Economics 442
Fall 2020
University of Wisconsin-Madison

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Social Sciences 7418

**Problem Set 2 Answers**

Due on 5:30pm CDT ~~Friday~~ Monday, October 12 by submission to Canvas. Be sure to put your name on your problem set. Put "boxes" around your answers to the algebraic questions.

1. Consider the Aggregate Demand-Aggregate Supply framework. Suppose lump sum taxes are decreased when the economy is at full employment, and the Fed does ***NOT*** target the interest rate. You can assume for simplicity expected inflation is always zero.

1.1 Show what happens in an IS-LM and AD-AS graph in the period lump sum tax decrease occurs.

**Answer:** In figure 1 below, black arrows indicate shifts in AD, IS due to decrease in lump sum taxes. Output rises from $Y_0$ to $Y_1$, interest rates rise to $i_1$ as LM shifts up (Gray arrows) due to the price level increase.

1.2 Show what happens over time to output, the price level, and the interest rate.

**Answer:** In Figure 2, white arrows indicate AS keeps on shifting up as expected price level rises with lagged price level (assumes $P^e_t = P_{t-1}$). This process continues as long as output exceeds the natural rate of output $Y_n$. Over time output returns to $Y_0$, price level rises to $P_{Final}$, the LM keeps on shifting up as M/P shrinks, and the interest rate rises $i_{Final}$.

