Flynn's Case for a Different Approach to Homeland Security

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Background

Six months prior to the attacks of 9/11/01, the bipartisan US Commission on National Security/21st Century, led by Senators Gary Hart and Warren B. Rudman, published its report on the state of U.S. homeland defense.[1] The Hart-Rudman Commission claimed that an attack on the American homeland was "likely" and that American preparedness was "fragmented" and "inadequate."

One year after the attacks, Hart and Rudman commissioned the Council on Foreign Relations to assemble an independent bipartisan task force to investigate the then current state of homeland defense. Stephen E. Flynn, as the Council on Foreign Relations' Jeane J. Kirkpatrick Senior Fellow in National Security Studies, was the Project Director of this task force.

The task force was made up of experts including former secretaries of state, former chairmen of the Joint Chiefs of Staff, former directors of the CIA and FBI, Nobel laureates, and the two aforementioned senators. The task force published its report under the title, *America Still Unprepared —Still in Danger* in October of 2002. The report's executive summary opens with the following statement:

> "A year after September 11, 2001, America remains dangerously unprepared to prevent and respond to a catastrophic terrorist attack on U.S. soil."[2]

In 2004, frustrated with the lack of action in response to this task force report, Flynn published a book in which he claimed the following: "Despite the passage of time, our state of homeland insecurity has not materially changed."[3]

In his book, Flynn verbally outlines many of the dynamics that underpin the lack of an appropriate response to the ongoing threat. Because many of these dynamics appear amenable to system dynamics analysis, I present here the implicit structures that underlie these robust but insidious dynamics and test alternative policies that might mitigate the resulting vulnerabilities. The structures are first presented in causal loop diagrams, then in a model and finally, alternative policies are run: two stemming from suggestions from Flynn, one new alternative, and a combination of two of these.

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[1] *Road Map for National Security: Imperative for Change*, The United States Commission on National Security/21st Century, 2/15/01.

[2] *America Still Unprepared—America Still in Danger*, Report of an Independent Task Force Sponsored by the Council on Foreign Relations, Gary Hart and Warren B. Rudman, Co-Chairs, Stephen E. Flynn, Project Director.

[3] Flynn, Stephen E. (2004). *America the Vulnerable: How Our Government is Failing to Protect us from Terrorism.* NY: HarperCollins.

Current Homeland Security Dynamics

Flynn has two main concerns: 1) An over-zealous response to attacks could cause more damage than the original attacks; and 2) The lack of a constituency to wisely protect the homeland has led to serious vulnerabilities. In this section Flynn's verbal arguments are presented as causal loop diagrams. First, I will present the over-reaction dynamics of port and terminal shutdown. Then second, I will present the dynamics that oppose large investments in infrastructure and border security by any of a) private enterprise, b) the public sector, or c) a combination of the two.

The Dynamics of an Over-Zealous Shutdown of Ports and Terminals

Flynn describes a discussion with John Meredith, CEO of Hutchison Port Holdings, regarding the security of the container industry. Containers of 40 feet x 8 feet x 8 feet are used to move cargo between trucks, trains and ships. The containers are transferred at terminals without being opened, improving the efficiency of this component of shipping from several days to one or two work shifts.

Meredith is concerned about the containers being used as the "poor man's missile" for attack, but he is also concerned about something else: the threat to the container industry should the government decide to shut down ports and terminals for weeks. He believes the country would face gridlock.

As shown in the causal loop diagram in Figure 1, the pressure on the leaders in the wake of an attack will be 1) to engage in perfect efforts of detection to avoid exposing their constituents to the danger of further attacks and 2) to appear to be active in gathering information for later forensic analysis. Flynn anticipates that in the event of an attack, the gut reaction of leaders will be to shut down ports and terminals.

Because anything short of shutting down the ports and terminals would be considered irresponsible by a frightened public, the leaders would capitulate by have every vehicle and container crossing the border inspected. The result of such a shutdown would be to slow down the supply chain for all transported goods. Terminals would become backlogged with goods and retail outlet shelves would go bare. Gas stations would be without gas and consumer confidence would fall. At the same time, there would be a surge of the number of vehicles stuck at ports and terminals. The empty shelves and pumps would be a constant reminder of the risk and impact of the past attack. Leaders would experience yet more pressure to carry out draconian policies to protect the public from such social disruption.

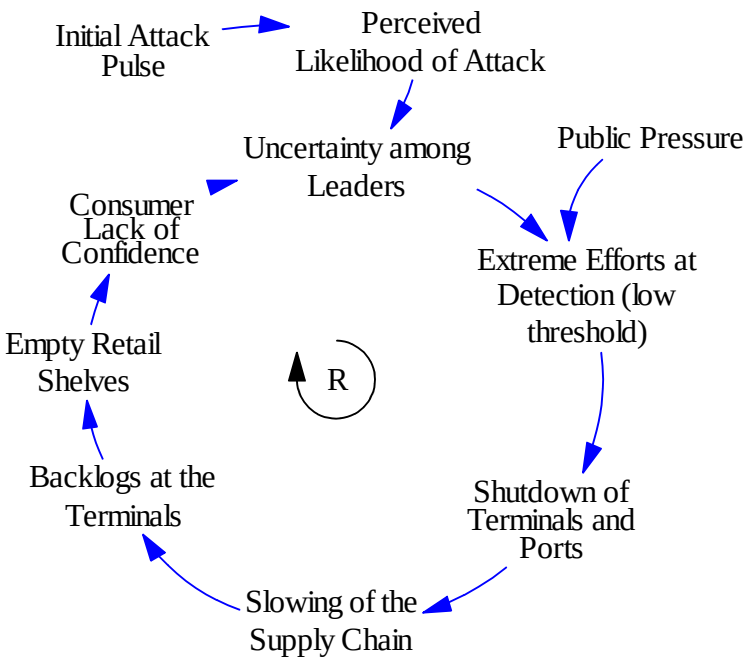


Figure 1. Over-zealous reaction to initial attack.

In addition to his concern with government over-reaction to attack, Flynn is also concerned with the lack of a constituency in government or the private sector to truly advocate and invest in homeland security, whether for infrastructure protection or border security. He points out the lack of investment in emergency respondents staffing, training and equipment as a serious symptom of the underlying dynamics.

The Dynamics Opposing Private Investment in Infrastructure Security

Flynn documents a "tragedy of the commons[4]," where the commons is the shared security of the entire infrastructure. Flynn points out that as each infrastructure company invests in expanding its market share, competing companies must step up their investments to keep pace. The larger the fraction of the budget that is dedicated to competition, the smaller the fraction of the budget that remains for security spending. Even though customers desire a high level of security for the infrastructure, that level cannot be reached by private companies in the context of market competition.

In Figure 2, a reinforcing loop embodies the competitive pressures of the infrastructure market. While there is a balancing loop from well-intentioned managers and the public that tries to promote a desired level of infrastructure security, it cannot offset the competitive pressures in the market. This structure represents the archetype of limits to growth, with a fraction invested in competition rising to a limit of 1. Flynn describes the well-intentioned manager as staying up at night with worry, but unable to risk the enterprise to engage in security efforts alone.

[4] Hardin, G. (1968). The Tragedy of the Commons, *Science*, 162, 1243-1248.

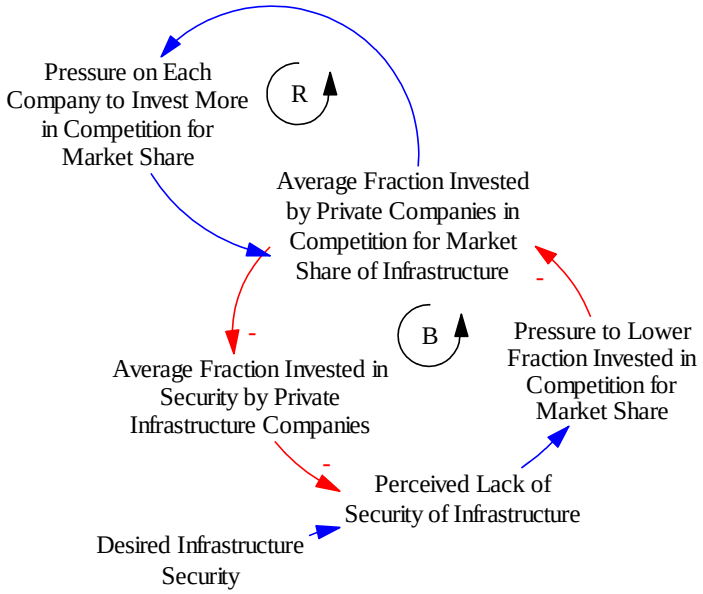


Figure 2. Tragedy of the Commons in the Security of Privately Owned Infrastructure

The Dynamics Opposing Public Investment in Homeland Security

A very similar structure, shown in Figure 3, underlies the tradeoffs in allocating parts of the public defense budget to military technology for the overseas offensive and homeland security. As the insurgency in Iraq grows, there is pressure on policy makers to allocate a high proportion of funds for the technology to be used there. With every foreign casualty, insurgency recruitment grows. This pattern represents a reinforcing loop.

According to Flynn, while the Pentagon may wish to see U.S. soil protected as well, the institution has considerable inertia in a) changing its cold-war philosophy from "bring the fight to the enemy," b) escaping its dependence on a belief that terrorism must be state-sponsored, and in c) changing its belief that homeland protection is about "policing" and thus not part of the Pentagon's mandate. Flynn points out that the U.S. is the only nation in the world that has a military dedicated to protecting its overseas interests before protecting its own soil.

In Figure 3, although there is a balancing loop of public pressure to improve the proportion invested in homeland security to some desired value, the reinforcing loop ultimately dominates. Once again, the archetype presented is one of limits to growth with a limit on proportion invested in technology for overseas offensive of 1. Flynn documents in his 2004 book that the Pentagon has 95% of the defense budget invested in the military effort outside the U.S. As a result, the ports and terminals remain soft targets and the emergency responders are understaffed, inadequately trained and poorly equipped.

In 2005, according to the Department of Defense FY2005 budget[5], the allocation to Procurement and RDTE (Research, Development, Testing and Evaluation) of $143.8 billion exceeds each of its operations and maintenance budget of $140.6 billion and its military personnel budget of $104.8 billion. These figures, totalling 389.2 billion only account for four main headings of the military budget of $422.2 billion. The total Department of Homeland Security budget for FY2005 is $40.2 billion.[6] With only 411 million for border security and just under $4 billion for first responders.

