Lecture 11: The Demand for Money and the Price Level

See Barro Ch. 10

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Where are we? Taking stock

1. We've spent the last 7 of 9 chapters building up an equilibrium model of growth and the business cycle
2. Persistent-but-not-permanent TFP/productivity/A_t, shocks look like a good candidate, because they help explain why: consumption (a little), investment (a lot), wages, interest rates, labor, and labor productivity all go down simultaneously, and why we have a slow recovery.
3. So far we've largely been money and price free! We have prices floating in the background, but because all people care about is real prices, real wages, real interest rates, whatever the price level is doesn't matter!
4. We're going to change that here, and talk about money as a medium of exchange, and some potential problems with it.
5. It will eventually give us an alternative candidate for business cycles (chapters 15 and 16)

Money-I

- So far we've analyzed two types of assets a household can have:
  - Physical capital (K)
  - Financial capital (B)
- We've left out money (M) so far because it's really hard to understand why people hold money...why?
- Now we'll try to justify why people hold money and analyze the consequences

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Money-II

- We'll be talking about fiat money, not commodity money (which is basically what we had before)
- Why don't people just use commodity money?
  - Potential legal restrictions on private money
  - Legally required to accept it
  - Potentially a public good
- It wasn't always this way...1837-1862...

Money-I

- Sometimes we think about the quantity of currency in circulation (physical dollars and cents)
- An expanded version of this also includes deposits held by banks at the Federal Reserve (promises that could be turned into currency on demand)
  - This is called "high-powered money" or "the monetary base."
- But the things we use for money are bigger than that: there is more money in bank accounts (things that should be able to be turned into currency on demand) than there is physical currency
- For instance, checking accounts
- This broader definition is M1.

Money-II

- But we really use even more things to trade: we can include savings accounts, CD's, money market mutual fund money
- For our intents and purposes in this chapter, currency is what we'll be thinking about
- Currency as a fraction of nominal GDP has been fairly constant in the U.S., at about 6%
- In other countries it's changed
- Leads to a question...why do people hold currency?

Demand for Money-I

- There are two countervailing effects on the demand for money (think currency and checking accounts)
  1. When you hold currency, you aren't earning interest, so you don't want to hold money
  2. When you hold currency, you're able to purchase things
- When thinking about the demand for money, think of things like this:
  1. Each morning, you look at prices P and interest rates i
  2. You decide how many times to run to the ATM
     - More trips to the ATM is costly
     - But it allows you to earn more interest
- Let's think of the demand for money as $\frac{M^d}{P}$, the "real" amount of money needed.

Demand for Money-Interest Rates

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- Need to hold less money at any given point in time. M^d, the nominal demand for money, falls.
- Given a price level P, $\frac{M^d}{P}$ is lower, the real demand for money falls

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- In this case, nominal demand for money doubles, and real demand stays the same. Behavior stays the same.

Demand for Money-Price Level-II

- If this doesn't make sense, consider the idea that the government comes in and declares all dollar amounts in the U.S. are now worth twice as much: then nothing changes, except now you have "twice" as much nominal money you need to pay for the same consumption, etc.

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Demand for Money-Other

- There are other things that impact the demand and real demand for money
- As the cost of going to the bank (think of ATM's) falls, the number of trips rises, and the demand for money falls (you need to hold less money at any given point)
  - You also may hold more money because money is now more convenient
- As you're able to use credit cards and checking accounts, you need less use of currency

Money Demand Function

- All of this leads us to posit a formula for nominal money demand:

$$M^d = P \cdot L(Y, i)$$

- Where M^d is nominal money demand, P is the price level, L is a function which takes in real income Y and nominal interest rates i.

- You can also write the real demand for money as:

$$\frac{M^d}{P} = L(Y, i)$$

- So think of $L(y, i)$ as the real demand for money.

Money Demand Function: Empirical Evidence

- There's good evidence for the money demand function
  1. Goldman: $i \uparrow 10\%$, $M^d \downarrow 3\%$
  2. Mulligan and Sala-i-Martin: $i \uparrow 10\%$ from 2% to 2.2%, $M^d \downarrow 2\%$.
  3. Mulligan and Sala-i-Martin: $i \uparrow 10\%$ from 6% to 6.6%, $M^d \downarrow 5\%$.
  4. Goldfeld: $Y \uparrow 10\%$, $M^d \uparrow 7\%$
  5. Goldfeld: $P \uparrow 10\%$, $M^d \uparrow 10\%$
- In other words, this empirically seems like a good function

Money Demand Function: So what?

