

Economics for Managers (MIM) Problem Set

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Microeconomics

Question 1.4

The Masters in Management (MIM) students at ESCP Europe are organising a party. The Reps finally agree that this time they will spend £240. They will buy some cans of Tyskie (£2 each) and some bottles of Cotes du Rhone (£10 each). To avoid arguments about preferences they decide to use Max's utility function for the whole group.

- Max: $U_M = xy$

Use the Lagrangian technique to solve their optimization problem: find their optimal consumption bundle (i.e. how many cans of beer and how many bottles of wine they buy), and calculate the total utility that they enjoy.

Hint: Maximilian Untergrundbahn, January 2013

If you're finding Joan's utility function difficult to differentiate see the YouTube video "Lagrangian Optimization: Example" by EconomicsHelpDesk¹

Question 1.5

The MIM Student Reps are planning a party and decide to use the following utility function.

$$U(X,Y) = 10X^2Y$$

Imagine that the price of good X is £5 and the price of good Y is £10. Use the Lagrangian technique to find the optimal consumption bundle if their budget is £3,000.

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¹ https://youtu.be/pA_bJtqXldM

Question 1.6

Assume that there are two goods in the world: apples and raspberries. Say that Geoffrey has a utility function for these goods of the following type, where r denotes the quantity of raspberries and a the quantity of apples.

$$U = 4r + 3a$$

- Draw the indifference curves that are defined by this utility function.
- What is the marginal rate of substitution between the raspberries and the apples when Geoffrey consumes 50 raspberries and 50 apples? What is the marginal rate of substitution between these two goods when Geoffrey consumes 100 raspberries and 50 apples? What do the answers to these questions imply about the type of goods the apples and raspberries are for Geoffrey?
- If the price of raspberries is \$1 per unit, the price of apples is \$1 per unit, and Geoffrey has \$100 to spend, what bundle of raspberries and apples would he buy? Would the marginal rate of substitution be equal to the ratio of the prices of these goods in the optimal bundle? If not, why not?
- If the unit prices of the raspberries and the apples are \$4 and \$3, respectively, what bundle of raspberries and apples would Geoffrey buy with his income of \$100?

Source: Schotter, Ch. 3, Ex. 2

Question 1.7

A savings bank is an institution that commits people to deposit a certain amount of money today and have it earn interest so that they can withdraw a greater amount in the future. For example, say that our society creates a savings bank that allows people to deposit \$100 today and get back \$110 next year if the money is continuously kept in the bank. (We will assume that our savings bank pays a flat 10% interest rate with no compounding). A study of consumer attitudes in our society shows that people have preferences between spending money today and saving money today in order to have more money tomorrow. Say that there are three different Elizabeths (Elizabeth's 1, 2 and 3) who each have \$100 and must decide how much of this \$100 to consume today and how much to place in the savings bank and let grow at 10%.

- Assuming that all their preferences can be represented by indifference curves that are bowed to the origin, draw three diagrams indicating the optimal consumption bundle for each of the Elizabeth's. Assume that Elizabeth 1 consumes the entire \$100 today, Elizabeth 2 consumes \$40 today and deposits \$60 in the bank and, and Elizabeth 3 deposits the entire \$100 in the bank. (The two goods on the axis of each diagram should be "consumption today" and "consumption tomorrow")
- What is the common name for the slope of the budget line in these three diagrams?

Source: Schotter, Ch. 3, Ex. 4

Question 2.3

Find the expression for the average fixed cost, average variable cost, and average cost functions where the total cost function is:

- a. $TC = 3 + 4q$
- b. $TC = 10 + q^2$
- c. $TC = 100 - 3q + 10q^2$

Source: Schotter, Ch. 10, Ex. 3

Question 2.4

Mutual Industries owns three plants at which it produces exactly the same cars. Plant 1 has cost function $TC_1 = 300 - 10q + 50q^2$. Plant 2 has cost function $TC_2 = 50 + 10q^2$, and plant 3 has cost function $TC_3 = 1,000 + 20q$. Mutual decided to produce 5 cars in the least costly way. Which plant will be chosen? Find its cost.

