capital stocks, g_0 and k_0, a competitive equilibrium for this economy is an allocation $\{c_t, k_{t+1}, C_t, K_{t+1}\}_{t\geq 0}$, and a price $\{r_t\}_{t\geq 0}$ such that:

1. Given prices and policy, the allocation solves the Consumer's Problem.

2. Price satisfies $r_t = f_{kt} = A(\frac{g_t}{K_t})^{\alpha}$, $\forall t$.

3. Government budget constraint (1.5) holds.

4. Resource constraint (1.6) is satisfied.

1.2.2.1 Characterizing Competitive Equilibrium

Let λ_t be the Lagrange multiplier on the time-t consumer's budget constraint (denoted Cons-BC below). The following equations, including first-order conditions for the consumer's problem and budget constraints, characterize the competitive equilibrium:

Cons-BC: $C_t + K_{t+1} - (1-\delta_k)K_t = (1-\tau_t)r_t K_t, \forall t$

Cons-FOC1: $\frac{\beta u'(c_{t+1})}{u'(c_t)} = \frac{\lambda_{t+1}}{\lambda_t}, \forall t$

Cons-FOC2: $\lambda_{t+1}[(1-\tau_{t+1})r_{t+1} + 1 - \delta_k] = \lambda_t, \forall t$

Price: $r_t = A\left(\frac{g_t}{K_t}\right)^{\alpha}, \forall t$

GBC: $E_t + g_{t+1} - (1-\delta_g)g_t = \tau_t r_t K_t, \forall t$

Feasibility: $C_t + K_{t+1} - (1-\delta_k)K_t + g_{t+1} - (1-\delta_g)g_t + E_t = AK_t\left(\frac{g_t}{K_t}\right)^{\alpha}$, $\forall t$

TVC1: $\lim_{t\to\infty} \lambda_t K_t = 0$

TVC2: $\lim_{t\to\infty} \lambda_t g_t = 0$

The following two propositions simplify the characterization of competitive equilibrium by reducing it down to two equations. These propositions will be used in the next section to describe Ramsey equilibrium allocations.

Proposition 1 *The allocations in a competitive equilibrium satisfy the following:*

$$C_t + K_{t+1} - (1-\delta_k)K_t + g_{t+1} - (1-\delta_g)g_t + E_t = AK_t\left(\frac{g_t}{K_t}\right)^{\alpha} \tag{1.7}$$

$$u'(C_t) = \beta u'(C_{t+1})[\frac{C_{t+1} + K_{t+2}}{K_{t+1}}] \tag{1.8}$$

Proof. Constraint (1.7) is part of the definition of competitive equilibrium. (1.8) is obtained by plugging GBC, Price, and Feasibility in Cons-FOC. See Appendix A for details. ■

Equation (1.8) is called the *implementability constraint* because it describes the conditions government policies can be implemented, given the best response of consumers and firms to government's choices.

Proposition 2 *Given allocations and period-0 policies that satisfy* (1.7) *and* (1.8)*, one can construct policies and prices which, together with the given allocations and period-0 policies, constitute a competitive equilibrium.*

Proof. See Appendix A. ■

1.2.3 Ramsey Equilibrium

Competitive equilibrium allocations describe the behavior of private agents given government policy. To analyze the policy selection behavior of the government, the setup of the model will be reinterpreted as a game and additional assumptions regarding the timing of the game will be made. It will be assumed that the government moves first at time 0 and sets the stream of future policies for all time $t \geq 0$. Consumers make their decisions after they observe the government policy. This timing assumption implies that the government can fully commit to its policies at the beginning of the game and cannot change its actions after consumers have made their savings decisions. The equilibrium notion used in this case is called Ramsey equilibrium.

Ramsey Equilibrium. Given initial capital stocks, g_0 and K_0, a Ramsey equilibrium is a government policy $\Pi = \{\tau_t, g_{t+1}, E_t\}_{t\geq 0}$, an allocation rule $\{C_t(\cdot), K_{t+1}(\cdot)\}_{t\geq 0}$, and a price function $\{r_t(\cdot)\}_{t\geq 0}$ such that:

1. Government policy Π solves:

$$\max_{\Pi} \sum_{t=0}^{\infty} \rho^t \{(1-\theta)u(C_t(\pi')) + \theta v(E_t)\}$$

   subject to

$$E_t + g_{t+1} - (1-\delta_g)g_t = \tau_t r_t(\pi')K_t(\pi')$$

2. For every policy π', the allocations $C(\pi')$ and $K(\pi')$, and the price system $r(\pi')$ constitute a competitive equilibrium.

The resulting allocations in Ramsey equilibrium are called Ramsey allocations and the resulting policies are called Ramsey policies. Propositions 1 and 2 will be used to characterize the Ramsey equilibrium.

1.2.3.1 Characterizing Ramsey Equilibrium

Ramsey Problem, maximizing the government's objective function subject to the feasibility and implementability constraints, will be used to characterize the Ramsey Equilibrium, following Chari and Kehoe (1999). Proposition 3 extends the results of Chari and Kehoe (1999) to the case with non-benevolent governments.

Ramsey Problem with Non-Benevolent Government:

$$\max_{C_t, K_{t+1}, E_t, g_{t+1}} \sum_{t=0}^{\infty} \rho^t \{(1-\theta)u(C_t) + \theta v(E_t)\}$$

subject to

$$C_t + K_{t+1} - (1-\delta_k)K_t + g_{t+1} - (1-\delta_g)g_t + E_t = AK_t \left(\frac{g_t}{K_t}\right)^{\alpha} \tag{1.9}$$

$$u'(C_t) = \beta u'(C_{t+1})[\frac{C_{t+1} + K_{t+2}}{K_{t+1}}] \tag{1.10}$$

Proposition 3 *Ramsey allocations and policies solve the Ramsey Problem with Non-Benevolent Government.*

Proof. This is a corollary of Propositions 1 and 2. ■

Let $\rho^t \lambda_t$ and $\rho^t \mu_t$ be the Lagrange multipliers on (11) and (12), respectively. Then the following equations, which include first-order conditions and the constraints of the problem, characterize the Ramsey Equilibrium:

$$\rho^t(1-\theta)u'_t + \rho^t\lambda_t + \rho^t\mu_t u''_t - \rho^{t-1}\mu_{t-1}\beta u''_t[\frac{C_t + K_{t+1}}{K_t}] - \rho^{t-1}\mu_{t-1}\beta u'_t \frac{1}{K_t} = 0$$

$$\rho^t\lambda_t - \rho^{t+1}\lambda_{t+1}[1 - \delta_k + A(1-\alpha)\left(\frac{g_{t+1}}{K_{t+1}}\right)^{\alpha}]$$

$$+\rho^t\mu_t\beta u'_{t+1}[\frac{C_{t+1} + K_{t+2}}{K_{t+1}^2}] - \rho^{t-1}\mu_{t-1}\beta\frac{u'_t}{K_t} = 0$$

$$\rho^t\theta v'_t + \rho^t\lambda_t = 0$$

$$\rho^t\lambda_t - \rho^{t+1}\lambda_{t+1}[1 - \delta_g + A\alpha\left(\frac{g_{t+1}}{K_{t+1}}\right)^{\alpha-1}] = 0$$

$$C_t + K_{t+1} - (1-\delta_k)K_t + g_{t+1} - (1-\delta_g)g_t + E_t = AK_t\left(\frac{g_t}{K_t}\right)^{\alpha}$$

$$\beta u'(C_{t+1})[\frac{C_{t+1} + K_{t+2}}{K_{t+1}}] = u'(C_t)$$

These equations describe the optimal behavior of the government and consumers at all time periods.

1.2.4 Balanced Growth Path

The main focus of the paper is long-run growth, so the balanced growth path will be analyzed[4]. On a balanced growth path, the following ratios must be constant:

$\frac{C_{t+1}}{C_t} = \gamma_C$, $\frac{E_{t+1}}{E_t} = \gamma_E$, $\frac{K_{t+1}}{K_t} = \gamma_K$, and $\frac{g_{t+1}}{g_t} = \gamma_g$ for all t.

Assuming $u(\cdot) = log(\cdot)$ and $v(\cdot) = log(\cdot)$, the balanced growth path can be found analytically.

Proposition 4 *Given initial private and public capital stocks, K_0 and g_0, the Balanced Growth Path is characterized by the following:*

- $\dfrac{C}{K} = \dfrac{(1-\beta)}{\beta}\rho[1-\delta_g + A\alpha(\dfrac{g}{K})^{\alpha-1}]$
- $\dfrac{E}{K} = A(\dfrac{g}{K})^{\alpha} - (\dfrac{1}{\beta} + \dfrac{g}{K})\rho[1-\delta_g + A\alpha(\dfrac{g}{K})^{\alpha-1}] + (1-\delta_k) + (1-\delta_g)\dfrac{g}{K}$
- $\tau = 1 - \dfrac{\frac{\rho}{\beta}[1-\delta_g + A\alpha(\frac{g}{K})^{\alpha-1}] - (1-\delta_k)}{A(\frac{g}{K})^{\alpha}}$
- $\gamma_C = \gamma_K = \gamma_E = \gamma_g = \gamma \equiv \rho[1-\delta_g + A\alpha(\dfrac{g}{K})^{\alpha-1}]$

where $\frac{g}{K}$ satisfies:

$$(1-\theta)\{A(\frac{g}{K})^{\alpha} - (\frac{1}{\beta} + \frac{g}{K})\rho[1-\delta_g + A\alpha(\frac{g}{K})^{\alpha-1}] + (1-\delta_k) + (1-\delta_g)\frac{g}{K}\}$$
$$-\theta\frac{(1-\beta)}{\beta}\rho[1-\delta_g + A\alpha(\frac{g}{K})^{\alpha-1}] =$$
$$\theta\rho[\delta_k - \delta_g + A\alpha(\frac{g}{K})^{\alpha-1} - A(1-\alpha)(\frac{g}{K})^{\alpha}]$$

[4]For the dynamic analysis of an endogenous growth model with public capital, see Futagami, Morita, and Shibata (1993).

Proof. See Appendix A. ■

The key ratio for the balanced growth path is the public-to-private capital ratio, $\frac{g}{K}$; all other variables are determined according to this ratio. Notice that this ratio depends on a number of things, including depreciation rates of public capital and private capital (δ_g and δ_k), rate of time preference of consumers and the government (β and ρ), public capital elasticity of output (α), and the type of the government (θ). Moreover it is shown that on the balanced growth path all variables grow at the same rate and hence the consumption-private capital ratio and the expropriation-private capital ratio stay constant.

