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Abstract

In a recent paper, Andina-Díaz et al. (2021) show that in a context of dynamic elections, rigid institutions induce political parties to push policies as far as the political system allows, whereas more flexible institutions can foster moderate alternation. We build on this paper to study the incentive of an elected government to reduce bureaucratic inefficiencies and increase institutional flexibility. We show that high levels of bureaucratic inefficiencies are very likely to persist over time, leading to a bureaucracy trap. Moreover, we find that regardless of the initial levels of bureaucratic inefficiencies, traditional long-life parties may have no incentive to undertake such a reform. This result provides a new argument to explain why bureaucratic inefficiencies persist in some countries over time.

Keywords: Gradual policy implementation; political alternation; institutional reform; bureaucratic trap

JEL: D02; D72

1 Introduction

In a recent paper, Andina-Díaz et al. (2021) (AFM hereafter) show that in a dynamic model of elections with endogenous status quo, rigid institutions induce political parties to push policies as far as the political system allows, whereas more flexible institutions can foster more moderate alternation. Key to this result is that policy implementation takes time, i.e., policies are progressively rather than instantaneously implemented.[1] This novel ingredient produces two important results. First, it gives the median voter an incentive to vote, every election, to a new party, producing equilibria with political alternation. Second, it makes punishment be contingent on the country's institutional flexibility, which yields the

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[1]The idea is that a country's institutions, both formal and informal, may preclude elected governments from setting rapid adjustments in policies and force them to implement new policies progressively, through a series of gradual changes.

aforementioned result of institutions affecting equilibrium policies. The authors also show that the more moderate alternation is, the higher the efficiency, in the sense of the better off every player in the society is (see Proposition 3 in AFM).

Given that efficiency, moderation and institutional flexibility go hand in hand, one may wonder whether political parties, once in power, have incentives to undertake reforms to reduce bureaucratic inefficiencies and increase institutional flexibility. This is the purpose of this note. Our results show that if benefits from reforms are experienced late in time, which is likely to occur in scenarios in which there are many bureaucratic inefficiencies, no party will undertake such reforms; it leading to a bureaucracy trap. In contrast, if benefits arrive earlier, there is room for institutional reforms. Nonetheless, only sufficiently impatient parties will undertake them. Traditional parties, with long-life concerns, will never choose to reduce bureaucratic inefficiencies. The results in this note thus suggest persistence of government inefficiencies and excessive regulation.

To have an intuition for this result, note that although greater flexibility allows political parties to enjoy more preferred policies for longer period when in office, it also exposes parties to less preferred policies when out of office. Then, political parties that care about policies and foresee future alternation will understand the pros and cons of a reform and will anticipate that, under certain conditions, cons can clearly offset pros. These conditions, hence our results, hinge on political parties suffering from disliked policies and them foreseing alternation in power.

This note contributes to the literature on bureaucratic inefficiencies and excessive regulation, suggesting a new argument to explain this phenomenon. Glaeser and Shleifer (2003) and Aghion et al. (2010) propose that excessive regulation can be explained by demand-side driven arguments that originate in lack of trust and perceived unfair outcomes. See also Pinotti (2012). Banerjee (1997) considers supply reasons instead, pointing to market failures in the provision of a scare resource and agency problems in the relationship government-bureaucrats. Last, Gratton et al. (2021) points to bureaucracy as a mechanism for politicians to make harder for consumers to learn politicians' abilities.

The remainder of the paper is organized as follows. Section 2 presents the model, Section 3 the results, and Section 4 concludes. Proofs of results are in the Appendix.

2 The alternating policy framework

For illustrating the argument, consider the dynamic model of elections with endogenous status quo in AFM, where elections run at discrete time $t \in \mathcal{N} \equiv \{1, 2, ...\}$. In each election the median voter M selects the party to govern during the term. There are two parties, L and R, with preferred policies $\bar{x}^L = -1$ and $\bar{x}^R = 1$. The median voter's preferred policy is $\bar{x}^M = 0$. We denote by $v_t \in \{L, R\}$ the choice of the median voter in t. The elected government in term t, v_t, observing the (endogenous) status quo policy x_{t-1}, announces the pursued policy p_t for term t. We assume $p_t \in [-1, 0]$ if $v_t = L$, and $p_t \in [0, 1]$ if

$v_t = R$.