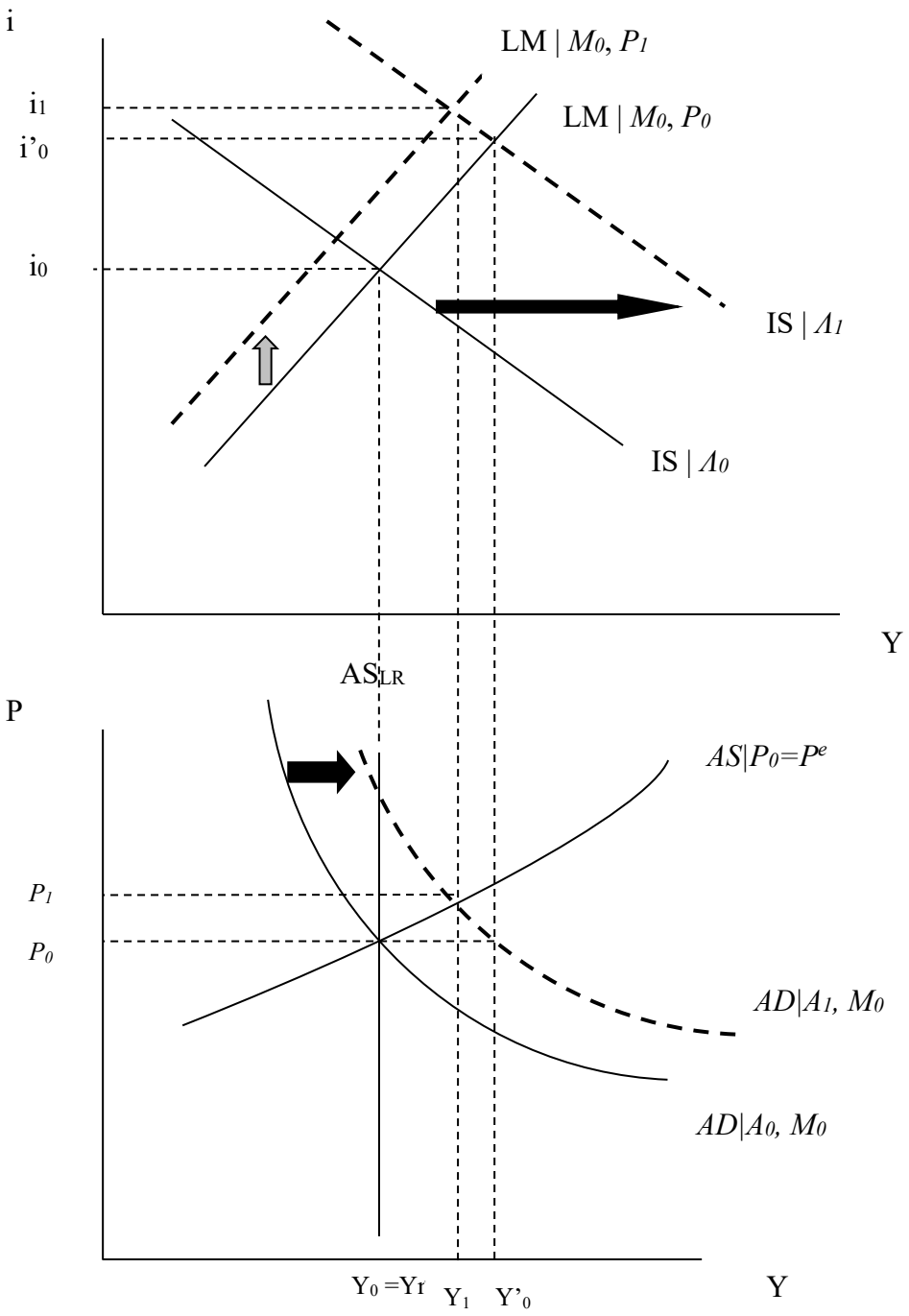



**Figure 1:** Decrease in Lump Sum Taxes, Immediate Impact

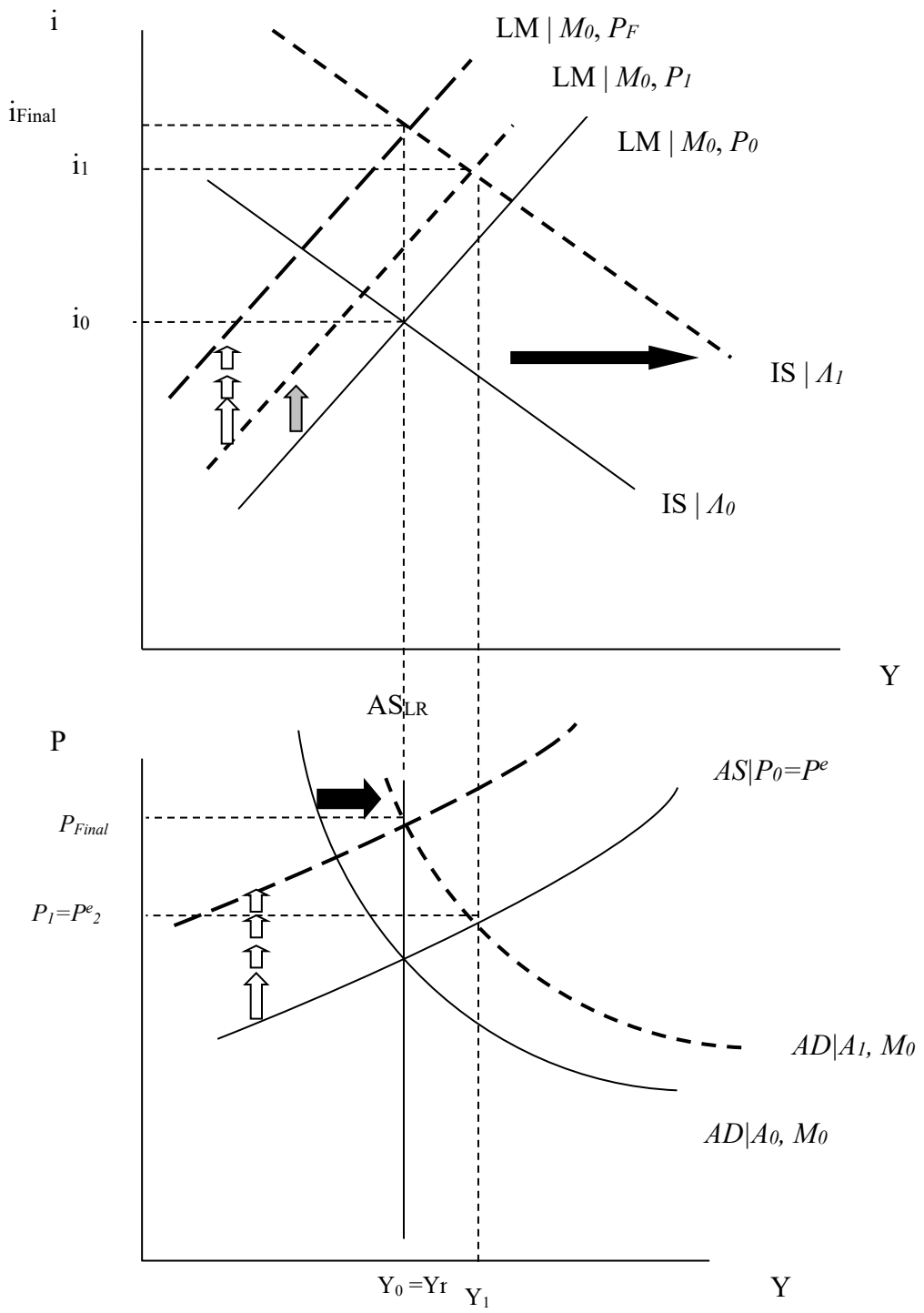



**Figure 2:** Decrease in Lump Sum Taxes, Medium Run

2. Use the same AD-AS model as in Problem 1, consider what happens if many firms go out of business, thus decreasing the natural level of output (also known as potential GDP). Answer using AD-AS graphs.

2.1 Show what happens in the period in which potential GDP changes.

**Answer:** ASLR shifts in to AS'LR (black arrow), short run AS shifts up (black arrow) to intersect at the same expected price level but on new AS'LR. Higher resulting price level results in shifted inward LM (black arrow), higher interest rates, lower output.