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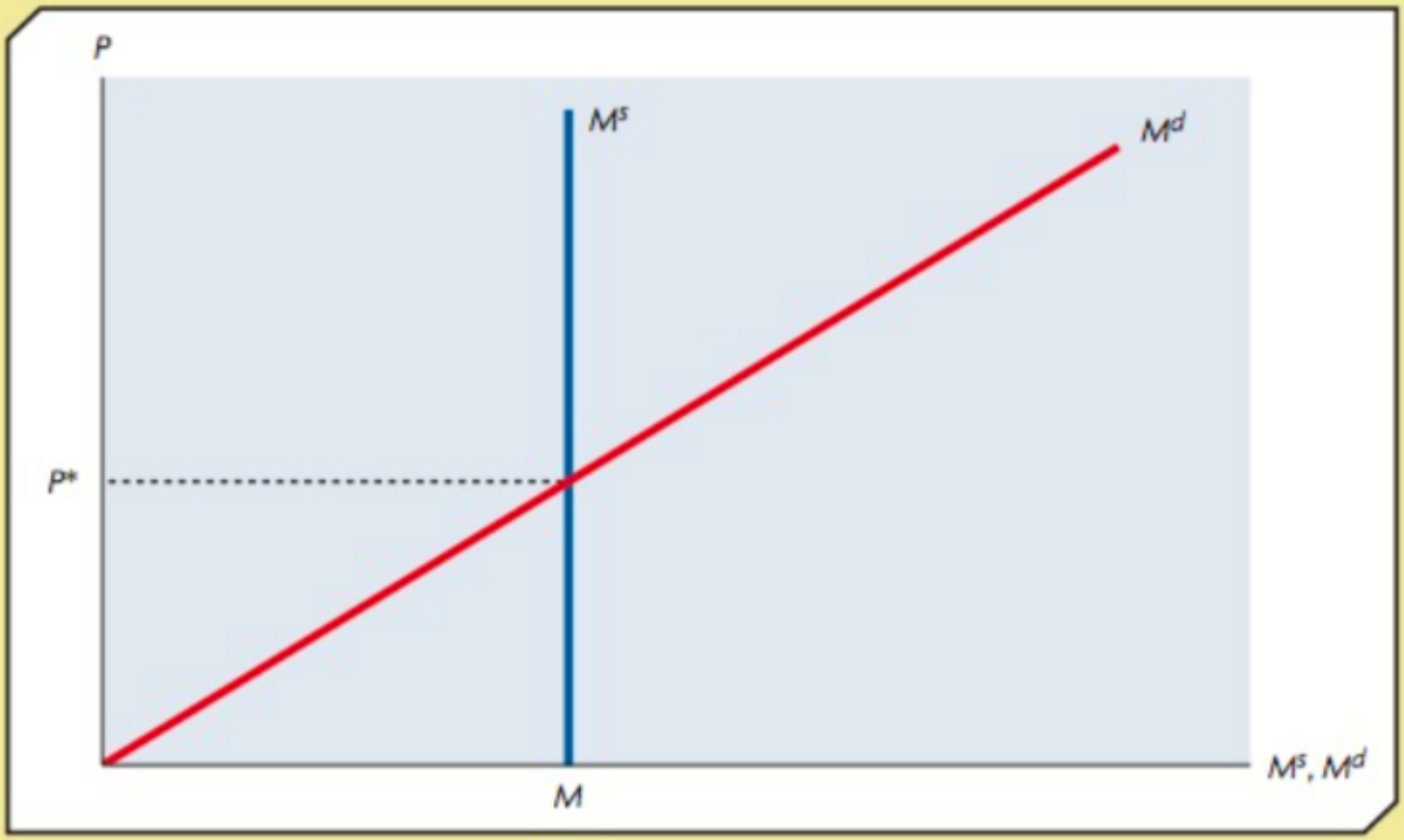
- So $M^s = PL(Y, i)$
- Or, $P = \frac{M^s}{L(Y,i)}$. Given interest rates, real GDP, and the total quantity of money, we can solve for what the price level must be

