Balancing Freedom & Security
in the Patriot Act 2001: A Mathematical Model

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Abstract: The USA Patriot Act (2001) has the laudable mission of providing national security and stability. Yet many see this hastily crafted legislation as raining down collateral damage upon individual liberties that are protected by the U.S. Constitution. This paper seeks to identify the relationship between the competing values of security and freedom in an effort to quantify the conditions under which a stable balance between them may continue to exist. The model predicts that if the mutual effects of competition are *small* with respect to the carrying capacity of these values, in conflict situations then freedom and security may both be reduced when they come into conflict, but *neither will become extinct.* However, if the competitive effect of these conflict situations increases whether for one or the other or both, then the model predicts that the principle of *competitive exclusion* will apply: hat one value will approach its maximum while the other goes to extinction. The paper concludes by providing a plausible explanation of what might happen in actuality.

1 Introduction

Social dilemmas such as abortion, euthanasia, gun control, etc., are often in reality fundamental questions of value choices (Madsen & Shafritz 1992). In fact, these value choices are usually more competitive than cooperative, and this competition is at the root of the dilemma. Taken by themselves, each value has deep significance and popular approval. No one, for example, would argue against freedom of choice, or the right to life. Juxtaposed together, however, the values quarrel with each other. Public policies attempting to set right one social problem may instigate yet another. One such public policy under review in this paper has generated a social dilemma between the competing goals of national security and individual freedoms. This is the Patriot Act of 2001, also known as Public Law No. 107-56, "*The Anti-Terrorism Bill.*

1.1 The Anti-Terrorism Bill

The intent of this bill is stated as *"An Act to deter and punish terrorist acts in the United States and around the world, to enhance investigatory tools, and for other purposes."* This statutory law was promulgated on October 26, 2002 at a time of great national emergency and a pressing need to ensure the safety and stability of the United States. The Patriot Act indeed has laudatory ideals behind it. It is patriotic to want one's nation-the property of all-to be safe and secure. Ours is a government *"of the people" where democracy prevails.* Following this theory, it became the prerogative of the sovereign people to demand stern security measures after September 11, 2001. Our national sense of security had already been severely weakened by the 1993 bombing of the World Trade Center, and the terrorist attacks in 2001 were its death knell. Government had to act quickly to restore confidence and to show this nation and others around the world that America remains a strong, decisive, and potent world leader.

Nevertheless, in the process of promulgating the policy and living with it, its critics have asserted, and their predictions have come to pass, that serious losses in individual liberty could follow on the heels of such a sharp policy instrument. The Act substantially increases the policy power of domestic and international U. S. law enforcdement and intelligence agencies. Because it has eliminated many of the checks and balances that allowed the judiciary to ensure that state police power is not abused, this bill has come under strong fire from civil libertarians. (Coates 2001, Coates 2002).

Today individual examples of the price of security at the expense of freedom are being observed. One that comes immediately to mind is the case of Dr. Steven Hatfill, the bio-defense scientist whose personal and professional lives have been turned upside down because he was seen as a *"person of interest"* in the anthrax probe (Rosen 2002). The redefinition of terms, such as terrorist in PL-107-56 Sec. 802, has raised concerns for intellectuals engaged in legitimate research. The creation of new phraseology by the Department of Justice such as "persons of interest" raises first Amendment concerns with respect to rights of freedom of expression and association. Here, Dr. Hatfill's immediate associates were also investigated.

The law also supercedes existing state and federal privacy policies if the FBI deems it necessary to obtain information connected to an intelligence investigation. Under its Titles I, II V, VII-IX, authorities may browse through anyone's personal records without showing reason. (Title I: *Enhancing Domestic Security Againste Terrorism*, Title II: *Enhancing Surveillance Procedures*, Title V: *Removing Obstacles to Investigate Terrorism*, Title VII: *Increased Information Sharing for Critical Infrastructure Protection*, Title VIII: *Strengthening the Criminal Laws Againste Terrorism*, and Title IX: *Improved Intelligence*).