The implementation of p_t is a gradual process with speed r, this parameter describing the institutional flexibility/rigidity of the country. In particular, given $r > 0$, x_{t-1}, and p_t, the policy implemented at time $\tau \in [0, 1]$ of term t, with $\tau = 0, 1$ representing the beginning and end of the term, is

$$\varkappa_\tau (x_{t-1}, p_t) = \begin{cases} \min \{p_t, x_{t-1} + r\tau\} & \text{if } p_t \geq x_{t-1}, \\ \max \{p_t, x_{t-1} - r\tau\} & \text{if } p_t < x_{t-1}. \end{cases} \tag{1}$$

For a given term t, the utility to player $i \in \{M, L, R\}$ at time τ in term t depends on the distance between the policy implemented at time τ and the player's preferred policy $\bar{x}^i$. Since the policy transitions continuously during the term and the player receives utility from the full policy path, the utility to player $i \in \{M, L, R\}$ in term t is

$$u_i (x_{t-1}, p_t) = \int_{\tau=0}^{\tau=1} - \left(\bar{x}^i - \varkappa_\tau (x_{t-1}, p_t) \right)^2 d\tau. \tag{2}$$

We focus on equilibria in pure strategies. Let $s = (s_M, s_L, s_R)$ denote a strategy profile and S be the set of all strategy profiles, with $s_M : \mathcal{H} \longrightarrow \{L, R\}$, $s_L : \mathcal{H} \longrightarrow [-1, 0]$, and $s_R : \mathcal{H} \longrightarrow [0, 1]$. Let $\mathcal{H} = \bigcup_{t \geq 1} H^t$, with H^t being the set of all possible histories at term t and h^t being a history at term t.[2]

For any $s \in S$ and discount factor $\delta \in (0, 1)$, player i's payoff in the dynamic game is given by

$$U_i (s) = \sum_{t=1}^{\infty} \delta^{t-1} u_i (x_{t-1}, p_t). \tag{3}$$

The equilibrium concept is subgame perfect equilibrium. We denote by $S^* \subset S$ the set of subgame perfect equilibrium strategy profiles. As in AFM, we focus attention on a particular set of strategies: the strategies $\widetilde{s}^a$ that define an *alternating a-profile*.

Definition 1. ***(Alternating** a**-profile)*** *For each $a \in [0, 1]$, a strategy profile is a (symmetric and stationary) alternating a-profile $\widetilde{s}^a \in S$ if the median voter chooses $v_t = L$ if $x_{t-1} > 0$, $v_t = R$ if $x_{t-1} < 0$, and $v_t = v \in \{L, R\} \backslash v_{t-1}$ otherwise, and political parties propose:*[3]

i) At $t = 1$, $|p_1| = a$ if the median voter at $t = 1$ behaves as described; and $|p_1| = 1$ otherwise.

ii) For any $t > 1$, $|p_t| = a$ if for all $t' \leq t$, the median voter at t' behaves as described and $|p_{t-1}| = a$; and $|p_t| = 1$ otherwise.

[2] A history h^t consists of the list of previously elected parties and their pursued policies $h^t = ((v_0, p_0), (v_1, p_1), ..., (v_{t-1}, p_{t-1}))$, with $v_0 \in \{L, R\}$ being randomly drawn with uniform probability. To make the game fully symmetric, AFM parametrize the initial conditions by $x \in [0, 1]$ such that, with probability 1/2, $v_0 = L$ and $x_0 = -x$ and, with probability 1/2, $v_0 = R$ and $x_0 = x$.

[3] Additionally, with some abuse of terminology and in order to make the stationary path induced by the strategy profile $\widetilde{s}^a$ already present in the initial conditions, if $a \in [0, \hat{x}]$, with $\hat{x} = min\{\frac{r}{2}, 1\}$, AFM assume $x = a$, i.e., the initial conditions are either $(v_0, x_0) = (R, a)$ or $(v_0, x_0) = (L, -a)$, each with probability one-half. If $a > \hat{x}$, which is outcome equivalent to $a = \hat{x}$, we assume $x = \hat{x}$.

In words, the alternating a-profile prescribes the voter to vote for a different party each election and the parties to propose policy $|p_t| = a$ in term t if and only if no player has previously deviated. Otherwise, the voter continues alternating but the parties propose their party lines forever.

