Asymmetric Information

Fall 2023
Econ 2316, Northeastern University
Prof. Josh Abel

P&R: chapter 17 (especially 17.2-17.3)
Emerson: chapter 22

Introduction

- Much of our analysis has assumed complete knowledge by all parties
- We've also studied uncertainty, when outcomes are unknown
- We now examine markets with asymmetric information, where some parties have more information than others
- You may think that those with more information will do better by taking advantage of those with less…
- …but outcomes are more subtle than that – markets can fail completely!
- Asymmetric information is found in tons of contexts:
  - Consumer goods, insurance, labor market, …
- In some instances, private solutions exist, and in others the government can help

Game of chance?

- Suppose I have 2 lottery tickets
  - A winner: worth $20
  - A loser: worth $0
- If you pay me, I will turn them over so I don’t know which is which, and then I’ll give you one at random.
- How much would you pay me for that offer?

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  - You should be willing to pay ~$0.

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  - You should be willing to pay ~$0.
- When buyers have less information than sellers, they should assume that "lemons" will be over-represented in their market

Adverse Selection

Lemons

- The Lemons Problem occurs when goods vary in quality, and the seller can observe the quality but the buyer cannot
- Buyers know they are at a “disadvantage” and will respond accordingly
- Sellers may have to sell their goods at a low price
- Or they may not be able to sell them at all!

Used car market

- Consider a market for used cars, with 100 buyers and 100 sellers
- There are 2 qualities:
  - High (“Peach”) – 50 cars
  - Low (“Lemon”) – 50 cars
- Agents’ values of the cars are given by:

$$V_{Buyer} = \begin{cases} 100 & \text{if Peach} \\ 60 & \text{if Lemon} \end{cases} \qquad V_{Seller} = \begin{cases} 90 & \text{if Peach} \\ 50 & \text{if Lemon} \end{cases}$$

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  - $P_{Peach} \in [90, 100],\ P_{Lemon} \in [50, 60]$
  - All 100 cars sell, generating overall surplus of 100*10 = 1,000

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- What if there is uncertainty, so neither buyer nor seller knows the quality?
  - $P \in [70, 80]$, all 100 cars sell for total surplus of 100*10 = 1,000
  - Some buyers find out they got a Peach :)
  - Others find out they got a Lemon :(

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- What if the seller knows the quality, but the buyer does not (asymmetric info)?

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  - But if buyers offer $80, owners of Peaches will not sell them
  - Only Lemons will transact in this market!

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- Buyers can anticipate this – they know there will be only Lemons, so they'll pay at most $60

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  - But if buyers offer $80, owners of Peaches will not sell them
  - Only Lemons will transact in this market!
- Buyers can anticipate this – they know there will be only Lemons, so they'll pay at most $60
  - $P \in [50, 60]$, 50 Lemons sell for total surplus of 50*10 = 500 < 1,000
- Market has "unraveled" – only low-quality items sell, and they sell at low prices
  - This phenomenon is known as adverse selection
  - Note that even the sellers, who have the information "advantage," are harmed

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  - So if such a seller says its car is a Peach, the consumer can trust it and pay a high price.
  - This can bring back the market for peaches and solve the adverse selection problem

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  - But offering a warranty on a Lemon is much more likely to cost you down the road
  - So, a warranty can solve the problem, because only sellers of Peaches will offer it – if a seller says its car is a Peach and offers a warranty, a buyer can trust it

The key feature of a good signal is differential costliness.

Health insurance

- One of the most important applications of adverse selection is in the market for health insurance
- Some people have a high probability of getting sick and requiring reimbursement, while others have a low probability
- The patients are better informed about their "type" than is the insurer, so there is potential for adverse selection:
  - Sickly types will tend to want to buy insurance, while Healthy types will not
- If a company is considering offering insurance, they have to decide how large to make the premium, taking adverse selection into account
  - The premium has to be low enough that the healthy types are willing to sign up…
  - …but high enough to cover all reimbursements
  - Such a premium might not exist – the market could unravel!