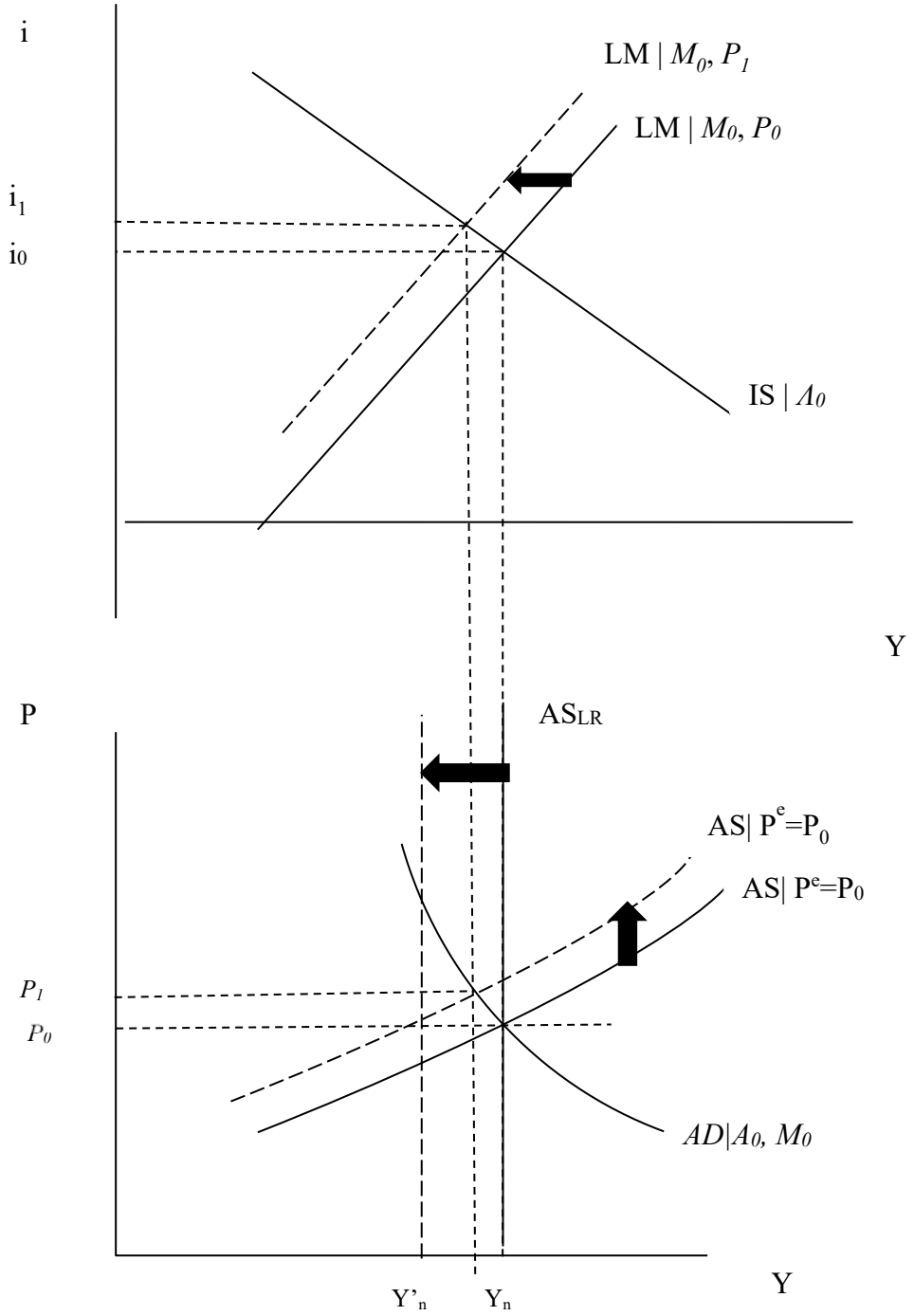



**Figure 3:** IS-LM, AD-AS, decrease in $Y_n$.

2.2 Show what happens over time, including the final equilibrium.

**Answer:** The AS curve keeps on shifting on up (white arrows), the price level keeps on rising, and hence the LM keeps on shifting in (white arrows), until output rises to Y'n