Proposition 4 in AFM characterizes the set of *alternating symmetric equilibria*. For length reasons, now we do not include the characterization, but rather briefly discuss the specific results that we use in this note. These are the following. First, the extreme alternating $\hat{x}$-profile, with $\hat{x} = min\{\frac{r}{2}, 1\}$, is always an equilibrium. Likewise, it directly follows that for any $a \in (\hat{x}, 1]$ the corresponding alternating a-profile, which is outcome equivalent to the alternating $\hat{x}$-profile, is also an equilibrium. Second, if institutional flexibility is sufficiently low ($r < r_1 \equiv \sqrt{3}$), the extreme alternating $\hat{x}$-profile, and all the outcome-equivalent profiles with $a > \hat{x}$, are the only equilibria. Third and last, if institutional flexibility is sufficiently high ($r > r_1$), there is a continuum of (sufficiently moderate) alternating profiles that constitute equilibria for patient enough agents. In particular, there exists $\bar{a}(r) \leq \hat{x}$ and, for all $a \in [0, \bar{a}(r))$, there exists $\bar{\delta}(a, r) \in (0, 1)$ such that, for all $\delta \geq \bar{\delta}(a, r)$, the alternating a-profile is an equilibrium strategy. (For a description of $\bar{a}(r)$ and $\bar{\delta}(a, r)$, see point (iii) of Proposition 4 in AFM.)

3 Results: The bureaucracy trap

The description above provides the ground for the analysis of the incentives of an elected government to reduce bureaucratic inefficiencies and allow policies to move quicker. Formally, this corresponds to an increase in r. This is because an implication of Proposition 4 in AFM is that if for a given r, an a-profile is an alternating equilibrium, then this a-profile is also an alternating equilibrium for any $r' > r$. We formally state this result next.

Lemma 1. *Fix $\delta \in (0, 1)$ and let $r'' > r' > r_1$. For any $a \in [0, \bar{a}(r')) \cup \{1\}$, if the alternating a-profile is an equilibrium when $r = r'$, it is also an equilibrium when $r = r''$.*

In light of this result, in the remainder of the paper we consider alternating equilibria described by an a-profile, with $a \in [0, \bar{a}(r')) \cup \{1\}$. This approach allows us to abstract from stability considerations, since by focusing on such alternating equilibria, after any increase in r the system can remain in the same alternating equilibrium, i.e., same a-profile. Note that, in practice, this is without loss of generality, since any additional alternating equilibrium (i.e., any equilibrium with $a \in [\hat{x}, 1))$ is outcome equivalent to that one with $a = 1$.

We are now in position to analyze the incentives of an elected government to reduce bureaucratic inefficiencies so as to increase institutional flexibility. We do it for two scenarios. The first scenario considers that changes in r take one term to be operative. The idea behind it is that existing institutional rigidities make it impossible that institutional reforms apply right after approval.[4] The result is the

[4]As a recent example, in Italy, a constitutional reform reducing the number of seats in the parliament was approved in the legislature number XVIII (2018-2022), but it becomes operative in the next (current) legislature.

following.

Proposition 1. *Assume that changes in r take one term to be implemented. Then, no party in power has an incentive to initiate a reform to reduce bureaucratic inefficiencies.*

The argument is that eliminating bureaucratic inefficiencies will allow pursued policies to get implemented quicker, which has pros and cons for political parties when there is alternation in power. Briefly, more flexible institutions allow a party to enjoy more preferred policies for a longer period when in office, but it also exposes it to less preferred ones when out of office. From here, it follows that cons clearly offset pros when changes in r take time to be operative, as the party initiating the reform will not be able to benefit from it till its next mandate. This argument suggests that as long as benefits are not experienced earlier in time, no reform will be initiated. However, if benefits arrive earlier, there is room for institutional reforms. The question here is to understand under which conditions it happens. To explore this idea we propose a second scenario, where changes in r have no delay. We obtain the following result.

