C.1. Instructions

Instructions from all treatments can be found in this section of the Online Appendix.

1. Inflation Targeting

2. Dual Mandate

3. Average Inflation Targeting - 4 period ahead horizon

4. Average Inflation Targeting - 10 period ahead horizon

5. Price Level Targeting

6. Nominal GDP Level Targeting

We provide all the common instructions and indicate where the instructions differed across treatments.

Experimental Instructions

Welcome! You are participating in an economics experiment at SFU Experimental Economics Lab. In this experiment you will participate in the experimental simulation of the economy. If you read these instructions carefully and make appropriate decisions, you may earn a considerable amount of money that will be immediately paid out to you in cash at the end of the experiment.

Each participant is paid CDN$7 for attending. Throughout this experiment you will also earn points based on the decisions you make. Every point you earn is worth $0.50. We reserve the right to improve this in your favour if average payoffs are lower than expected.

During the experiment you are not allowed to communicate with other participants. If you have any questions, the experimenter will be glad to answer them privately. If you do not comply with these instructions, you will be excluded from the experiment and deprived of all payments aside from the minimum payment of CDN $7 for attending.

The experiment is based on a simple simulation that approximates fluctuations in the real economy. Your task is to serve as private forecasters and provide real-time forecasts about future output and inflation in this simulated economy. The instructions will explain what output, inflation, and the interest rate are and how they move around in this economy, as well as how they depend on forecasts. We will allow you to practice making forecasts for several unpaid periods before we begin paid periods in this experiment. You will then participate in 50 paid periods.

In this simulation, households and firms (whose decisions are automated by the computer) will form forecasts identically to yours. So to some degree, outcomes that you will see in the game will depend on the way in which you form your forecasts. Your earnings in this experiment will depend on the accuracy of your individual forecasts.

On the next page we will discuss what inflation and output are, and how to predict them. All values will be given in basis points, a measurement often used in descriptions of the economy. All values can be positive, negative, or zero at any point in time.

Your task

Your task in this experiment is to forecast future output and inflation as correctly as possible.
You will submit forecasts for the next period's inflation and output, measured in basis points:

- 1% = 100 basis points
- 3.25% = 325 basis points
- -0.5% = -50 basis points
- -4.8% = -480 basis points

These are just a handful of examples of how basis points work. You can submit any forecast
you wish, positive or negative or zero, but please only submit integers.

How the economy evolves

We will now explain the factors that influence output and inflation and the relationships between the different
variables in the economy.

The economy consists of six main variables: shocks, inflation, output, interest rate, price level and nominal
output. Each period, you will receive the following information that will help you make forecasts.

Current Shock

A shock is a random "event" that directly affects how much people want to spend, and consequently, how much
will be produced.

The shocks change every period and are influenced by a random component and past shocks.

More precisely, the shocks that you observe will follow the process specified in your instructions.

At any time period t, the shock is calculated as follows:

$$Shock_t = 60 + 0.8(Shock_{t-1}) + Random\ Component_t$$

- The random component is 0 on average, and has a standard deviation of 93 basis points.
- Roughly 2/3rds of the time, the shock is between -155 and +155 basis points
- 95% of the time, the shock will be between -310 and +310 basis points

Intuitively, you can think of the shocks as weather shocks. Over the long run, the weather has no effect on how
much consumers want to buy. However, from day to day, there may be random changes to the weather. You can
think of a positive shock as unexpectedly nice weather. When the weather is especially nice, consumers are
spending more time out of their homes and increasing their expenditures (for example, buying ice cream, going
out for a nice dinner, going to the beach). A negative shock can be thought of unexpectedly terrible weather,
where no one wants to leave their homes, causing expenditures to be relatively low. Gradually, the shocks, like
weather, will revert back to their long-run levels. As the shocks dissipate, new random events occur that will
make consumers want to increase or decrease their expenditures.

Consider the following examples:

$$Shock_1 = 30$$
$$Shock_2 = 60 + 30 * 0.8 + Random\ Component_2$$
$$= 60+24 + Random\ Component_2$$
$$Shock_2 = 84 + (-150)$$
$$= -66$$
$$Shock_3 = \ldots$$

Each period, you and the other forecasters will be submitting your beliefs about the following period's output and inflation. The median of each of the forecasts will be employed as the aggregate forecast in the given period and play an important role in determining the current level of output and inflation. The median, rather than the average forecast, is used so that a small number of subjects cannot have a significant effect on the economy.

