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Human Capital and Corruption: A microeconomic model of the bribes market with democratic contestability

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resumo

Para ultrapassar eventuais falhas de mercado, a sociedade cria leis que estimulam ou penalizam os comportamentos dos indivíduos no sentido da eficiência. No nosso modelo que tem fundamentação microeconómica, comparamos os desvios das entidades públicas em duas situações opostas: autocracia vs. democracia. Assumimos que em autocracia os governantes têm um monopólio sobre o mercado das 'influências' enquanto que em democracia há concorrência entre o governo e a oposição. Os nossos resultados parecem compatíveis com factos estilizados bem conhecidos: (1) em democracia o nível de corrupção é menor que em autocracia, mantendo-se positivos; (2) em situações em que o nível de capital humano é maior, os regimens são mais democráticos e o nível de corrupção é menor; e (3) o nível de corrupção é maior em economias mais reguladas.

résumé / abstract

corruption. Nous modelons ce comportement dans le cas d'une autocratie et d'une démocratie, en utilisant un cadre micro-économique. Nous supposons que dans le cas d'une autocratie les décideurs ont le monopole du marché de corruption, tandis que dans une démocratie des groupes contradictoires entrent en concurrence pour le marché de corruption. Les modèles construits produisent des résultats qui sont compatibles avec des faits stylisés bien connus, nommément que (1) dans une démocratie, par rapport à une autocratie, le niveau de corruption est inférieur quoique toujours positif, (2) dans les environnements où le niveau du capital humain est plus élevé, le régime politique est plus proche de la démocratie et le niveau de corruption est plus bas, et que (3) le niveau de corruption est plus élevé pour les économies plus réglées.

To overcome market failures society creates common laws that stimulate or penalize individual actions, the enforcement of which depends on the actions of public authorities who may be susceptible to corruption. We model this behaviour for an autocracy versus a democracy, using a microeconomic framework. We assume that in an autocracy rulers have a monopoly over the bribes market, whereas in a democracy conflicting groups compete in the bribes market. The models constructed produce results that are compatible with the well-known stylized facts, namely that (1) in a democracy the level of corruption is lower than in an autocracy, although still positive, that (2) in environments where the level of human capital is higher, regimes are closer to democracies and the level of corruption is lower, and that (3) the level of corruption is higher in more regulated economies.

JEL Classification: J24; D73; C63

Pour surmonter les lacunes du marché la société crée des droits coutumiers qui stimulent ou pénalisent l'action des individus et dont l'application dépend de l'action des pouvoirs publics qui peuvent être ouverts à la

1. Introduction

Researchers have been interested in the determinants and effects of corruption for quite some time – Aidt (2003), Jain (2001), Rose-Ackerman (1999), Bardhan, (1997), and Ades and Di Tella (1997) provide excellent and comprehensive surveys on the subject. Recently, the availability of adequate data on corruption, especially indices of corruption perceptions for different countries, boosted new and interesting studies (Goel and Nelson, 2005; Xin and Rudel, 2004; Fisman and Svensson, 2002).

Corruption, although unethical, may be perfectly rational from an individual frame of reference (Barreto, 2000). Corruption can therefore take place in any economic transaction involving the public sector, since any economic transaction brings mutual benefits to both parties.

Given that natural resources are a factor in production, by imposing restrictions on their use governments create economic incentives for producers to overcome these restrictions. In addition, economic incentives also exist for producers to adjust the production process (for example, through the division of labour) and the level of output. The producers therefore have an incentive for attempting to corrupt the government agents who control the consumption rate for natural resources and the level of competition.

A government strategy which maximizes the potential for corruption involves imposing very strict limits on the use of natural resources and, in addition, a concentrated market. In this way, the value of a natural resource (its shadow price) is enhanced and comes to represent a greater gain when the imposed limits are overcome. It is easy for governments to justify such policies. In the first place, it is easy to convince the public that they should economize on natural resources and that policies should therefore be restrictive. Secondly, it is also easy to convince the public that the existence of economies of scale means that production is more efficient if it is in the hands of one sole producer.

We assume that government controls the use of natural resources but this concept can be conceptually extended to accommodate any market regulation policy.

Despite having imposed tight restrictions on the use of the natural resource, government officials can organize ways of "selling" permission to overstep these limits. For example, the measurements of the natural resource used are not directly observed by the public and "inspectors" can alter the figures.