Proposition 2. *Assume that changes in r become effective immediately in the same term. In this case, patient governments do not have incentives to reduce bureaucratic inefficiencies, whereas sufficiently impatient governments have. In particular:*

1. *If $a \in [0, \bar{a}(r))$, there exists function $\tilde{a}(r)$ such that the party in power has an incentive to reduce bureaucratic inefficiencies if and only if $\delta < \frac{3-a}{3+a}$ and either (i) $r < 2.5$ and $a < \tilde{a}(r)$, or (ii) $r \geq 2.5$. For all $r < 2.5$, $\tilde{a}(r) < \bar{a}(r)$.*

2. *If $a = 1$, the party in power has an incentive to reduce bureaucratic inefficiencies if and only if either (i) $r < 2$ or (ii) $r \geq 2$ and $\delta \leq 0.5$.*

The result in this proposition states that even in the case in which institutional reforms apply right after approval, if parties are sufficiently patient, no elected government that foresees future alternation in power will have incentives to initiate the reform (unless alternation is extremely polarized). If we think of traditional political parties as long-life parties −given their desire to survive and endure in time−, the results in this note suggest that when talking about institutional reforms, little can be expected from traditional parties. If room for reforms is still open, most likely it will come from parties putting a lot of attention on present returns. This could be the case of countries where political parties are not strongly rooted institutions, but candidates' names play a more important role in elections. It could also be the case of new parties that doubt about future survival or myopic parties that do not foresee future alternation.

Finally, note that we might expect a country's institutional rigidities to be correlated with the time lag required to reduce such rigidities. If so, we should expect countries with many bureaucratic inefficiencies (i.e., low r) very likely to be under the scenario of Proposition 1. This implies that such inefficiencies are expected to persist in time, suggesting the existence of a bureaucracy trap. If, in contrast, r is large, we may be in a scenario closer to Proposition 2, where there is room for institutional reforms. However, as argued above, it requires political parties to be sufficiently impatient.

4 Conclusion

This note builds on Andina-Díaz et al. (2021) to show that, in a system of political alternation, if institutions are rigid enough, so that reforms are experienced with delay, parties do not have incentives to initiate a reform that reduces bureaucratic inefficiencies, which leads to a bureaucracy trap. Moreover, even if there is sufficient flexibility and reforms can be implemented without delay, the incentives to initiate them require of sufficiently impatient parties. Hence, our results suggest that, even in that case, traditional long-life parties may not have incentives to initiate a reform that reduces bureaucratic inefficiencies and introduces institutional flexibility.

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A Appendix

Proof of Lemma 1. From point (iii) of Proposition 4 in AFM, $\bar{a}(r)$ is not decreasing in r and $\bar{\delta}(a,r)$ is decreasing in r. Thus, it follows that for any $a \in [0, \bar{a}(r'))$, if the alternating a-profile is an equilibrium when $r = r'$, then it is also an equilibrium when $r = r''$. The corresponding result for $a = 1$ follows from Proposition 2 in AFM, which shows that the most extreme alternating policy profile is an equilibrium for any possible discount factor. **QED**

Proof of Proposition 1. We distinguish two cases: $a \in [0, \bar{a}(r))$ and $a = 1$.

- Case 1: $a \in [0, \bar{a}(r))$.

The proof is based on the analysis of the sign of the derivative, with respect to r, of the discounted future utility (from $t+1$ onwards) of the party in charge at time t. Without loss of generality, we can focus on any term t at which $v_t = R$, and check how an increase of r will affect the future discounted utility of party R from time $t+1$ onwards. We assume that the system is in an alternating equilibrium with a-profile, $\widehat{s}^a$. At time t, the (discounted) utility induced by the (equilibrium) strategy $\widehat{s}^a$ to R from $t+1$ onwards is:

$$\begin{aligned} U_R(a,r,\delta) &= \delta u_R(a,-a) + \delta^2 u_R(-a,a) + \delta^3 u_R(a,-a) + \delta^4 u_R(-a,a) + ... \\ &= \delta \frac{u_R(a,-a)}{1-\delta^2} + \frac{\delta^2 u_R(-a,a)}{1-\delta^2}. \end{aligned} \tag{4}$$

where,

$$\begin{aligned} u_R(-a,a) &= -\int_0^{\frac{2a}{r}} (1+a-r\tau)^2 d\tau - \int_{\frac{2a}{r}}^1 (1-a)^2 d\tau = \frac{4a^2(a-3)}{3r} - (a-1)^2, \quad (5) \\ u_R(a,-a) &= -\int_0^{\frac{2a}{r}} (1-a+r\tau)^2 d\tau - \int_{\frac{2a}{r}}^1 (1+a)^2 d\tau = \frac{4a^2(a+3)}{3r} - (a+1)^2. \quad (6) \end{aligned}$$

By replacing (5)-(6) in expression (4), and taking its derivative with respect to r we get:

$$\frac{dU_R(a,r,\delta)}{dr} = \frac{4a^2\delta(a+3+\delta(a-3))}{3r^2(\delta^2-1)}, \tag{7}$$

which is negative for all possible values of the parameters.