Source: Schotter, Ch. 10, Ex. 4

Question 2.5

A good recipe for a French Peruvian dish called ceviche requires 16 ounces of fillet of red snapper, 3 ounces of lime juice, 1 ounce of coriander, and 8 ounces of Bermuda onion. This combination of inputs is expressed in the following production function:

$$y = \text{Min} \left\{ \frac{z_1}{16}, \frac{z_2}{3}, z_3, \frac{z_4}{8} \right\}$$

In this production function, z_1 is fillet of red snapper, z_2 is lime juice, z_3 is coriander, and z_4 is Bermuda onion. The unit of measure for each input is the ounce, and the unit of measure for ceviche (the output) is the quantity produced by the recipe. If a restaurant has on hand 32 ounces of snapper, 9 ounces of lime juice, 5 ounces of coriander, and 48 ounces of onion, how many “units” of ceviche can it produce?

Source: Schotter, Ch. 8, Ex. 2

Question 2.6

Consider “La Marmotte”, January 2012.

Firstly, what is the highest amount of profit that the restaurant could earn? How many meals should they produce? Then, draw a rough graph to show the level of output consistent with profit maximisation.

Output <i>daily</i>	Costs						Revenue			Profit π
	VC	FC	TC	AVC	ATC	MC	MR	AR	TR	
66	164	500					30	30		
67	193	500					30	30		
68	224	500					30	30		

Question 2.7

Consider “La Marmotte”, January 2012.

The variable costs for *La Marmotte* are given by the following equation:

$$AVC = q^{1.05} - 140 + \left(\frac{4000}{q}\right)$$

Calculate the profit maximising level of output.

Question 5.5

Consider the following game in which player 1 chooses a row and player 2 choose a column.

	L	C	R
T	3, 1	0, 5	1, 2
M	4, 2	8, 7	6, 4
B	5, 7	5, 8	2, 5

- Does player 1 have a dominant strategy?
- Does player 2 have a dominant strategy?
- What is the Nash equilibrium for this game? Is it *ever* possible for either player to use a strategy other than his dominant strategy? Explain

Hint: See the video, “An Introduction to Game Theory”, February 2015.²

Source: Schotter, Ch. 11, Ex. 7

² <https://youtu.be/YndXmFGaRmU>

Question 5.6

Consider the following matrix, which shows the payoffs for a game between two firms in a duopolistic industry.

		Firm II	
		Low price	High price
Firm I	Low price	0, 0	20, -8
	High price	-8, 20	5, 5

- What is the only Nash equilibrium in pure strategies for this game?
- Are there dominant strategies for each firm?
- Now suppose that the cost structure in the industry has changed so that the new payoffs for the game are as shown below. Is the Nash equilibrium determined in Part a of this problem still an equilibrium?

		Firm II	
		Low price	High price
Firm I	Low price	0, 0	0, -10
	High price	-10, 0	5, 5

- Are there now any other equilibria?
- If there are now several equilibria for the game, which one do you think is likely to be chosen? Why?

Hint: See the video, “An Introduction to Game Theory”, February 2015.³

Source: Schotter, Ch. 19, Ex. 9

Question 5.7

- Is the bar scene from “A Beautiful Mind” a Nash equilibrium?⁴
- Is the boat scene from “The Dark Knight” a Prisoner’s Dilemma?⁵

Question 4.6

A discriminating monopoly sells in two markets (1 and 2). Assume that no arbitrage is possible between the two markets.

The demand curve in market 1 is given by $P_1 = 100 - (q_1 / 2)$.

The demand curve in market 2 is given by $P_2 = 100 - q_2$.

The monopoly’s cost function is given by $TC(Q) = Q^2$ with $Q = q_1 + q_2$

³ <https://youtu.be/YndXmFGaRmU>

⁴ A Beautiful Mind, February 2008 https://www.youtube.com/watch?v=uAJDD1_Oexo

⁵ Joker’s Social Experiment, December 2010 https://www.youtube.com/watch?v=K4GAQtGtd_0

- a. Calculate the monopoly's profit-maximizing quantity and price in market 1 and market 2.
- b. Calculate the total profit of the discriminating monopoly.
- c. Suppose now that a new manager controls the firm and decides to decompose the monopoly plant into two plants, where plant 1 sells in market 1 only and plant 2 sells in market 2 only. Calculate the profit-maximizing output level sold by each plant. Calculate the sum of profits of the two plants and explain the results.

Hint: Firms should produce such that marginal profit = 0.