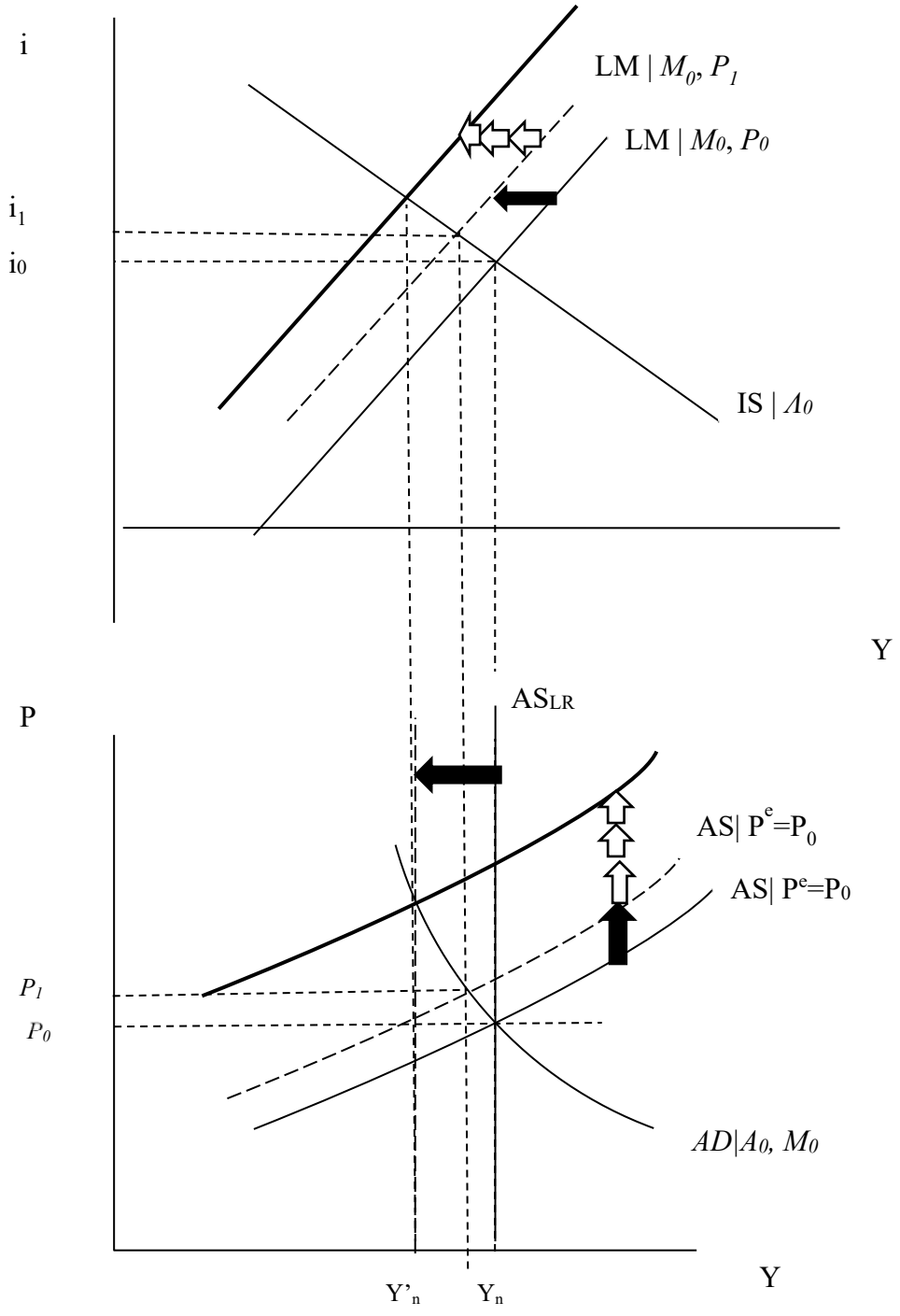



**Figure 4:** IS-LM, AD-AS, increase in $Y_n$.

2.3 Would decreasing unemployment benefits increase or decrease potential GDP in this model? Explain your answer, perhaps using equations.

**Answer:** Recall equation (5) from the AD-AS handout:

(5) $$P = P^e(1+\mu)F\left(\left[1-\frac{Y}{L}\right], z\right)$$

Where z, unemployment benefits, has a negative impact on output because it increases disincentives to work. Hence, increasing unemployment benefits would further shift in the long run AS curve, i.e., it decreases potential GDP.

(Optional: Interestingly, increasing unemployment benefits would increase government transfers (equivalent to decrease lump sum taxes), so that it would shift out the IS, AD curves. Hence, in the short run, raising unemployment benefits in the real world would have an ambiguous effect on output.)

3. Since the end of 2019, the price of oil has declined from $60/barrel to $40/barrel. Consider the impact of the oil price decrease.
3.1 Show the impact in the period in which oil prices decrease, using an AD-AS diagram.