Money Supply and Demand-I

Figure 10.1 *The Nominal Quantity of Money Supplied Equals the Nominal Quantity Demanded*



Dane's Question

1. Does appreciation of gold in Fort Knox offset operating expenditures?

2. Operating expenditures on civilian & military payroll, contractors in 2012 was about $651 million

3. Fort Knox holds about $175 billion in gold

4. Average rate of return on gold has averaged 0.32%/year since 1990 (Ken French)

5. This yields, on $175 billion in gold, about $560 million

6. About 86% of Fort Knox's operating expenditures are paid for by gold appreciation

Money Supply and Demand-II

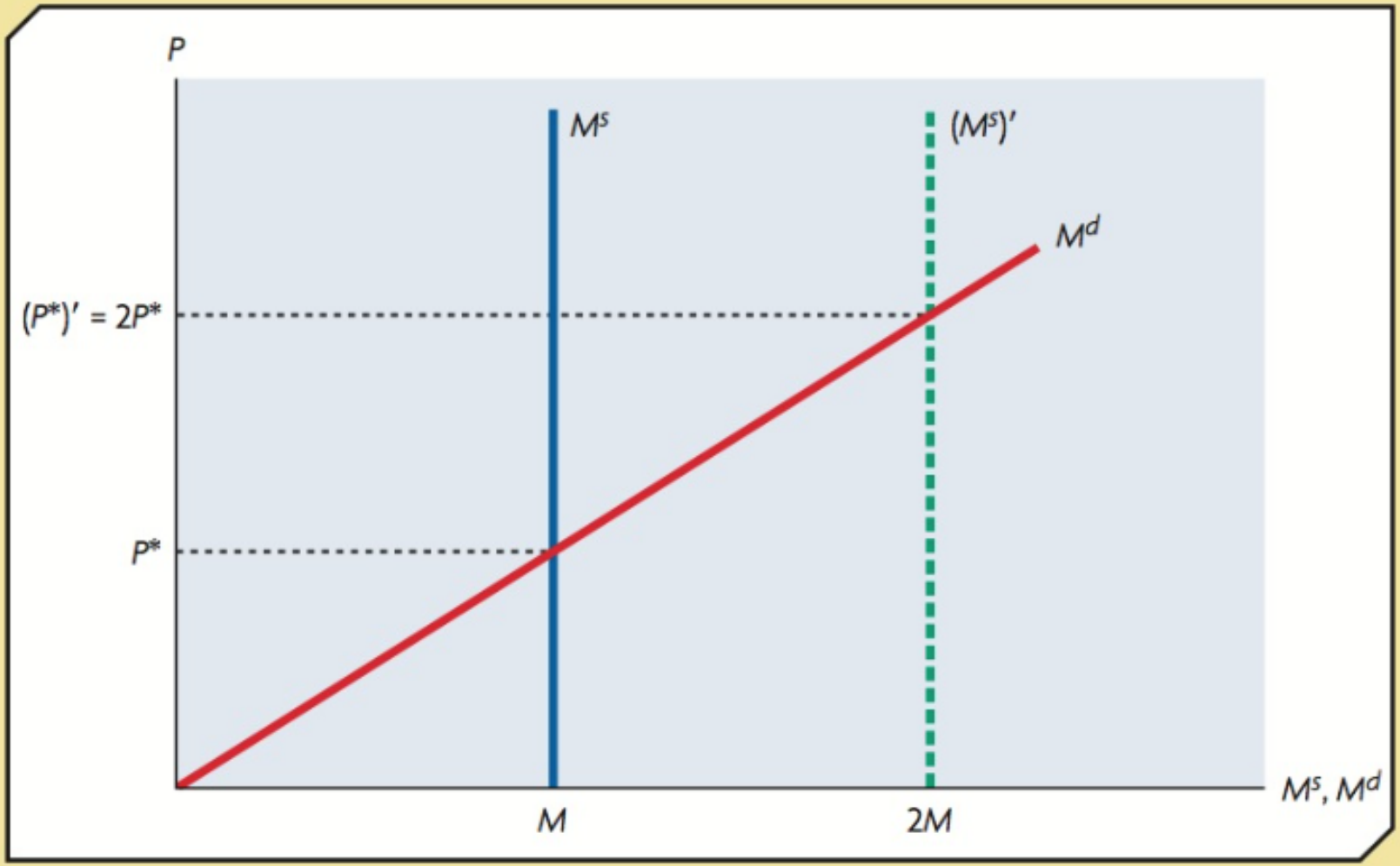
- The demand for money depends on the price level
- The quantity of money is set
- Therefore, in order for everyone to be willing to hold all the currency that exists, money demand must equal money supply
- The price level adjusts until supply equals demand