Proposition 5 *As the public-to-private capital ratio $\frac{g}{K}$ increases growth rate decreases.*

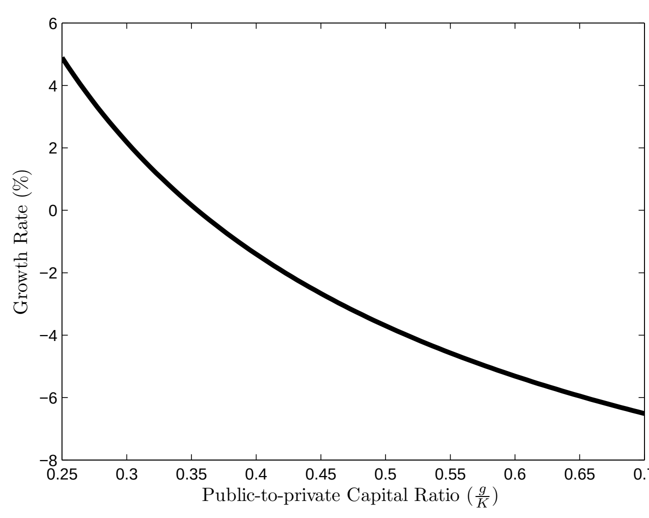


Figure 1.1: Growth and $\frac{g}{K}$. Parameter values are $A = \frac{1}{3}$, $\alpha = 0.25$, $\beta = \rho = 0.9$, and $\delta_k = \delta_g = 0.07$.

This result is different from what one would get by looking at the competitive equilibrium. In a competitive equilibrium, growth rate would be given by:

$$\gamma^{CE} = \beta[1 - \delta_k + (1-\tau)A(\frac{g}{K})^{\alpha}] \tag{1.11}$$

So, in a competitive equilibrium, the higher $\frac{g}{K}$ is, the higher the growth rate. Note that, in the competitive equilibrium case, taxes are taken as given. In Ramsey equilibrium, however, taxes are not constant and they depend on $\frac{g}{K}$. In equilibrium the increase in τ more than offsets the increase in $\frac{g}{K}$, and the growth rate decreases as a result.

Case 1 (Full Depreciation) *Assume* $\delta_g = \delta_k = 1$.

In this case the equation determining $\frac{g}{K}$ simplifies significantly:

$$\frac{g}{K} = \frac{\frac{\rho}{\beta}\alpha}{\theta(1-\rho) + \rho(1-\alpha)} \tag{1.12}$$

Proposition 6 *A self-interested government sets a higher public-to-private capital ratio for all* $\rho < 1$.

From the above expression for $\frac{g}{K}$, if the government is benevolent, i.e. $\theta = 1$, it chooses:

$$(\frac{g}{K})^{BEN} = \frac{\rho\alpha}{\beta(1-\rho\alpha)} \tag{1.13}$$

If the government is self-interested, i.e. $\theta = 0$, it chooses:

$$(\frac{g}{K})^{SELF-INT} = \frac{\alpha}{\beta(1-\alpha)} \tag{1.14}$$

The rate of time preference of the government does not matter for public-to-private capital ratio if the government is totally self-interested. If the government is benevolent, then as it becomes more patient it chooses a higher public-to-private capital ratio. However, this increase does not hurt the growth rate; growth rate still goes up as the government gets more patient.

Note that many endogenous growth models with public investment, starting with Barro (1990), find the optimal public investment-to-private capital ratio to be equal to the ratio of output elasticities of the two inputs, i.e. $\frac{\alpha}{1-\alpha}$. However, in the case of a benevolent government in this model, the optimal choice of the government is lower than that ratio. This is because in this model, unlike Barro (1990) and others, public investment is taken as a stock variable rather than a flow variable and the government policy involves choosing next period's capital level rather than current investment. Hence, Barro (1990)'s golden rule is discounted by the rate of time preference of the government and consumers. As long as the consumers are at least as patient as the government, the optimal $\frac{g}{K}$ in this model is smaller than $\frac{\alpha}{1-\alpha}$. Impatience of consumers implies that a high public-to-private capital ratio is not desirable when public investment is financed by distortionary income taxes.

Proposition 7 (Government Policy) *When public and private capital fully depreciate*

(a) all types of governments set the same productive public investment share of output.

(b) total public investment increases as a government gets less benevolent.

(c) tax rate increases as a government gets less benevolent.

First consider productive public investment as a share of income. Given that there is full depreciation of productive public capital, this share is equal to $\frac{g_{t+1}}{Y_t}$. Moreover, $g_{t+1} = \gamma \cdot g_t$. Hence, by simple algebra:

$$\frac{g_{t+1}}{Y_t} = \frac{i_g}{Y} = \rho\alpha \tag{1.15}$$

Notice that this value is independent of θ, so all types of governments choose the same share of public investment.

So, in countries with high $\frac{g}{K}$, i.e. countries with self-interested governments, the productive private investment share is smaller than in countries with benevolent governments. Total public investment, on the other hand, does depend on the type of the government and it can easily seen that $\frac{\partial(\frac{i_g+E}{Y})}{\partial\theta} < 0$.

$$\frac{i_g + E}{Y} = \rho\alpha + (1-\theta)(1-\rho) \tag{1.16}$$

Now consider the tax rate:

$$\tau = \rho\alpha + (1-\theta)(1-\rho) \tag{1.17}$$

When the government is benevolent ($\theta = 1$):

$$\tau^{BEN} = \rho\alpha \tag{1.18}$$

When the government is totally self-interested, ($\theta = 0$):

$$\tau^{SELF-INT} = 1 - \rho + \rho\alpha \tag{1.19}$$

Notice that when the government is totally benevolent all of the tax revenues are used for financing the productive public investment. A self-interested government uses only part of the tax revenues for productive public investment and provides the same amount of productive public investment. The government engages in more non-productive activities as it becomes less patient, i.e. $\frac{\partial(\frac{E}{Y})}{\partial\rho} < 0$.

Proposition 8 *When public and private capital fully depreciate ($\delta_k = \delta_g = 0$):*

(a) *private investment decreases as a government gets less benevolent.*

(b) *growth rate of the economy decreases as a government gets less benevolent.*

Share of private investment in total output can be calculated as below. Note that as θ decreases, $\frac{i_k}{Y}$ decreases.

$$\frac{k_{t+1}}{Y_t} = \frac{i_k}{Y} = \beta[\theta(1-\rho) + \rho(1-\alpha)] \tag{1.20}$$

Growth rate is given by:

$$\gamma = A(\rho\alpha)^{\alpha} \left(\beta[\theta(1-\rho) + \rho(1-\alpha)]\right)^{1-\alpha} \tag{1.21}$$

It is easy to show that the growth rate increases with θ. This is consistent with the results that private investment and productive public investment increase with θ.

Case 2 (Less Than Full Depreciation) *Assume* $0 < \delta_g < 1$, $0 < \delta_k < 1$.

In this case there is no way to simplify the formulas presented above. However, it is still possible to see how a benevolent government differs from a self-interested one. Table 1.1 shows public investment share of output, private investment share of output, public-to-private capital ratio, and growth rate corresponding to different degrees of benevolence. These figures are calculated for $A = \frac{1}{3}$, $\beta = 0.9$, $\rho = 0.9$, $\alpha = 0.25$, $\delta_k = 0.07$, and $\delta_g = 0.07$.

Public investment share of output is again roughly the same across different types of government but private investment share is much higher in countries with benevolent governments. Growth rate is also higher in these countries while tax rate is lower.

Table 1.1: **Balanced Growth Path Values**

θ	**0**	**0.10**	**0.25**	**0.50**
g/K	0.28	0.30	0.33	0.40
g/Y	1.17	1.22	1.32	1.52
K/Y	4.12	4.05	3.95	3.77
i^g/Y	0.12	0.11	0.10	0.08
E/Y	0	0.06	0.15	0.30
τ	0.12	0.18	0.25	0.38
i^k/Y	0.41	0.37	0.31	0.21
Growth Rate	3%	2.1%	1%	-1.5%

1.3 Empirical Implications of the Model

The theory has implications about the total public investment and economic growth. A self-interested government chooses a high level of public investment, and the increased taxes to finance that investment causes the private investment to fall, hence the low growth rate. If countries are lined up according to their total public investments, the model predicts that those would high levels of public investment would have low growth rates.

Another implication of the model is that the total public-to-private investment ratio is inversely related to the growth rate. Figure 1.3 depicts the relationship of public-to-private investment ratio and economic growth implied by the model.

The model also implies that productive public investment and expropriated tax revenues are inversely correlated (see Figure 1.4). A benevolent government would choose a high productive public investment share of output and would not embezzle resources for its own use. A self-interested government, on the other hand, would choose a lower productive public investment and use a large part

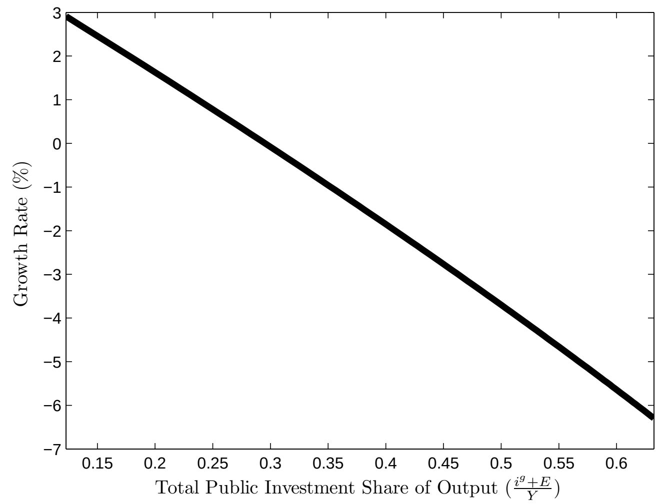


Figure 1.2: Total Public Investment and Growth. Parameter values are $A = \frac{1}{3}$, $\alpha = 0.25$, $\rho = \beta = 0.9$, $\delta_k = \delta_g = 0.07$.

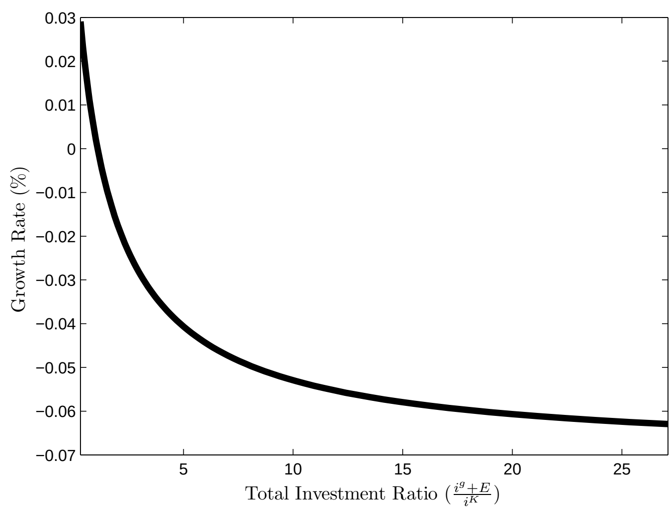


Figure 1.3: Total Public-to-private Investment Ratio and Growth. Parameter values same as in Figure 1.2.

of tax revenues for non-productive purposes. This means that if the total public investment observed is high, then it is likely that most of this public investment is non-productive, aimed at providing private returns for politicians. Figure 1.5 depicts this relationship.