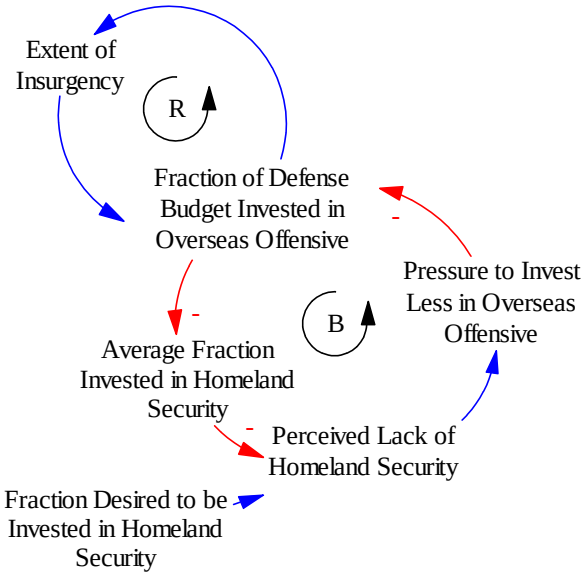


Figure 3. Pressure to Invest Public Money in Overseas Offensive Rather than Homeland Security

[5] http://www.defenselink.mil/releases/2004/nr20040202-0301.html
[6] http://www.dhs.gov/dhspublic/ interapp/editorial/editorial_0391.xml

The Dynamics Trading Off Public and Private Investment in Border Security

At the borders, the dynamics of the cargo transportation sector are quite surprising. Flynn describes a squeezed "balloon effect" where hardened security leads to alternative routes to attack. The example he describes is the case of a household owner who invests everything in a perfect front door lock, only to discover the burglar has entered by the window.

Squeezed Balloon Effect Archetype

I represent this squeezed balloon effect in Figure 4 below. The actual number of successful attempts to enter by door is the *product* of the number of attempts and the true probability of success by door. However, the perceived probability of successful entry by door is a *fraction*, with the number of successful attempts in the numerator and the number of attempts in the denominator. The attempts by door and by window are functions of the perceived probability of success by door. In summary, as the success rate by door drops, the burglar goes for the window.

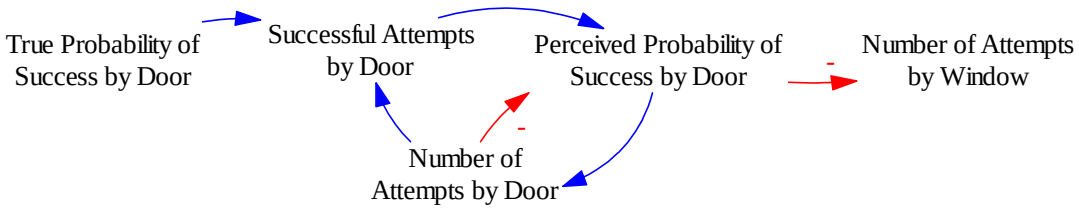


Figure 4. Squeezed Balloon Effect

Border Security Dynamics

Figure 5 depicts the dynamics that underlie why efforts at border security by the public sector do not ultimately lead to improved border security. First, as the government improves border security, the trucking industry faces major slowdowns at the border. Rather than incur the costs of large trucks sitting idle at the border, the major companies have the large trucks offload their cargo at terminals on one side of the border and hire smaller companies to transport cargo across the border to their terminals on the other side. There, the large trucks pick up the cargo for delivery inside the US.

The impact of these extra steps is to increase the probability of interception of the cargo by smugglers, thieves, and terrorists. These criminals cannot easily cross the border themselves, but following the squeezed balloon effect, they can place contraband or explosives in the containers or remove goods at the terminals. In addition, the smaller trucking companies don't have the money or time to do extensive background checks on the drivers they hire. Under the guise of a legitimate truck driver, a terrorist could enter the country.

The private companies will try and guard against theft; nevertheless, the compensation of private industry for the inefficiencies of public border security leads to security holes. As the public border security improves, the challenge it faces increases.

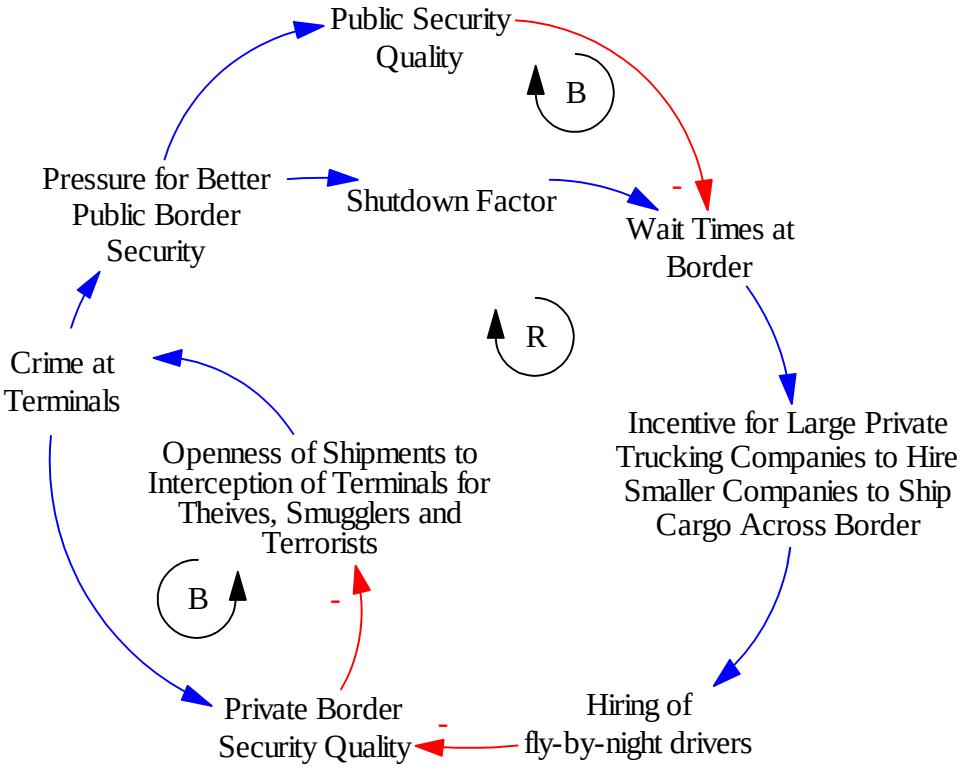


Figure 5. Border Security Shared by Public and Private Sectors

A Model of Homeland Security Dynamics

The following model structure yields the dynamics described in the previous sections. The model, with equations presented in the appendix, consists of the following sectors:

1) Perceived likelihood of attack. This sector has stocks for the perceived likelihoods for government, the public and the private sector. These stocks increase after the pulse of a violent event and decay proportionately according to a time factor. In the current formulation, risk perception follows the same pattern, regardless of whether the perceivers are the public, the government or the private sector. The simplifying assumption of the commonality of risk perception pattern is not necessarily the case and can be relaxed using independent parameters in place of the common time to reassess risk shown in Figure 6.

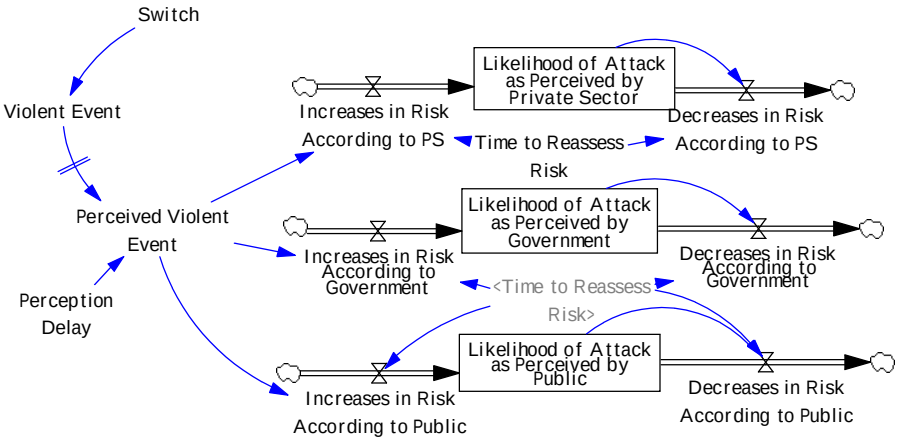


Figure 6. Perceived Likelihood of Attack

2) Politics and Society. This sector has a stock for political leadership uncertainty in response to both the government's perceived likelihood of attack and consumer confidence. As uncertainty grows, the government presses for a higher proportion of traffic to be inspected. One policy that will be tested later is the mitigating effect of the public's lowering of the pressure for this reaction (termed "security maturity" by Flynn). The ratio of the proportion of traffic inspected to normal proportion of goods inspected is labeled a *shutdown factor*.

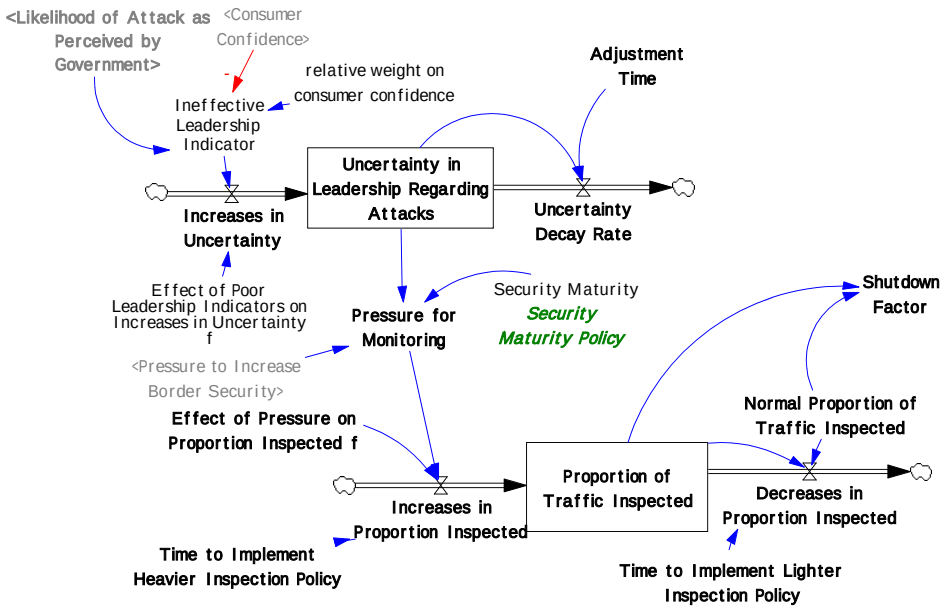


Figure 7. Politics and Society

3) Transportation Flow. This sector has stocks for vehicles en route and vehicles at rest at terminals. The shutdown factor slows the rates of setting off en route to terminals and of leaving the terminals. Since those vehicles that have left already accumulate at the terminals, a backlog of vehicles is created there.