1.2 The Competing Issues of Security and Freedom

In studying the two abstract quantities of security and freedom (individual liberties), and recognizing that each has an effect upon the other, it was useful for Verzi to turn to the study of population dynamics. Here it has been shown that when two species compete for the same resource, or inhibit each other's growth, they are said to be in a state of competition. Classic models predict that competing populations may both survive if their competitive effects upon each other are small relative to the carrying capacity for their populations, but that the principle of competitive exclusion will apply when the effect of their competition becomes too large: Namely that when two species seriously inhibit each other's growth, one of the species usually becomes extinct (Hsu *et al.* 1979, Murray 1989).

In the United States, the general populace is ready to sacrifice some personal freedom in order to implement new security measures. Yet many believe that it is impossible to guarantee an acceptable standard for safety in an open, democratic society, or a free enterprise system Carr 2002). Public policy is not a perfect solution to social ills. It is merely an approximation, or even a caricature of an answer. As Simon (1949) and others have pointed out, we can merely "satisfice" rather than optimize in the public policy arena, where utilities are intransitive. Nevertheless, in general the populace in the United States, has enjoyed an acceptable standard for security and freedom over many years. Yet, with the passage of this bill and the pressing need for national security, the nature of the competition between freedom and security will likely change significantly, and individual liberty may be inhibited. (See Justice William Brennan in Brown v. Glines, 444 U. S. 348, 1980: *"Because they invariably have the visage of overriding importance, there is always a temptation to invoke security 'necessities' to justify an encroachment upon civil liberties. For that reason, the military-security argument must be approached with a healthy skepticism."*

This paper seeks to identify the relationship between the important values of security and freedom in an effort to quantify the conditions under which a stable balance between them may continue to exist. In this section, we begin a modeling process to analyze the interdependent system of freedom and security within the United States, building on theoretical population models (Lotka-Volterra 1925).

2 Methods

We study the interdependent system of freedom and security using a minimal competition model with a linear logistics term that exhibits stability similar to that of more complicated models, while permitting direct analysis. Since freedom and security clearly inhibit each other, we consider the interaction of these two values in a dynamic competition model. If $F(t)$ and $S(t)$ represent freedom and security, a first step toward modeling their interdependence may be to consider adapt a classic model for competition to these values in the following interdependent system:

$$\frac{dF}{dt} \;=\; g_F\left(F - \frac{F^2}{K_F} - c_F\frac{FS}{K_F}\right) \tag{1}$$

$$\frac{dS}{dt} \;=\; g_S\left(S - \frac{S^2}{K_S} - c_S\frac{FS}{K_S}\right) \tag{2}$$

where g_i represent linear growth rates, K_i the carrying capacities (upper bounds), and c_i competitive effects of interaction for freedom (F) and security (S).

In Eq. (1) above, the first term on the right-hand side models freedom increasing proportional to the amount already present. The last term (negative) represents the detrimental effect of competition with security when their interests conflict in the law or its interpretation; freedom will decrease proportional to

the product of the amount of freedom and security present at the time of the interaction. The middle term (negative) is logistic in nature: There is an upper bound, or carrying capacity on the amount of freedom possible, so that if $F = K_F$, then $1 - F/K_F = 0$, and the net change from these two terms would be 0. Likewise, in the absence of interaction with security, the net growth of freedom would be completely described by the first two terms as approaching an upper bound. Equation (2) similarly describes changes in security, increasing proportional to the amount of security present, relative to an upper bound, and decreasing in the presence freedom-security conflict issues.

Stability analysis is facilitated if a system is non-dimensional, and the number of parameters is minimized. We, therefore, set $\rho = g_F/g_S$, the (dimensionless) ratio of growth rates, and $\lambda = K_F/K_S$, the (dimensionless) ratio of carrying capacities. Then

$$\frac{df}{d\tau} = f - f^2 - \alpha f s \tag{3}$$

$$\frac{ds}{d\tau} = \rho\left(s - s^2 - \beta f s\right) \tag{4}$$

describes the non-dimensional dynamic relationship between freedom and security as compared to their respective carrying capacities. Here $\tau = g_f t$ (time rescaled to conflict situations), $\alpha = c_f/\lambda$, and $\beta = c_s\lambda$. Since λ is dimensionless, then α and β have dimensions of c_i, the positive or negative effect of competitive interaction, and the system now model changes resulting over conflict situations (τ), i.e. a change in law, or a court interpretation that sets a precedent, based upon values for the variables f and s just prior to the conflict.