Output

Output refers to a measure of the quantity of goods the economy is over- or under producing in a given period.

At any time period t, output is calculated as follows:

$$Output_t = Median\ Forecast\ of\ output_{t+1} + Median\ Forecast\ of\ inflation_{t+1} - Interest\ Rate_t + Shock_t$$

The value of today's output is determined by the median expectations (forecasts) of tomorrow's output and inflation, as well as today's shock and interest rate. If you, the forecasters, predict that the future economy will be producing more output and there will be more inflation, consumers will want to spend more in the current period. Firms will then produce more to meet consumer demand.

Likewise, positive shocks to consumer demand will have a positive effect on how much will be produced.

Increases in the nominal interest rate will make it more expensive for consumers to borrow and will create more incentive for them to save. With higher interest rates, consumers will decrease their demand for goods, leading to lower production, which will indirectly reduce inflation.

Inflation

Inflation is the rate at which overall prices change between two periods.

At any time period t, inflation is calculated as follows:

$$Inflation_t = 0.998(Median\ Forecast\ of\ Inflation_{t+1}) + 0.125(Output_t)$$

Inflation is determined largely by your forecast about future inflation. The idea behind this is simple: If you, the professional forecasters, communicate to the public that inflation is likely to rise in the future, consumers will spend more immediately to avoid paying relatively higher prices (positive inflation) in the future. This increase in demand will cause prices to start rising, i.e. current inflation will increase.

Current output will also have a small positive effect on current inflation. Importantly, variables that affect output will also have a small positive effect on inflation.

You will also have information about other macroeconomic variables that evolve over time.

Price level

The price level is an index measuring the price of output in the economy. The price level evolves with the rate of inflation:

$$Price\ Level_t = Price\ Level_{t-1} + Inflation_t$$

When inflation is positive, the price level increases. When inflation is negative, the price level declines. The price level is shown as an index with a starting value of 1000.

Example 1. Suppose the price level in the previous period is 1000. The inflation rate in the current period is 200 basis points. The price level in the current period is:
Price level = 1000 + 200 = 1200.

Example 2. Instead, suppose the inflation rate in the current period is -200 basis points. The price level in the current period is
Price level = 1000 – 200 = 800.

Nominal output level

The nominal output level is the nominal value of output in the experimental economy. The nominal output level evolves with both output and inflation over time:

$$Nominal\ Output\ Level_t = Output_t + Price\ Level_t$$

The nominal output level is higher when output (production) and the price level are higher, and vice versa. Nominal output is shown as an index with a starting value of 1000.

INFLATION TARGETING TREATMENT

Central Bank Policy

The main objective of the central bank in this experiment is to keep the nominal output level at its target level. The target for nominal output is 1000. The central bank sets the interest rate to bring nominal output to its target.

Interest Rate

The interest rate is the rate at which consumers and firms borrow and save in this experimental economy.

The interest rate responds to the distance between the current inflation rate and its target zero. The interest rate also responds to deviations of output from 0 as they are linked to deviations of inflation from its target. The response to output is much weaker than the response to inflation as output is not the principal target of the Central Bank's policy

At any time period *t*, the interest rate is calculated as follows:

$$Interest\ Rate_t = 60 + 1.5(Inflation_t - 0) + 0.125(Output_t - 0) \quad if\ Interest\ Rate_t > 0$$
$$= 0 \quad otherwise$$

When inflation is high and above its target of 0 basis points, the central bank will increase interest rates more than one-for-one with inflation. The central bank will also increase interest rate, though less aggressively, in response to positive output. When inflation is further above its target, the increase in the interest rate is larger.

The increase in the interest rate has a direct negative effect on consumer demand and output, and an indirect negative effect on inflation. *When inflation is above target, a higher interest rate leads to lower inflation and thus helps bring it back towards its target.*

When inflation is below the target of 0 basis points, the central bank will decrease interest rates more than one-for-one with negative inflation. The central bank will also decrease the interest rate in response to negative output, though less aggressively. When inflation is further below its target, the decrease in the interest rate is larger.

Lower interest rates have a direct positive effect on consumer demand and output, and an indirect positive effect on inflation. *When inflation is below target, a lower interest rate leads to higher inflation and thus helps bring it back towards its target.*

It is also important for you to realize that, even though the central bank is aiming for inflation at its target of zero, it may not be able to accomplish this every period because of the persistent random shocks that are occurring each period and the public's (your) expectations. However, the economy will be kept relatively more stable as a consequence of the central bank's reaction to inflation and output.