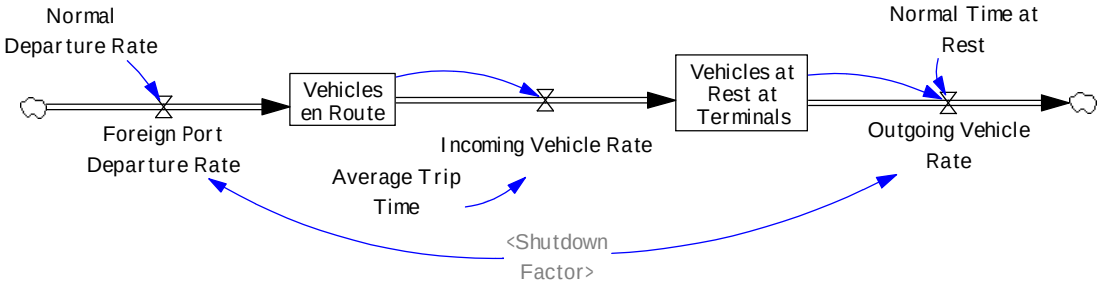


Figure 8. Transportation Flow

4) Commerce. This sector has stocks for items in manufacturing, items at terminals and items on retail shelves. The shutdown factor slows the rate of materials shipment to manufacturing and the rate of shipment of goods from terminals to retail shelves. With shutdown greater than 1, goods pile up at terminals and retail shelves go bare.

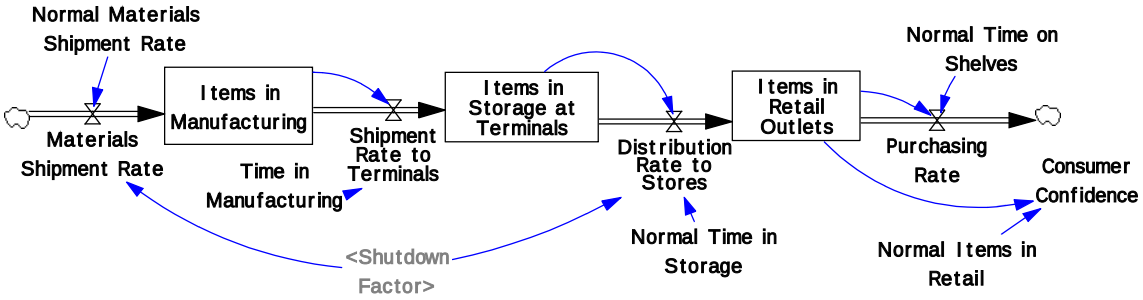


Figure 9. Commerce

5) Private Sector Investments in Infrastructure Security. This sector has one stock with two main loops. The stock is the average fraction of budget invested in competition for market share in a private infrastructure industry. The magnitude of this stock encourages each individual company to invest a higher fraction in competition, creating a reinforcing loop.

The average fraction invested in security is simply the difference between the average competition investment fraction and one. As investment in competition goes up, the investment in security goes down. Even though there is a desired level of security pressing for decreases in the average competition investment fraction, the balancing loop does not dominate the behavior. Ultimately the reinforcing loop prevails.

A policy that will be discussed later is the inclusion of a loop that establishes insurance incentives for investing in higher quality infrastructure security. This is in effect a balancing loop that can offset the dynamics of the two main loops.

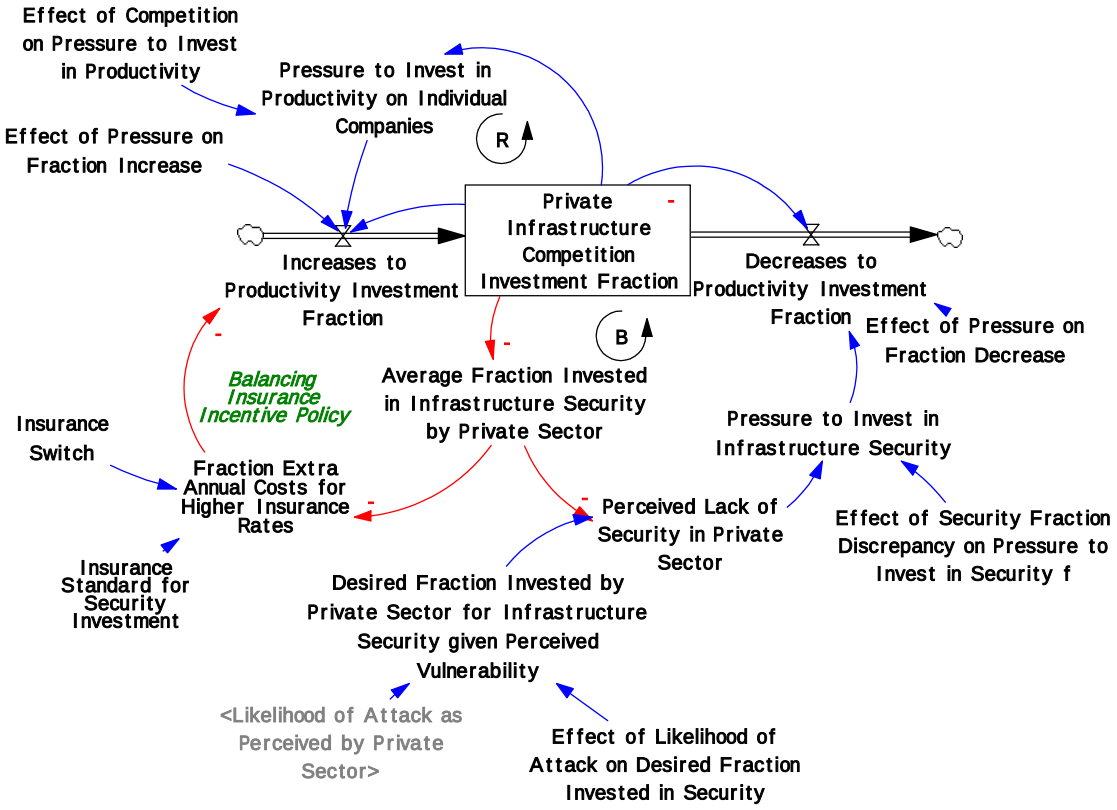


Figure 10. Private Sector Investments in Security

6) Public Sector Investments in Security. This sector has exactly the same structure as the last one, though instead of the average fraction invested in competition, the main stock is the fraction invested in the overseas offensive. The magnitude of the offensive leads to more insurgency that leads to a higher investment in the technology required for the overseas offensive, creating a reinforcing loop.

As before, the average fraction invested in security lowers as the fraction invested in the overseas offensive increases. While there is a desired average fraction invested in homeland security driving decreases in the fraction invested in the overseas offensive, the balancing loop is dominated by the reinforcing one.

A third loop represents the policy of adding insurance incentives for good quality security as described in the section above. As well, a cap on overseas spending represents another possible policy to increase homeland security spending.

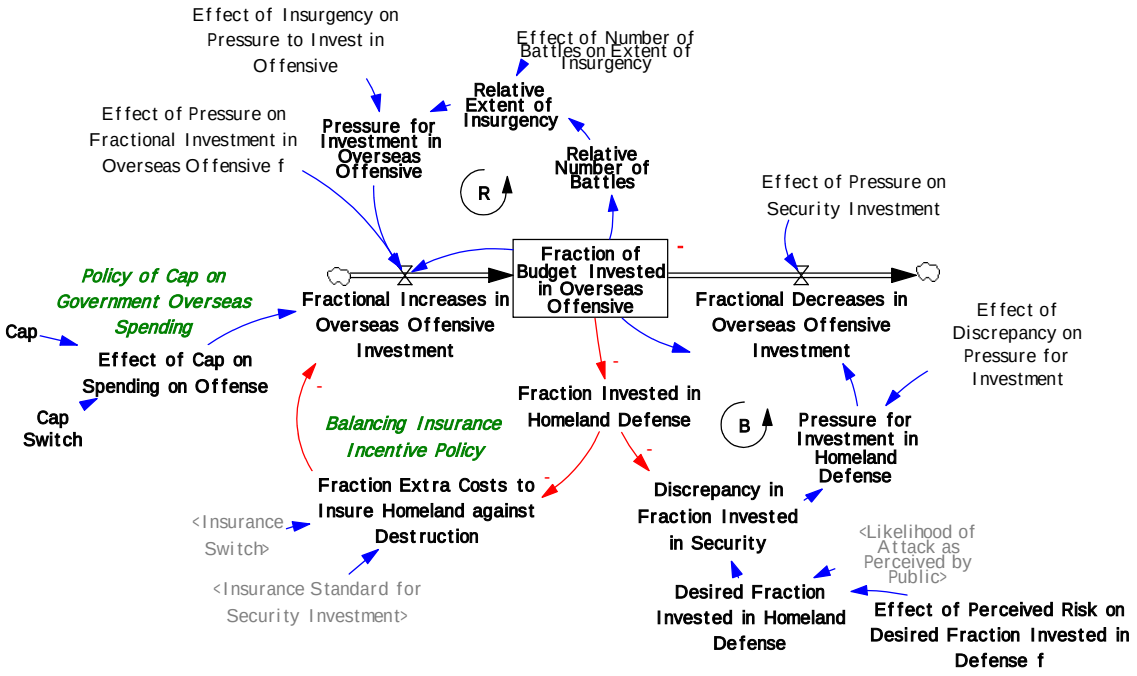


Figure 11. Public Sector Investments in Security.

7) Border Security. This sector has two stocks: public sector border security quality and private sector border security quality. There is one reinforcing loop and one balancing one, as indicated in the causal loop diagram of Figure 12.

As public sector border security quality increases, it increases border wait times, creating an incentive for private trucking companies to rely on questionable smaller companies to carry goods across the border. This reliance lowers the private component of border security, making interception of the containers at the extra terminals more likely, leading to more contraband, illegal immigrants, and potentially, terrorists attempting to cross the border.

The security holes on either side of the border leads to a demand for more security at the border, slowing wait times again. While the private security companies may attempt to police their terminals against crime, that balancing loop dynamics won't be enough to counter the reinforcing loop dynamics in the main loop.