Money Supply and Demand-III

- This may be a little confusing at first! Note that as the price level rises, you demand more money!
- Why?
- Imagine the following: the government declares every dollar is worth !$!2 New Dollars
- In order for supply to equal demand, $M^s = M^d$.
- If it didn't, if M^d remained the same while M^s shifted out, then people would (for instance) spend their money on goods
- If, for instance, there weren't enough goods (demand has shifted out) then the price level will rise
- This will keep happening until the price makes it so that $M^s = M^d$.

Money Supply and Demand-VI

Figure 10.2 *An Increase in the Nominal Quantity of Money*



$$M^s = PL(Y, i)$$

(!) Important Warning (!)

- Note that because a high price level means that money isn't worth much, the demand curve slopes up
- A **decrease** in the demand for money is therefore a **counterclockwise** rotation
- Basically the y-axis is flipped from what you might be used to

Money Supply and Demand-V

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- Similarly for people choosing to save.

Money Supply and Demand-VI

- Double money supply M^s
  - This doubles the price level P
  - In order for markets to clear, real wage $\frac{w}{P}$ and real interest rates $\frac{R}{P}$ must stay unchanged, so they double as well.
  - People face all the same tradeoffs on real wages and real interest rates, so κ, and L stay the same.
  - So real GDP $Y = A(\kappa K)^{\alpha} L^{1-\alpha}$ doesn't change either
- In real terms, nothing changed.
- This should make sense to you: if we declared every dollar was actually !$2! New Dollars, and prices could adjust easily, then nothing would change.

Neutrality of money

- What we've just discussed is the neutrality of money
- We're saying that in an economy where prices can adjust, changes in the money supply don't change anything
- It's nearly universally accepted that the neutrality of money holds in the long run: we'll see evidence on this in the next chapter
- There is significant disagreement about whether or not (and to what degree) it's neutral in the short run
- Most of this disagreement revolves around the degree to which prices can change
- This will set us up for chapters 15 and 16.
- For now we'll look a little more at the supply and demand for money

Supply and Demand of Money

- We have the equation relating the price level P, money supply M^s, and money demand $L(\overset{(+)}{Y}, \overset{(-)}{i})$:

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- Let's go through some examples