Health insurance example – patients

- Consider patients with indirect utility $U = Y^{1/2}$
- If healthy, their income is $Y_G = 25$. However, there is a risk that they will have a bad health event that requires treatment costing 16, leaving $Y_B = 9$.
- Half of patients are "healthy types," with sickness probability of $p_H = ⅜$
- Half of patients are "sickly types," with sickness probability of $p_S = ¾$
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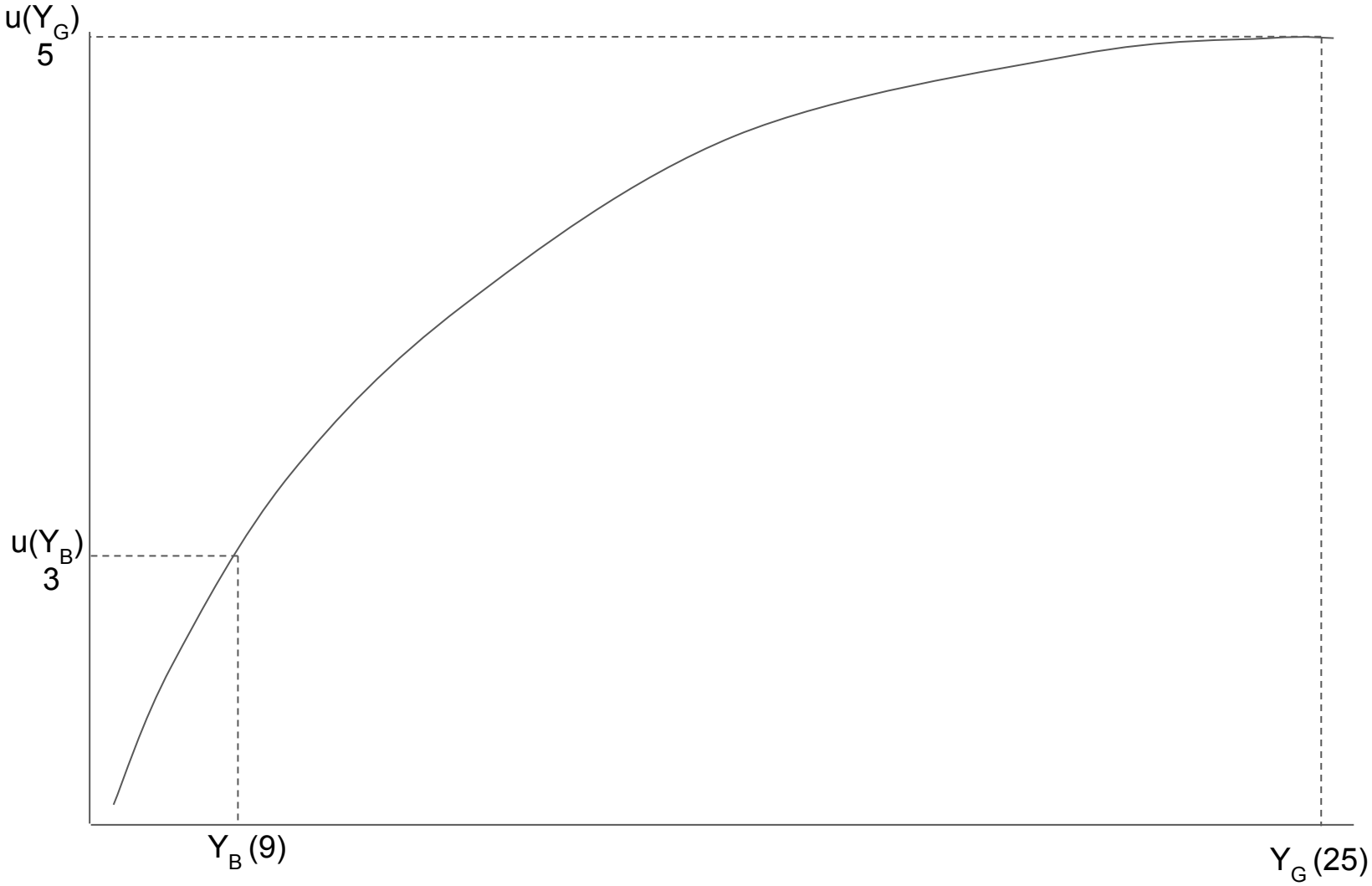
$$E[U]_H = \frac{3}{8} \cdot 9^{1/2} + \frac{5}{8} \cdot 25^{1/2} = 4.25$$