Thus, the enforcement of law depends on the actions of public authorities who could be corrupted. A new market emerges where 'influences' are traded. Legislators have incentives to deviate from the goal of efficiency and produce laws that maximize the gains that can be expected from bribes. We model this behaviour for an autocracy versus a democracy, using a microeconomic framework. We assume that in an autocracy rulers have a monopoly over the bribes market, whereas in a democracy conflicting groups compete in the bribes market.

The present paper is structured as follows. In the next section we formalize the model. In the Section 3, using simulation techniques, we analyse the level of social welfare that occurs when a government imposes a maximum level of use for a natural resource, which is distributed amongst various producers. The Section 4 details a reduced model of interaction between government officials and the opposition and Section 5 concludes the paper.

2. Formalization of the model

In our economy there is a natural resource and decisions on how it is assigned are the responsibility of the government. The use of this natural resource has, on the one hand, a positive effect in terms of company output and, on the other hand, a negative externality for people. The government therefore has to make a ruling on the use of this natural resource that takes both the positive and the negative effects into account.

In abstract terms, the production of goods and services requires capital, labour and the natural resource whose use causes environmental damage (e.g. air pollution) that has a negative effect on the welfare of citizens.

Since environmental damage is not taken into account in the producers' decisions, there is a need for the government to intervene. Let us suppose that technology allows for the partial substitution of factors that may be condensed into a Cobb-Douglas production function and that there are increasing returns to scale.

In technological terms, assuming increasing returns to scale implies that the existence of several producers in the market conducts to a higher output and a less efficient outcome that imply greater use of the natural resource. Such circumstances enable corrupt government officials to convince the electorate to adopt policies that are not the best in terms of social welfare, i.e. a monopolistic market structure, but increase the potential gains for these individuals.

One of these policies concerns the level of market concentration. The existence of economies of scale introduces the officials' argument for the existence of a "natural monopoly" which favours market concentration. If we observe the situation in various different countries, it can be seen that this justification has been used frequently by governments (together with the Schumpeterian issue of appropriate investment in innovation and development) to justify awarding concessions to just a few companies. In Portugal, for example, this argument is used to justify the existence of monopolies in water supply, waste collection, rail transport, urban public transport and port authorities, amongst others.

A second policy is associated with the natural resource's consumption rate. The fact that there is a positive relationship between consumption of the natural resource and output emerges here as a justification on the part of governments for allowing a level of use of the natural resource that is beyond that which is socially beneficial, causing environmental damage.

Both of these policies favour the producers who are already operating in the market and who therefore push for the situation to be maintained by paying bribes.

In formal terms, let us assume that a producer using a level of capital k, labour supply l and amount m of the natural resource, has the output level y:

$$y(k,l,m) = A \cdot k^{\alpha} \cdot l^{\beta} \cdot m^{\gamma}, \ \alpha + \beta + \gamma > 1, \tag{1}$$

As there are economies of scale, this implies $\alpha + \beta + \gamma > 1$.

Assuming that the market rate for capital is rate r, which includes depreciation and risk, that the hourly-paid market wage is w and that the private sector price of the natural resource is zero, the profits of a producer whose production function is represented by the expression (1) will be:

$$\pi(k,l,m) = y(k,l,m) \cdot p - k \cdot r - l \cdot w, \tag{2}$$

Concentrating on market structure, let us assume, still in general terms, that the aggregate market demand is known and decreases linearly according to price:

$$D = D_0 - b \cdot p \Rightarrow p = (D_0 - D) / b \tag{3}$$

Thus the selling price of the product depends on aggregate output.

Assuming, additionally, that the producers compete according to Cournot, it follows that the

profits of a producer who assumes D^+ as a reference, this being the level of output of the other producers, will be expressed as follows:

$$\pi = y \cdot (D_0 - D^+ - y) \mid b - k \cdot r - l \cdot w \tag{4}$$

The level of activity of each producer will depend on the price of the factors they use, the level of aggregate production amongst the other producers, D^+, which is assumed to be exogenous, and the total amount of the natural resource that the government allows them to use.