Question 1

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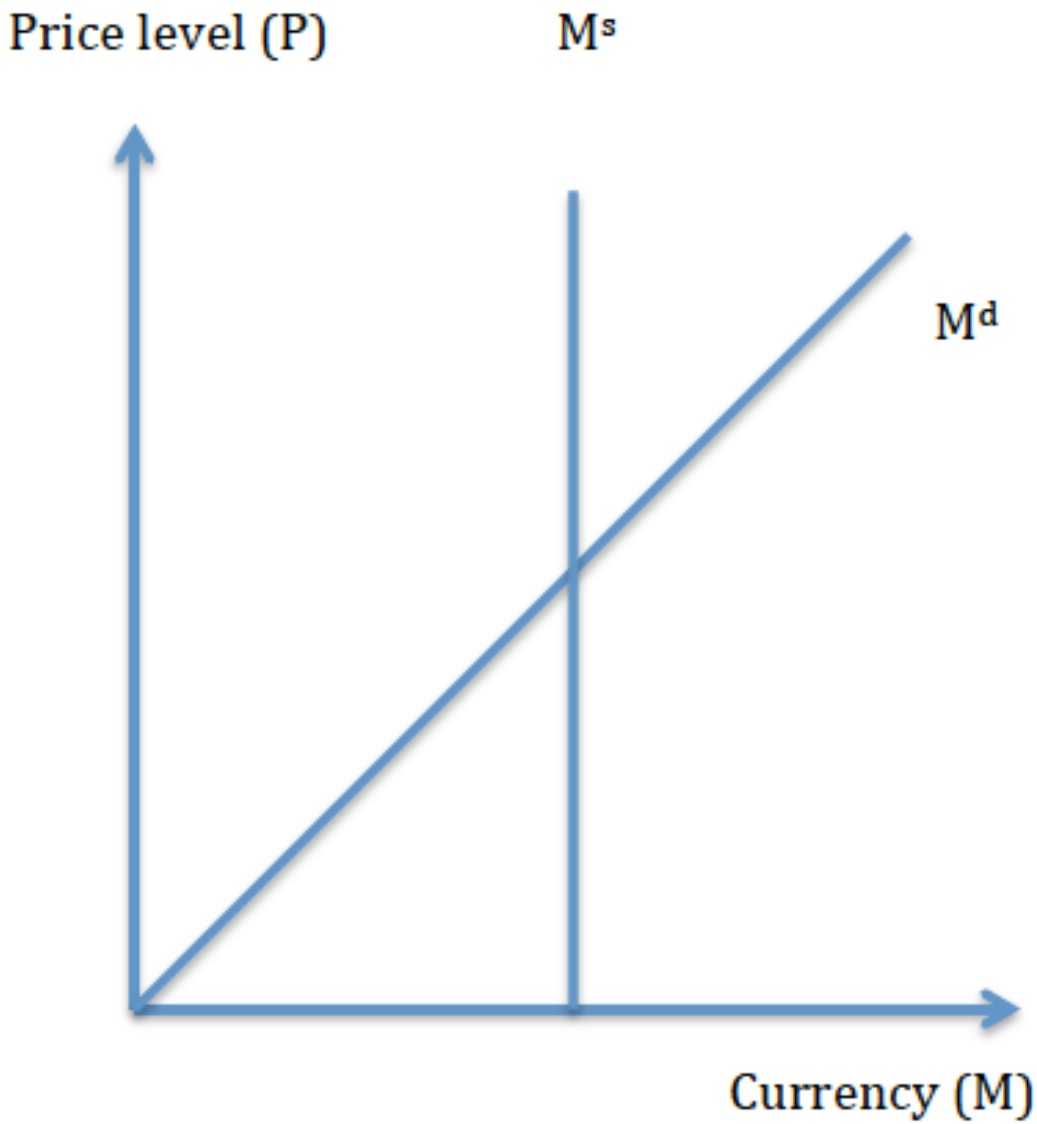
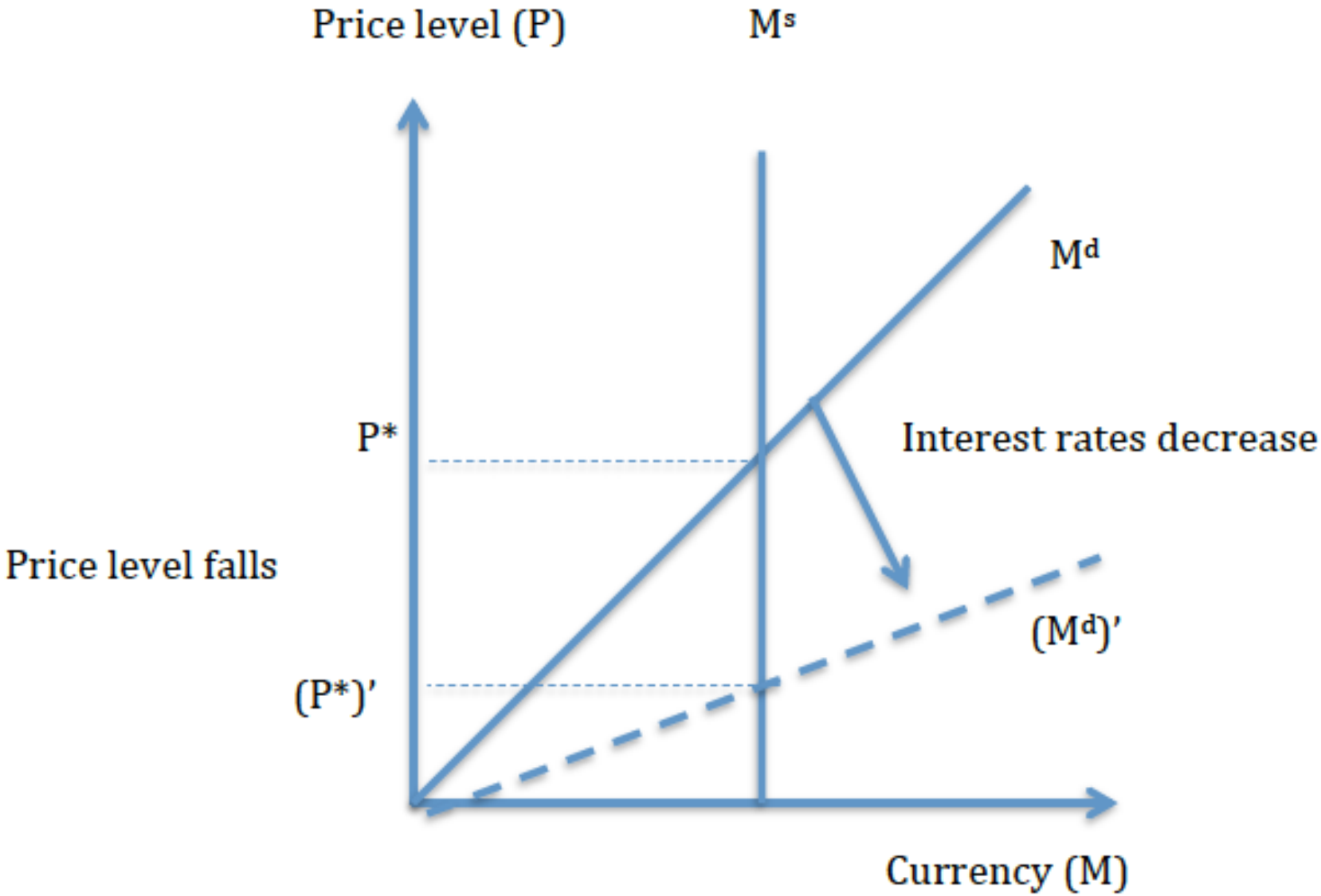
- Let's draw this!