Deterministic models simulate physical systems under simplifying assumptions in order to draw theoretical conclusions about unknown events, or to test changes in predicted equilibrium solutions for the physical systems they represent upon variation of parameters within the system. An equilibrium solution represents a point or trajectory where a differential system will no longer change (i.e. when the left-hand sides of the equations equal 0). The equilibrium solutions for Eq. (3)-(4) are $(f, s) = (0, 0), (1, 0), (0, 1)$, and (f^*, s^*). The first solution represents the loss of both freedom and security, while the next two represent freedom or security going to an upper bound, respectively, while the other goes to extinction, exhibiting the principle of *competitive exclusion*. However, the third solution represents a positive point of balance for freedom and security, defined in terms of α and β. Fortunately, the first solution is always unstable, but the stability of the remaining solutions depends solely on the magnitude of these two parameters.

Stable points of equilibrium attract nearby trajectories, while unstable points repel them. Stability of equilibrium solutions may be analyzed by linearizing a system near these solutions and checking the signs of the eigenvalues for the corresponding linear operator. Instead, we choose to illustrate the stability of these solutions by numerically integrating the dimensionless system for different values of α and β. It can be shown analytically that regardless of the value assigned for ρ, the end result for the survival of freedom and/or security depends only on the magnitudes for these two parameters. We therefore set $\rho = 1$, corresponding to $g_F = g_S$ in the physical system (Eq. (1)-(2)). An examination of the eigenvalues for the dimensionless system (Eq. (3)-(4)) indicates four possible outcomes:

(a) The equilibrium points (1,0) and (0,1) are unstable and (f^*, s^*) is stable.
(b) The equilibrium points (1,0) and (0,1) are stable and (f^*, s^*) is unstable.
(c) The equilibrium points (1,0) and (f^*, s^*) are unstable and (0,1) is stable.
(d) The equilibrium points (0,1) and (f^*, s^*) are unstable and (1,0) is stable.

We integrate the dimensionless system over many interactions (τ), starting with different initial values for f and s, and vary the parameters α and β in Figs. 1a-1d to illustrate a-d above.

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3 Results

In Fig. 1a, $\alpha = 0.3$ and $\beta = 0.2$. In four separate simulations illustrated in Fig. 1a with different initial values for freedom and security (the four corners of the slide), all trajectories tend to (f^*, s^*). This is because for $\alpha, \beta < 1$, the competitive effects that freedom and security have upon each other are both small. This equilibrium point is globally stable, since (1,0) and (0,1) are unstable for $\alpha, \beta < 1$. This is good news for freedom and security, because solutions are tending toward a point where they may coexist, when the measure of their mutually competitive effect upon each other is small, since α and β closely approximate c_i in the physical system, so long as the carrying capacities for freedom and security are close to each other.

In Fig. 1b, we set $\alpha = 1.2$ and $\beta = 1.3$,and again run four separate simulations that begin with initial values representing f, s small, f, s large, f large and s small, and finally f small and s large. Now solutions tend to either (1,0) indicating that freedom asymptotically approaches its upper bound and security asymptotically approaches extinction, or (0,1) indicating the opposite result. These points of equilibrium are stable (attractors) when $\alpha, \beta > 1$, or when their mutually competitive effect upon each other is large. Each solution attracts trajectories that begin nearby, and their regions of attraction are separated by a separatrix passing through (f^*, s^*). (The equilibrium point (f^*, s^*) depends upon values chosen for α and β, and therefore varies from Fig. 1a to Fig. 1b.) The positive solution (f^*, s^*) is now unstable, indicating that any perturbation from balance will be drawn away from this solution toward one of the two stable points. In terms of the physical system, the model predicts that one or the other of freedom or security will go to extinction while the other goes to its maximum when their competitive effects upon each other are large.