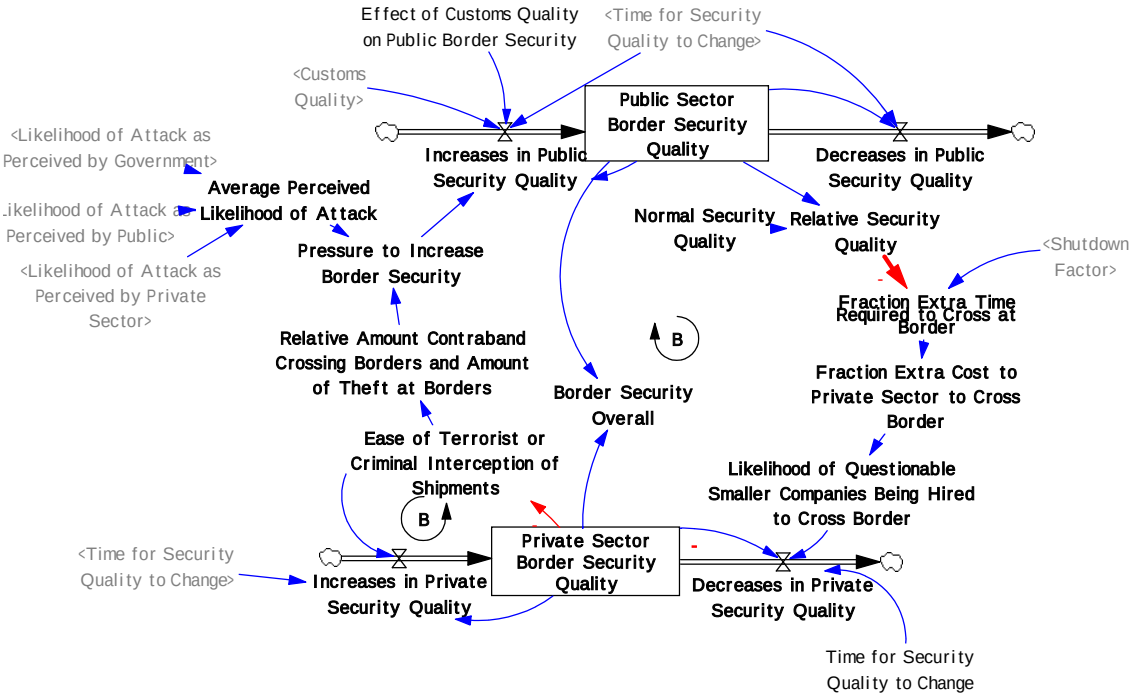


Figure 12. Border Security

8) Customs Quality. The quality of customs efforts to detect illegal contraband is a function of the fraction of public budget invested in homeland defense. Allocations to staffing, equipment, and training are parameters in the model.

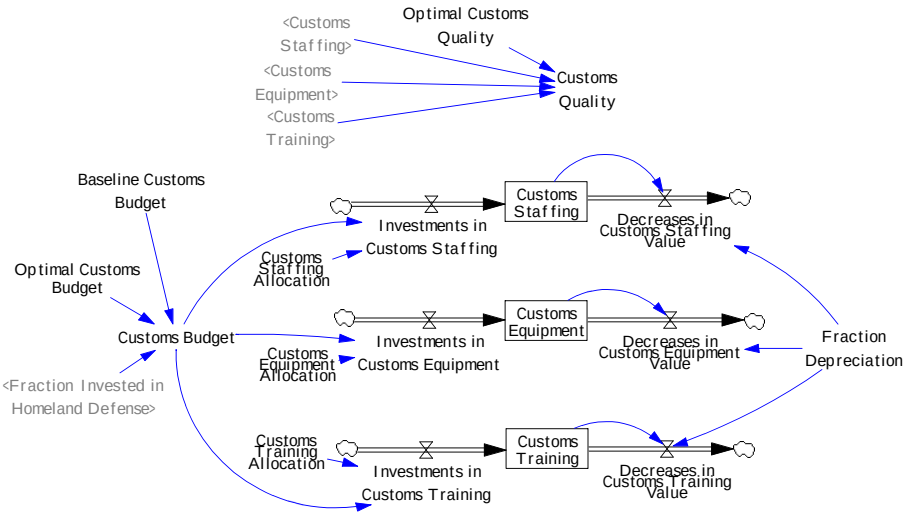
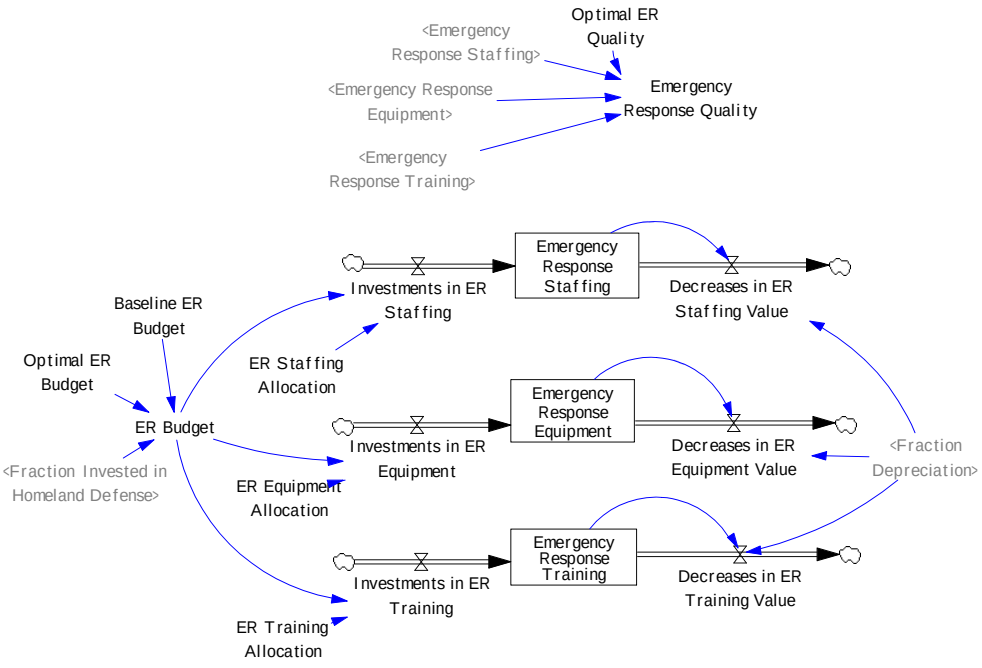


Figure 13. Customs Quality

9) Emergency Response Quality. The quality of emergency response efforts to mitigate losses in a disaster is a function of the fraction of public budget invested in homeland defense. The model structure is similar to that for customs efforts. Allocations to staffing, equipment, and training are parameters in the model.



10)
Figure 14. Emergency Response Quality

The Policies

"…the great challenge facing us now is to invent the corrective feedbacks that are needed to keep custodians honest."

--From Tragedy of the Commons, Garrett Hardin, 1968.

In this section, four policies are introduced with graphs depicting their impacts compared to baseline on key variables. In the next section, policies will compared to each other.

1. Security Maturity in the Public

Because Flynn's focus is primarily container security and the transportation sector in general, the main policy he advocates for is "security maturity" on the part of the public with better detection technology built right into containers. By "security maturity," Flynn hopes that the public will be educated to understand that it must accept some level of risk as part of life.

He believes that if the public doesn't press for a quick reaction, the politicians won't shut down ports and terminals as completely. Figure 15 displays the impact on the shutdown of ports and terminals of a baseline violent event pulse alone and one occuring in the context of a public capable of security maturity. In contrast to baseline, the pressure on the politicians for shutdown would be lowered and a lower proportion of the traffic would be inspected. There would be a minimal slowing of the supply chain, leaving some retails shelves barer than usual, but not empty. There would be backlogs of vehicles, but not gridlock.

In the model runs shown below, the thicker lines depict the baseline case where a violent act sends a pulse to government's the perceived likelihood of attack (not shown) at 5 years. Curves 3 and 4 depict the number of vehicles stuck at terminals, while curves 1 and 2 depct the state of retail inventory. In the security maturity runs, shown by the thinner lines, we see comparably less fluctuation in vehicles at terminals and in inventory on retail shelves.

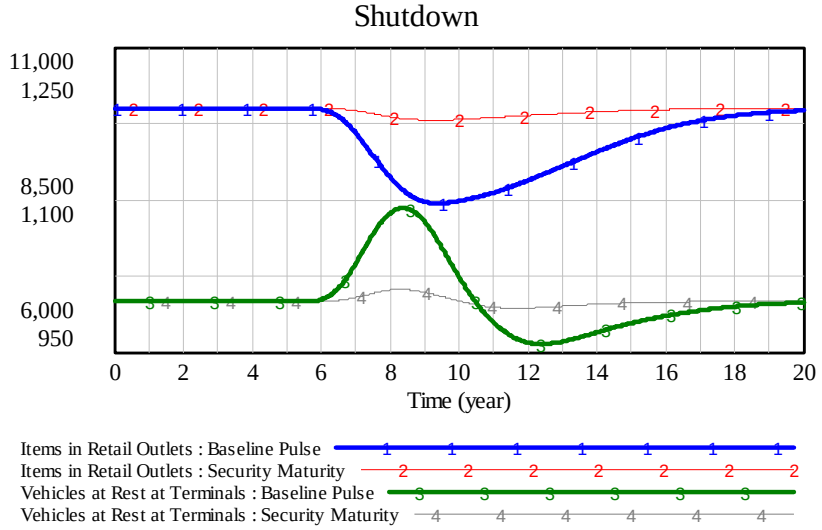


Figure 15. Effect of Shutdown under Pulse Alone and Security Maturity

2. Cap on Overseas Spending

Flynn worries about the lack of a constituency for the homeland with the pressures to spend on the technology for overseas military efforts. He is concerned about Pentagon inertia in letting go of its cold-war philosophies, that 1) homeland defense is not the business of the military but of domestic policing and 2) there are always foreign nations to fight that sponsor terrorism so there is no need to target the shadowy terrorist groups on the homeland. He doesn't advocate any particular policy to address these tendencies, but one might infer that he is advocating for a cap on overseas spending.

While a cap on spending on military technology for overseas use seems in principle to be one way to leave more funds for homeland defense, there remains a problem in the long term. Curve 1 below indicates the spending on homeland defense in the absence of any new policy while Curve 2 indicates the homeland defense spending given a cap on spending.

First, as shown below, this cap-on-spending policy would not alleviate the need for security maturity, because the shutdown factor would be the same in the baseline case or the cap-on-spending case (see Curves 3 and 4 at the top of the graph). As well, while the cap on overseas spending would yield more temporary spending on homeland defense (see Curve 2), the same equilibrium state of spending allocations would be found in the long run in the absence of any specific attack on the homeland.

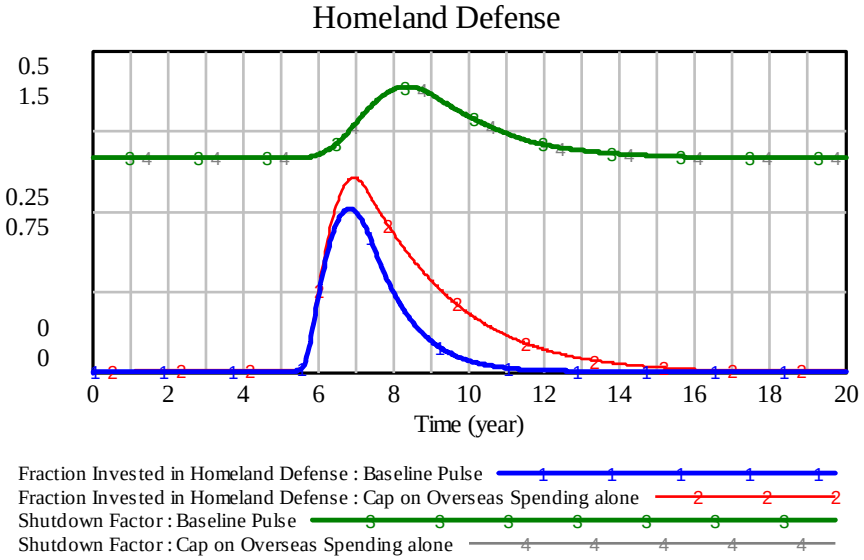


Figure 16. Effect of Cap on Overseas Spending on Homeland Defense Budget Fraction.