Note that the central bank cannot lower interest rates below zero. For large negative values of inflation and output, the central bank will simply set the interest rate at zero.

You will not observe the current interest rate when you are forming your forecast about the following period's inflation and output. After you submit your forecasts, the computer will simultaneously solve for the current period's inflation, output and interest rate taking into consideration the forecasts and the realized shock.

DUAL MANDATE TREATMENT

Central Bank Policy

The main objective of the central bank in this experiment is to keep the inflation rate and output at their targets. The inflation target is equal to 0 basis points. The target for output is 0 basis points as well. The central bank sets the interest rate to bring the inflation rate and output to their targets.

Interest Rate

The interest rate is the rate at which consumers and firms borrow and save in this experimental economy.

The interest rate responds to the distance between the current inflation rate and its target zero. The interest rate also responds to the distance between the current output and its target zero.

At any time period *t*, the interest rate is calculated as follows:

$$Interest\ Rate_t = 60 + 4.5(Inflation_t - 0) + 4.5(Output_t - 0) \quad if\ Interest\ Rate_t > 0$$
$$= 0 \quad otherwise$$

When inflation and output are high and above their targets of 0 basis points, the central bank will increase interest rates more than one-for-one with inflation and output. When inflation and output are further above their targets, the increase in the interest rate is larger.

The increase in the interest rate has a direct negative effect on consumer demand and output, and an indirect negative effect on inflation. *When inflation and output are above target, a higher interest rate leads to lower inflation and output and thus helps bring both back towards their targets.*

When inflation and output are low and below their targets of 0 basis points, the central bank will decrease interest rates more than one-for-one with negative inflation and output. When inflation and output are further below their target, the decrease in the interest rate is larger.

Lower interest rates have a direct positive effect on consumer demand and output, and an indirect positive effect on inflation. *When inflation and output are below target, a lower interest rate leads to higher inflation and output and thus helps bring both back towards their targets.*

It is also important for you to realize that, even though the central bank is aiming for inflation at its target of zero, it may not be able to accomplish this every period because of the persistent random shocks that are occurring each period and the public's (your) expectations. However, the economy will be kept relatively more stable as a consequence of the central bank's reaction to inflation and output.

Note that the central bank cannot lower interest rates below zero. For large negative values of inflation and output, the central bank will simply set the interest rate at zero.

You will not observe the current interest rate when you are forming your forecast about the following period's inflation and output. After you submit your forecasts, the computer will simultaneously solve for the current period's inflation, output and interest rate taking into consideration the forecasts and the realized shock.

AVERAGE INFLATION TARGETING – 4 PERIOD AND 10 PERIOD HORIZON TREATMENTs

Central Bank Policy

The main objective of the central bank in this experiment is to keep the average inflation rate over 4 (10) periods at its target. The average inflation target is equal to 0 basis points. The central bank sets the interest rate to bring the average inflation rate to its target.

Interest Rate

The interest rate is the rate at which consumers and firms borrow and save in this experimental economy.

The interest rate responds to the distance between the average inflation rate over the current and past 3 (10) periods and its target zero. The interest rate also responds to deviations of output from 0 as they are linked to deviations of inflation from its target. The response to output is much weaker than the response to inflation as output is not the principal target of the Central Bank's policy.

At any time period *t*, the interest rate is calculated as follows:

$$Interest\ Rate_t = 60 + 5.5(Average\ Inflation_t - 0) + 3(Output_t - 0) \quad if\ Interest\ Rate_t > 0$$
$$= 0 \quad\quad\quad otherwise$$

where

Average Inflation$_1$ = Inflation$_1$	in Period 1
Average Inflation$_2$ = (Inflation$_1$ + Inflation$_2$)/2	in Period 2
Average Inflation$_t$ = (Inflation$_1$ + Inflation$_2$ + Inflation$_3$)/3	in Period 3
Average Inflation$_t$ = (Inflation$_t$ + Inflation$_{t-1}$ + Inflation$_{t-2}$ + Inflation$_{t-3}$) / 4	in Periods 4+
(Average Inflation$_t$ = (Inflation$_t$ + Inflation$_{t-1}$ + Inflation$_{t-2}$ + … + Inflation$_{t-9}$) / 4	in Periods 10+)*

When average inflation is high and above its target of 0 basis points, the central bank will increase interest rates more than one-for-one with average inflation. The central bank will also increase interest rate, though less aggressively, in response to positive output. When average inflation is further above its target, the increase in the interest rate is larger.