Source: Vanessa Strauss-Kahn, ESCP Europe Business School

Question 5.3

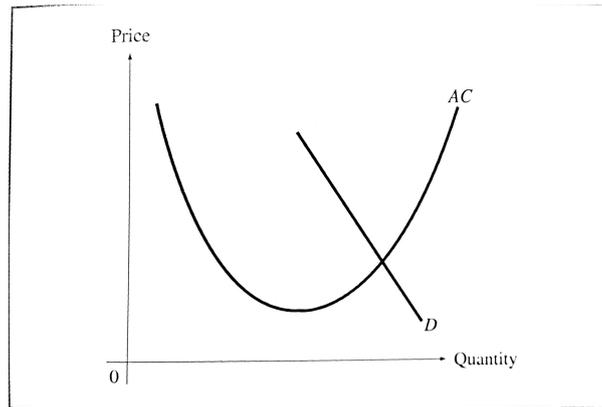
As of October 2014 the UK supermarket industry had the following sales figures. Calculate the Herfindahl Index (the sum of the squared market shares).

Company	Total sales (£000s)	Market share (%)
Tesco	7,006,000	
Asda	4,202,000	
Sainsbury's	3,916,000	
Morrisons	2,665,000	
The Co-operative	1,551,000	
Waitrose	1,254,000	
Aldi	1,171,000	
Lidl	851,000	
Iceland	468,000	
Farmfoods	168,000	
Others	529,000	

Hint: *Markets for Managers*, Ch. 5.1.

Question 5.4

Consider the figure below, which depicts the demand and cost situation of a monopolist. Is the monopoly price sustainable in this situation?



Source: Schotter, Ch. 18, Ex. 3

Question 3.2

Assume that the market demand curve is $Q_D = 40 - 2p$ and the market supply curve is $Q_S = 4p - 20$

- Find the equilibrium price and quantity.
- Calculate the consumer surplus and producer surplus.
- Suppose the government imposes on each firm a \$3 tax on each unit sold. What is the new equation for the supply curve?
- Calculate the new price and quantity.
- What is the price received by the producer?
- Find the tax revenue of the government and calculate how much is paid by the consumer and how much by the producer.
- How much consumer surplus has been lost?
- How much producer surplus has been lost?
- What is missing?

Source: Lynne Kiesling, Northwestern University

Question 5.1

Say that a monopolist has a cost function of the following type: $C(q) = bq$, which indicates that there are no fixed costs and that the marginal costs are constant. A regulatory agency claims that setting the price of this firm's product so that it is equal to the average cost will provide the "best" outcome for society.

- Demonstrate that the claim of the regulatory agency is correct given the firm's cost function
- Is it true that average-cost pricing produces an optimal result for all cost functions?
- What is special about this particular cost function that makes the agency's claim true?

Source: Schotter, Ch. 18, Ex. 4

Question 5.2

Two firms, Orangina (firm 1) and Fanta (firm 2), compete on prices. The demand curves faced by firm 1 and 2 are: $Q_1 = 90 - 3P_1 + 2P_2$ and $Q_2 = 90 - 3P_2 + 2P_1$. The firms have a similar marginal cost of $MC = 6$.

- Calculate Orangina and Fanta's profits.
- Suppose that the two firms merge, what is the profit of the newly created firm (Fantarina)?
- Why are anti-trust authorities likely to be opposed to this merger?

Hint: Find an inverse demand function by rearranging in terms of P , and find the profit maximising condition.

Source: Vanessa Strauss-Kahn, ESCP Europe Business School

Question 3.8

Explain how adverse selection and moral hazard apply to an all-you-can-eat buffet.

Question 3.9

Suppose that a person wants to buy a used car. She knows that half of the available used cars are good cars and the other half are "lemons". She is willing to pay \$10,000 for a good car and \$2,000 for a lemon.

- Assume that this buyer cannot distinguish the good cars from the bad cars. How much would she be willing to pay for any car?
- What types of car will be offered for sale in the market at the price calculated in part a?
- Based on your answer in Part b, calculate the ultimate equilibrium price of a car in the used-car market.

Source: Schotter, Ch. 23, Ex. 2

Question 3.10

Imagine a market where there are 8 buyers (who can buy a maximum of one unit each) and 6 sellers (who can sell a maximum of two units each). There is a Grade 4 (i.e. high quality) product available. Assume that the buyers place a value of £24 on

the product. It costs £14 to produce the 1st unit, and £1 more to produce the 2nd unit. Draw the demand and supply diagram and clearly mark the equilibrium price.