3. Insurance Incentives for Security Quality

Flynn does not mention insurance incentives in his recommendations, but a policy of insurance incentives to secure the infrastructure more effectively for both public agencies and private corporations is tested here.

Once again, as shown by Curves 5 and 6, shutdown is not affected by the insurance incentives, suggesting that the political and social dynamics are independent of security funding. Nevertheless, as shown by a comparison of Curves 3 and 4, the insurance incentives add a strong check against the public sector tendency to overspend on military technology for the overseas offensive. Also, as shown by a comparison of Curves 1 and 2, insurance incentives add a strong check against the tragedy of the commons tendencies where competition inhibits private companies from implementing high quality security practices.

In Figure 17, the higher equilibrium values for both private and public investment in homeland security are only obtained with insurance incentives. Basically, when there are incentives, these institutions build security expenditures into their budgets before they spend on anything else. As a result, that baseline equilibrium increase in safety expenditure is accomplished regardless of the ongoing reinforcing loops of competition and overseas offensive costs.

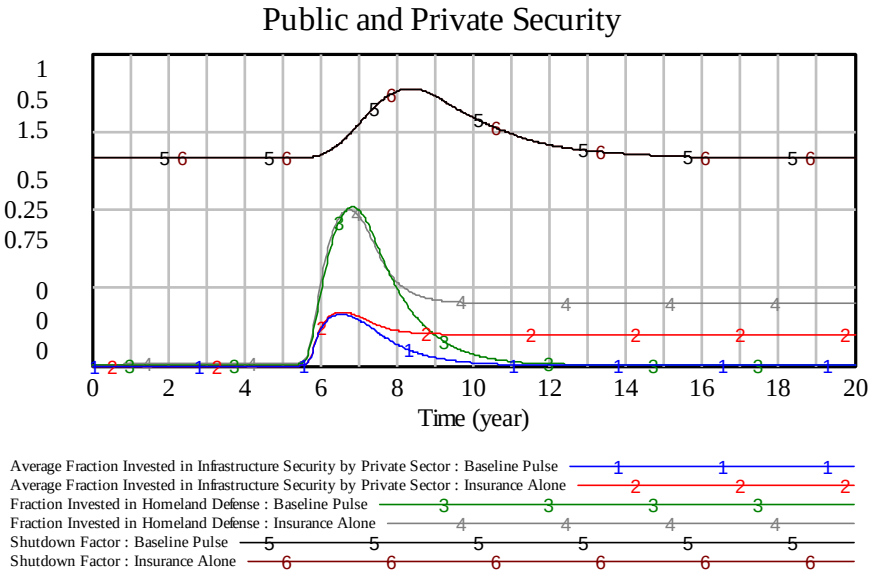


Figure 17. Effect of Insurance on Private and Public Security Investment Fractions

3. Combination of Security Maturity and Insurance Incentives

Because the independent impacts of a) security maturity on short term shutdown practices and b) insurance incentives on long term homeland defense expenditures, a combination policy is tested here.

Since private sector border security is affected by wait times (influenced by security maturity) and public security quality (influenced by insurance incentives), both policies are combined to yield the best security.

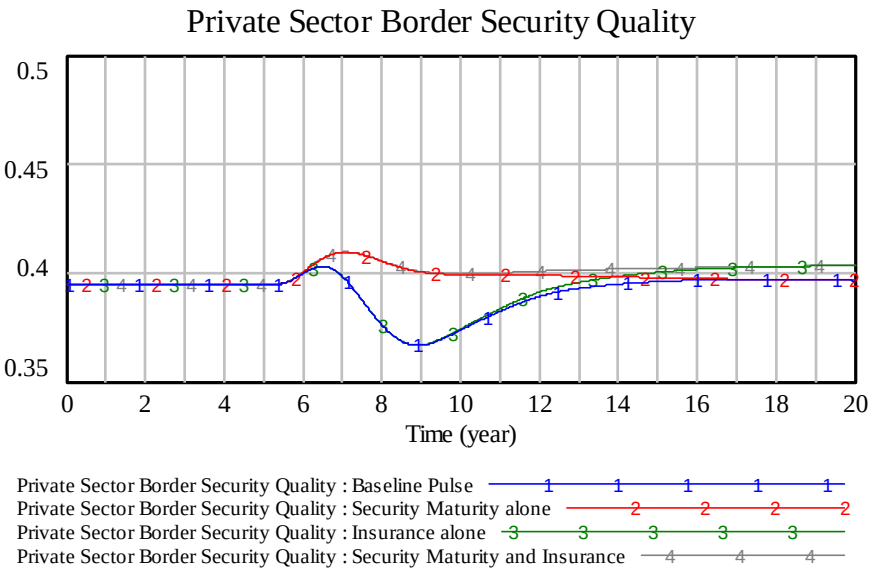


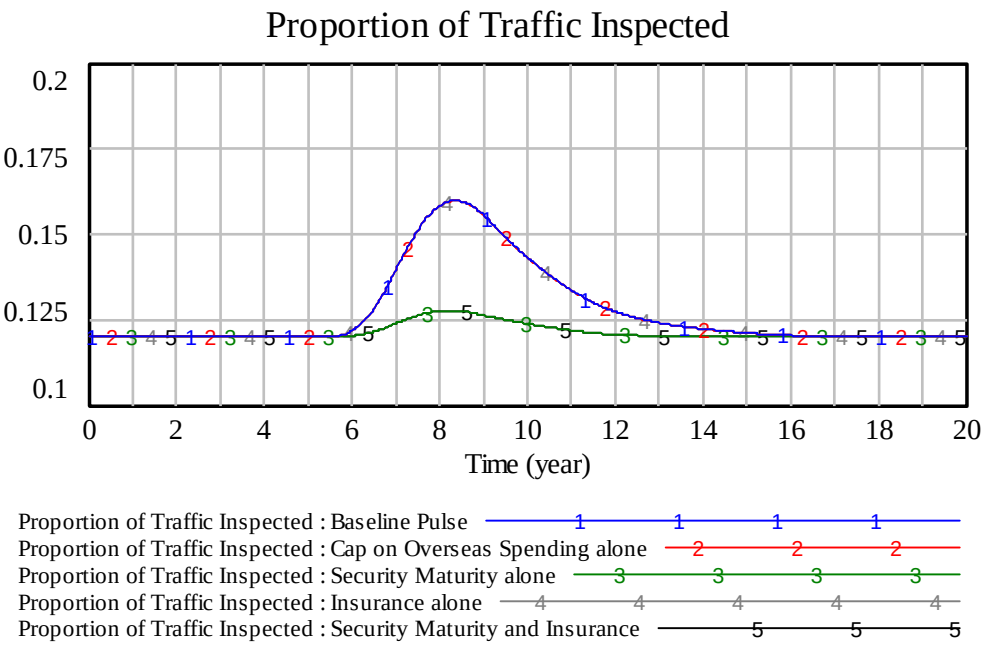
Figure 18. Effect of Combined Policy of Security Maturity and Insurance on Private Border Security

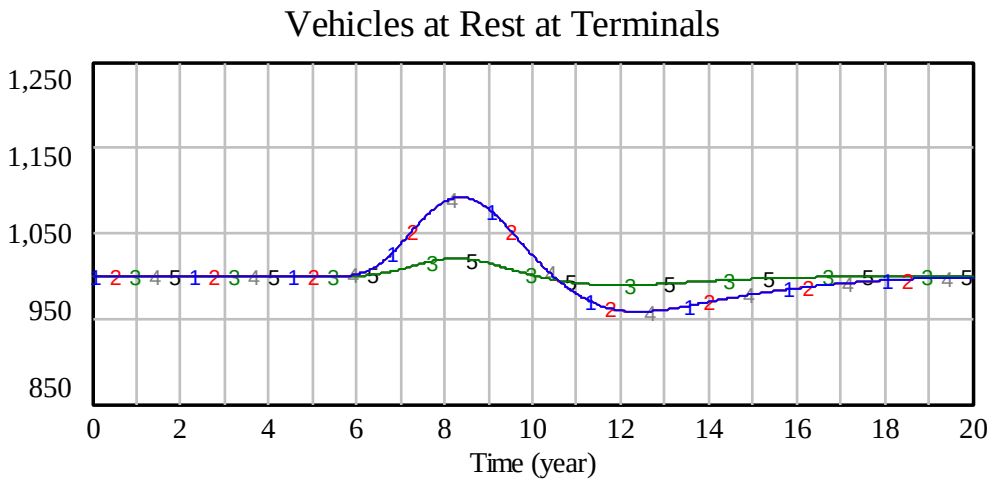
Policy Comparisons

In this section, four policies are compared to each other and the baseline for how they affect the key stocks of the model described earlier. The policies are 1) baseline of no change (in blue); 2) cap on overseas spending alone (in red) ; 3) security maturity alone in which the public pressures politicians for shutdown of ports and terminals at 60% of the usual level (in green); 4) insurance alone in which there are insurance incentives for hardening targets (in grey); and 5) a combination policy of security maturity and insurance (in black).

Extent of Shutdown of Ports and Terminals

Security Maturity Matters. When the public shows security maturity (Policies 3 and 5), the proportion of traffic inspected after a disaster is lessened, averting the fluctuations in vehicles stuck at terminals and in retail inventory. It doesn't matter whether insurance incentives are implemented as well or not for this mitigating effect of security maturity. When it is absent, the negative effects on the transportation sector and the supply chain are seen.