Assuming that each unit of the natural resource consumed causes the environmental damage Pa, that the wages received by employees is equal to the effort expended (i.e. working does not lead to a direct increase in employee welfare, only in the consumption of goods and services) and that the capital is "neutral" (capital interest do not lead to any increase in social welfare because they represent remuneration for the sacrifice of saving), in overall social terms welfare is expressed by the sum of the producer's profit added to the consumer gains, from which the environmental damage is subtracted:

$$F = \sum_{i=1}^{n} y(k_i, l_i, d_i) + 0.5 \cdot (D_0 / b - p) \cdot D - \sum_{i=1}^{n} d_i \cdot Pa \tag{5}$$

If we take into consideration the fact of the market economy and the fact that producers, even in a monopoly, have little influence on the labour and capital market, we can assume that capital remuneration, r, the hourly-paid wages, w, and the unitary environmental damage, Pa, are exogenous factors. Note that any discussion on the level of efficiency/inefficiency of public planning in terms of the production of goods and services lies beyond the scope of this study.

In this context, producers aspire to a government which imposes the simplest possible laws in order to allow producers to maximize the aggregate benefits defined in equation (5).

As scale economies are present in the production process, if the size of a producer increases, fewer resources will be needed for each output unit produced. Therefore, if concessions for the use of the natural resource are granted to various producers with the eventual possibility of mergers or the acquisition of rights to the natural resource, the market will tend towards a monopoly structure. Government officials take advantage of this situation to justify the existence of one sole producer in the market, an argument that is easily accepted by the electorate.

However, the lack of competition in the market is socially harmful since the monopolist will set a level of output whose marginal production costs are lower than the market price. Regulation apparently allows this problem to be overcome but, on the one hand, it attracts corruption and, on the other hand, it requires the regulator to have previous knowledge of the most socially beneficial performance.

3. Simulation of market behaviour

In this section, using simulation techniques we will analyse the level of social welfare that occurs when a government imposes a maximum level of use for a natural resource, which is distributed amongst various producers. These compete but cannot merge (i.e. the government controls the level of market concentration).

Starting with equations (1)-(5) and setting the model to, $\alpha = \beta = \gamma = 0.5$, $D_0 = 100$, b = 10, r = 15%[1] e w =10, we see a rise in social welfare when the situation changes from a monopoly to a duopoly (n=1 para n=2). As can be seen in Figure 1, this is accompanied by the use of larger amounts of the natural resource (m):

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1 We consider here 15% which is the Internal Rate of Return for new firm risky private investments – approximately, 4% of interest without risk within a 8 year amortization period.

Figure 1 – Relationship between the level of social welfare, number of producers and use of the natural resource
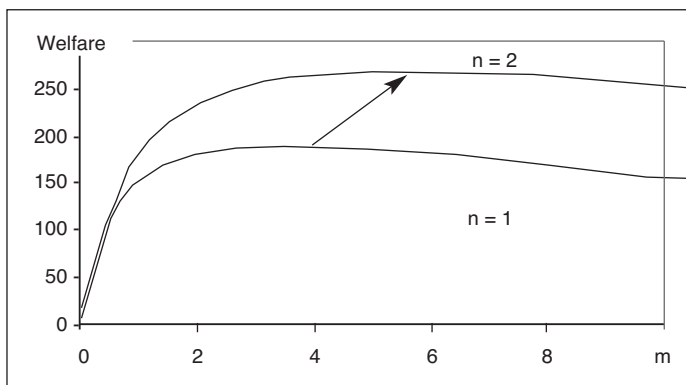

However, it is possible to see from the same figure that even if the consumption level for the natural resource remains steady (i.e. veers from the vertical), the transition from monopoly to duopoly increases social welfare. This is due to the fact that even though there is no increase in the consumption of the natural resource, there will be an increase in production through the greater use of labour and capital, as the next figure shows.

Figure 2 – Relationship between the use of labour and capital, number of producers and use of the natural resource
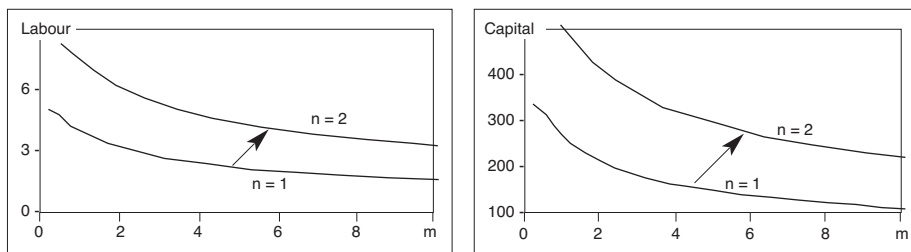
It is possible to observe from Figure 1 that, with a given number of producers in the market, there is an optimum level for consumption of the natural resource. Restricting ourselves to these optimum points, in Figure 3 we can see the evolution of social welfare according to the number of producers operating in the market. In concrete terms, the existence of a certain amount of competition favours social welfare. In our simulation, the evolution of the level of welfare together with the number of producers reaches a maximum at n = 2. At up to n =10, social welfare is higher than in a monopoly (n=1). However, the existence of economies of scale in the production process means that the number of competitors has to be limited (n≤10) so that technological inefficiency is not superimposed on the gains created by the existence of competition.