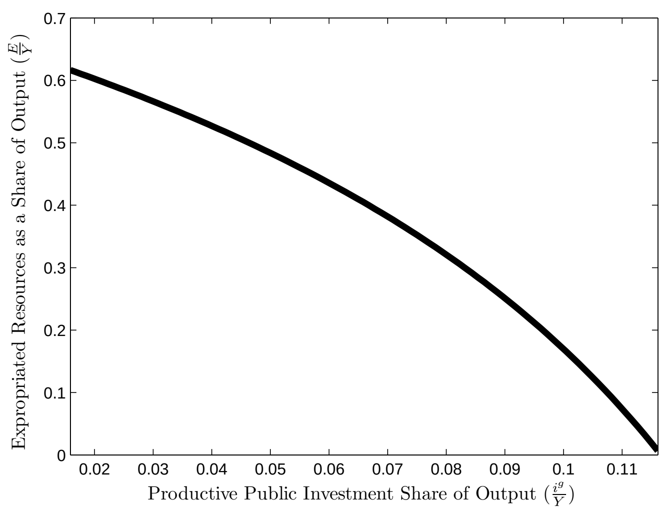


Figure 1.4: Productive Public Investment and Expropriated Resources as a Share of Output. Parameter values same as in Figure 1.2.

Moreover, according to the model, private investment is lower in countries with self-interested governments, while total public investment is higher. As a result, the public-to-private investment ratio in corrupt countries is higher (see Figure 1.6). This is consistent with the findings of Tanzi and Davoodi (1997), Mauro (1995) and Mauro (1995). Mauro (1995) finds that corruption decreases private investment, while Tanzi and Davoodi (1997) maintain that corruption increases public investment.

Finally, the model predicts that economic growth would be lower in countries with high corruption. This is also consistent with empirical work pioneered

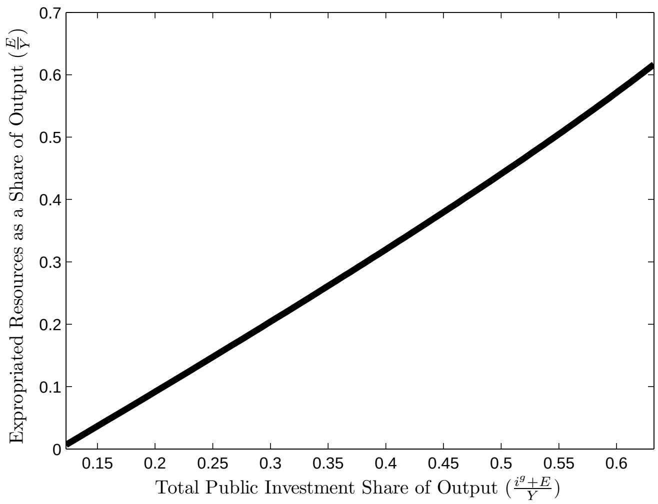


Figure 1.5: Total Public Investment Share of Output and Expropriated Resources as a Share of Output. Parameter values same as in Figure 1.2.

by Mauro (1995).

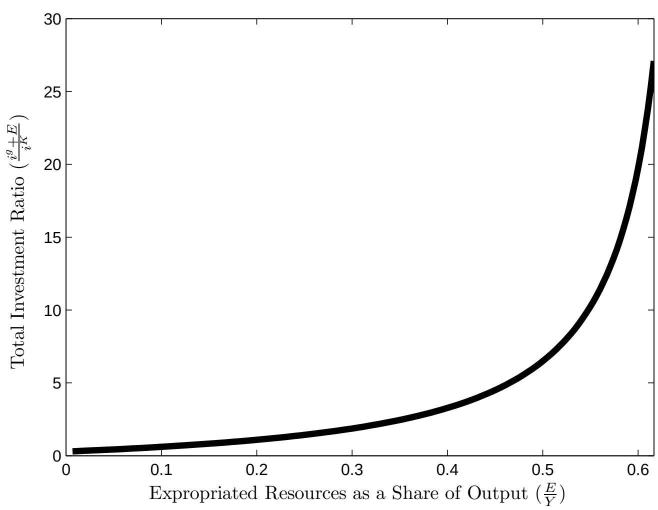


Figure 1.6: Expropriated Resources and Total Public-to-private Investment Ratio. Parameter values same as in Figure 1.2.

While there is empirical evidence supporting the implications of the model regarding share of public investment, corruption, and growth, there are no studies examining how the public-to-private capital ratio differs across countries. In the next section I present data and compare it with the implications of the model regarding public-to-private capital.

1.4 Data

I took the public investment and private investment data from Easterly and Rebelo (1993) data set. This data is gathered from sources including World Bank country reports, United Nations' national accounts data, and the World Bank's annual *World Development Report*. It includes more than 100 countries for 1970 through 1988. The authors calculate private investment by subtracting public investment from total investment. However their data set lacks private investment figures for many advanced countries. I used OECD data to complement the Easterly-Rebelo data set and I calculated decade averages of public and private investment in 1980s as a fraction of GDP.

Public capital stock and private capital stock data are not readily available. As a proxy for these variables, I used public investment and private investment data obtained from the (extended) Easterly-Rebelo data set. Note that as long as public capital and private capital depreciate at the same rate, the ratio of the two capitals $\frac{g}{K}$ would equal to the ratio of the investments $\frac{i^g}{i^k}$. Therefore, using investment ratio rather than capital ratio would be a good proxy if the two capitals depreciate at similar rates.

I took the growth rates from Heston, Summers, and Aten (2006) and I calculated the average growth rate of real GDP per capita in year 2000 constant prices for 1980-1990.

The measure of corruption is obtained from Transparency International's Corruption Perceptions Index (CPI) for 2006. The CPI ranks countries by their perceived levels of public sector corruption, as determined by expert assessments and opinion surveys. It scores countries on a scale from zero to ten, with ten indicating a highly clean country and zero indicating a highly corrupt country. Note that the CPI values are from 2006 whereas other data are for 1980-1990. There is no CPI for that decade as the earliest CPI is collected in 1995. However, there is persistence in this index; countries that are corrupt in 1995 seem to stay corrupt in 2006. The correlation coefficient for 1995 CPI and 2006 CPI for countries that are reported in both is 0.93. See Appendix B for details. Hence, 2006 CPI would be a good enough measure for perceived corruption in 1980s.

There are 86 countries in the whole sample and the complete list of countries included is in Appendix B. Table 1.2 presents descriptive statistics of the variables analyzed.

Figure 1.7 shows the relationship between the public-to-private investment ratio and the growth rate. The correlation coefficient is -0.23, which is significantly different than 0. Note that the correlation is not driven by the extreme points. If we take out countries[5] whose public-to-private investment ratio is higher than 5 the correlation coefficient decreases to -0.29. This case is shown

[5]These countries are Ethiopia, Hungary, Mauritania, Jamaica, Burundi, Mozambique, Poland, and Niger.

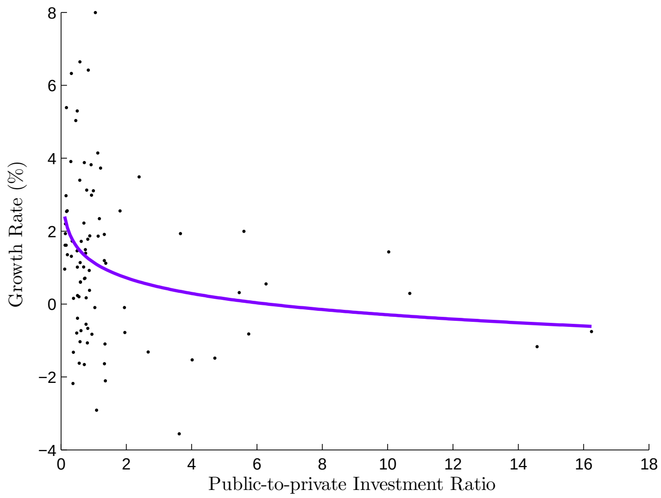


Figure 1.7: Public-to-private Investment Ratio and Growth in the data (All countries).

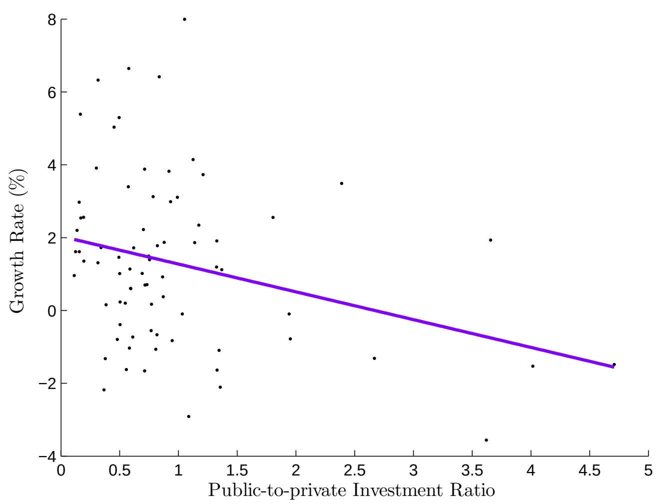


Figure 1.8: Public-to-private Investment Ratio and Growth in the data (Countries with $\frac{g}{K} \leq 5$).

in Figure 1.8. While there is more dispersion of growth rates at low levels of public-to-private investment ratio, the growth rate is never too high when the investment ratio is high. The dispersion of growth rates at low levels can be explained by this theory through changes across countries in public capital elasticity of output (α), rate of time preference of the government ρ, and that of consumers. The model predicts, keeping the type of the government constant, a higher public capital elasticity of output, a more patient government, and less patient consumers result in higher investment ratios.

As Figure 1.9 shows, corruption and the public-to-private investment ratio are positively related. (Recall that high numbers in the Corruption Perceptions Index refer to low corruption.) The correlation coefficient between the public-to-private capital ratio and the Corruption Perceptions Index is -0.24 and it is significantly different than 0. Again, extreme points do not drive this relationship. If we take out countries whose public-to-private investment ratios are above 5, the correlation coefficient would decrease to -0.43. This case is shown in Figure 1.10. This result is one of the main points made in this paper. Several authors have maintained that corruption causes public investment as a share of output or of total investment to be high (e.g. Tanzi and Davoodi (1997) and Keefer and Knack (2007)). What is shown here is that with high corruption, public capital per private capital is too high. Self-interested governments distort the capital mix and reduce the productivity of private capital.