Answer 1a



Answer 1b


Price level (P)
Ms
Md
P*
Interest rates decrease
Price level falls
(Md)'
(P*)'
Currency (M)

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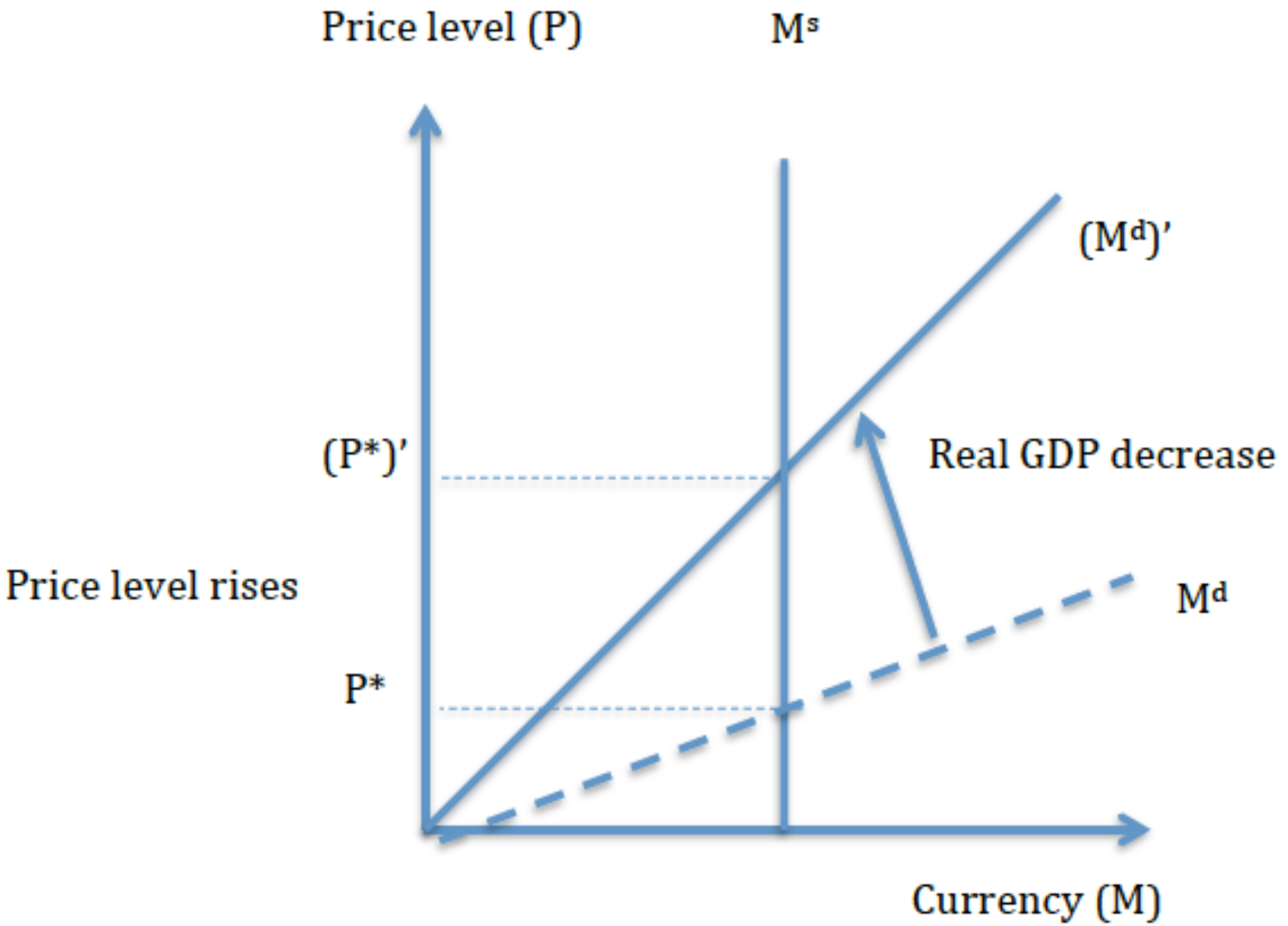