In Fig. 1c, we set $\alpha < 1$ and $\beta > 1$ so that the competitive effect of freedom upon security (c_F) is small, while the competitive effect of security upon freedom (c_S) is large. It is not surprising that for three different initial conditions, all trajectories tend to (1,0), indicating that freedom increases to its carrying capacity as security tends toward extinction. Figure 1d shows the opposite result, when $\alpha > 1$ and $\beta < 1$. The results in Figs. 1c and 1d will occur regardless of initial values for freedom and security, since all other points of equilibrium are unstable, making the attractor globally stable.

4 Discussion

Dynamical systems serve as a way to make predictions about unknown values or trends in interdependent systems, if we know about the present state of the system and what may cause it to change. The parameter values may result from stochastically fitting the system to observed trends or data. We applied a competition model for two species that inhibit each others' growth to the interdependent relationship between *freedom* (individual liberties) and *security* in our democratic system at a time when their competitive effects upon each other may take a dramatic change. The model predicts that if the mutual competitive effects are *small* in conflict situations (changes in the law or its interpretation), then freedom and security may both be reduced, but *neither will become extinct.* However, if the competitive effect of these conflict situations increases too rapidly at each conflict situation, with respect to their carrying capacities, whether for one or the other or both, then the model predicts that the principle of competitive exclusion will apply: Either freedom tends toward its maximum while security tends toward 0, or that security tends towards a maximum as freedom goes to 0, neither of which is acceptable in our democratic society.

It seems plausible that in the absence of freedom, security would tend to move to a maximum, but it is unrealistic to assume that the opposite should apply over time. In this simplistic model, we have not considered the effect of a threat from outside our borders, which would surely cause freedom to go to zero in the absence of security. A more complex line of modeling might be to pursue a 3-dimensional system

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for the dynamic interaction of freedom, homeland security, and threats from outside our borders, treating freedom as prey for competing predators of security and threat (Hsu *et. al.* 1978). Rather than a doomsday prophecy, we offer the 2-dimensional model covered in this paper as a first step to quantify and analyze the intangible and coupled values of freedom and security at a time when the United States seeks to maximize both quantities. An alternative modeling approach may be to apply engineering control theory, in an effort to maximize the sum of both freedom and security.

4.1 Epilogue

The tension between strong security, versus individual freedom is a concept as old as the foundations of the United States. The Founding Fathers worried about how they could make security and stability compatible with democracy (Diamond, 1981). They saw majorities as having dangerous propensities to folly, feebleness, ignorance, not to mention tyranny of majorities. Their implicit reasoning was that enthusiastic majoritarian adoption of one social good might compete with and inhibit the life of another. Indeed, the nature of competition is often set into win/lose modes-or what is known as the zero sum game. Yet, happily the direst predictions have not come to pass and the Framers did make, as Tocqueville noted, *"democratie safe for the world"* (Toqueville 1899) (as safe as it could be) with their system of checks and balances, and levels of government in the American federal system of government. As this policy plays out on the stage of American life, one hopes that this will continue to be the case.