Figure 1.11 depicts the relationship between Corruption Perceptions Index and Public Investment Share of Output. The correlation coefficient is -0.33 and it is statistically significant. This is in line with the model's results. Corrupt governments inflate the amount of public investment by reducing the productive public investment and increasing the amount of funds expropriated. Keefer and Knack (2007) find a similar result and claim that public investment reported

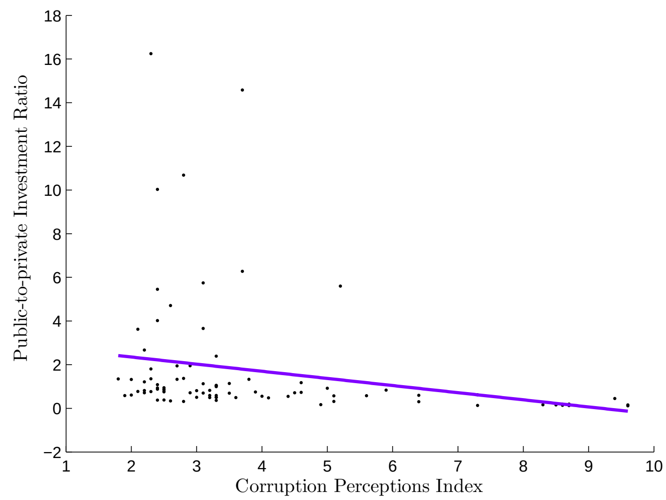


Figure 1.9: Corruption and Public-to-private Investment Ratio in the data (All Countries).

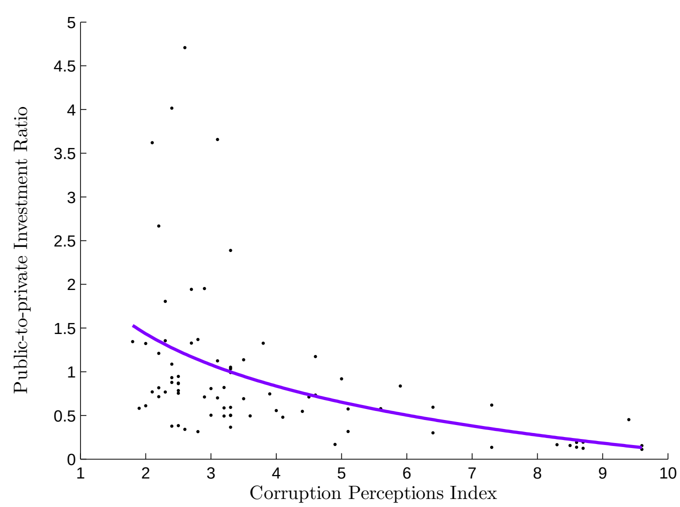


Figure 1.10: Corruption and Public-to-private Investment Ratio in the data (Countries with $\frac{g}{K} \leq 5$).

should not be used for policy suggestions because the reported public investment data is an overestimation of the actual productive public investment.

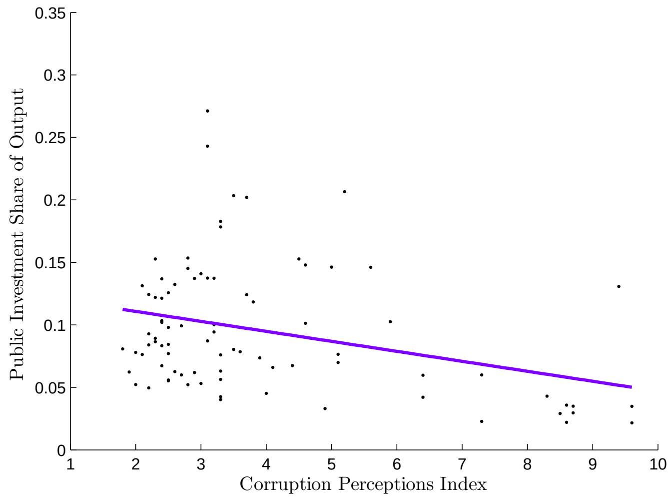


Figure 1.11: Corruption and Public Inv. in the data.

Finally, Figure 1.12 demonstrates the relationship between corruption and growth. The correlation coefficient is 0.43 and it is significantly different than 0. This concurs not only the implication of the model but also what other scholars have argued (see Mauro (1995), Tanzi and Davoodi (1997)).

Table 1.3 summarizes the correlation coefficients for all the variables. Recall that countries with high CPI values are relatively clean economies. Hence, a negative correlation of a variable with CPI means that variable is high in corrupt countries.

1.5 Concluding remarks

In many macroeconomic models that deal with government choices, the government is assumed to be benevolent. When the government is totally benevolent

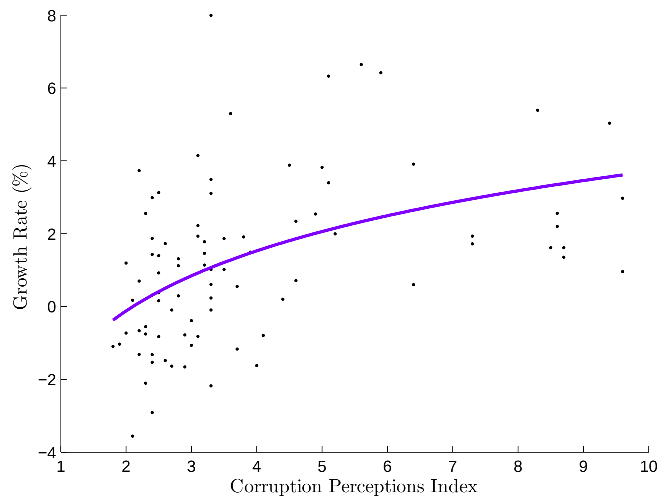


Figure 1.12: Corruption and Growth in the data.

one would not expect to see political corruption in the economy. In this paper the assumption of a benevolent government is relaxed and a simple model that tries to explain the interaction between political corruption, public investment, and economic growth is developed. In line with many other studies, one result of the model is that corruption is detrimental to economic growth. A self-interested government chooses a high productive public-to-private capital ratio, thereby increasing the returns to private capital. However, this increase in the capital ratio requires the tax rates to go up, causing the after-tax returns to be lower. The net effect on growth is negative. Also, part of the tax revenues are expropriated by the government, so the share of output that goes to productive public investment in corrupt countries is low.

An interesting extension of the model would be to consider the case when the government does not have access to a commitment technology and compare the result to those of Azzimonti-Renzo, Sarte, and Soares (2003).

In this model the type of government is taken as given and the reasons as to why some governments are more self-interested than others are not explored. The type of government in any country might depend on the historical, cultural, institutional, and macroeconomic environment in that country. My aim for future research is to explore the macroeconomic determinants of corruption.

Table 1.2: **Descriptive Statistics**

	Mean	**Std. Dev.**	**Minimum**	**Maximum**
Whole Sample (86 Countries)				
Public Investment Share	0.10	0.05	0.02	0.27
Private Investment Share	0.11	0.06	0.005	0.29
Public-to-private Capital Ratio	1.72	2.90	0.11	16.24
Growth Rate (%)	1.22	2.25	-3.56	8.00
Corruption Perceptions Index	3.92	2.08	1.80	9.60
Advanced Countries[a] (14 Countries)				
Public Investment Share	0.05	0.03	0.02	0.13
Private Investment Share	0.20	0.08	0.12	0.29
Public-to-private Capital Ratio	0.26	0.21	0.11	0.84
Growth Rate (%)	2.94	2.02	0.20	6.41
Corruption Perceptions Index	7.69	1.83	4.40	9.60
Developing Countries[a] (72 Countries)				
Public Investment Share	0.11	0.05	0.04	0.27
Private Investment Share	0.10	0.06	0.005	0.25
Public-to-private Capital Ratio	2.00	3.05	0.30	16.24
Growth Rate (%)	0.88	2.15	-3.56	8.00
Corruption Perceptions Index	3.18	1.12	1.80	7.30
Least Corrupt Countries[b] (11 Countries)				
Public Investment Share	0.04	0.03	0.02	0.13
Private Investment Share	0.22	0.10	0.10	0.29
Public-to-private Capital Ratio	0.22	0.16	0.11	0.62
Growth Rate (%)	2.49	1.46	0.95	5.38
Corruption Perceptions Index	8.60	0.78	7.30	9.60
Most Corrupt Countries[b] (10 Countries)				
Public Investment Share	0.08	0.03	0.05	0.13
Private Investment Share	0.08	0.03	0.04	0.12
Public-to-private Capital Ratio	1.37	1.00	0.58	3.62
Growth Rate (%)	-0.26	1.91	-3.56	3.93
Corruption Perceptions Index	2.07	0.14	1.80	2.20

[a]*According to the classification of the IMF. See Appendix B for the list of advanced countries.*

[b]*Top and bottom 10 countries according to the Corruption Perceptions Index (2006). See Appendix B for the list of these countries.*

Table 1.3: **Correlation Coefficients**

	$\mathbf{i^g/Y}$	$\mathbf{i^k/Y}$	$\mathbf{g/K}$ **(all)**	$\mathbf{g/K}$ $(\leq \mathbf{5})$	**Growth Rate**	**CPI**
$\mathbf{i^g/Y}$	1					
$\mathbf{i^k/Y}$	-0.11*	1				
$\mathbf{g/K}$ **(all)**	0.45	-0.58	1			
$\mathbf{g/K}(\leq 5)$	0.59	-0.58	-	1		
Growth Rate	0.16*	0.55	-0.23	-0.29	1	
CPI	-0.33	0.51	-0.24	-0.43	0.43	1

**Not significant.*

Chapter 2

Self-selection of Politicians and Corruption

2.1 Introduction

The characteristics of the people elected for public office affect the quality of public policies. One of the most important characteristics with several policy implications, like the ones discussed in Chapter 1, is honesty. Caselli and Morelli (2004) define honesty as the character trait that leads an official to perform his duties without harassing private citizens for bribes or other kickbacks. If one takes the level of corruption in an economy as an indicator of the (lack of) honesty of the political elite; given the dispersion of corruption across countries, it would mean that the honesty levels of politicians are largely diversified across countries. Moreover, research such as Mauro (2004), shows that the corruption level in a country is persistent over time. If politicians in these countries come to power through elections, this would mean that the electorate in these countries repeatedly elect dishonest political candidates for office. One explanation of this seemingly irrational behavior of voters is that the types of political candidates are not known to the electorate and hence the voters are unable to separate honest candidates from dishonest ones. This type of argument focuses on the voting process when the set of political candidates are given and not on why those political candidates decided to run for office in the first place. Caselli and Morelli (2004), on the other hand, provide another explanation for the election of dishonest politicians. They argue that the dishonest people have more reasons to run for office than the honest ones because they ask for bribes once elected, while honest politicians rely on legitimate sources of income when in office. Therefore, the authors maintain, there is a self-selection of dishonest people into politics. Faced with a pool of dishonest candidates, voters have no choice but to elect dishonest people to office.