Vehicles at Rest at Terminals
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Time (year)
Vehicles at Rest at Terminals : Baseline Pulse
Vehicles at Rest at Terminals : Cap on Overseas Spending alone
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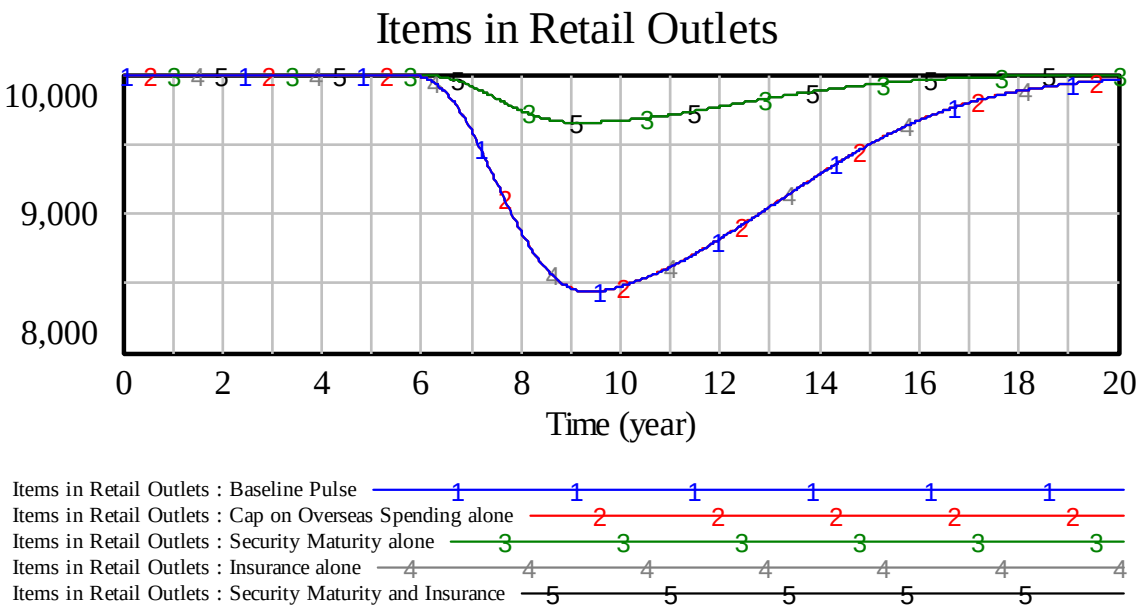
Vehicles at Rest at Terminals : Security Maturity and Insurance


Items in Retail Outlets
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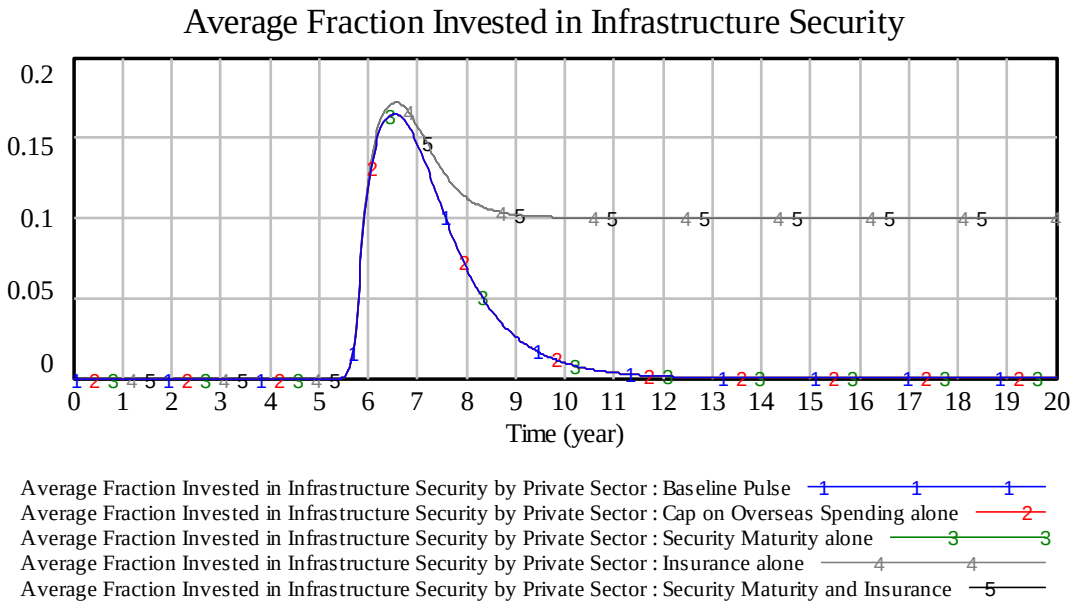
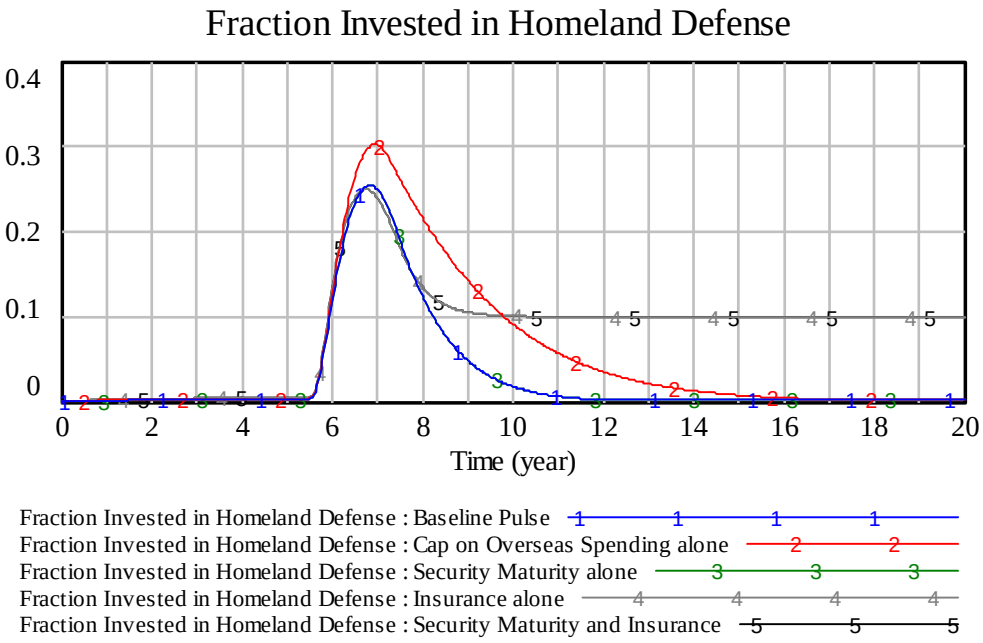
Items in Retail Outlets : Security Maturity alone
Items in Retail Outlets : Insurance alone
Items in Retail Outlets : Security Maturity and Insurance

Public and Private Homeland Infrastructure Defense

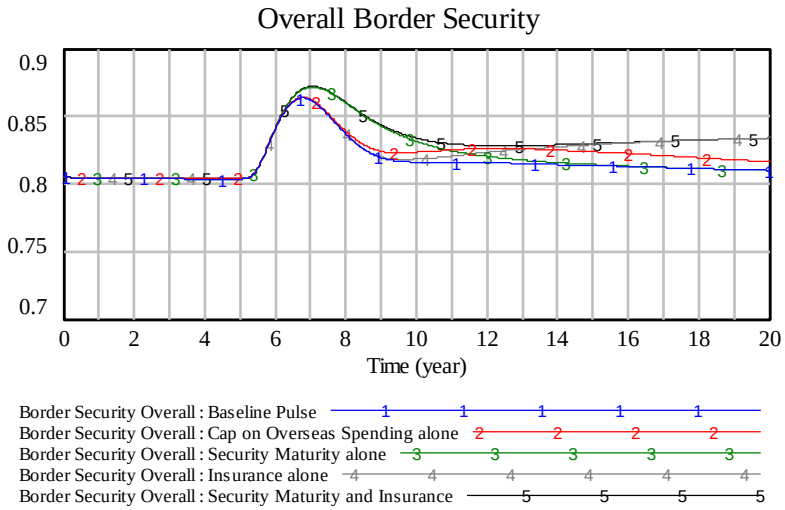
Insurance Matters. When the insurance incentives for higher security standards are present (Policies 4 and 5), the fraction invested by the private infrastructure companies in security jumps to a higher and sustainable equilibrium. Also, the fraction invested in homeland security by the government makes a similar sustainable jump. A cap on overseas spending may be temporarily useful, but its advantage over insurance incentives soon disappears.





Overall Border Security

Both Security Maturity and Insurance Matter. Overall border security is assumed to be the sum of the trading off public and private border security. Border security is positively affected in the short run by security maturity (Policies 3 and 5) but in the long run by insurance incentives (Policies 4 and 5). As a result, the combined policy 5 maximizes border security given the tradeoffs between public and private security



Detection and Preparedness

Insurance Matters. For both customs and emergency response, a short term benefit is seen for a cap on overseas spending (Policy 2), but the strongest positive impact on quality is seen for insurance incentives (Policies 3 and 5).

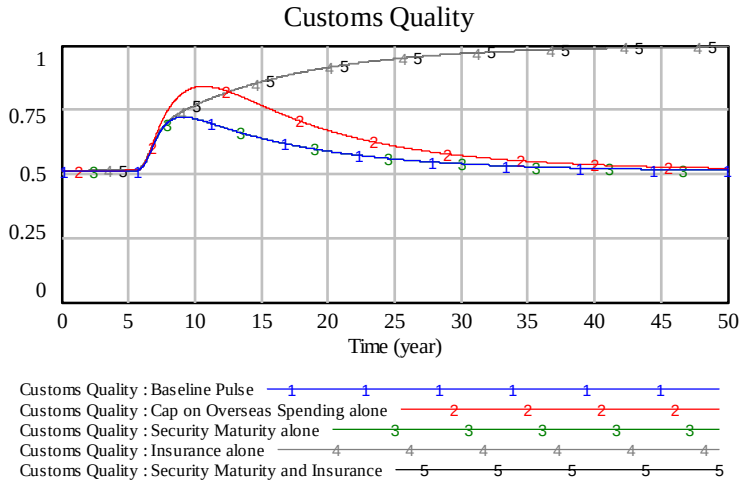


Figure 19 Effect of Each Policy on Customs Detection Capability

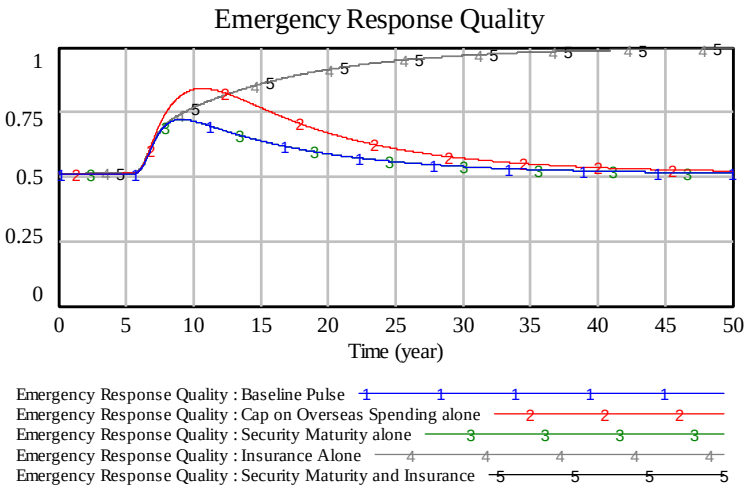


Figure 18. Emergency Response Quality

In summary, while there is a short term benefit to a cap on overseas spending, there is no long run improvement in any of the indicators of better quality homeland security. In contrast, supply chain variables are affected by security maturity and spending allocations are affected by insurance incentives for maintenance of higher quality security standards. A combined policy of security maturity and insurance incentives has the best performance across all measures.

Conclusions

The dynamics of homeland security as outlined by Flynn set up a set of reference modes well matched by output from a model structure influenced by his book, America the Vulnerable.

Flynn outlined two major concerns: 1) the dangers of shutdown of ports and terminals and 2) the lack of a constituency for homeland defense. These two concerns are indeed subject to different dynamics as simulated in the model presented here.

First the shutdown danger is driven by public pressure on politicians to attempt to engage in perfect security, by implementing draconian policies including efforts to inspect every vehicle that attempts to enter the country. The effect of this kind of shutdown is to induce wait times at borders, and a general slowing of the supply chain. A new kind of "security maturity" or a public educated to consider a threshold level of risk acceptable is necessary to alleviate the vicious cycle in consumer confidence.

Second, tradeoffs between public and private security as well as independent dynamics leading to underinvestment by both sectors in homeland security can be addressed with insurance incentives.

The best policy, based on the simulations run on the model structure herein, appears to be a combination of security maturity to prevent pressure on politicians for shutdown in the short run after an attack, and stable insurance incentives for both the public and private sector to invest in good quality homeland defense that would lead to long term maintenance of secure borders and infrastructure.

Flynn believes that security maturity can only exist with a transparent government allowing the public to learn the dangers that affect it, rather than a government that believes it must protect the public from the truth. The terrorists know where the vulnerabilities are; publication of these to the public would only lead to enhanced security not threats to it. In addition, there is a history of insurance incentives leading to standards for higher safety in workplaces, so it does make sense that they would help maintain security standards as well.

As a final note, I found it interesting that I wouldn't have guessed at this combined policy as a solution to better homeland defense. First, the idea that public attitudes control the supply chain is new to me. Secondly, although my politics would not have led me to guess that an insurance incentive approach would be the best policy for long term change, I must accept its evident effectiveness as demonstrated by this work.

APPENDIX: Equations

(001) Adjustment Time= 1
Units: year

(002) Average Fraction Invested in Infrastructure Security by Private Sector= 1-Private Infrastructure Competition Investment Fraction
Units: dmnl

(003) Average Perceived Likelihood of Attack= (Likelihood of Attack as Perceived by Government+Likelihood of Attack as Perceived by Private Sector+Likelihood of Attack as Perceived by Public)/3
Units: dmnl

(004) Average Trip Time= 1
Units: years

(005) Baseline Customs Budget= 100000
Units: dollars/year

(006) Baseline ER Budget= 100000
Units: dollars/year

(007) Border Security Overall= Private Sector Border Security Quality+Public Sector Border Security Quality
Units: dmnl

(008) Cap= 0.5
Units: dmnl/year

(009) Cap Switch= 0
Units: dmnl

(010) Consumer Confidence= Items in Retail Outlets/Normal Items in Retail
Units: dmnl

(011) Customs Budget= Baseline Customs Budget+Optimal Customs Budget*Fraction Invested in Homeland Defense
Units: dollars/year

(012) Customs Equipment= INTEG (+Investments in Customs Equipment-Decreases in Customs Equipment Value, 820000)
Units: dollars

(013) Customs Equipment Allocation= 0.8
Units: dmnl

(014) Customs Quality= (Customs Equipment+Customs Staffing+Customs Training)/Optimal Customs Quality
Units: dmnl

(015) Customs Staffing= INTEG (+Investments in Customs Staffing-Decreases in Customs Staffing Value, 51100)
Units: dollars

(016) Customs Staffing Allocation= 0.05
Units: dmnl

(017) Customs Training= INTEG (+Investments in Customs Training-Decreases in Customs Training Value, 155000)
Units: dollars

(018) Customs Training Allocation= 0.15
Units: dmnl

(019) Decreases in Customs Equipment Value= Customs Equipment*Fraction Depreciation
Units: dollars/year

(020) Decreases in Customs Staffing Value= Customs Staffing*Fraction Depreciation
Units: dollars/year

(021) Decreases in Customs Training Value= Customs Training*Fraction Depreciation
Units: dollars/year

(022) Decreases in ER Equipment Value= Emergency Response Equipment*Fraction Depreciation
Units: dollars/year

(023) Decreases in ER Staffing Value= Fraction Depreciation*Emergency Response Staffing
Units: dollars/year

(024) Decreases in ER Training Value= Emergency Response Training*Fraction Depreciation
Units: dollars/year

(025) Decreases in Private Security Quality= Max(Likelihood of Questionable Smaller Companies Being Hired to Cross Border*Private Sector Border Security Quality,0)/Time for Security Quality to Change

Units: dmnl/year

(026) Decreases in Proportion Inspected= Max((Proportion of Traffic Inspected-Normal Proportion of Traffic Inspected)/Time to Implement Lighter Inspection Policy ,0)
Units: dmnl/year

(027) Decreases in Public Security Quality= Public Sector Border Security Quality/Time for Security Quality to Change
Units: dmnl/year

(028) Decreases in Risk According to Government= Likelihood of Attack as Perceived by Government/Time to Reassess Risk
Units: dmnl/year

(029) Decreases in Risk According to PS= Likelihood of Attack as Perceived by Private Sector/Time to Reassess Risk
Units: dmnl/year

(030) Decreases in Risk According to Public= Likelihood of Attack as Perceived by Public/Time to Reassess Risk
Units: dmnl/year

(031) Decreases to Productivity Investment Fraction= Effect of Pressure on Fraction Decrease*Max(Private Infrastructure Competition Investment Fraction*Pressure to Invest in Infrastructure Security,0)
Units: dmnl/year

(032) Desired Fraction Invested by Private Sector for Infrastructure Security given Perceived Vulnerability= Likelihood of Attack as Perceived by Private Sector*Effect of Likelihood of Attack on Desired Fraction Invested in Security
Units: dmnl

(033) Desired Fraction Invested in Homeland Defense= Effect of Perceived Risk on Desired Fraction Invested in Defense f(Likelihood of Attack as Perceived by Public)
Units: dmnl

(034) Discrepancy in Fraction Invested in Security= Max(Desired Fraction Invested in Homeland Defense -Fraction Invested in Homeland Defense ,0)
Units: dmnl

(035) Distribution Rate to Stores= (Items in Storage at Terminals/Normal Time in Storage)*(1/Shutdown Factor)
Units: items/year

(036) Ease of Terrorist or Criminal Interception of Shipments= Max(1-Private Sector Border Security Quality,0)

Units: dmnl

(037) Effect of Cap on Spending on Offense= IF THEN ELSE(Cap Switch=0,1,Cap)
Units: dmnl/year

(038) Effect of Competition on Pressure to Invest in Productivity= 1
Units: pressure
Units/yeararbitrary

(039) Effect of Customs Quality on Public Border Security= 0.1
Units: dmnl

(040) Effect of Discrepancy on Pressure for Investment= 1
Units: pressure
Units/year

(041) Effect of Insurgency on Pressure to Invest in Offensive= 1
Units: dmnl

(042) Effect of Likelihood of Attack on Desired Fraction Invested in Security= 3
Units: dmnl

(043) Effect of Number of Battles on Extent of Insurgency= 1
Units: dmnl

(044) Effect of Perceived Risk on Desired Fraction Invested in Defense f([(0,0)-(1,1)],(0,0.00438596),(0.0458716,0.00438596),(0.0703364,0.0175439),(0.0825688,0.02754),(0.0948012,0.0482456),(0.116208,0.135965),(0.125382,0.219298),(0.137615,0.29386),(0.155963,0.434211),(0.174312,0.583333),(0.201835,0.767544),(0.223242,0.859649),(0.259939,0.938596),(0.318043,0.986842),(0.385321,0.986842),(0.5,1),(1,1))
Units: dmnl

(045) Effect of Poor Leadership Indicators on Increases in Uncertainty f([(0,0)-(0.5,0.6)],(0,0),(0.0183486,0.05),(0.0458716,0.09),(0.0749235,0.13),(0.12844,0.2),(0.185015,0.225),(0.237003,0.24),(0.298165,0.25),(0.345566,0.25),(0.377676,0.25),(0.43578,0.25),(0.5,0.25))
Units: dmnl/year

(046) Effect of Pressure on Fraction Decrease= 1
Units: dmnl/pressure
Units

(047) Effect of Pressure on Fraction Increase= 1
Units: dmnl/pressure
Units

(048) Effect of Pressure on Fractional Investment in Overseas Offensive f([(0,0)-(1,1)],(0,0),(1,1))
Units: dmnl/year

(049) Effect of Pressure on Proportion Inspected f([(0,0)-(1,1)],(0,0),(0.0489297,0),(0.0978593,0.004),(0.16208,0.02),(0.250765,0.08),(0.360856,0.25),(0.504587,0.4),(0.675841,0.47),(0.795107,0.495),(1,0.5))
Units: dmnl

(050) Effect of Pressure on Security Investment= 1
Units: dmnl/pressure
Units

(051) Effect of Security Fraction Discrepancy on Pressure to Invest in Security f([(0,0)-(1,1)],(0,0),(0.2,0),(0.259939,0.0131579),(0.336391,0.0877193),(0.394495,0.20614),(0.409786,0.324561),(0.415902,0.54386),(0.449541,0.741228),(0.498471,0.881579),(0.559633,0.947368),(0.648318,0.982456),(0.8,1),(1,1))
Units: pressure

(052) Emergency Response Equipment= INTEG (+Investments in ER Equipment-Decreases in ER Equipment Value, 820000)
Units: dollars

(053) Emergency Response Quality= (Emergency Response Equipment+Emergency Response Staffing+Emergency Response Training)/Optimal ER Quality
Units: dmnl

(054) Emergency Response Staffing= INTEG (+Investments in ER Staffing-Decreases in ER Staffing Value, 51100)
Units: dollars

(055) Emergency Response Training= INTEG (+Investments in ER Training-Decreases in ER Training Value, 155000)
Units: dollars

(056) ER Budget= Baseline ER Budget+Optimal ER Budget*Fraction Invested in Homeland Defense
Units: dollars/year

(057) ER Equipment Allocation= 0.8
Units: dmnl

(058) ER Staffing Allocation= 0.05
Units: dmnl

(059) ER Training Allocation= 0.15
Units: dmnl

(060) FINAL TIME = 50
Units: yearThe final time for the simulation.

(061) Foreign Port Departure Rate= Normal Departure Rate/Shutdown Factor
Units: vehicles/year

(062) Fraction Depreciation= 0.1
Units: dmnl/year

(063) Fraction Extra Annual Costs for Higher Insurance Rates= Insurance Switch*(Insurance Standard for Security Investment-Average Fraction Invested in Infrastructure Security by Private Sector)
Units: dmnl

(064) Fraction Extra Cost to Private Sector to Cross Border= Fraction Extra Time Required to Cross at Border
Units: dmnl

(065) Fraction Extra Costs to Insure Homeland against Destruction= Insurance Switch*(Insurance Standard for Security Investment-Fraction Invested in Homeland Defense)
Units: dmnl

(066) Fraction Extra Time Required to Cross at Border= Shutdown Factor/(0.001+Relative Security Quality)
Units: dmnl

(067) Fraction Invested in Homeland Defense= 1-Fraction of Budget Invested in Overseas Offensive
Units: **undefined**

(068) Fraction of Budget Invested in Overseas Offensive= INTEG (+Fractional Increases in Overseas Offensive Investment-Fractional Decreases in Overseas Offensive Investment, 1)
Units: dmnl

(069) Fractional Decreases in Overseas Offensive Investment= Effect of Pressure on Security Investment*(Fraction of Budget Invested in Overseas Offensive*Pressure for Investment in Homeland Defense)
Units: dmnl/year

(070) Fractional Increases in Overseas Offensive Investment= Effect of Pressure on Fractional Investment in Overseas Offensive f(Pressure for Investment in Overseas Offensive)*Max(1-(Fraction of Budget Invested in Overseas Offensive+Fraction Extra Costs to Insure Homeland against Destruction),0)*Effect of Cap on Spending on Offense
Units: dmnl/year

(071) Incoming Vehicle Rate= Max(Vehicles en Route/Average Trip Time,0)
Units: vehicles/year

(072) Increases in Private Security Quality= (Ease of Terrorist or Criminal Interception of Shipments*(1-Private Sector Border Security Quality)/Time for Security Quality to Change)
Units: dmnl/year

(073) Increases in Proportion Inspected= Effect of Pressure on Proportion Inspected f(Pressure for Monitoring)/Time to Implement Heavier Inspection Policy
Units: dmnl/year

(074) Increases in Public Security Quality= ((1-Public Sector Border Security Quality)*Pressure to Increase Border Security+(Effect of Customs Quality on Public Border Security)*Customs Quality)/Time for Security Quality to Change
Units: dmnl/year

(075) Increases in Risk According to Government= Perceived Violent Event/Time to Reassess Risk
Units: dmnl/year

(076) Increases in Risk According to PS= Perceived Violent Event/Time to Reassess Risk
Units: dmnl/year

(077) Increases in Risk According to Public= Perceived Violent Event/Time to Reassess Risk
Units: dmnl/year

(078) Increases in Uncertainty= Effect of Poor Leadership Indicators on Increases in Uncertainty f(Ineffective Leadership Indicator)
Units: dmnl/year

(079) Increases to Productivity Investment Fraction= Effect of Pressure on Fraction Increase*Pressure to Invest in Productivity on Individual Companies* Max (1-(Private Infrastructure Competition Investment Fraction + Fraction Extra Annual Costs for Higher Insurance Rates),0)
Units: dmnl/year

(080) Ineffective Leadership Indicator= relative weight on consumer confidence*(1-Consumer Confidence)+(1-relative weight on consumer confidence)*Likelihood of Attack as Perceived by Government
Units: dmnl

(081) INITIAL TIME = 0
Units: yearThe initial time for the simulation.

(082) Insurance Standard for Security Investment= 0.2
Units: dmnl

(083) Insurance Switch= 0
Units: dmnl

(084) Investments in Customs Equipment= Customs Budget*Customs Equipment Allocation
Units: dollars/year

(085) Investments in Customs Staffing= Customs Budget*Customs Staffing Allocation
Units: dollars/year

(086) Investments in Customs Training= Customs Budget*Customs Training Allocation
Units: dollars/year

(087) Investments in ER Equipment= ER Budget*ER Equipment Allocation
Units: dollars/year

(088) Investments in ER Staffing= ER Budget*ER Staffing Allocation
Units: dollars/year

(089) Investments in ER Training= ER Budget*ER Training Allocation
Units: dollars/year

(090) Items in Manufacturing= INTEG (Materials Shipment Rate-Shipment Rate to Terminals, 10000)
Units: items

(091) Items in Retail Outlets= INTEG (Distribution Rate to Stores-Purchasing Rate, 10000)
Units: items

(092) Items in Storage at Terminals= INTEG (Shipment Rate to Terminals-Distribution Rate to Stores, 10000)
Units: items

(093) Likelihood of Attack as Perceived by Government= INTEG (+Increases in Risk According to Government-Decreases in Risk According to Government, 0)
Units: dmnl

(094) Likelihood of Attack as Perceived by Private Sector= INTEG (+Increases in Risk According to PS-Decreases in Risk According to PS, 0)
Units: dmnl

(095) Likelihood of Attack as Perceived by Public= INTEG (+Increases in Risk According to Public-Decreases in Risk According to Public, 0)
Units: dmnl

(096) Likelihood of Questionable Smaller Companies Being Hired to Cross Border= Fraction Extra Cost to Private Sector to Cross Border
Units: dmnl

(097) Materials Shipment Rate= Normal Materials Shipment Rate/Shutdown Factor
Units: items/year

(098) Normal Departure Rate= 1000
Units: vehicles/year

(099) Normal Items in Retail= 10000
Units: items

(100) Normal Materials Shipment Rate= 10000
Units: items/year

(101) Normal Proportion of Traffic Inspected= 0.12
Units: dmnl

(102) Normal Security Quality= 0.38
Units: dmnl

(103) Normal Time at Rest= 1
Units: years

(104) Normal Time in Storage= 1
Units: year

(105) Normal Time on Shelves= 1
Units: year

(106) Optimal Customs Budget= 1e+006
Units: dollars/year

(107) Optimal Customs Quality= 2e+006
Units: dollars

(108) Optimal ER Budget= 1e+006
Units: dollars/year

(109) Optimal ER Quality= 2e+006
Units: dollars/year

(110) Outgoing Vehicle Rate= (Vehicles at Rest at Terminals/Normal Time at Rest)/Shutdown Factor
Units: vehicles/year

(111) Perceived Lack of Security in Private Sector= Max(Desired Fraction Invested by Private Sector for Infrastructure Security given Perceived Vulnerability -Average Fraction Invested in Infrastructure Security by Private Sector,0)
Units: dmnl

(112) Perceived Violent Event= Smooth(Violent Event,Perception Delay)
Units: dmnl

(113) Perception Delay= 1
Units: year

(114) Pressure for Investment in Homeland Defense= Effect of Discrepancy on Pressure for Investment*Max((Discrepancy in Fraction Invested in Security),0)
Units: pressure
Units/year

(115) Pressure for Investment in Overseas Offensive= Relative Extent of Insurgency*Effect of Insurgency on Pressure to Invest in Offensive
Units: dmnl

(116) Pressure for Monitoring= (1-Security Maturity)*(relative weight on uncertainty*Uncertainty in Leadership Regarding Attacks+(1-relative weight on uncertainty)*Pressure to Increase Border Security)
Units: dmnl

(117) Pressure to Increase Border Security= Average Perceived Likelihood of Attack+Relative Amount Contraband Crossing Borders and Amount of Theft at Borders
Units: dmnl

(118) Pressure to Invest in Infrastructure Security= Effect of Security Fraction Discrepancy on Pressure to Invest in Security f(Perceived Lack of Security in Private Sector)
Units: pressure

Units/year

(119) Pressure to Invest in Productivity on Individual Companies= Effect of Competition on Pressure to Invest in Productivity*Private Infrastructure Competition Investment Fraction
Units: pressure
Units/year

(120) Private Infrastructure Competition Investment Fraction= INTEG (+Increases to Productivity Investment Fraction-Decreases to Productivity Investment Fraction, 1)
Units: dmnl

(121) Private Sector Border Security Quality= INTEG (+Increases in Private Security Quality-Decreases in Private Security Quality, 0.395)
Units: **undefined**

(122) Proportion of Traffic Inspected= INTEG (+Increases in Proportion Inspected-Decreases in Proportion Inspected, 0.12)
Units: dmnl

(123) Public Sector Border Security Quality= INTEG (Increases in Public Security Quality-Decreases in Public Security Quality, 0.41)
Units: dmnl

(124) Purchasing Rate= Items in Retail Outlets/Normal Time on Shelves
Units: items/year

(125) Relative Amount Contraband Crossing Borders and Amount of Theft at Borders= Ease of Terrorist or Criminal Interception of Shipments
Units: dmnl

(126) Relative Extent of Insurgency= Effect of Number of Battles on Extent of Insurgency*Relative Number of Battles
Units: dmnl

(127) Relative Number of Battles= Fraction of Budget Invested in Overseas Offensive
Units: dmnl

(128) Relative Security Quality= Public Sector Border Security Quality/Normal Security Quality
Units: dmnl

(129) relative weight on consumer confidence= 0.1
Units: dmnl

(130) relative weight on uncertainty= 0.95

Units: dmnl

(131) SAVEPER = TIME STEP
Units: year [0,?]The frequency with which output is stored.

(132) Security Maturity= 0
Units: dmnl

(133) Shipment Rate to Terminals= Items in Manufacturing/Time in Manufacturing
Units: items/year

(134) Shutdown Factor= Max(Proportion of Traffic Inspected/Normal Proportion of Traffic Inspected,0.5)
Units: dmnl

(135) Switch= 1
Units: dmnl

(136) Time for Security Quality to Change= 1
Units: years

(137) Time in Manufacturing= 1
Units: year

(138) TIME STEP = 0.03125
Units: year [0,?]The time step for the simulation.

(139) Time to Implement Heavier Inspection Policy= 1
Units: years

(140) Time to Implement Lighter Inspection Policy= 1
Units: year

(141) Time to Reassess Risk= 1
Units: year

(142) Uncertainty Decay Rate= Uncertainty in Leadership Regarding Attacks/Adjustment Time
Units: dmnl/year

(143) Uncertainty in Leadership Regarding Attacks= INTEG (Increases in Uncertainty-Uncertainty Decay Rate, 0)
Units: dmnl

(144) Vehicles at Rest at Terminals= INTEG (Incoming Vehicle Rate-Outgoing Vehicle Rate, 1000)
Units: vehicles

(145) Vehicles en Route= INTEG (Foreign Port Departure Rate-Incoming Vehicle Rate, 1000)
Units: vehicles

(146) Violent Event= Switch*PULSE(5, 0.5)
Units: dmnl