Part A- Present 3 graphs that show the evolution of the inflation rate, the interest rate and output over the 20 periods of your simulation. Explain the economic mechanisms behind the change in the evolution of the 3 variables caused by the demand shock.

Part A will analyze the dynamics of the 3 equation NCM model over 20 time periods following a permanent AD shock denoted by a fall in A from 1.1 to 1.09. We will use graphs (A,B,C) from our R simulation and compare these with the graphical framework in Figure 1 to illustrate how the central bank responds. This simulation uses parameters specified by the question. For a more interactive version of the model check out my web app located at :

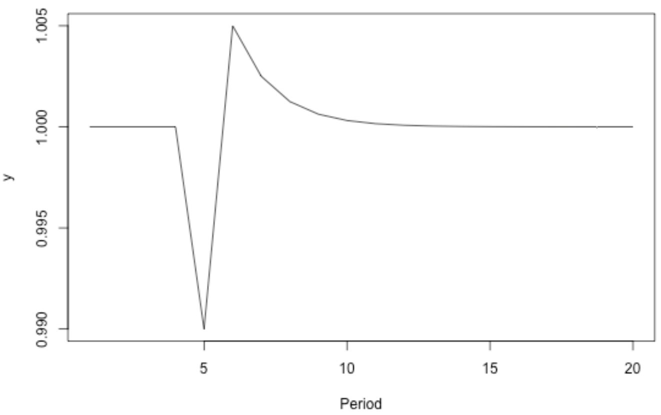
http:macromodels.shinyapps.ioworking_app_ga=2.19598904.12255646.1648234837-1558294345.1648059051

Following 5 time periods of equilibrium output=1, target inflation=2% and a stabilizing real interest rate=0.05, a permanent negative aggregate demand shock occurs. Drawing parallels to the recent covid-19 pandemic helps illustrate a real-world example of a permanent AD shock that rattles consumer confidence. The virus outbreak causes a permanent shift in the IS curve to IS* as shown in figure 3 which sees a reduction in output as denoted by the $y_{t=5} - y_e$ output gap to 0.99. The consequence of this drop in output is a corresponding reduction in the rate of inflation to below target. Given this lower inflation rate the backwards looking Phillips curve is now defined as $(PC(\pi^T = 1\%))$ and intersects the MR at different point.

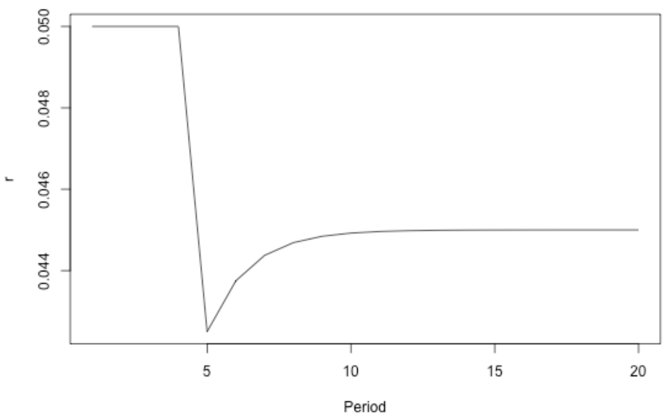
The central bank is now faced with a demand deficient economy uneasy about the virus with inflation rates and output levels both off target. It decides to intervene by setting an interest rate=0.042 as outlined by its reaction function (MR curve). This can be seen in fig 1 as a change from r_1 to $r_{t=5}$.

The government's credible monetary policy has restored consumer confidence and led to a positive output gap as denoted by $y_s - y_e$. Since output is now above equilibrium inflation starts to pick up again, prompting the central bank to gradually revise interest rates upwards until inflation returns to target at $(PC(\pi^I = 2\%))$. Since the pandemic is still lingering on, and demand has thus suffered a more permanent aggregate demand shock, the central bank decides to choose a stabilising real interest rate r_s of 0.0449.