Figure 3 – Relationship between social welfare and number of producers
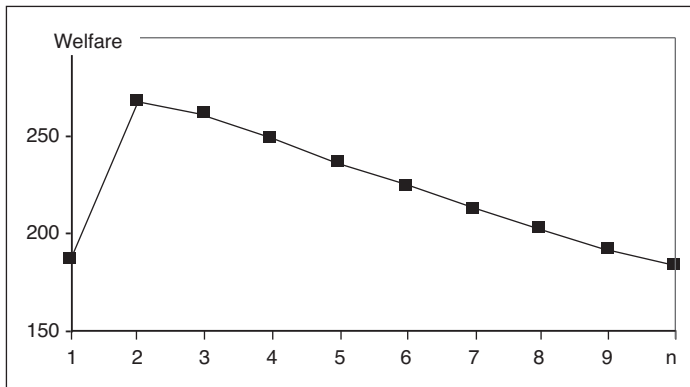
Another important issue that our model enables us to analyse is whether, as an alternative to maintaining a fixed level for the use of the natural resource, it would be in society's interests for the government to set a price for the use of the natural resource (internalise the impact) and to use this money to compensate for the environmental damage caused, whilst making the producers responsible for setting the criteria for the amount used. In this case, the cost of the natural factor has to be added to the profit function:

$$\pi = y \cdot (D_0 - D^+ - y) \mid b - k \cdot r - l \cdot w - m \cdot pa \tag{6}$$

In the simulation it can be seen that when social damage is incorporated into the optimization model for producers, consumption of the natural resource falls slightly and is partially replaced by labour and capital. However, in terms of social welfare, the policies are identical.

To conclude, the best policy for a government is to set reasonable limits on the levels of use of the natural resource and to distribute the rights to more than one producer (at least two but less than ten, in the case of our settings), or else to set the price of the natural resource as environmental damage and let the producers decide on the best ratios for labour, capital and natural resource. However, the producers must not be allowed to merge towards monopoly or create a cartel.

Given the theoretical equivalence of the two policies (imposing either a maximum level of use or a price), in empirical terms it is to be expected that approximately 50% of governments would opt for each of them. However, the vast majority of governments (and in the case of some resources, all of them) opt to limit use. In our opinion, this is due to the fact that putting a price on use reduces the potential gains for corrupt government officials.

From this micro-foundation model we illustrate how a policy which favours the existence of corruption is unfavourable to social welfare. This being the case, in a second step we may, in abstract terms, condense possible government policies into the variable c which has the value of 1 if the policy is optimum and 0 if it promotes the highest possible levels of corruption and lower levels of social welfare.

3. Simulation of market behaviour

In this reduced model, the gains of government officials during the present period, B, are shown as a decreasing function of government policy c, when social welfare, WF, rises:

$$\begin{cases} B(\chi), B'(\chi) < 0 \\ \\ WF(\chi), WF'(\chi) > 0 \end{cases} \quad (7)$$

If the government policy veers away from the optimum (i.e. if the value of c veers from 1), the likelihood of the government being replaced by the opposition increases. This happens because the public reacts to the reduced level of welfare in relation to its optimum level WF*, increasing the probability of the government falling as the distance between WF* – WF increases.

As the optimum value is difficult to observe (the information is not fully accurate), the likelihood of a government defeat also increases in line with the level of political activity on the part of the opposition (measured by the parameter ψ) and the receptivity of the public to opposition activities (measured by the parameter ξ). This receptivity, in empirical terms, may be measured by the average level of education of the electorate, since a more educated electorate tends to be able to understand and discern the relevant information better than a less educated one (Gibbons and Johnston, 1974). As Welch (1970: 42) argues, "… increased education may enhance a [person]'s ability to acquire and decode information about costs and … characteristics of other inputs."

The opposition incurs costs in informing the electorate (e.g. pamphlets, announcements and speeches) which are derived from the unit price of creating opposition, po, multiplied by the amount of opposition realized, po $\cdot\psi$.