The increase in the interest rate has a direct negative effect on consumer demand and output, and an indirect negative effect on inflation. *When inflation is above target, a higher interest rate leads to lower inflation and thus helps bring average inflation back towards its target.*

When average inflation is below the target of 0 basis points, the central bank will decrease interest rates more than one-for-one with negative average inflation. The central bank will also decrease the interest rate in response to negative output, though less aggressively. When average inflation is further below its target, the decrease in the interest rate is larger.

Lower interest rates have a direct positive effect on consumer demand and output, and an indirect positive effect on inflation. *When average inflation is below target, a lower interest rate leads to higher inflation and thus helps bring average inflation back towards its target.*

It is also important for you to realize that, even though the central bank is aiming for average inflation at its target of zero, it may not be able to accomplish this every period because of the persistent random shocks that are occurring each period and the public's (your) expectations. However, the economy will be kept relatively more stable as a consequence of the central bank's reaction to inflation and output.

Note that the central bank cannot lower interest rates below zero. For large negative values of average inflation and output, the central bank will simply set the interest rate at zero.

You will not observe the current interest rate when you are forming your forecast about the following period's inflation and output. After you submit your forecasts, the computer will simultaneously solve for the current period's inflation, output and interest rate taking into consideration the forecasts and the realized shock.

PRICE LEVEL TARGETING TREATMENT

Central Bank Policy

The main objective of the central bank in this experiment is to keep the price level at its target level. The target for the price level is 1000. The central bank sets the interest rate to bring nominal output to its target.

Interest Rate

The interest rate is the rate at which consumers and firms borrow and save in this experimental economy.

The interest rate responds to the distance between the price level and its target level of 1000. The interest rate also responds to deviations of output from 0 as they are linked to deviations of the price level from its target.

At any time period t, the interest rate is calculated as follows:

$$Interest\ Rate_t = 60 + 0.8(Price\ Level_t - 1000) + 1.3(Output_t - 0) \quad if\ Interest\ Rate_t > 0$$
$$= 0 \qquad\qquad\qquad\qquad\qquad\qquad otherwise$$

When the price level is high and above its target of 1000 basis points, the central bank will increase interest rates. The central bank will also increase interest rate in response to positive output. When the price level is further above its target, the increase in the interest rate is larger.

The increase in the interest rate has a direct negative effect on consumer demand and output, and an indirect negative effect on inflation, and thus the price level. *When the price level is above target, a higher interest rate leads to lower inflation and thus helps bring the price level back towards its target.*

When the price level is below the target of 1000 basis points, the central bank will decrease interest rates. The central bank will also decrease the interest rate in response to negative output. When the price level is further below its target, the decrease in the interest rate is larger.

Lower interest rates have a direct positive effect on consumer demand and output, and an indirect positive effect on inflation, and thus the price level. *When the price level is below target, a lower interest rate leads to higher inflation and thus helps bring the price level back towards its target.*

It is also important for you to realize that, even though the central bank is aiming for the price level to be at its target of 1000, it may not be able to accomplish this every period because of the persistent random shocks that are occurring each period and the public's (your) expectations. However, the economy will be kept relatively more stable as a consequence of the central bank's reaction to the price level and output.

Note that the central bank cannot lower interest rates below zero. For low price levels and large negative values of output, the central bank will simply set the interest rate at zero.

You will not observe the current interest rate when you are forming your forecast about the following period's inflation and output. After you submit your forecasts, the computer will simultaneously solve for the current period's inflation, output and interest rate taking into consideration the forecasts and the realized shock.

NOMINAL GDP LEVEL TARGETING TREATMENT

Central Bank Policy

The main objective of the central bank in this experiment is to keep the nominal output level at its target level. The target for nominal output is 1000. The central bank sets the interest rate to bring nominal output to its target.

Interest Rate

The interest rate is the rate at which consumers and firms borrow and save in this experimental economy.

The interest rate responds to the distance between nominal output level and its target level of 1000.