In this paper we provide a model, similar to that by Caselli and Morelli (2004), to explain the self-selection of political candidates when the types of the candidates are not publicly known. Unlike Caselli and Morelli (2004), we consider the case when all political candidates face the same probability of election. This probability is endogenously determined in the model and depends on the number of candidates and the number of seats in the parliament. The more candidates, the lower the chance of getting elected for each candidate.

In the model, agents have two options to choose from. They can either become entrepreneurs, earning profits and paying bribes to corrupt politicians, or they can run for politics and become politicians if elected or entrepreneurs if not. Politicians earn salaries and decide on the amount of bribes they will request from the entrepreneurs. Agents differ with respect to their honesty, which is measured by the moral cost they incur when requesting bribes if they become politicians. Honesty of the agents is distributed in the population according to a distribution function. We show that the characteristics of this distribution function plays a role in ensuring the uniqueness of equilibrium and also on the results of the comparative static exercises undertaken.

The model predicts which types of people run for politics and the total amount of bribes requested in equilibrium. We show that, under certain conditions, the equilibrium strategy for entering politics is a threshold function. We study the effects of changing politicians' salaries, entrepreneurial profits, and campaigning costs on the threshold types. Our results turn out to be in line with those of Caselli and Morelli (2004). We also compare our results to the results of Poutvaara and Takalo (2007).

It is important to note that the model we present is based on the citizen-candidate model introduced by Osborne and Slivinski (1996) and Besley and Coate (1997).

2.2 The Model

Each agent is born with a type $\theta \in \Theta = [0, 1]$, which determines the honesty of the agent and is indexed. Higher θ means that the agent is more honest. Honesty determines the moral cost incurred by the agent when engaging in corrupt activities and it is unobservable. The distribution of types across the population is given by Φ, where $\Phi[0, 1] = 1$, and this distribution is common knowledge. Everyone lives for one period and the economy lasts one period. At the beginning of the period, each agent chooses to become an entrepreneur or a politician.

An entrepreneur's utility is a function $u_E : \mathbb{R} \to \mathbb{R}$ and it depends on the amount of bribes paid.

$$u_E(b_E) = \pi - b_E \tag{2.1}$$

where π is the entrepreneur's profits and b_E is the bribe paid by the entrepreneur to the politicians. Note that we assume the honesty of an agent does not affect her returns from politics because there are no moral costs incurred by entrepreneurs when paying bribes to corrupt politicians.

A politician's utility is a function $u_P : \Theta \times \mathbb{R} \rightarrow \mathbb{R}$ and it depends on the politician's type and the amount of bribes received.

$$u_P(\theta, b) = W + b - m(\theta, b) - F \tag{2.2}$$

where W is the politician's salary, m is the moral cost incurred when asking for bribes, and F is the fixed cost entering the political competition (campaigning costs). Moral cost m depends on the politician's type and the amount of bribes received. We assume the following about the moral cost of politicians, m:

Assumption 1 *m is a twice continuously differentiable function on Θ.*

Assumption 2 $\dfrac{\partial m(\cdot, b)}{\partial \theta} > 0$, $\forall b$.

Assumption 3 $\dfrac{\partial m(\theta, \cdot)}{\partial b} > 0$ *on* $\forall \theta$.

Assumption 4 $m(\theta, 0) = 0$, $\forall \theta$.

Assumption 5 $\dfrac{\partial^2 m(\cdot, \cdot)}{\partial \theta \partial b} > 0$, $\forall \theta$.

Assumption 2 states that for any bribe level, moral cost increases as an agent becomes more honest. Assumption 3 states that for any type of politician, moral cost increases as the politician demands more bribes and Assumption 4 states that an agent incurs no moral costs if she decides to receive no bribes. Finally, Assumption 5 states that the effect of bribes on moral cost increases as an agent becomes more honest. The marginal cost of taking bribes is higher for (relatively) honest people than it is for (relatively) dishonest people.

Let $R : \Theta \to \{0, 1\}$ denote the choice of becoming an entrepreneur or politician. If a type-θ agent decides to become an entrepreneur, $R(\theta) = 0$, and if she decides to run for politics, $R(\theta) = 1$.

After agents decide on whether to become entrepreneurs or run for politics, elections take place and some of the candidates are elected as politicians. Since θ is an unobservable parameter, a political candidate's probability of getting elected does not depend on θ. Let λ denote the measure of politicians required in the economy. This measure can be thought of as the number of seats to be filled in the parliament. The probability of getting elected depends only on the measure of political candidates and λ. Let this probability be denoted by p.

Those who run for politics but lose the election become entrepreneurs. However, they pay for the campaigning costs, and hence, their payoff is given by:

$$u_{PE}(b_E) = \pi - b_E - F \tag{2.3}$$

Those elected for office determine how much bribes to demand. They choose the amount of bribes that maximizes their utility. Hence, a type-θ politician solves the following problem:

$$\max_{b}\{W + b - m(\theta, b) - F\} \tag{2.4}$$

Let $B^* : \Theta \to [0, \bar{B}]$ denote the amount of bribes each type would demand. Therefore B^* is the solution to (2.4). We assume an upper bound $\bar{B}$ to the amount of bribes politicians demand. This upper bound can be thought of as the value of the total entrepreneurial profits in the economy.

Assumption 6 *For $\theta = 0$, there exists $\hat{b} < \bar{B}$ such that $u_P(0, \hat{b}) > u_P(0, \bar{B})$. For $\theta = 1$ there exists $\tilde{b} > 0$ such that $u_P(1, \hat{b}) > u_P(1, 0)$.*

This assumption states that even the most dishonest agent prefers a bribe level lower than the upper bound and that even the most honest agent demands strictly positive bribes, no matter how small those bribes may be. Assumption 6 assures that the optimal bribe schedule B^* is strictly decreasing in the honesty level of an agent (see the proof of Theorem 1).

Theorem 1 (Characterization of the Bribe Function) *Given Assumptions 1 and 3-6, B^* is a continuous and strictly decreasing function on $(0, 1)$.*

Proof. See Appendix C. ■

We assume that politicians possess the bargaining power when it comes to bribes. Entrepreneurs pay whatever amount is demanded by the politicians.

For simplicity, we assume all entrepreneurs pay the same amount of bribes, regardless of their type. This amount is equal to the average expected bribes to be paid in the economy. Then the average expected bribes for entrepreneurs, whose measure in the population is $(1-\lambda)$, equal to:

$$b_E = \frac{\int_{\theta \in \mathbb{P}} B^*(\theta)\, d\Phi(\theta)}{(1-\lambda)} \tag{2.5}$$

where $\mathbb{P}$ denotes the set of all elected politicians.

Definition of Equilibrium. A subgame perfect equilibrium of the election game is a bribe function B^* and an entry function R^* such that

1. For each $\theta \in \Theta$, $R^*(\theta) = 1$ implies that the utility from running for politics is greater than or equal to the utility from entrepreneurship:

$$p\,(W + B^*(\theta) - m(\theta, b) - F) + (1-p)\,(\pi - E_{R^*,B^*}[b_E] - F) \geq \pi - E_{R^*,B^*}[b_E] \tag{2.6}$$

and $R^*(\theta) = 0$ implies the utility from entrepreneurship is greater than or equal to the utility from running for politics:

$$p\,(W + B^*(\theta) - m(\theta, b) - F) + (1-p)\,(\pi - E_{R^*,B^*}[b_E] - F) \leq \pi - E_{R^*,B^*}[b_E] \tag{2.7}$$

2. For each $\theta \in \Theta$, the bribe function $B^*(\theta)$ solves:

$$\max_b \{W + b - m(\theta, b) - F\} \tag{2.8}$$

3. Probability of election is given by:

$$p = \frac{\lambda}{\int_\Theta R^*(\theta)\, d\Phi(\theta)} \tag{2.9}$$

Threshold Function. Strategy R is a threshold function if there exists $\underline{\theta} \in \Theta$ such that for all $\theta < \underline{\theta}$, $R(\theta) = 1$.

With a threshold function, we can write the measure of political candidates as $\Phi[0, \underline{\theta}]$. The probability of election depends on this measure. For a threshold function R the probability of getting elected becomes

$$p(\underline{\theta}) = \begin{cases} \dfrac{\lambda}{\Phi[0, \underline{\theta}]} & \text{if } \lambda \leq \Phi[0, \underline{\theta}] \\ 1 & \text{otherwise} \end{cases} \tag{2.10}$$

Theorem 2 (Equilibrium Characterization) *Under Assumptions 1-6, there exists an equilibrium. Moreover, any equilibrium entry strategy is a threshold function.*

Proof. See Appendix C. ■

Whenever an agent with a given honesty finds politics to be more attractive than entrepreneurship, agents who are less honest also prefer to be politicians.

Hence, it is not possible to have an equilibrium in which only honest agents prefer to run for politics and dishonest ones prefer entrepreneurship. This causes a self-selection of dishonest candidates into politics.

Corollary 1 *If an individual with type $\theta = 0$ chooses entrepreneurship over politics, so will any individual with type $\theta > 0$.*

If the most dishonest agent chooses to stay out of politics, more honest types will also prefer to stay out of politics. To prevent this from happening, we will assume a big cost to all agents if nobody runs for office.

Corollary 2 *If an individual with type $\theta = 1$ chooses politics over entrepreneurship, so will any individual with type $\theta < 1$.*

If the most honest individual runs for politics, so will everyone else. This equilibrium outcome is referred to as *universal democracy* by Poutvaara and Takalo (2007).

Consider the (indirect) utility of an entrepreneur as a function of the most honest agent that runs for office:

$$v_E^*(\underline{\theta}) = \pi - p(\underline{\theta}) \frac{\int_0^{\underline{\theta}} B^*(\theta)\, d\Phi(\theta)}{(1-\lambda)} \tag{2.11}$$

Note that a sufficient condition for $v_E^*(\underline{\theta}) > 0$ is to assure that no politician demands bribes greater than the total entrepreneurial profits per politician in the economy. Hence we will assume:

Assumption 7 $\bar{B} = \dfrac{\pi(1-\lambda)}{\lambda}$

Let ε_E be the elasticity of the indirect utility of an entrepreneur with respect to the honesty level of the most honest political candidate:

$$\varepsilon_E = \frac{d(v_E^*)}{d\underline{\theta}} \frac{\underline{\theta}}{v_E^*} \tag{2.12}$$

The type of the most honest political candidate affects the indirect utility of entrepreneurs through two channels. One channel is the probability of election. When the threshold honesty $\underline{\theta}$ increases, it means there are more political candidates, and hence the probability of getting elected drops for all types. The other channel is the affect on the total bribes that would be requested by all candidates (not politicians) in the economy. As $\underline{\theta}$ increases, this bribe amount increases. These two channels affect the sign of the derivative in opposite directions. Which channel dominates the other depends on the characteristics of the distribution of types, Φ, in the economy. As a result, without additional assumptions on Φ, we cannot determine the sign of $\dfrac{d(v_E^*)}{d\underline{\theta}}$.