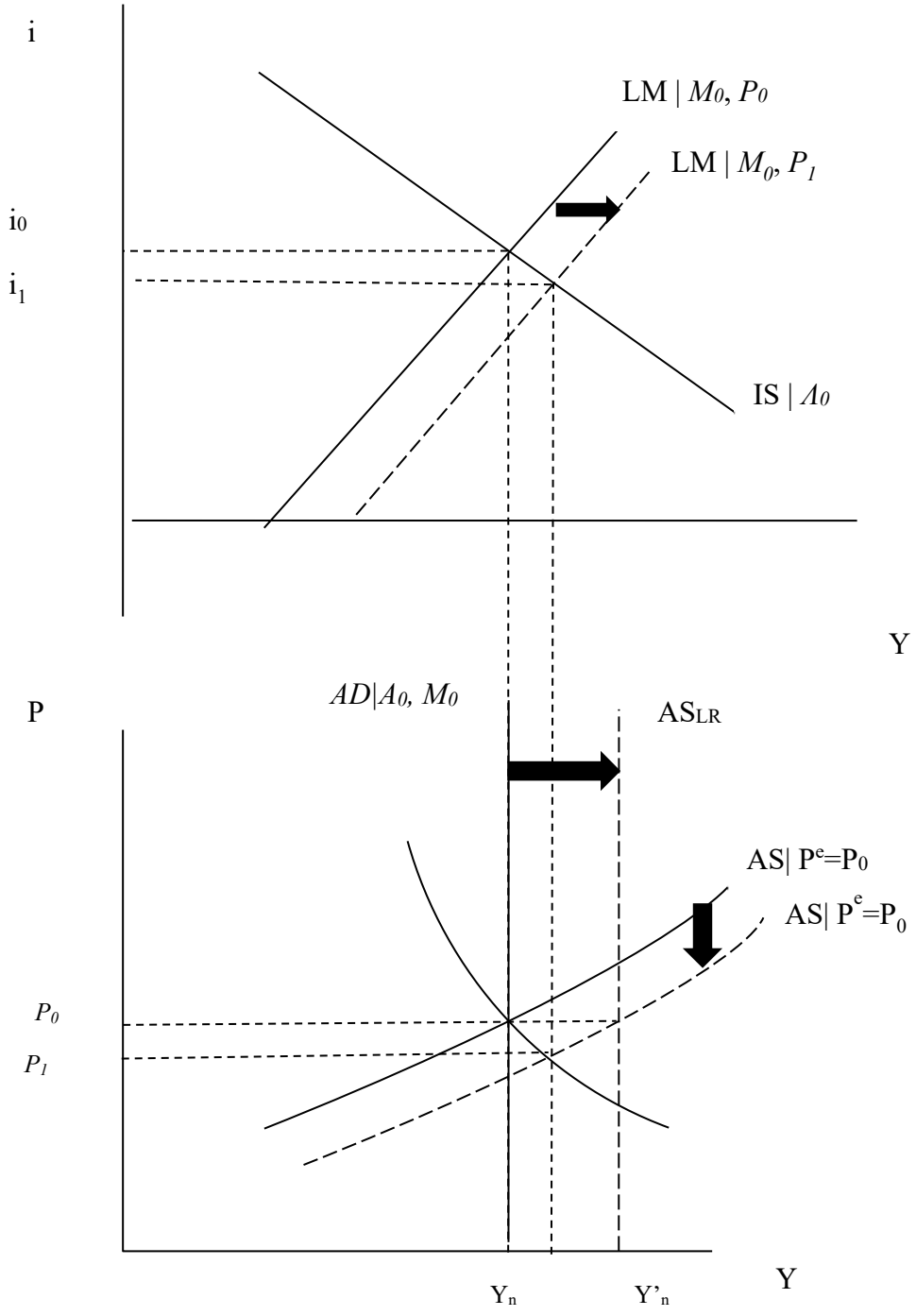



**Figure 5:** IS-LM, AD-AS, increase in $Y_n$.

3.2 Show the impact over time, using an AD-AS diagram. Be sure to indicate the final equilibrium.

**Answer:** The AS curve keeps on shifting on down (white arrows), the price level keeps on falling, and hence the LM keeps on shifting out (white arrows), until output rises to $Y'_n$.