Is this confusing? What happens to the price in recessions?

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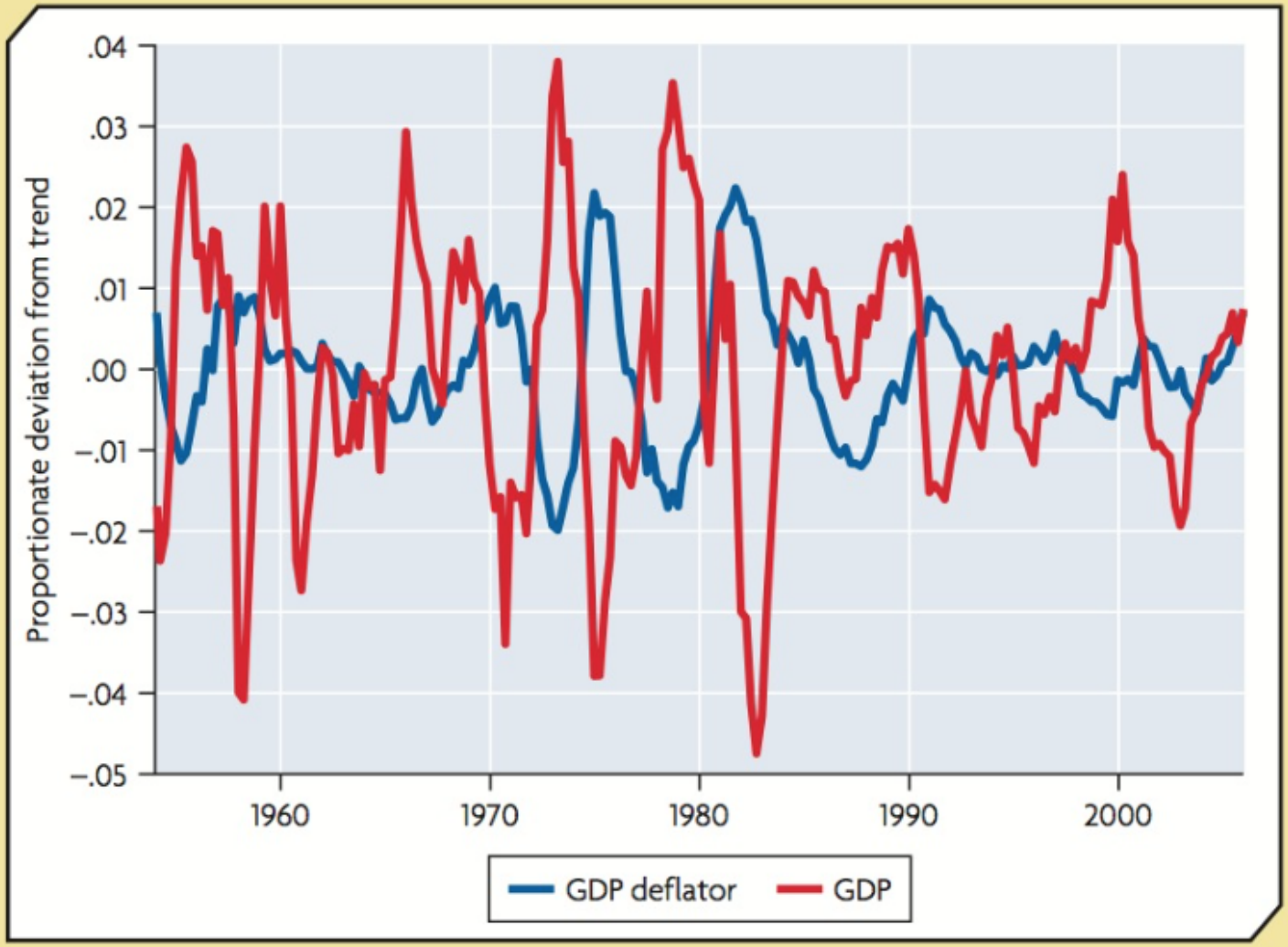
- The two effects conflict, result depends on how strong two effects are
- Empirically, we see i falling only a little and $L(Y, i)$ is less responsive to changes in i
- Consequently, in a recession we think the Y effect dominates and $L(Y, i)$