The government determines the value of c which maximizes its expected gains, VG, with ξ, ψ and po given, whilst the opposition determines the level of political activity ψ which maximizes its expected gains, VO, with ξ, χ and po given (assuming that the government does not influence po).

In this way, the expected gains from being in power, VG, and from being in opposition, VO, are shown in the resolution of the following dynamic optimization problem:

$$f = P(Gov - out) = f(\chi, \psi, \xi)$$

$$\begin{cases} VG = \max_{\chi}\left[B(\chi) + \beta \cdot \left\{VG \cdot (1 - f) + VO \cdot f\right\}\right] \\ \\ VO = \max_{\psi}\left[-po \cdot \psi + \beta \cdot \left\{VO \cdot (1 - f) + VG \cdot f\right\}\right] \end{cases} \quad (8)$$

$$f_{\chi} < 0, f_{\psi}(\chi, 0, \xi) > 0, f_{\xi} > 0, \quad (9)$$

$$f(\chi, 0, \xi) = 0, f_{\psi}(\chi, 0, \xi) = \infty, f_{\psi}(\chi, \infty, \xi) = 0$$

This represents a symmetry in which all the agents (government and opposition) adopt the same strategy – for the government, the policy is represented by χ and for the opposition, ψ.

Therefore, the level of good governance (as opposed to the level of corruption) will result from the interaction between the government and the opposition in a similar way to the competition that takes place between companies to win market leadership.

From the results shown below, the model demonstrates that the level of corruption in a democracy is lower than in an autocracy and is very much dependent on the ability of the opposition groups to captivate the electorate.

$$f = f(\chi_0, \psi_0, \xi_0)$$

$$\begin{cases} VG(\chi_0, \psi_0) = B(\chi_0) + \beta \cdot \{VG(\chi_1, \psi_1) \cdot (1-f) + VO(\chi_1, \psi_1) \cdot f\} \\ \\ VO(\chi_0, \psi_0) = -po \cdot \psi_0 + \beta \cdot \{VO(\chi_1, \psi_1) \cdot (1-f) + VG(\chi_1, \psi_1) \cdot f\} \end{cases} \qquad (10)$$

In an analysis of comparative statics, $\chi_1 = \chi_0 = \chi, \psi_1 = \psi_0 = \psi$:

$$\begin{cases} VG(\chi, \psi) = B(\chi) + \beta \cdot \{VG(\chi, \psi) \cdot (1-f) + VO(\chi, \psi) \cdot f\} \\ \\ VO(\chi, \psi) = -po \cdot \psi_0 + \beta \cdot \{VO(\chi, \psi) \cdot (1-f) + VG(\chi, \psi) \cdot f\} \end{cases}$$

$$\begin{cases} VG(\chi, \psi) \cdot [1 - \beta \cdot (1-f)] = B(\chi) + \beta \cdot VO(\chi, \psi) \cdot f \\ \\ VO(\chi, \psi) \cdot [1 - \beta \cdot (1-f)] = -po \cdot \psi_0 + \beta \cdot VG(\chi, \psi) \cdot f \end{cases} \qquad (11)$$

$$\begin{cases} VG(\chi, \psi) = [B(\chi) + \beta \cdot VO(\chi, \psi) \cdot f] / [1 - \beta \cdot (1-f)] \\ \\ VO(\chi, \psi) = [-po \cdot \psi_0 + \beta \cdot VG(\chi, \psi) \cdot f] / [1 - \beta \cdot (1-f)] \end{cases}$$

the first optimization condition can be derived:

$$\begin{cases} VG_\chi = [B_\chi + \beta \cdot VO_\chi \cdot f + \beta \cdot VO \cdot f_\chi] [1 - \beta \cdot (1-f)] = 0 \\ \\ VO_\psi = [-po + \beta \cdot VG_\psi \cdot f + \beta \cdot VG \cdot f_\psi] [1 - \beta \cdot (1-f)] = 0 \end{cases}$$

$$\qquad (12)$$

$$\begin{cases} \chi : B_\chi = -\beta \cdot [VO_\chi \cdot f + VO \cdot f_\chi] \\ \\ \psi : po = \beta \cdot [VG_\psi \cdot f + VG \cdot f_\psi] \end{cases}$$

This demonstrates that when the price of creating opposition, po, is infinite we are faced with a strong dictatorship and when po is reduced, the level of democracy rises.