Let ε_P be the elasticity of the probability of election for a political candidate with respect to the honesty level of the most honest candidate.

$$\varepsilon_P = -\frac{dp}{d\underline{\theta}} \frac{\underline{\theta}}{p} \tag{2.13}$$

The sign of this elasticity is always positive, because equation (2.10) ensures that $\frac{dp}{d\underline{\theta}} < 0$.

The following assumption ensures that ε_P is well defined.

Assumption 8 Φ *has a Radon-Nikodym derivative,* ϕ.

Under these additional assumptions, we can prove that the equilibrium characterized in Theorem 2 is unique:

Theorem 3 (Uniqueness of Equilibrium) *There exists a* *unique* *equilibrium if* $\varepsilon_E > \varepsilon_P$.

Proof. See Appendix C. ■

Note that $\varepsilon_E > \varepsilon_P$ is only a sufficient condition for uniqueness, and not a necessary one.

Note also that one implication of the constraint $\varepsilon_E > \varepsilon_P$ is that $\varepsilon_E > 0$ must hold. This, in turn, implies a constraint on the admissible distribution of types Φ for uniqueness of equilibrium. Our goal is to study this constraint in future research.

2.3 Comparative Statics

Once the uniqueness of equilibrium is established, we can study the affects of exogenous changes in the economy on the threshold honesty level $\underline{\theta}$. One comparative static exercise of interest is to see how increasing politicians' salary affects the threshold honesty in the economy. The following theorem states that the threshold honesty increases when politicians' salary increases. More honest people decide to run for politics when the salary they expect to earn as politicians increases.

Theorem 4 *Let $\varepsilon_E > \varepsilon_P$. Then the threshold honesty level $\underline{\theta}$ increases with politicians' salary, W.*

Proof. See Appendix C. ∎

Similar comparative static exercises have been done by other studies. While it is not possible to make direct comparisons between our results and the results of others, it is still worthwhile to put our results in the context of the literature. The closest model to ours is built and studied by Caselli and Morelli (2004). In this paper, the authors consider the competence of political candidates rather than their honesty. However, they claim in earlier versions of the paper that their results could be applied to honesty as well. Their findings are in line with our theorem. Their model predicts that the honesty of the elected body is weakly increasing in political rewards. Poutvaara and Takalo (2007), on the other hand, claim that increasing political rewards may result in a decrease in the average quality of candidates. Their argument is that campaigning costs are the decisive factor and when these costs are high, low-quality candidates prefer not to run for politics because their chances of getting elected are low. Increasing political rewards increases the returns to politics for everyone, including the low-quality agents, causing them to enter the political competition. Hence causes the overall quality of the political candidates to deteriorate. Notice that their argument lies on the premise that high- and low-quality agents are faced with different election probabilities. In our model, however, everyone is faced with the same probability.

Other comparative static exercises of interest are with respect to campaigning costs and entrepreneurial profits in the economy. Proofs of the theorems are very similar to that of Theorem 4, and hence, omitted.

Theorem 5 *Let $\varepsilon_E > \varepsilon_P$. Then the threshold honesty level $\underline{\theta}$ decreases with campaigning costs, F, associated with running for politics.*

Theorem 6 *Let $\varepsilon_E > \varepsilon_P$. Then the threshold honesty level $\underline{\theta}$ decreases with entrepreneurial profits, π.*

We find that the threshold honesty of the political candidates decreases when entrepreneurship becomes more attractive than politics, which could be a result of an increase in campaigning costs or increasing profits. These results are again in line with those of Caselli and Morelli (2004).

2.4 Concluding Remarks

In this paper, we built a citizen-candidate model, in which agents are heterogenous with respect to their honesty and they choose whether to become entrepreneurs or run for politics. We characterized the subgame perfect equilibrium of the model and analyzed the effects of changing exogenous parameters, such as politicians' salaries, entrepreneurial profits and campaigning costs, on the equilibrium outcome. One important observation we made is that the distribution of honesty in the population is important when making policy recommendations with regards to reducing corruption in an economy. We plan to explore further the role the distribution of honesty in the population plays in our results.

Appendix

Appendix A - Proofs of Propositions in Chapter 1

Proof of Proposition 1

The first constraint, the feasibility constraint, is part of the definition of CE. The second one is obtained by plugging GBC, Price, and Feasibility in Cons-FOC.

$$u'(C_t) = \beta u'(C_{t+1})[(1 - (\frac{E_{t+1} + g_{t+2} - (1-\delta_g)g_{t+1}}{r_{r+1}K_{t+1}}))r_{t+1} + 1 - \delta_k]$$

$$u'(C_t) = \beta u'(C_{t+1})[A(\frac{g_{t+1}}{K_{t+1}})^\alpha - (\frac{E_{t+1} + g_{t+2} - (1-\delta_g)g_{t+1}}{A(\frac{g_{t+1}}{K_{t+1}})^\alpha K_{t+1}})A(\frac{g_{t+1}}{K_{t+1}})^\alpha + 1 - \delta_k]$$

$$u'(C_t) = \beta u'(C_{t+1})[\frac{A(\frac{g_{t+1}}{K_{t+1}})^\alpha K_{t+1} - E_{t+1} - g_{t+2} + (1-\delta_g)g_{t+1}}{K_{t+1}} + 1 - \delta_k]$$

$$u'(C_t) = \beta u'(C_{t+1})[\frac{C_{t+1} + K_{t+2} - (1-\delta_k)K_{t+1}}{K_{t+1}} + 1 - \delta_k]$$

$$u'(C_t) = \beta u'(C_{t+1})[\frac{C_{t+1} + K_{t+2}}{K_{t+1}}]$$

Proof of Proposition 2

Aggregate allocations $\{C_t, K_t\}_{t\geq 0}$, initial conditions g_0 and K_0, and first-period policies g_1, τ_0 and E_0 are given. Prices $\{r_t\}_{t=0}^{\infty}$ and policies $\{\tau_t, E_t, g_{t+1}\}_{t=1}^{\infty}$ need to be constructed. To this end first-order conditions will be used. Given the assumptions on the utility function of consumers, the first-order conditions are both necessary and sufficient for consumer and firm maximization.

The following four equations can be used to construct r_t, τ_t, E_t, and g_{t+1} at each time t:

$$r_t = A\left(\frac{g_t}{K_t}\right)^{\alpha} \tag{14}$$

$$\tau_{t+1} = 1-\left[\frac{u'_t}{\beta u'_{t+1}} - 1 + \delta_k\right]\frac{1}{A\left(\frac{g_{t+1}}{k_{t+1}}\right)^{\alpha}} \tag{15}$$

$$C_t + K_{t+1} - (1-\delta_k)K_t + g_{t+1} - (1-\delta_g)g_t + E_t = AK_t\left(\frac{g_t}{K_t}\right)^{\alpha} \tag{16}$$

$$g_{t+1} - (1-\delta_g)g_t + E_t = A(1-\tau_t)K_t\left(\frac{g_t}{K_t}\right)^{\alpha} \tag{17}$$

Proof of Proposition 4

As shown in the main discussion, Ramsey Problem is characterized by the following equations:

$$\rho^t\frac{(1-\theta)}{C_t} + \rho^t\lambda_t - \rho^t\frac{\mu_t}{C_t^2} + \rho^{t-1}\beta\frac{\mu_{t-1}}{C_t^2}[\frac{C_t+K_{t+1}}{K_t}] - \rho^{t-1}\beta\frac{\mu_{t-1}}{C_tK_t} = 0 \tag{18}$$

$$\rho^t\lambda_t - \rho^{t+1}\lambda_{t+1}[1-\delta_k + A(1-\alpha)\left(\frac{g_{t+1}}{K_{t+1}}\right)^{\alpha}] + \rho^t\beta\frac{\mu_t}{C_{t+1}}[\frac{C_{t+1}+K_{t+2}}{K_{t+1}^2}] - \rho^{t-1}\beta\frac{\mu_{t-1}K_t}{C_t} = 0 \tag{19}$$

$$\rho^t\frac{\theta}{E_t} + \rho^t\lambda_t = 0 \tag{20}$$

$$\rho^t\lambda_t - \rho^{t+1}\lambda_{t+1}[1-\delta_g + A\alpha\left(\frac{g_{t+1}}{K_{t+1}}\right)^{\alpha-1}] = 0 \tag{21}$$

$$C_t + K_{t+1} - (1-\delta_k)K_t + g_{t+1} - (1-\delta_g)g_t + E_t = AK_t\left(\frac{g_t}{K_t}\right)^{\alpha} \tag{22}$$

$$\frac{\beta}{C_{t+1}}[\frac{C_{t+1}+K_{t+2}}{K_{t+1}}] = \frac{1}{C_t} \tag{23}$$

On a balanced growth path, the following ratios must be constant: $\frac{C_{t+1}}{C_t} = \gamma_C$, $\frac{E_{t+1}}{E_t} = \gamma_E$, $\frac{K_{t+1}}{K_t} = \gamma_K$, and $\frac{g_{t+1}}{g_t} = \gamma_g$ for all t.