Cyclical Behavior of the Price Level

- We're left with what might be an initially confusing prediction!
- During Recessions, the price level should *rise*?!
- Let's look at the data

The price level is countercyclical!

Figure 10.4 *Cyclical Behavior of U.S. Real GDP and the Price Level*



The price level is countercyclical!

- This doesn't make sense if you were thinking a recession is when demand shifts down and supply stays the same
- But that isn't our model: ours is not that demand shifted down, it's that supply shifted down.
- People are less productive, so fewer things are being made: it makes sense prices would be higher in recessions!
- Note that all this assumes that M^s is constant. We'll discuss it not being constant shortly.

Price-level targeting

- Up until now we've been taking M^s and $(M^s)'$ as exogenous, as given
- In reality, it responds to shocks: governments and central bankers move it around when things happen
- Start with our equation:

$$P = \frac{M^s}{L(Y, i)}$$

- Now assume that bankers want to fix $P = \bar{P}$, keep prices constant
- In that case, they have to shift around M^s so that this holds:

$$\bar{P} = \frac{M^s}{L(Y, i)} \implies M^s = \bar{P}L(Y, i)$$

- So if bankers want to set the price level, they must set the money supply to be something specific.
- With this assumption we can analyze what happens to M

Trend growth of money

- Think about growth: Y is going up while i is staying relatively constant.

$$M^s = \bar{P}L(Y, i)$$

- Consequently, $L(Y, i)$ is constantly increasing (shifting clockwise)
- In order for $\bar{P}$ to stay the same, M^s must also be increasing
- Empirical estimates of $L(Y, i)$ suggest Y and M should increase by roughly the same amount
- We see this, but will discuss it more

Cyclical Behavior of Money

- Think about business cycles: Y is going up (ignore i)

$$M^s = \bar{P}L(Y, i)$$

- In booms, $L(Y, i)$ is increasing (shifting clockwise)
- In order for $\bar{P}$ to stay the same, M^s must also be increasing in booms and falling during busts
- Empirically, it is true that M and Y are positively correlated (M is weakly procyclical)
- As we've seen, it isn't procyclical enough to make prices not be countercyclical! (I.e. "$\bar{P}$" is an exaggeration).

Seasonal Variation in Money

- This was actually, in part, the reason for the Federal Reserve
- Seasonal variations in the need for money used to be a huge deal in agrarian days
- We wanted an "elastic currency" to mute price fluctuations
- This is the case: in December, when demand for money is high, the Federal Reserve also engineers more money to keep prices less volatile than they otherwise would be
- Everyone largely ignores this facet of the Federal Reserve, but it's historically phenomenally important.
- We'll return to this when we talk about the Federal Reserve and financial crises later in the semester