At any time period t, the interest rate is calculated as follows:

$$Interest\ Rate_t = 60 + 1.1(Nominal\ Output_t - 1000) \qquad if\ Interest\ Rate_t > 0$$
$$= 0 \qquad otherwise$$

When the level of nominal output is above its target level of 1000, the central bank will increase interest rates more than one-for-one in response to this discrepancy. When nominal output is further above its target, the increase in the interest rate is larger.

The increase in the interest rate has a direct negative effect on consumer demand and output, and an indirect negative effect on inflation. When inflation decreases, the price level decreases. As output and the price level decrease, nominal output decreases. Thus, *when nominal output is above its target, higher interest rate leads to lower nominal output and thus helps bring it back towards its target.*

When the level of nominal output is below its target level of 1000, the central bank will decrease interest rates more than one-for-one in response to this discrepancy. When nominal output is further below its target, the decrease in the interest rate is larger.

The decrease in the interest rate has a direct positive effect on consumer demand and output, and an indirect positive effect on inflation. When inflation increases, the price level increases. As output and price level increase, nominal output increases. *Thus, when nominal output is below its target, lower interest rate leads to higher nominal output and thus helps bring it back towards its target.*

Lower interest rates have a direct positive effect on consumer demand and output, and an indirect positive effect on inflation, and thus the price level. *When the price level is below target, a lower interest rate leads to higher inflation and thus helps bring the price level back towards its target.*

It is also important for you to realize that, even though the central bank is aiming for a stable level of nominal output at its target of 1000, it may not be able to accomplish this every period because of the persistent random shocks that are occurring each period and the public's (your) expectations. However, the economy will be kept relatively more stable as a consequence of the central bank's reaction to the nominal output from its target.

Note that the central bank cannot lower interest rates below zero. For low nominal outputs, the central bank will simply set the interest rate at zero.

You will not observe the current interest rate when you are forming your forecast about the following period's inflation and output. After you submit your forecasts, the computer will simultaneously solve for the current period's inflation, output and interest rate taking into consideration the forecasts and the realized shock.

Score

Your score will depend on the accuracy of your inflation and output forecasts. The absolute difference between your forecasts and the actual values for output and inflation are your absolute forecast errors.

Absolute Forecast Error = absolute (Your Forecast – Actual Value)
Total Score = 0.30(2^-0.01(Absolute Forecast Error for Output)) + 0.30(2^-0.01 (Absolute Forecast Error for Inflation))

The maximum score you can earn each period is 0.6 points.
Your score will decrease as your forecast error increases. Suppose your forecast errors for each of output and inflation are:

0	-Your score will be 0.6	300	-Your score will be 0.075
50	-Your score will be 0.42	500	-Your score will be 0.02
100	-Your score will be 0.3	1000	-Your score will be 0
200	-Your score will be 0.15	2000	-Your score will be 0

Information about the Interface, Actions, and Payoffs

During the experiment, your main screen will display information that will help you make forecasts and earn more points.

At the top left of the screen, you will see your subject number, the current period, time remaining, and the total number of points earned. You will also see four history plots.

The top history plot displays past interest rates and past and current shocks.

The second plot displays your past forecasts of inflation and realized inflation levels. (*IT/DM/AIT Treatments:* You will also be shown the central bank's inflation target of 0 in orange.)

The third plot displays your past forecast of output and realized output levels.

Your forecasts will always be shown in blue while the realized value will be shown in red. You can see the exact value for each point on a graph by placing your mouse at that point. The difference between your forecasts and the actual realized levels constitutes your forecast errors.

The fourth plot will show price level and nominal output. The price level will be presented on the left axis in purple while the nominal output will be presented on the right axis in green. (*PLT Treatment:* You will also be shown the central bank's nominal output level target of 1000 in orange.) (*NGDP Treatment:* You will also be shown the central bank's nominal output level target of 1000 in orange.)

You may submit positive, negative or zero forecasts. Please use whole numbers. Please review your forecasts before pressing the SUBMIT button. Once the SUBMIT button has been clicked, you will not be able to revise your forecasts until the next period. You will earn zero points if you do not submit both forecasts.

You will have 75 seconds to submit forecasts for output and inflation for the first 10 rounds, and 60 seconds for the remaining 40 periods. Your score converted into Canadian dollars ($0.50 per point) plus the show up fee will be paid to you in cash at the end of the experiment.

B.2. Experimental interface

Participants interacted in an online interface where they repeatedly made inflation and output forecasts. Figure 1 presents a sample screenshot from the inflation targeting treatment.

Figure 1: Screenshot of participants' screens during the experiment