- Case 2: $a = 1$.

An increase of r does not preclude parties from keeping on using the partisan equilibrium strategies. We distinguish two scenarios. If $r \geq 2$, after an increase of r parties keep on alternating between policies 1 and -1. However, if $r < 2$, an increase in r generates a new (asymmetric) alternation between policies.

We start considering scenario $r < 2$. In this case, the incentives to increase institutional flexibility are even smaller than those studied in case 1 above. To see it, suppose that party R is in power and $\hat{x} = x'$ (hence there is policy alternation between $-x'$ and x'). Now assume that party R increases r by $\epsilon > 0$.

Then, in the next period, given the partisan equilibrium strategies, the policy moves to $-x' - \epsilon$, hence generating a new (asymmetric) alternation between $-x' - \epsilon$ and x', which is detrimental to party R. To see it, note that:

$$U_R(x', r, \delta) = \delta \frac{u_R(x', x' - r)}{1 - \delta^2} + \frac{\delta^2 u_R(x' - r, x')}{1 - \delta^2}, \tag{8}$$

where,

$$u_R(x' - r, x') = -\int_0^1 (1 - x' + r - r\tau)^2 d\tau = -\frac{r^2}{3} + r(x' - 1) - (x' - 1)^2, \tag{9}$$

$$u_R(x', x' - r) = -\int_0^1 (1 - x' + r\tau)^2 d\tau = -\frac{r^2}{3} + r(x' - 1) - (x' - 1)^2. \tag{10}$$

By replacing (9)-(10) in expression (8), taking its derivative with respect to r and evaluating it at $x' = \frac{r}{2}$, we get:

$$\frac{dU_R(x', r, \delta)}{dr} = \frac{\delta(2r - 3x + 3)}{3(\delta - 1)} = \frac{\delta\left(\frac{r}{2} + 3\right)}{3(\delta - 1)},$$

which is negative for all possible values of the parameters.

We now proceed with scenario $r \geq 2$. In this scenario, we can use the same steps of the proof of case 1. Hence, we just need to evaluate expression (7) at $a = 1$, which yields $\frac{4(4-2\delta)\delta}{3(\delta^2-1)r^2} < 0$. **QED**

Proof of Proposition 2. We distinguish two cases: $a \in [0, \bar{a}(r))$ and $a = 1$.

- Case 1: $a \in [0, \bar{a}(r))$.

The proof is based on the analysis of the sign of the derivative, with respect to r, of the discounted future utility (from t onwards) of the party in charge at time t. Without loss of generality, we can focus on any term t at which $v_t = R$, and check how an increase of r will affect the future discounted utility of party R from time t onwards. We assume that the system is in an alternating equilibrium with a-profile, $\widetilde{s}^a$. At time t, the (discounted) utility induced by the (equilibrium) strategy $\widetilde{s}^a$ to R from t onwards is:

$$\begin{aligned} U_R(a, r, \delta) &= u_R(-a, a) + \delta u_R(a, -a) + \delta^2 u_R(-a, a) + \delta^3 u_R(a, -a) + ... \\ &= \frac{u_R(-a, a)}{1 - \delta^2} + \frac{\delta u_R(a, -a)}{1 - \delta^2}. \end{aligned} \tag{11}$$

By replacing (5)-(6) in expression (11), and taking its derivative with respect to r we get:

$$\frac{dU_R(a, r, \delta)}{dr} = \frac{4a^2(a - 3 + \delta(a + 3))}{3r^2(\delta^2 - 1)}, \tag{12}$$

which is positive for $r > 1$, $a \leq min\{r - 1, 1\}$ and $\delta \leq \frac{3-a}{3+a}$. We are interested in seeing when these conditions apply to the strategy profiles of case 1. From AFM we know that, in order to have an equilibrium with $a \in [0, \bar{a}(r))$:

(I) If $r \leq 2$ it is needed that $a < \bar{a}_L(r)$ and $\delta \geq \bar{\delta}_L(a,r)$, where $\bar{a}_L(r)$ and $\bar{\delta}_L(a,r)$ are the particularizations of $\bar{a}(r)$ and $\bar{\delta}(a,r)$ for the case $r \leq 2$ and are defined, respectively, in expressions (16) and (18) in AFM.