Question 3.11

Draw the graphical version of the Spence signalling model conditions of asymmetric information. Assume that obtaining a MiM degree provides the right amount of education (y^*) to serve as a separating equilibrium.

Clearly mark the wage premium that low skilled workers would need to receive to entice them into doing the MIM

Question 3.6

In 2013 the UK government auctioned off 2 licenses for providing 4G mobile phone services. The table below shows the bids that were made:⁶

Company	Bid
Everything Everywhere Ltd	£588m
Hutchison 3G UK Ltd	£225m
Niche Spectrum Ventures Ltd (a subsidiary of BT Group plc)	£187m
Telefónica UK Ltd	£550m
Vodafone Ltd	£791m

If the government operates a second-price sealed bid (i.e. “Vickrey”) auction with uniform pricing, answer the following questions:

- a. Which companies win the licenses?
- b. How much do they each have to pay?
- c. Do either company generate consumer surplus?
- d. Briefly explain why companies will bid more honestly in this type of auction rather than under a *first* price sealed bid auction.

⁶ Assume that these are the bidder’s marginal valuation of the license. See <http://media.ofcom.org.uk/news/2013/winners-of-the-4g-mobile-auction/>

Macroeconomics

Question 2.9

Imagine that Firm A has the following production function:

$$y_A = f(L, K)$$

Whilst firm B has the following production function:

$$y_B = f(L^{1/2}, K^{1/2})$$

Assume that both firms start with 6 units of labour and 4 units of capital, and that both inputs are doubled. Calculate what happens to the output for Firm A and Firm B. Which firm has constant returns to scale?

Question 12.1

The fictitious country Mordor starts off with 1,000 machines, and every year, 5% of the machines depreciate or wear out. Fortunately, the people in this land produce 75 machines per year, every year. The key equation for keeping track of capital is quite simple:

$$\text{Next year's capital} = \text{This year's capital} + \text{Investment} - \text{Depreciation}$$

Fill in the table:

Year	Capital	Depreciation	Investment
1	1,000	0.05 x 1,000	75
2	1,025		75
3			75
4			75
5			75

Source: Cowen and Tabarrok, Ch. 8, q. 11.

Question 12.3

Draw a diagram showing the basic Solow growth model. What will be the effect on output (Y), based on the following scenarios:

- a. A reduction in the savings rate
- b. An increase in population
- c. A fall in the rate of depreciation

Source: Romer, 1.3.

Question 7.4

Consider the Diamond-Dybvig model and imagine that there are 2 patient and 2 impatient depositors. They have each invested €1,000 and their contracts state that they can either withdraw today (and receive €1,000) or withdraw tomorrow (and receive €2,000). Hence $R = 2$. The bank can invest the deposits in either a long-term investment (which pays $R = 2.0$ times the amount invested, tomorrow), or a short-term investment (which pays the original amount regardless of whether it is withdrawn today or tomorrow). If the long-term investment is liquidated early it pays $L = 0.5$ times the original amount invested.

- Assume that the patient depositors wait until tomorrow to withdraw, whilst the impatient withdraw today. At this moment in time, how should the bank divide its assets between short-term and long-term investments?
- Assuming that the impatient depositors withdraw today, draw the 2x2 game that faces the 2 patient depositors
- Are there any pure strategy Nash equilibria?

Question 8.2

Use the Dynamic Equation of Exchange to show the following situations:

- Under a Gold standard productivity gains will lead to deflation
- Even though the Fed increased the money supply on December 31st 1999, because this was in response to fear surrounding the Y2K bug, it didn't lead to inflation
- Hyperinflation occurs when people lose confidence *in currency*, and therefore their desire to hold it dramatically falls (i.e. their desire to spend money dramatically increases)

Question 8.3

Draw a dynamic AD-AS diagram that satisfies the following criteria: (i) the Solow growth rate is 2% per year; (ii) AD is consistent with a level of total spending ($M+V$) equal to 6% per year; (iii) SRAS is consistent with inflation expectations of 4% per year. If a productivity shock caused the Solow growth rate to increase to 4% per year what would inflation be if prices were perfectly flexible? (Assume spending growth ($M+V$) doesn't change).