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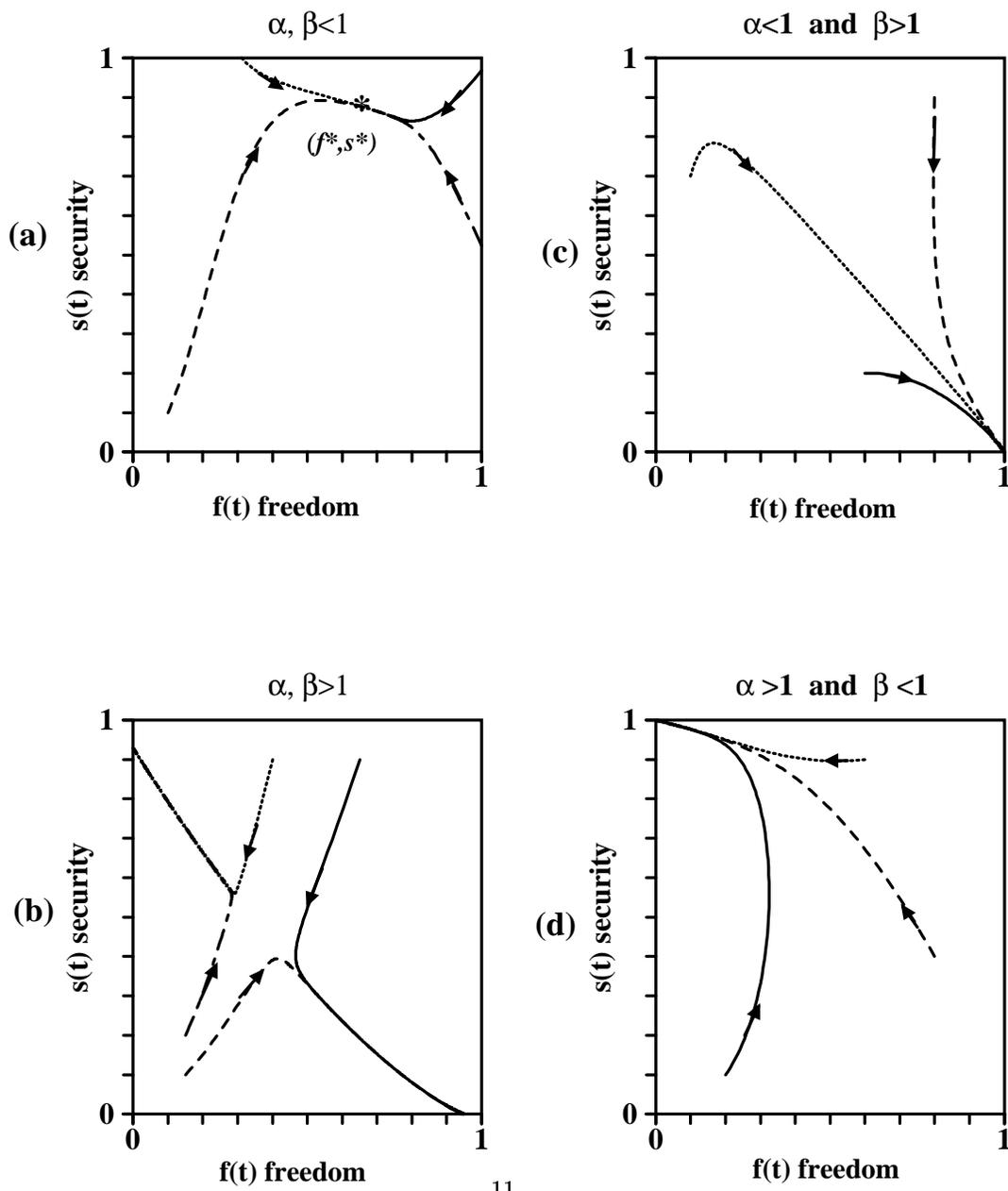The Center for Democracy and Technology (2001) November 29.

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Fig. 1 Freedom and security may coexist or each may cause the other to become extinguished. The competitive effects that freedom and security have upon each other at points of conflict determine their paths. Eq. (3)-(4) are integrated for different parametric values in (a)-(d). Fixing α and β in each slide, four simulations are run for different initial quantities of freedom and security. **(a)** When the competitive effects are both small, both freedom and security may coexist. **(b)** When the competitive effects are both large, either freedom or security will tend to a maximum, while the other goes to extinction, depending upon their initial values. **(c)** and **(d)** If one parameter is large, and the other small, then the quantity with the greater competitive effect will approach a maximum, while the other tends to extinction.

α, β<1

1

s(t) security

0

(a)

(f*,s*)

0   f(t) freedom   1

α<1 and β>1

1

s(t) security

0

(c)

0   f(t) freedom   1

α, β>1

1

s(t) security

0

(b)

0   f(t) freedom   1

α >1 and β <1

1

s(t) security

0

(d)

0   f(t) freedom   1

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Figure 1: