What if repression is an option?

R will accept offer in t=2 when

$$\mathbf{Reduce}\left[(1-x_2)*(1+r) > \left(\frac{p}{1+w*r}\right)*(1+r)*(1-d)\ \&\&\ 1>p>0\ \&\&\ w>0\ \&\&\ r>0\ \&\&\ d>0,\ x_2\right]$$

$$w>0\ \&\&\ 0<p<1\ \&\&\ r>0\ \&\&\ d>0\ \&\&\ x_2<\frac{1-p+d\,p+r\,w}{1+r\,w}$$

offer is

$$x_2 := \frac{1-p+d\,p+r\,w}{1+r\,w}$$

G makes this offer rather than fighting when:

$$\mathbf{Reduce}\left[(x_2)*(1+r) > \left(1-\frac{p}{1+w*r}\right)*(1+r)*(1-d)\ \&\&\ 1>p>0\ \&\&\ w>0\ \&\&\ r>0\ \&\&\ d>0,\ d\right]$$

$$0<p<1\ \&\&\ w>0\ \&\&\ r>0\ \&\&\ d>0$$

Always offer this deal. R accepts in t=1 when

$$\mathbf{FullSimplify}[\mathbf{Reduce}[(1-x_1)+\delta*(1-x_2)*(1+r) > (p)*(1-d)+\delta*(p)*(1+r)*(1-d)\ \&\&\ 1>p>0\ \&\&\ w>0\ \&\&\ r>0\ \&\&\ d>0,\ x_1]]$$

$$w>0\ \&\&\ 0<p<1\ \&\&\ r>0\ \&\&\ d>0\ \&\&\ x_1<1+\frac{(-1+d)\,p\,(1+r\,w\,(1+\delta+r\,\delta))}{1+r\,w}$$

$$x_1 := 1+\frac{(-1+d)\,p\,(1+r\,w\,(1+\delta+r\,\delta))}{1+r\,w}$$

But nothing is good enough to prevent war when:

$$\mathbf{Reduce}[(1)+\delta*(1-x_2)*(1+r) < (p)*(1-d)+\delta*(p)*(1+r)*(1-d)\ \&\&\ 1>p>0\ \&\&\ w>0\ \&\&\ r>0\ \&\&\ d>0,\ p]$$

$$r>0\ \&\&\ \left(\left(0<d<1\ \&\&\ w>0\ \&\&\ \delta>\frac{-d-d\,r\,w}{-r\,w+d\,r\,w-r^2\,w+d\,r^2\,w}\ \&\&\ \frac{-1-r\,w}{-1+d-r\,w+d\,r\,w-r\,w\,\delta+d\,r\,w\,\delta-r^2\,w\,\delta+d\,r^2\,w\,\delta}<p<1\right)\ ||\ \left(d>1\ \&\&\ w>0\ \&\&\ \delta<\frac{-d-d\,r\,w}{-r\,w+d\,r\,w-r^2\,w+d\,r^2\,w}\ \&\&\ \frac{-1-r\,w}{-1+d-r\,w+d\,r\,w-r\,w\,\delta+d\,r\,w\,\delta-r^2\,w\,\delta+d\,r^2\,w\,\delta}<p<1\right)\right)$$

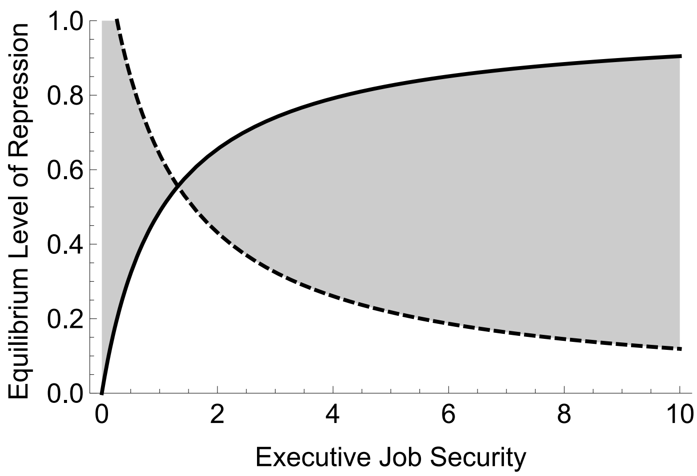
$$\mathbf{Reduce}\left[\delta>\frac{-d-d\,r\,w}{-r\,w+d\,r\,w-r^2\,w+d\,r^2\,w}\ \&\&\ 1>p>0\ \&\&\ w>0\ \&\&\ r>0\ \&\&\ d>0,\ d\right]$$