Hint: See the video, "An Introduction to the Dynamic AD-AS Model", September 2014.⁷

Source: Cowen and Tabarrok

⁷ <https://www.youtube.com/watch?v=qXYNUjWYopo>

Question 8.4

- a. Write down the equation of the AD curve and calculate the slope.
- b. In reality high rates of inflation are likely to reduce real growth. How should the Solow curve be drawn if this is the case?

Hint: See the video, “An Introduction to the Dynamic AD-AS Model”, September 2014.⁸

Source: Cowen and Tabarrok

Question 8.5

Using the dynamic AD-AS model, which of the following events would constitute a negative shock to aggregate demand:

- a. Increase in the money supply
- b. An earthquake causes major disruption to the countries’ infrastructure
- c. Rise in government spending
- d. Better quality education and training
- e. Higher levels of consumer fear

Hint: See the video, “An Introduction to the Dynamic AD-AS Model”, September 2014.⁹

Question 8.6

Which of the following is *clearly* an example of *both* an aggregate demand shock *and* a real shock:

- a. Steelworkers go on strike, so less steel is produced
- b. Businesses read about the glories of the internet, so demand for high tech investment purchases increase
- c. U.S. senators read about the glories of the internet, so demand for high-tech government purchases increase
- d. A series of investment banks like Lehman Brothers and Bear Sterns go bankrupt
- e. Around 2000, the glories of the internet fade a bit so innovations increase at a slower rate for a few years
- f. The U.S. government launches two costly wars almost simultaneously, so government purchases increase dramatically
- g. The U.S. government launches two costly wars almost simultaneously, using the draft to force many men to work much longer hours and supply more labour than they would otherwise

Hint: See the video, “An Introduction to the Dynamic AD-AS Model”, September 2014.

⁸ <https://www.youtube.com/watch?v=qXYNUjWYopo>

⁹ <https://www.youtube.com/watch?v=qXYNUjWYopo>

Source: Cowen and Tabarrok

Question 8.7

Consider the disinflation that occurred in the U.S. in 1981-82 whilst Paul Volcker was Chairman of the Fed. Expected inflation and actual inflation are both 10%, real growth is 3%, and assume that velocity is 0%. Hence:

AD: Money growth = Inflation + Real growth

We can define a simple SRAS curve as follows:

SRAS: Inflation = Expected inflation + 1 x (Real growth rate – Solow growth rate)

- a. Calculate how fast the money supply grew back when inflation was 10% in 1980 and real growth was at the Solow rate of 3%. How fast did the money supply grow at this point, before Volcker started fighting inflation?
- b. Calculate how fast Volcker will let the money supply grow in the long run, after he pulls inflation down to 4% per year. (Remember that he is assuming that in the long run the economy will grow at the Solow growth rate).
- c. In the short run, when Volcker cuts money growth to the rate calculated in part b, the economy won't grow at the Solow rate. Instead, real output will grow at whatever rate the SRAS dictates. In terms of algebra, this means you have to combine the SRAS and the AD: it's a system of two equations and two unknowns. You know the values of money growth, expected inflation and the Solow growth. Solve to find the values for real growth and inflation.

Source: Cowen and Tabarrok

Question 8.8

The Taylor Rule is a general guideline that allows policymakers to ascertain an appropriate interest rate for various growth rates of inflation and output. We can use a simple version of the rule:¹⁰

Taylor rule = 1 + (1.5 × inflation) – (1 × unemployment gap)

- a. Assuming that the natural rate of unemployment is 8%, complete the following table to calculate the implied Taylor rule interest rate for Germany, France, Greece and the Eurozone, as of January 2013.

Country	Inflation	Unemployment rate	Unemployment gap	Implied Taylor rule
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¹⁰ See Nechio, F., “Monetary policy when one size does not fit all” *FRBSF Economic Letter*, June 13th 2011

Germany	1.65	5.4		
France	1.17	10.8		
Greece	0.21	26.5		
Eurozone	2.00	12.0		

- b. The main refinancing rate in January 2013 was 0.75. Based on the information above, was monetary policy too tight, or too loose in the Eurozone?

Hint: *Markets for Managers*, Ch. 8.2.