Plug (20) in (21):

$$\frac{E_{t+1}}{E_t} = \rho[1 - \delta_g + A\alpha \left(\frac{g_{t+1}}{K_{t+1}}\right)^{\alpha-1}]$$

In order for this ratio to be constant over time, $\frac{g_t}{K_t}$ must be constant for all t. Denote this ratio by $X = \frac{g}{K}$. Then:

$$\gamma_E = \rho[1 - \delta_g + A\alpha X^{\alpha-1}]$$

Equation (23) on balanced growth path implies:

$$\frac{C_t}{K_t} + \gamma_K = \frac{\gamma_C}{\beta}$$

So $\frac{C_t}{K_t}$ is a constant for all t, hence $\gamma_C = \gamma_K$. So, on balanced growth path:

$$\frac{C}{K} = (\frac{1-\beta}{\beta})\gamma_K \tag{24}$$

Rewrite equation (22):

$$\frac{C_t}{K_t} + \frac{K_{t+1}}{K_t} - (1 - \delta_k) + \frac{g_{t+1}}{K_t} - (1 - \delta_g)\frac{g_t}{K_t} + \frac{E_t}{K_t} = A \left(\frac{g_t}{K_t}\right)^{\alpha}$$

On balanced growth path:

$$(\frac{1-\beta}{\beta})\gamma_K + \gamma_K - (1-\delta_k) + X\gamma_K - (1-\delta_g)X + \frac{E_t}{K_t} = AX^\alpha$$

So, $\frac{E_t}{K_t}$ is a constant for all t; hence $\gamma_E = \gamma_K$ and:

$$\frac{E}{K} = AX^\alpha - (\frac{1}{\beta} + X)\gamma_K + (1-\delta_k) + (1-\delta_g)X \tag{25}$$

Now consider (18). Plug (20) in (18):

$$\frac{\rho(1-\theta)}{C_t} - \frac{\rho\theta}{E_t} - \frac{\rho\mu_t}{C_t^2} + \frac{\beta\mu_{t-1}}{C_t^2}[\frac{C_t + K_{t+1}}{K_t}] - \frac{\beta\mu_{t-1}}{C_t}\frac{1}{K_t} = 0$$

Multiply it by K_t and consider the balanced growth path:

$$\frac{\rho(1-\theta)K}{C} - \frac{\rho\theta K}{E} - \frac{\rho\mu_t K}{C_t C} + \frac{\beta\mu_{t-1}K}{C_t C}[\frac{C_t + K_{t+1}}{K_t}] - \frac{\beta\mu_{t-1}}{C_t} = 0$$

Rewrite it:

$$\frac{\rho(1-\theta)K}{C} - \frac{\rho(1-\gamma)K}{E} - \rho\frac{\mu_t}{C_t}\frac{K}{C} + \frac{\mu_{t-1}}{C_{t-1}}\beta\left(\frac{K}{\gamma_K C}[\frac{C}{K} + \gamma_K] - \frac{1}{\gamma_K}\right) = 0 \tag{26}$$

Now consider (19). Plug (20) and (21) in (19):

$$-\left(\rho\gamma_K - \rho^2[1-\delta_k + A(1-\alpha)\left(\frac{g_{t+1}}{K_{t+1}}\right)^\alpha]\right)\frac{\theta}{E_{t+1}} +$$
$$+\frac{\mu_t\beta\rho}{C_{t+1}}[\frac{C_{t+1} + K_{t+2}}{K_{t+1}^2}] - \mu_{t-1}\frac{\beta}{C_t K_t} = 0$$

Multiply by K_{t+1} and consider the balanced growth path:

$$-\left(\rho\gamma_K - \rho^2[1-\delta_k + A(1-\alpha)X^\alpha]\right)\theta\frac{K}{E} + \frac{\mu_t\beta\rho}{\gamma_K C_t}[\frac{C}{K} + \gamma_K] - \mu_{t-1}\frac{\beta\gamma_K}{\gamma_K C_{t-1}} = 0$$

Rewrite it:

$$-\rho\left(\gamma_K - \rho[1-\delta_k + A(1-\alpha)X^\alpha]\right)\theta\frac{K}{E} + \frac{\mu_t}{C_t}\frac{\beta\rho}{\gamma_K}[\frac{C}{K} + \gamma_K] - \beta\frac{\mu_{t-1}}{C_{t-1}} = 0 \quad (27)$$

(26) and (27) are difference equations for $\frac{\mu}{C}$. They have to be satisfied at the same time. Hence, this condition can be used to find X. The X that satisfies both (26) and (27) is given by:

$$\frac{\rho(\frac{(1-\theta)K}{C} - \frac{\theta K}{E})}{\frac{K}{C}} = \rho\left(\rho[1-\delta_g + A\alpha X^{\alpha-1}] - \rho[1-\delta_k + A(1-\alpha)X^\alpha]\right)\theta\frac{K}{E} \quad (28)$$

Once $\frac{C}{K}$ and $\frac{E}{K}$ are substituted from equations (24) and (25), one can solve for X using (28).

Now consider the Euler equation from the consumer's problem:

$$\frac{C_{t+1}}{C_t} = \beta[(1-\tau_{t+1})r_{t+1} + 1 - \delta_k]$$

From the government's problem:

$$\frac{C_{t+1}}{C_t} = \rho[1-\delta_g + A\alpha X^{\alpha-1}]$$

Equating the two:

$$\tau = 1 - \frac{\frac{\rho}{\beta}[1-\delta_g + A\alpha X^{\alpha-1}] - (1-\delta_k)}{AX^{\alpha}}$$

Then the balanced growth path is characterized as follows:

- $\dfrac{C}{K} = \dfrac{(1-\beta)}{\beta}\rho[1-\delta_g + A\alpha X^{\alpha-1}]$
- $\dfrac{E}{K} = AX^{\alpha} - (\dfrac{1}{\beta} + X)\rho[1-\delta_g + A\alpha X^{\alpha-1}] + (1-\delta_k) + (1-\delta_g)X$
- $\dfrac{g}{K} = X$
- $\tau = 1 - \frac{\frac{\rho}{\beta}[1-\delta_g + A\alpha X^{\alpha-1}] - (1-\delta_k)}{AX^{\alpha}}$
- $\gamma_C = \gamma_K = \gamma_E = \gamma_g = \rho[1-\delta_g + A\alpha X^{\alpha-1}]$

where X satisfies:

$$(1-\theta)\big\{AX^{\alpha} - (\frac{1}{\beta} + X)\rho[1-\delta_g + A\alpha X^{\alpha-1}] + (1-\delta_k) + (1-\delta_g)X\big\}$$
$$-\theta\frac{(1-\beta)}{\beta}\rho[1-\delta_g + A\alpha X^{\alpha-1}] =$$
$$\theta\rho[\delta_k - \delta_g + A\alpha X^{\alpha-1} - A(1-\alpha)X^{\alpha}]$$

Appendix B - Data

List of countries included in the sample

Algeria, Argentina, Australia, Austria, Bangladesh, Belize, Benin, Bolivia, Botswana, Brazil, Burkina Faso, Burundi, Cameroon, Canada, Central African

Republic, Chile, China, Colombia, Costa Rica, Côte d'Ivoire, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Ethiopia, Finland, Gabon, Ghana, Greece, Grenada, Guinea, Haiti, Honduras, Hong Kong, Hungary, India, Indonesia, Italy, Jamaica, Kenya, South Korea, Lesotho, Malawi, Malaysia, Mali, Malta, Mauritania, Mauritius, Mexico, Morocco, Mozambique, Nepal, Netherlands, New Zealand, Niger, Nigeria, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Poland, Rwanda, Senegal, Sierra Leone, Singapore, South Africa, Sri Lanka, Sudan, Suriname, Swaziland, Syria, Taiwan, Thailand, Togo, Tunisia, Turkey, UK, Uruguay, USA, Venezuela, Zambia, and Zimbabwe.

Advanced countries included in the sample

Australia, Austria, Canada, Finland, Greece, Hong Kong, Italy, Netherlands, New Zealand, Singapore, South Korea, Taiwan, UK, and USA.

Least corrupt countries included in the sample

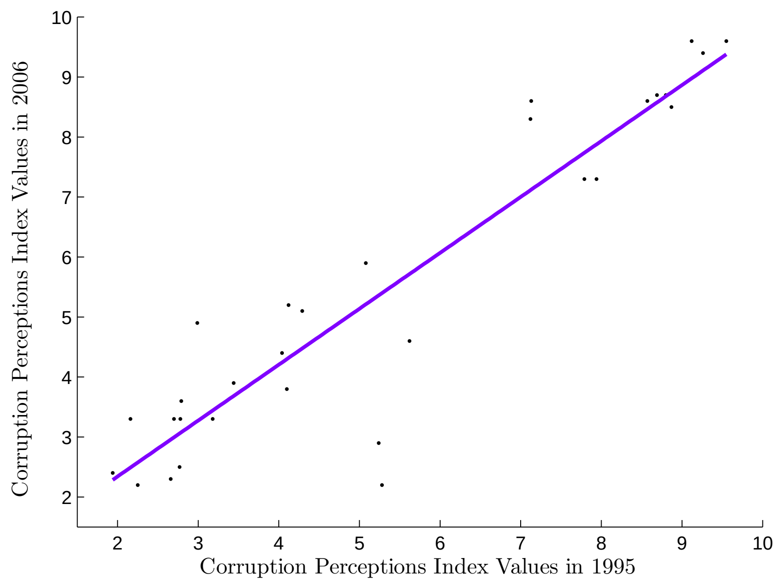
Australia, Austria, Canada, Chile, Finland, Hong Kong, Netherlands, New Zealand, Singapore, UK, and USA.

Most corrupt countries included in the sample

Bangladesh, Côte d'Ivoire, Equatorial Guinea, Guinea, Haiti, Kenya, Nigeria, Pakistan, Sierra Leone, and Sudan.

Corruption Perceptions Index in 1995 and 2006

Only 30 countries in the sample have CPI values in 1995. These countries are Argentina, Australia, Austria, Brazil, Canada, Chile, China, Colombia, Finland, Greece, Hong Kong, Hungary, India, Indonesia, Italy, Malaysia, Mexico, Netherlands, New Zealand, Pakistan, Philippines, Singapore, South Africa, South Korea, Taiwan, Thailand, Turkey, UK, USA, and Venezuela. The correlation coefficient between 1995 CPI values and 2006 CPI values for these countries is 0.93.



Appendix C - Proofs of Theorems in Chapter 2

Proof of Theorem 1

Proof. First, we will show that B^* is a continuous function. Since m is a C^2 function, $\dfrac{\partial m(\theta, \cdot)}{\partial b}$ is a C^1 function for all $\theta \in \Theta$. Under Assumption 3, the Implicit Function Theorem implies that for each θ there exists $\epsilon > 0$ such that B^* is single valued and continuous on $N_\epsilon(\theta)$ [1]. This implies that B^* is a continuous function.

Next, we will show that B^* is decreasing. Let $\theta_2 > \theta_1$ and

$$b_1 \in \underset{[0,\bar{B}]}{\operatorname{argmax}}\{W + b - m(\theta_1, b) - F\} \tag{29}$$

[1] See Theorem 1.3.1 on page 8 in Krantz and Parks (2002).

and

$$b_2 \in \underset{[0,\bar{B}]}{\operatorname{argmax}}\{W + b - m(\theta_2, b) - F\} \tag{30}$$

For a contradiction suppose $b_2 > b_1$. Inequalities (29) and (30) imply

$$b_1 - m(\theta_1, b_1) > b_2 - m(\theta_1, b_2) \tag{31}$$

and

$$b_2 - m(\theta_2, b_2) > b_1 - m(\theta_2, b_1) \tag{32}$$

respectively. Therefore, we have

$$b_1 - b_2 > m(\theta_1, b_1) - m(\theta_1, b_2) \tag{33}$$

and

$$b_2 - b_1 > m(\theta_2, b_2) - m(\theta_2, b_1) \tag{34}$$

Inequalities (33) and (34) imply

$$m(\theta_1, b_2) - m(\theta_1, b_1) > b_2 - b_1 > m(\theta_2, b_2) - m(\theta_2, b_1) \tag{35}$$

This inequality contradicts with Assumption 5. Hence we conclude $b_2 < b_1$.