$$\left(0<p<1\ \&\&\ w>0\ \&\&\ r>0\ \&\&\ \delta<\frac{-1-r\,w}{r\,w+r^2\,w}\ \&\&\ 1<d<\frac{r\,w\,\delta+r^2\,w\,\delta}{1+r\,w+r\,w\,\delta+r^2\,w\,\delta}\right)\ ||\ \left(0<p<1\ \&\&\ w>0\ \&\&\ r>0\ \&\&\ \frac{-1-r\,w}{r\,w+r^2\,w}\leq\delta\leq0\ \&\&\ d>1\right)\ ||\ \left(0<p<1\ \&\&\ w>0\ \&\&\ r>0\ \&\&\ \delta>0\ \&\&\ 0<d<\frac{r\,w\,\delta+r^2\,w\,\delta}{1+r\,w+r\,w\,\delta+r^2\,w\,\delta}\right)\ ||\ (0<p<1\ \&\&\ w>0\ \&\&\ r>0\ \&\&\ \delta>0\ \&\&\ d>1)$$

```
Unset[δ]
Unset[w]
Unset[d]
```

```
δ = .95; w = 1; d = 0.2
Plot[{(r w δ + r^2 w δ)/(1 + r w + r w δ + r^2 w δ), (-1 - r w)/(-1 + d - r w + d r w - r w δ + d r w δ - r^2 w δ + d r^2 w δ)},
 {r, 0, 10}, Frame → {True, True, False, False},
 FrameLabel → {"Executive Job Security", "Equilibrium Level of Repression"},
 LabelStyle → Directive[Larger],
 PlotStyle → {{Black, Thick}, {Black, Thick, Dashed}}, PlotRange → {0, 1},
 Filling → {1 → {2}}]
```

```
0.2
```



What if repression is an option?

R will accept offer in t=2 when

```
Reduce[(1 - x2) * (1 + r) > (p/(1 + w * r)) * (1 + r) * (1 - d) && 1 > p > 0 && w > 0 && r > 0 && d > 0, x2]
```

$$w > 0 \ \&\& \ 0 < p < 1 \ \&\& \ r > 0 \ \&\& \ d > 0 \ \&\& \ x_2 < \frac{1 - p + d\,p + r\,w}{1 + r\,w}$$

offer is

In[2]:=
$$x_2 := \frac{1 - p + d\,p + r\,w}{1 + r\,w}$$

G makes this offer rather than fighting in t=2 when:

```
Reduce[(x2) * (1 + r) > (1 - p/(1 + w * r)) * (1 + r) * (1 - d) && 1 > p > 0 && w > 0 && r > 0 && d > 0, d]
```

$$0 < p < 1 \ \&\& \ w > 0 \ \&\& \ r > 0 \ \&\& \ d > 0$$

Always offer this deal. R accepts an offer in t=1, such that rejection entails repression, as long as

In[3]:=
$$\mathbf{FullSimplify}\Big[\mathbf{Reduce}\Big[(1-x_1)+\delta*(1-x_2)*(1+r)>\left(\frac{p}{1+\alpha}\right)*(1-d)+\delta*\left(\frac{p}{1+\alpha}\right)*(1+r)*(1-d)\ \&\&\ 1>p>0\ \&\&\ w>0\ \&\&\ r>0\ \&\&\ d>0\ \&\&\ 0<\alpha<w*r,\ x_1\Big]\Big]$$

Out[3]=
$$w>0\ \&\&\ \alpha>0\ \&\&\ r>\frac{\alpha}{w}\ \&\&\ 0<p<1\ \&\&\ d>0\ \&\&\ x_1<\frac{(1+r\,w)\,(1+\alpha)+(-1+d)\,p\,(1+r\,w+(1+r)\,(r\,w-\alpha)\,\delta)}{(1+r\,w)\,(1+\alpha)}$$

So G offers.

In[4]:=
$$x_1:=\frac{(1+r\,w)\,(1+\alpha)+(-1+d)\,p\,(1+r\,w+(1+r)\,(r\,w-\alpha)\,\delta)}{(1+r\,w)\,(1+\alpha)}$$

But nothing is good enough to prevent rejection when:

In[5]:=
$$\mathbf{Reduce}\Big[(1)+\delta*(1-x_2)*(1+r)<\left(\frac{p}{1+\alpha}\right)*(1-d)+\delta*\left(\frac{p}{1+\alpha}\right)*(1+r)*(1-d)\ \&\&\ 1>p>0\ \&\&\ w>0\ \&\&\ r>0\ \&\&\ d>0\ \&\&\ 0<\alpha<w*r,\ p\Big]$$

Out[5]=
$$\alpha>0\ \&\&\ \Bigg(\bigg(0<d<1\ \&\&\ r>0\ \&\&\ w>\frac{\alpha}{r}\ \&\&\ \delta>\frac{-d-d\,r\,w-\alpha-r\,w\,\alpha}{-r\,w+d\,r\,w-r^2\,w+d\,r^2\,w+\alpha-d\,\alpha+r\,\alpha-d\,r\,\alpha}\ \&\&\ (-1-r\,w-\alpha-r\,w\,\alpha)\Big/\big(-1+d-r\,w+d\,r\,w-r\,w\,\delta+d\,r\,w\,\delta-r^2\,w\,\delta+d\,r^2\,w\,\delta+\alpha\,\delta-d\,\alpha\,\delta+r\,\alpha\,\delta-d\,r\,\alpha\,\delta\big)<p<1\bigg)\ ||$$
$$\bigg(d>1\ \&\&\ r>0\ \&\&\ w>\frac{\alpha}{r}\ \&\&\ \delta<\frac{-d-d\,r\,w-\alpha-r\,w\,\alpha}{-r\,w+d\,r\,w-r^2\,w+d\,r^2\,w+\alpha-d\,\alpha+r\,\alpha-d\,r\,\alpha}\ \&\&\ (-1-r\,w-\alpha-r\,w\,\alpha)\Big/\big(-1+d-r\,w+d\,r\,w-r\,w\,\delta+d\,r\,w\,\delta-r^2\,w\,\delta+d\,r^2\,w\,\delta+\alpha\,\delta-d\,\alpha\,\delta+r\,\alpha\,\delta-d\,r\,\alpha\,\delta\big)<p<1\bigg)\Bigg)$$