When po is infinite, the government adopts the most corrupt policy possible. In the second equation the level of opposition activity is zero:

$$\beta \cdot [VG_\psi \cdot f + VG \cdot f_\psi] = \infty \Rightarrow f_\psi = \infty \Rightarrow [\psi = 0, f = 0, VO = 0] \qquad (13)$$

meaning that the government remains in power regardless of its politics and government officials adopt whatever maximizes their level of corruption:

$$B_\chi = -\beta \cdot \left[VO_\chi \cdot 0 + 0 \cdot f_\psi \right] = 0 \Rightarrow \chi = 0 \tag{14}$$

When the price of creating opposition, po, is zero, we are faced with a «perfect» democracy and the government adopts a form of politics that only contains a certain level of corruption (no government is incorruptible). In the second equation, there is a positive level of opposition which makes it likely that the government will change and that it is worth creating an opposition.

$$\beta \cdot \left[VG_\psi \cdot f + VG \cdot f_\psi \right] = 0 \Rightarrow \frac{f_\psi}{f} = -\frac{VG_\psi}{VG} \Rightarrow \left[\infty > \psi* > 0; 1 > f* > 0; VO* > 0 \right] \tag{15}$$

Note that, if taken to absurd lengths, the level of opposition would be infinite and the government would fall immediately, thus implying that there are no gains for government officials. Therefore it would not be worth forming an opposition, since there would be no gains to be had from forming a government. If the government implements optimum policies, the government officials remain in power but still gain nothing, and so there are no incentives to form any opposition. However, if the opposition is finite, the likelihood of the government officials who have maintained a certain level of corruption losing office is lower when the units representing the gains to be had from remaining in office and the gains to be had from creating an opposition are positive.

From these two limited cases, it may be concluded that when the cost of forming an opposition is lower, the level of opposition is greater, as are the chances of government officials being removed from office and their level of corruption being reduced.

$$\beta \cdot \left[VG_\psi \cdot f + VG \cdot f_\psi \right] = p \Rightarrow \frac{f_\psi}{f} = -\frac{VG_\psi}{VG} + \frac{p}{\beta \cdot VG \cdot f} > -\frac{VG_\psi}{VG}$$

$$\tag{16}$$

$$\Rightarrow \left[\psi < \psi*; f < f*; VO < VO* \right] \Rightarrow \left[\chi > \psi*; VG > VO* \right]$$

Note that when opposition agents are subsidized, there are no longer incentives to become government and government officials no longer concern themselves with re-election (as it is equally optimal to be in the opposition), thus increasing the level of corruption (the incumbent government does not care in pleasing the electorate). In addition, it may also be concluded that when the level of "education" of a population, as reflected in the parameter ξ, is higher, the level of opposition and of government corruption will be lower. In this sense, formal education may be seen here as a means of tempering the discrepancy between the actual levels of corruption in particular countries in relation to the optimum levels (Dewey, 1985; Parker, 2003). Perversely, it may also justify a lack of investment, on the part of dictatorships, in policies to promote levels of human capital in their respective populations, as was the case with the Salazar regime in Portugal (Carreira, 1996).

5. Conclusion

Corruption tends to be a factor in economic inefficiency, since the economic incentives for corruption only exist when governments do not commit themselves to optimum policies.

In our work, we have aimed to study, in theoretical terms, the implications of the existence of opposition to a government (i.e. a democracy) in relation to the corruption level of government officials and the social welfare of a nation. To this end, we have constructed a dynamic theoretical model in which two groups alternate between the positions of government/opposition with probability f. We assume that the probability of the government being thrown out rises in line with the level of inefficiency (corruption), the level of opposition activity and the level of education of the electorate.

Using computational methods and algebraic manipulation on a reduced model, we concluded that the freedom to create opposition leads to a fall in the level of corruption amongst government officials (and a rise in efficiency) without, however, totally eliminating it. In addition, the level of education (the human capital) of the electorate equates with a fall in the cost of creating opposition, thus contributing towards a reduction in the level of corruption and consequently a rise in economic efficiency.

Our results therefore appear to accord with the empirical stylized facts, namely that in less democratic countries people tend to be less educated (Parker, 2003), governments only loose power when there are very high levels of opposition and the level of development and economic growth tends to be lower than in more «democratic» countries (Barro, 1991; Repkine, 2003). Conversely, as a rule, the autocratic government officials benefit from obviously higher levels of welfare and wealth than the most of the population, as well as officials in the more democratic countries (Barro, 1994).

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