By Assumption 6, solutions to the expression in (2.4) are characterized by

$$\frac{\partial m(\theta, \cdot)}{\partial b} = 1 \tag{36}$$

Equation (36) and Assumption 5 imply that B^* is strictly decreasing.

■

Proof of Theorem 2

Proof. First we will show if there exists an equilibrium, then R^* is a threshold function. For a contradiction, suppose there exists an equilibrium entry strategy $\hat{R}$ which is not a threshold function. Since $\hat{R}$ is not a threshold function, there exists $\theta_1, \theta_2 \in \Theta$ such that:

1. $\theta_2 > \theta_1$.
2. $\hat{R}(\theta_2) = 1$ and $\hat{R}(\theta_1) = 0$.

Theorem 1 implies that the less honest agent would demand higher bribes, and hence $B^*(\theta_1) > B^*(\theta_2)$. Assumption 2 implies that the more honest agent incurs a higher moral cost, and hence:

$$m(\theta_2, B^*(\theta_2)) > m(\theta_1, B^*(\theta_2)) \tag{37}$$

Inequality (37) implies

$$B^*(\theta_2) - m(\theta_1, B^*(\theta_2)) > B^*(\theta_2) - m(\theta_2, B^*(\theta_2)) \tag{38}$$

We also know that a type-θ_1 agent would get a lower utility from demanding $B^*(\theta_2)$ than from demanding $B^*(\theta_1)$, and so:

$$B^*(\theta_1) - m(\theta_1, B^*(\theta_1)) > B^*(\theta_2) - m(\theta_1, B^*(\theta_2)) \tag{39}$$

Inequalities (38) and (39) together imply:

$$B^*(\theta_1) - m(\theta_1, B^*(\theta_1)) > B^*(\theta_2) - m(\theta_2, B^*(\theta_2)) \tag{40}$$

However, this inequality implies that the type-θ_1 agent gets a higher utility from running for politics than the type-θ_2 agent. Given that their utility from entrepreneurship is the same, this would mean that the type-θ_1 would run for politics while the type-θ_2 agent prefers entrepreneurship. This contradicts with the implications of $\hat{R}$. Hence, an equilibrium does not exist if the entry function is not a threshold function.

Now we are going to show an equilibrium exists. Consider the difference function:

$$\begin{gathered}\Psi(\theta) = p(\theta)[W + B^*(\theta) - m(\theta, B^*(\theta)) - F] + \\ (1 - p(\theta))[\pi - p(\theta)\frac{\int_0^\theta B^* d\Phi}{(1-\lambda)} - F] - [\pi - p(\theta)\frac{\int_0^\theta B^* d\Phi}{(1-\lambda)}]\end{gathered} \tag{41}$$

Function $\Psi(\theta)$ is the utility difference between running for office and becoming an entrepreneur for type θ, given that all types below θ decide to run for office. Any $\underline{\theta}$ with $\Psi(\underline{\theta}) = 0$ is an equilibrium. Such a type is a threshold type because if some $\underline{\theta}$ is indifferent between running for office and becoming an entrepreneur, any type below $\underline{\theta}$ would strictly prefer to run for office. And any type above $\underline{\theta}$ would strictly prefer to be an entrepreneur. Moreover any threshold equilibrium with a threshold in $(0, 1)$ is characterized by $\Psi(\underline{\theta}) = 0$. Reorganizing equation (41) we get:

$$\Psi(\theta) = p(\theta)[W + B^*(\theta) - m(\theta, B^*(\theta))] - p(\theta)[\pi - p(\theta)\frac{\int_0^\theta B^* d\Phi}{(1-\lambda)}] - F \tag{42}$$

Since p, m, and B^* are continuous functions of $\theta \in (0,1]$, Ψ is also a continuous function. If $\Psi(\theta) < 0$, there exists an equilibrium in which no type wants to run for office. If $\Psi(1) > 0$, there exists an equilibrium such that everyone would run for office. If $\Psi(0) > 0$ and $\Psi(1) < 0$, by the Intermediate Value Theorem, there exists a $\underline{\theta} \in (0,1)$ such that $\Psi(\underline{\theta}) = 0$ and we have an equilibrium. ■

Proof of Theorem 3

Proof. Consider the derivative of the difference function Ψ with respect to $\underline{\theta}$:

$$\frac{d\Psi}{d\underline{\theta}} = \frac{dp(\underline{\theta})}{d\underline{\theta}}[W + B^*(\underline{\theta}) - m(\underline{\theta}, B^*(\underline{\theta}))] + p(\underline{\theta})\left[\frac{dB^*(\underline{\theta})}{\underline{\theta}} - \frac{dm(\underline{\theta}, B^*(\underline{\theta}))}{d\underline{\theta}}\right] - \frac{dp(\underline{\theta})}{d\underline{\theta}}v_E^* - p(\underline{\theta})\frac{dv_E^*}{d\underline{\theta}} \tag{43}$$

We are interested in the sign of this derivative and we know the following:

- Equation (2.10) implies $\frac{dp(\underline{\theta})}{d\underline{\theta}} < 0$.
- By Assumption 4, $[W + B^*(\underline{\theta}) - m(\underline{\theta}, B^*(\underline{\theta}))] > 0$.
- From equation (2.10), $p(\underline{\theta}) > 0$.
- Theorem 1 implies $\left[\frac{dB^*(\underline{\theta})}{\underline{\theta}} - \frac{dm(\underline{\theta}, B^*(\underline{\theta}))}{d\underline{\theta}}\right] < 0$.
- By Assumption 7, $v_E^* > 0$.

- $\varepsilon_E > \varepsilon_P$ implies

$$-\frac{dp(\underline{\theta})}{d\underline{\theta}} v_E^* - p(\underline{\theta}) \frac{dv_E^*}{d\underline{\theta}} < 0$$

Therefore, we conclude

$$\frac{d\Psi}{d\underline{\theta}} < 0 \tag{44}$$

The fact that Ψ is a decreasing function of $\underline{\theta}$ implies that at most one of the following could be true at a time:

1. There exists a threshold $\underline{\theta}$ such that $\Psi(\underline{\theta}) = 0$.

2. $\Psi(1) \geq 0$.

3. $\Psi(0) \leq 0$.

This implies a unique equilibrium.

■

Proof of Theorem 4

Proof. By Theorem 3, for each salary level W, there exists a unique threshold honesty level $\underline{\theta} \in [0, 1]$. Let $\underline{\theta}^1$ be the threshold honesty corresponding to the salary level W^1. First, suppose that $\underline{\theta}^1 \in (0, 1)$. This implies $\Psi(\underline{\theta}^1, W^1) = 0$. At a higher salary level W^2, $\Psi(\underline{\theta}^1, W^2) > 0$. From equation (44), we conclude $\underline{\theta}^2 > \underline{\theta}^1$. If $\underline{\theta}^1 = 0$, $\Psi(0, W^1) \leq 0$, and $\underline{\theta}^2 \geq 0$. If $\underline{\theta}^1 = 1$, $\Psi(1, W^1) \geq 0$, and $\underline{\theta}^2 = 1$. ■

Bibliography

ASCHAUER, D. A. (1989): "Is Public Expenditure Productive?," *Journal of Monetary Economics*, 23, 177–200.

AZZIMONTI-RENZO, M., P.-D. G. SARTE, AND J. SOARES (2003): "Optimal Public Investment with and without Government Commitment," Working Paper 03-10, Federal Reserve Bank of Richmond.

BARRO, R. J. (1990): "Government Spending in a Simple Model of Endogenous Growth," *Journal of Political Economy*, 98, S103–S125.

BARRO, R. J., AND X. SALA-I MARTIN (1992): "Public Finance in Models of Economic Growth," *Review of Economic Studies*, 59(4), 645–661.

BESLEY, T., AND S. COATE (1997): "An Economic Model of Representative Democracy," *The Quarterly Journal of Economics*, 112(1), 85–114.

CASELLI, F., AND M. MORELLI (2004): "Bad Politicians," *Journal of Public Economics*, 88(3-4), 759–782.

CHARI, V., AND P. J. KEHOE (1999): "Optimal Fiscal and Monetary Policy," vol. 1 of *Handbook of Macroeconomics*, chap. 26, pp. 1671–1745. Elsevier.

DEVARAJAN, S., V. SWAROOP, AND H.-F. ZOU (1996): "The Composition of Public Expenditure and Economic Growth," *Journal of Monetary Economics*, 37(2-3), 313–344.

EASTERLY, W., AND S. REBELO (1993): "Fiscal Policy and Economic Growth," *Journal of Monetary Economics*, 32, 417–458.

FUTAGAMI, K., Y. MORITA, AND A. SHIBATA (1993): "Dynamic Analysis of an Endogenous Growth Model with Public Capital," *Scandinavian Journal of Economics*, 95(4), 607–25.

HAQUE, M. E., AND R. KNELLER (2008): "Public Investment and Growth: The Role of Corruption," Centre for Growth and Business Cycle Research Discussion Paper Series 98, Economics, The University of Manchester.

HESTON, A., R. SUMMERS, AND B. ATEN (2006): *Penn World Table Version 6.2*Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania.

JONES, L. E., R. E. MANUELLI, AND P. E. ROSSI (1993): "Optimal Taxation in Models of Endogenous Growth," *Journal of Political Economy*, 101(3), 485–517.

KEEFER, P., AND S. KNACK (2007): "Boondoggles, Rent-Seeking, and Political Checks and Balances: Public Investment under Unaccountable Governments," *The Review of Economics and Statistics*, 89(3), 566–572.

KRANTZ, S. G., AND H. R. PARKS (2002): *The Implicit Function Theorem: History, Theory, and Applications*. Birkhaeuser.

MAURO, P. (1995): "Corruption and Growth," *The Quarterly Journal of Economics*, 110(3), 681–712.

——— (1997): "The Effects of Corruption on Growth, Investment, and Government Expenditure," in *Corruption and the Global Economy*, ed. by K. A. Elliott. Institute of International Economics, Washington D.C.

——— (2004): "The Persistence of Corruption and Slow Economic Growth," *IMF Staff Papers*, 51(1).

OSBORNE, M. J., AND A. SLIVINSKI (1996): "A Model of Political Competition with Citizen-Candidates," *The Quarterly Journal of Economics*, 111(1), 65–96.

POUTVAARA, P., AND T. TAKALO (2007): "Candidate Quality," *International Tax and Public Finance*, 14, 7–27.

TANZI, V., AND H. R. DAVOODI (1997): "Corruption, Public Investment, and Growth," IMF Working Papers 97/139, International Monetary Fund.