Question 8.9

In December 2013 many economists believed that there was a deficiency in aggregate demand (AD) in the Eurozone. The rate of inflation was 0.7% and real GDP growth was -0.1%. According to Eurostat the forecast for real GDP growth in 2 years time is 1.5%. If you assume that this is the Solow growth rate, and take an inflation target of 2%, by how much should policymakers attempt to increase AD by?

Show your answer on a graph.

Hint: See the video, “An Introduction to the Dynamic AD-AS Model”, September 2014.¹¹

Question 7.2

As of April 2015, UK income tax applied at the following rates:

Standard personal allowance (0%)	£0 - £10,600
Basic rate (20%)	£10,601 - £31,785
Higher rate (40%)	£31,786 - £150,000
Additional rate (45%)	£150,000 +

Complete the table below:

Job	Salary	Tax obligation	Proportion of income paid in tax
Bar staff	£12,000 ¹²		
Trainee manager, McDonalds	£18,500 ¹³		
Recent graduate,	£33,200 ¹⁴		

¹¹ <https://www.youtube.com/watch?v=qXYNUjWYopo>

¹² <http://www.careerbuilder.co.uk/article/msn-312-job-search-britains-lowest-paying-jobs/>

¹³ <http://www.mcdonalds.co.uk/ukhome/whatmakesmcdonalds/questions/work-with-us/wages/what-is-the-average-salary-of-a-mcdonalds-restaurant-employee.html>

ESCP Europe			
CEO, HSBC	£7.4m ¹⁵		

Question 7.3

An economics lecturer is invited to provide a day of teaching in Bulgaria, for a fee of £700. Although the flights will be paid for he will incur £65 of out of pocket travel expenses. Generally speaking, he feels that he needs to be able to earn £500 to compensate for being away from home overnight.

- Assuming that this income would incur a 40% tax rate, will he take the job?
- What would the tax rate need to be for him to take the job?
- How much tax revenue is generated in both cases?

Question 9.1

According to Okun's law a 2% increase in GDP is required to reduce unemployment by 1%. In late 2008 Larry Summers feared that the US unemployment rate was set to reach 10%.¹⁶

- Assume that the natural rate of unemployment was 6%. By how many percentage points would GDP need to rise by to maintain unemployment at its natural rate?
- In 2008 US GDP was approximately \$14.4 trillion. But how much would GDP need to rise to get unemployment down to its natural rate?

Source: Cowen and Tabarrok

Question 9.2

We can define "m" as the marginal propensity to consume. This is the proportion of any additional income that an agent spends on consumption. For example, in the 2008 stimulus around 30% of rebate checks were spent.¹⁷

- Combine the following equations and solve for Y

$$Y = C + I + G$$

$$C = m(Y - T)$$

¹⁴ <http://www.esceurope.eu/escp-europe-programmes/master-in-management/overview-master-in-management-escp-europe-business-school/master-in-management-mim-escp-europe-business-school/student-profiles-master-in-management-escp-europe-business-school/>

¹⁵ <http://www.cityam.com/1415705309/which-ceos-european-bank-have-biggest-pay-checks-two-uk-banks-take-second-and-third-place>

¹⁶ See Weinzierl, M.C., and Werker, E.D., "Barack Obama and the Bush Tax Cuts" January 2009

¹⁷ See Weinzierl, M.C., and Werker, E.D., "Barack Obama and the Bush Tax Cuts" January 2009

- b. Find the derivative of this equation with respect to taxes. This gives the “tax multiplier”.
- c. Find the derivative of this equation with respect to government spending. This gives the “spending multiplier”.
- d. Assume that the 2008 stimulus was split between 50% tax cuts and 50% spending increases. Calculate the weighted multiplier
- e. Use your answer to part d to calculate the size of the fiscal stimulus required to boost GDP by your answer to part b of the previous question
- f. According to *The Economist* Obama estimated that the tax multiplier was 1.0 and the spending multiplier was 1.6.¹⁸ If this is the case, what size should the stimulus be?

Hint: *Markets for Managers*, Ch. 9.2.

Question 9.5

Use a graph to show why fiscal policy and monetary policy are ineffective at increasing real growth in the face of a negative productivity shock.

Hint: See the video, “An Introduction to the Dynamic AD-AS Model”, September 2014.¹⁹

References

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¹⁸ “Much ado about multipliers” *The Economist*, September 24th 2009

¹⁹ <https://www.youtube.com/watch?v=qXYNUjWYopo>