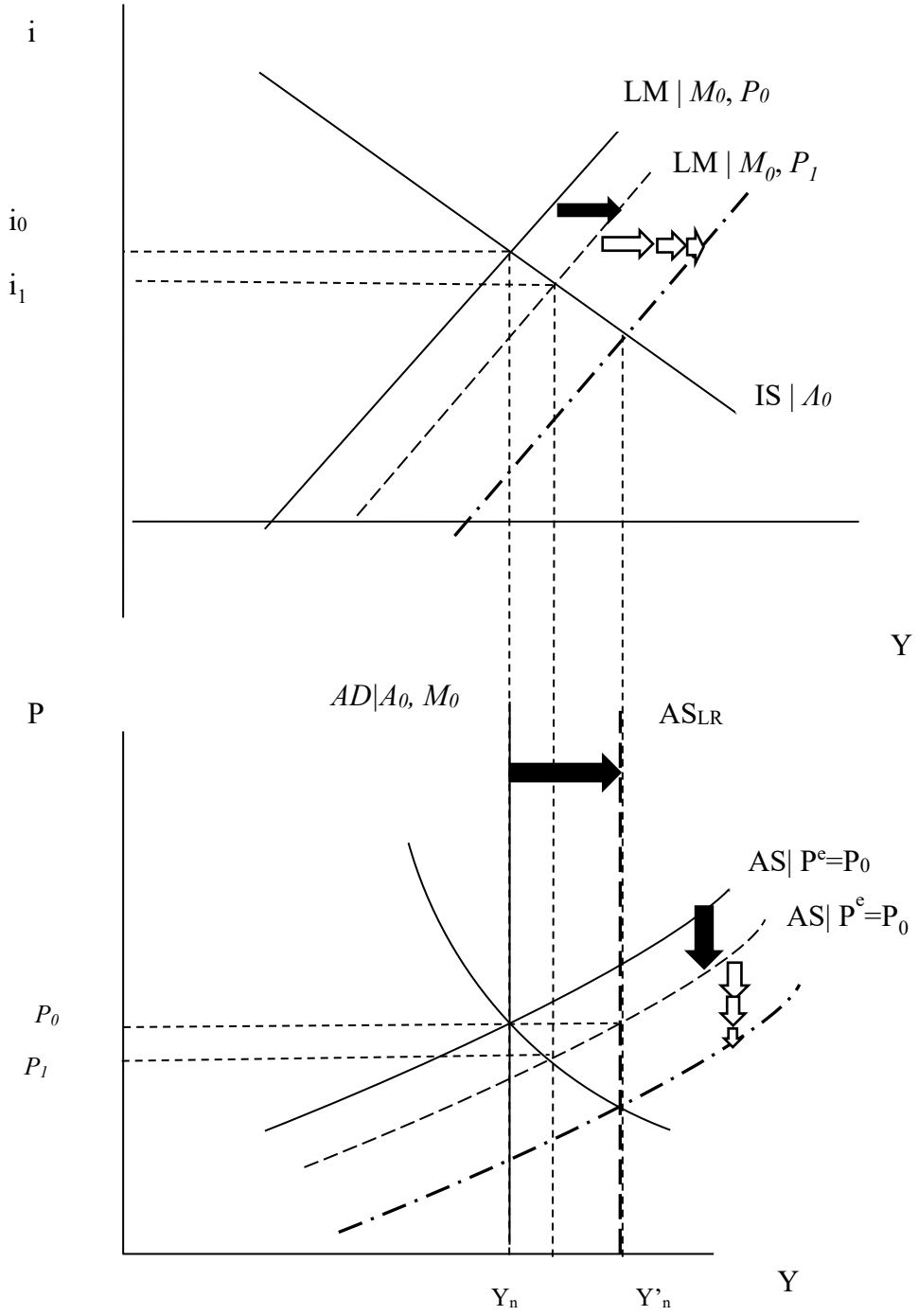


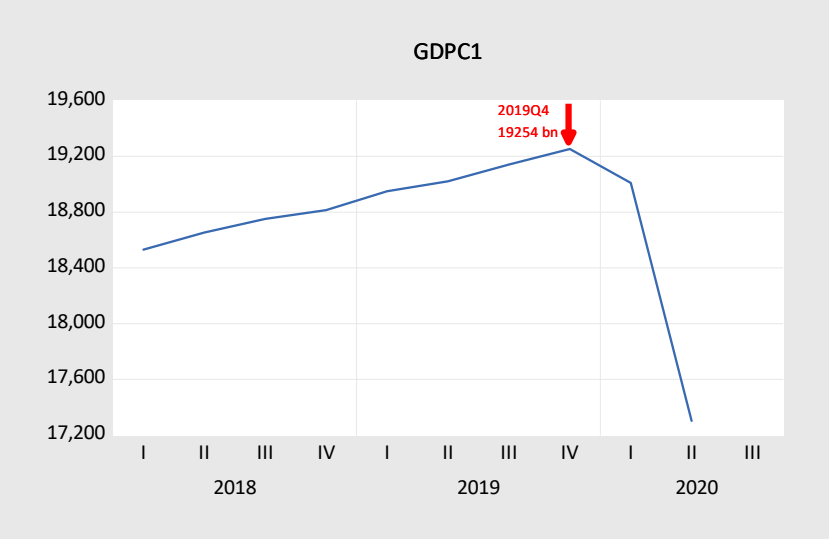

**Figure 6:** IS-LM AD-AS medium run in response to Yn increase.

3.3 Suppose the decline in oil prices drives a decline in demand for construction in oil belt. How does that change your answer to 3.1?

**Answer:** This effect would shift in the IS curve (it's an exogenous decline in ***I***) and the AD curve. The AS curve would still shift out, so the net effect is ambiguous in the short run. (In the medium run, we still approach the new Yn.)

4. This is an exercise to identify, download and manipulate macroeconomic data.
4.1 Download quarterly data on the level of real GDP from St. Louis Fed app FRED, https://fred.stlouisfed.org/ . The data should be measured in billions of Chained 2012$. What quarter did peak GDP occur?

**Answer:** The series is *GDPC1* in FRED. Peak was in 2019Q4.




4.2 Calculate what the quarter-on-quarter annualized growth rate in GDP is for 2019Q1-2020Q2. Show your work!

**Answer:** Use the formula (GDPC1/GDPC1(-1))^4=1 :

| | Formula: (gdpc1/gdpc1(-1))^1-1 |
|---|---|
| 2019Q1 | 0.007251 |
| 2019Q2 | 0.003707 |
| 2019Q3 | 0.006369 |
| 2019Q4 | 0.005862 |
| 2020Q1 | -0.012627 |
| 2020Q2 | -0.089861 |

4.3 Are there two consecutive quarters of negative growth in the most recent quarters? If so, when are they.
**Answer:** Yes, 2020Q1 and 2020Q2 (in yellow above).