In[7]:=
$$\mathbf{Reduce}\Big[\delta>\frac{-d-d\,r\,w-\alpha-r\,w\,\alpha}{-r\,w+d\,r\,w-r^2\,w+d\,r^2\,w+\alpha-d\,\alpha+r\,\alpha-d\,r\,\alpha}\ \&\&\ 1>p>0\ \&\&\ w>0\ \&\&\ r>0\ \&\&\ d>0\ \&\&\ w*r>\alpha>0,\ d\Big]$$

Out[7]=
$$\bigg(0<p<1\ \&\&\ \alpha>0\ \&\&\ r>0\ \&\&\ w>\frac{\alpha}{r}\ \&\&\ \delta<\frac{-1-r\,w}{r\,w+r^2\,w-\alpha-r\,\alpha}\ \&\&\ 1<d<\frac{\alpha+r\,w\,\alpha-r\,w\,\delta-r^2\,w\,\delta+\alpha\,\delta+r\,\alpha\,\delta}{-1-r\,w-r\,w\,\delta-r^2\,w\,\delta+\alpha\,\delta+r\,\alpha\,\delta}\bigg)\ ||$$
$$\bigg(0<p<1\ \&\&\ \alpha>0\ \&\&\ r>0\ \&\&\ w>\frac{\alpha}{r}\ \&\&\ \frac{-1-r\,w}{r\,w+r^2\,w-\alpha-r\,\alpha}\le\delta\le\frac{-\alpha-r\,w\,\alpha}{-r\,w-r^2\,w+\alpha+r\,\alpha}\ \&\&\ d>1\bigg)\ ||$$
$$\bigg(0<p<1\ \&\&\ \alpha>0\ \&\&\ r>0\ \&\&\ w>\frac{\alpha}{r}\ \&\&\ \delta>\frac{-\alpha-r\,w\,\alpha}{-r\,w-r^2\,w+\alpha+r\,\alpha}\ \&\&\ 0<d<\frac{\alpha+r\,w\,\alpha-r\,w\,\delta-r^2\,w\,\delta+\alpha\,\delta+r\,\alpha\,\delta}{-1-r\,w-r\,w\,\delta-r^2\,w\,\delta+\alpha\,\delta+r\,\alpha\,\delta}\bigg)\ ||$$
$$\bigg(0<p<1\ \&\&\ \alpha>0\ \&\&\ r>0\ \&\&\ w>\frac{\alpha}{r}\ \&\&\ \delta>\frac{-\alpha-r\,w\,\alpha}{-r\,w-r^2\,w+\alpha+r\,\alpha}\ \&\&\ d>1\bigg)$$

```
Unset[δ]
Unset[w]
Unset[d]
```

In[36]:= $\delta = .95;\ w = 1;\ d = 0.2;\ \alpha = .5$

$$\text{Plot}\Big[\Big\{\frac{r\,w\,\delta + r^2\,w\,\delta}{1 + r\,w + r\,w\,\delta + r^2\,w\,\delta},$$

$$\frac{-1 - r\,w}{-1 + d - r\,w + d\,r\,w - r\,w\,\delta + d\,r\,w\,\delta - r^2\,w\,\delta + d\,r^2\,w\,\delta},\ \frac{\alpha + r\,w\,\alpha - r\,w\,\delta - r^2\,w\,\delta + \alpha\,\delta + r\,\alpha\,\delta}{-1 - r\,w - r\,w\,\delta - r^2\,w\,\delta + \alpha\,\delta + r\,\alpha\,\delta},$$

$$\frac{-1 - r\,w - \alpha - r\,w\,\alpha}{-1 + d - r\,w + d\,r\,w - r\,w\,\delta + d\,r\,w\,\delta - r^2\,w\,\delta + d\,r^2\,w\,\delta + \alpha\,\delta - d\,\alpha\,\delta + r\,\alpha\,\delta - d\,r\,\alpha\,\delta}\Big\},$$

```
 {r, 0, 10}, Frame → {True, True, False, False},
 FrameLabel → {"newly discovered oil resources, r", "war thresholds on d and p"},
 LabelStyle → Directive[Larger], PlotStyle →
  {{Black, Thick}, {Black, Thick, Dashed}, {Red, Thick}, {Red, Thick, Dashed}},
 PlotRange → {0, 1}, Filling → {1 → {{2}, {None, GrayLevel[0.69]}}},
 Filling → {3 → {{4}, {None, Red}}}]
```

Out[36]= 0.5

Out[37]=