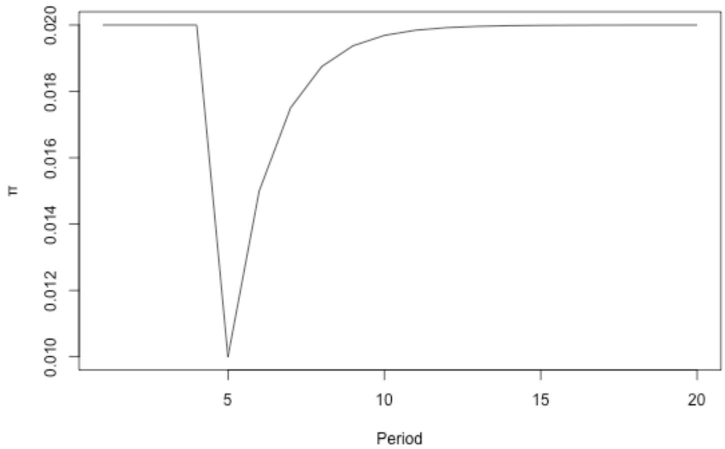
A. Output



B. Interest Rate



C. Inflation Rate



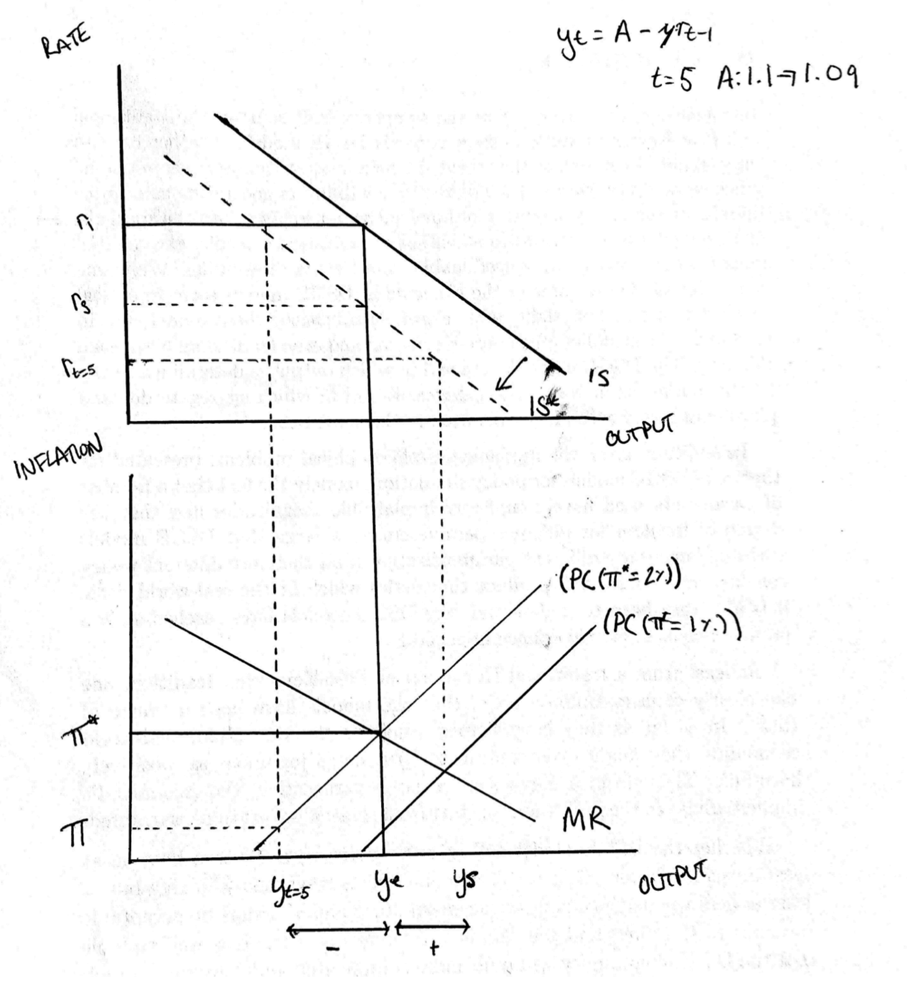


Figure 1. Permanent negative aggregate demand shock.

V

A data.frame: 20 × 3

π	y	r
<dbl>	<dbl>	<dbl>
0.02000000	1.000000	0.05000000
0.02000000	1.000000	0.05000000
0.02000000	1.000000	0.05000000
0.02000000	1.000000	0.05000000
0.01000000	0.990000	0.04250000
0.01500000	1.005000	0.04375000
0.01750000	1.002500	0.04437500
0.01875000	1.001250	0.04468750
0.01937500	1.000625	0.04484375
0.01968750	1.000313	0.04492188
0.01984375	1.000156	0.04496094
0.01992187	1.000078	0.04498047
0.01996094	1.000039	0.04499023
0.01998047	1.000020	0.04499512
0.01999023	1.000010	0.04499756
0.01999512	1.000005	0.04499878
0.01999756	1.000002	0.04499939
0.01999878	1.000001	0.04499969
0.01999939	1.000001	0.04499985
0.01999969	1.000000	0.04499992

Table 1. Output values for the NCM values

R code

1. Time Vectors

```
y<-vector(length=20)
r<-vector(length=20)
π<-vector(length=20)
```

2. Parameter specification

```
a<-1.1
α<-β<-1
γ<-2
π_T<-0.02
yε<-1
y[1]<-yε
π[1]<-π_T
r[1]<-(a-yε)/γ
```

3. Loop for 2:20 periods

```
for(t in 2:20){
   if(t<5){a<-1.1}else{a<-1.09}
   #IS curve
   y[t]<-a-(γ*r[t-1])

   #Philips curve


   δy<-y[t]-yε
   π[t]<-π[t-1]+(α*δy)

   #IR rule
   δπ<-π[t]-π_T
   p2<-(α*β*δπ)/((γ*1)+(γ*α^2*β))

   #taylor
   taylor<-0.5*δπ^2+0.5*δy^2

   p1<-(a-yε)/γ
   r[t]<-p1+p2


}
```

4. Plotting graphs

```
plot (y, type="l", xlab= "Period", ylab= "output")
plot (r, type="l", xlab= "Period", ylab= "rate")
plot (π, type="l", xlab= "Period", ylab= "π")
```