4.4 Examine the data in 2001. Are there two consecutive quarters of negative growth in that year? Was there a recession in that year?
Answer: Use the same formula as in 4.2:

| | Formula: (gdpc1/gdpc1(-1))^1-1 |
|---|---|
| 2000Q4 | 0.006229 |
| 2001Q1 | -0.002852 |
| 2001Q2 | 0.005846 |
| 2001Q3 | -0.004150 |
| 2001Q4 | 0.002724 |
| 2002Q1 | 0.008745 |

There were two quarters of negative growth, but they were not consecutive.

4.5 Download the Congressional Budget Office estimate of real potential GDP, measured in billions of Chained 2012$, from FRED. Use these numbers to calculate the output gap – measured as log(real GDP/real potential GDP) – for 2020Q2.
**Answer:** The real potential GDP variable in FRED is GDPPOT.

| | GDPC1 | GDPPOT | LOG(GDPC1/GDPPOT) |
|---|---|---|---|
| 2020Q1 | 19010.85 | 19115.94 | -0.005513 |
| 2020Q2 | 17302.51 | 19203.79 | -0.104256 |
| 2020Q3 | NA | 19267.72 | NA |

In words, output in Q2 was 10.4% below the level of output that could be produced when factors of production are used at their natural levels.

5. Consider the following data from US Treasury http://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yield (accessed 10/5/2020):

| Date | 1 Mo | 3 Mo | 6 Mo | 1 Yr | 2 Yr | 3 Yr | 5 Yr | 7 Yr | 10 Yr | 20 Yr | 30 Yr |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/01/20 | 0.09 | 0.09 | 0.10 | 0.12 | 0.14 | 0.16 | 0.27 | 0.46 | 0.68 | 1.23 | 1.45 |

Suppose the expectations hypothesis of the term structure holds (term premium = 0). Calculate the expected one year interest rate, one year from 10/1/2020.

According to the expectations hypothesis of the term structure, for a two year bond,

$$i^{e}_{1t+1} = 2i_{2t} - i_{1t}$$

Substituting in 0.14% and 0.12% (red circles) for the two and one year bond yields results in:

$$i^{e}_{1t+1} = 2 \times 0.0014 - 0.0012 = 0.0016$$

Or

| 0.16% |
|---|

6. Yield curve and growth. Download data on interest rates (.xls) from http://www.ssc.wisc.edu/~mchinn/treasyields.xls . GS10 is ten year Treasury yields, TB3MS is 3 month Treasury yields.

6.1 Calculate the year-on-year growth rate of real GDP as $\log\left(\frac{Y_t}{Y_{t-4}}\right)$ , and regress on the interest rate spread *lagged one year*, for 1967Q1 to 2020Q2. Report the regression results.

**Answer:** Growth is in %, spread is in %:

Dependent Variable: GROWTH
Method: Least Squares
Date: 10/08/20 Time: 16:54
Sample (adjusted): 1967Q1 2020Q2
Included observations: 214 after adjustments

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 1.452881 | 0.227373 | 6.389861 | 0.0000 |
| SPREAD(-4) | 0.772344 | 0.113577 | 6.800198 | 0.0000 |

| | | | |
|---|---|---|---|
| R-squared | 0.179067 | Mean dependent var | 2.681160 |
| Adjusted R-squared | 0.175194 | S.D. dependent var | 2.224567 |
| S.E. of regression | 2.020325 | Akaike info criterion | 4.253696 |
| Sum squared resid | 865.3231 | Schwarz criterion | 4.285153 |
| Log likelihood | -453.1454 | Hannan-Quinn criter. | 4.266407 |
| F-statistic | 46.24270 | Durbin-Watson stat | 0.375895 |
| Prob(F-statistic) | 0.000000 | | |

6.2 Interpret what an increase of 1 percentage point in the spread means for the growth rate, *in words.*

**Answer:** Each 1 percentage point increase in the 10 year-3 month spread is associated with a 0.77 percentage point acceleration in the year-on-year GDP growth rate, one year hence.

6.3 Report what the predicted year-on-year growth rate for 2021Q3 is. Show your work!

**Answer:**

| | spread = gs10-tb3ms |
|---|---|
| 2020Q1 | 0.266667 |
| 2020Q2 | 0.543333 |
| 2020Q3 | 0.536667 |

$$growth = 1.453 + 0.772 \times 0.537 = 1.87\%$$

In other words, the spread predicts growth in 2021Q3 to be 1.87% (on an annualized basis).

(Notice that the adjusted-R2 is quite low…)

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