(II) If $r > 2$ it is needed that $a < 1$ (since $\bar{a}(r) = 1$) and $\delta \geq \bar{\delta}_H(a,r)$, where $\bar{\delta}_H(a,r)$ is the particularization of $\bar{\delta}(a,r)$ for the case $r > 2$ and is defined in expression (23) in AFM.

Consider first scenario (I), with $r \leq 2$. To have equilibria where incentives to increase r are positive we need $\frac{3-a}{3+a} \geq \bar{\delta}_L(a,r)$ (as defined in expression (18) in AFM). The comparison of the two expressions shows that this is true when $\sqrt{3} < r < 2$ and $0 < a \leq \tilde{a}_L(r)$, where $\tilde{a}_L(r)$ is the largest root of the polynomial $\alpha^3(6-r) + \alpha^2(6-3r) + 2\alpha^4 + \alpha\left(-r^3 - 3r + 2\right) + 3r^3 - 9r$. It is verifiable that, for all $r \leq 2$, $\tilde{a}_L(r) < \bar{a}_L(r)$ (as defined in expression (16) in AFM).

Consider now scenario (II), with $r > 2$. To have equilibria where incentives to increase r are positive we need $\frac{3-a}{3+a} \geq \bar{\delta}_H(a,r)$ (as defined in expression (23) in AFM). The comparison of the two expressions shows that this is true when $2 < r < 2.5$ and $0 < a \leq \tilde{a}_H(r)$, where $\tilde{a}_H(r)$ is the largest root of the polynomial $12 - 9r + (18-6r)\alpha + (8-r)\alpha^2 + 2\alpha^3$, and when $r \geq 2.5$ and $0 < a \leq 1$. It is verifiable that, for all $2 < r < 2.5$, $\tilde{a}_H(r) < \bar{a}(r) = 1$. Hence, we complete the proof of case 1 by defining $\tilde{a}(r) = \tilde{a}_L(r)$ if $r \leq 2$ and $\tilde{a}(r) = \tilde{a}_H(r)$ if $r > 2$.

- Case 2: $a = 1$.

An increase of r does not preclude parties from keeping on using the partisan equilibrium strategies. We distinguish two scenarios. If $r \geq 2$, after an increase of r parties keep on alternating between policies 1 and -1. However, when $r < 2$ an increase in r generates a new (asymmetric) alternation between policies.

We first consider scenario $r < 2$. In such a case, the incentives to increase institutional flexibility are even higher than those in case 1. To see it, suppose that party R is in power and $\hat{x} = x'$ (hence there is policy alternation between $-x'$ and x'). Now assume that party R increases r by $\epsilon > 0$. Then, in current period, given the partisan equilibrium strategies, the policy moves to $x' + \epsilon$, hence generating a new (asymmetric) alternation between $x' + \epsilon$ and $-x'$, which is surely better to party R (compared to an alternation between x' and $-x'$). The payoff is:

$$U_R(x', r, \delta) = \frac{u_R(-x', -x' + r)}{1 - \delta^2} + \frac{\delta u_R(-x' + r, -x')}{1 - \delta^2}, \tag{13}$$

where,

$$u_R(-x', -x' + r) = -\int_0^1 (1 + x' - r\tau)^2 d\tau = -\frac{r^2}{3} + r(x+1) - (x+1)^2, \tag{14}$$

$$u_R(-x' + r, -x') = -\int_0^1 (1 + x' - r + r\tau)^2 d\tau = -\frac{r^2}{3} + r(x+1) - (x+1)^2. \tag{15}$$

By replacing (14)-(15) in expression (13), taking its derivative with respect to r and evaluating it at $x' = \frac{r}{2}$, we get:

$$\frac{dU_R(x', r, \delta)}{dr} = \frac{-2r + 3x + 3}{3 - 3\delta} = \frac{3 - \frac{r}{2}}{3 - 3\delta},$$

which is positive for all possible values of the parameters.

When $r \geq 2$ we can use the same steps of the proof of case 1. Hence, we just need to evaluate expression (12) at $a = 1$, which yields $\frac{8(2\delta-1)}{3(\delta^2-1)r^2}$. From a straight inspection, it is positive only when $\delta < 0.5$. **QED**