$$E[U]_S = \frac{3}{4} \cdot 9^{1/2} + \frac{1}{4} \cdot 25^{1/2} = 3.5$$


u(Y_G)
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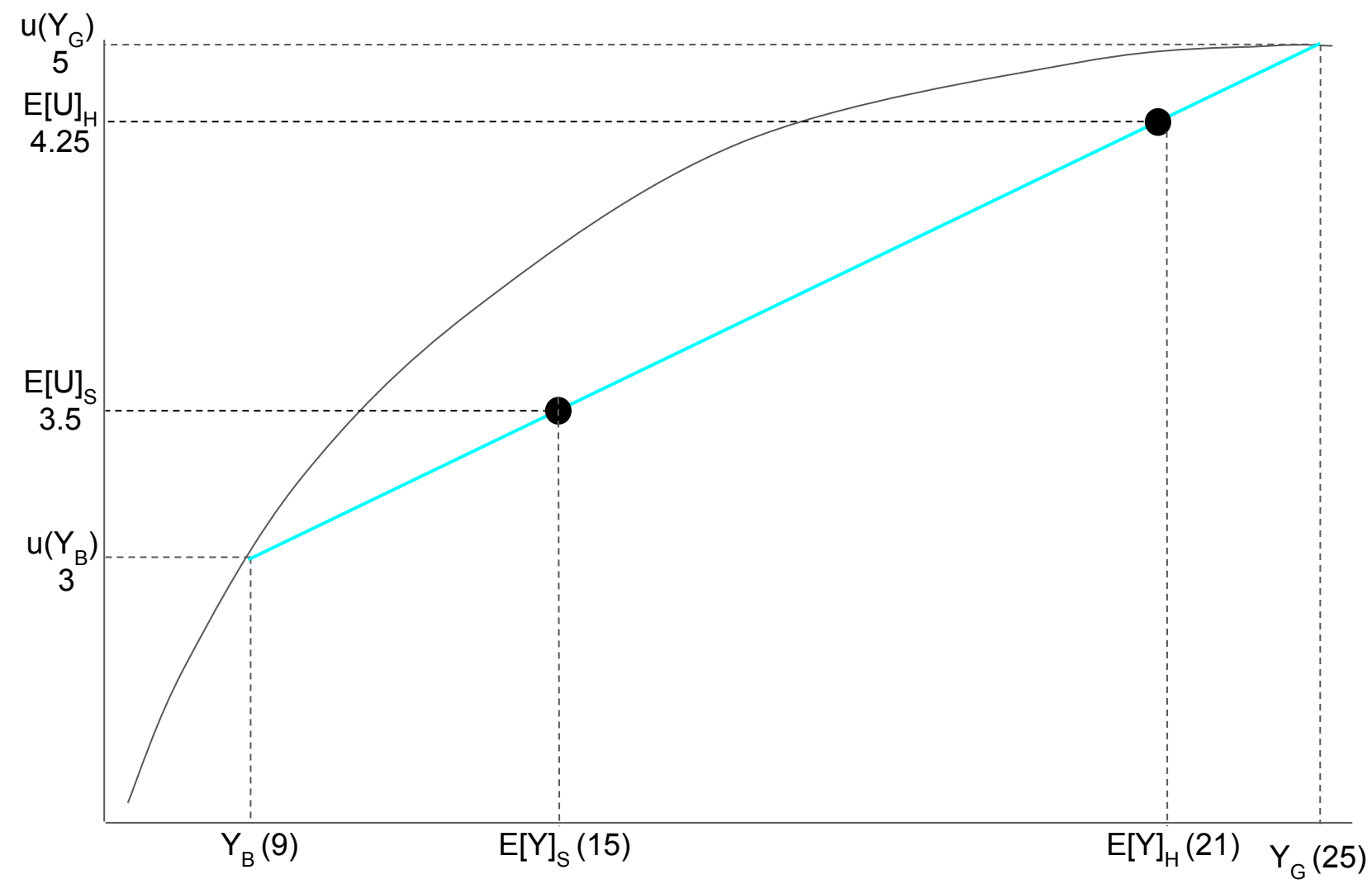
Y_B (9)
Y_G (25)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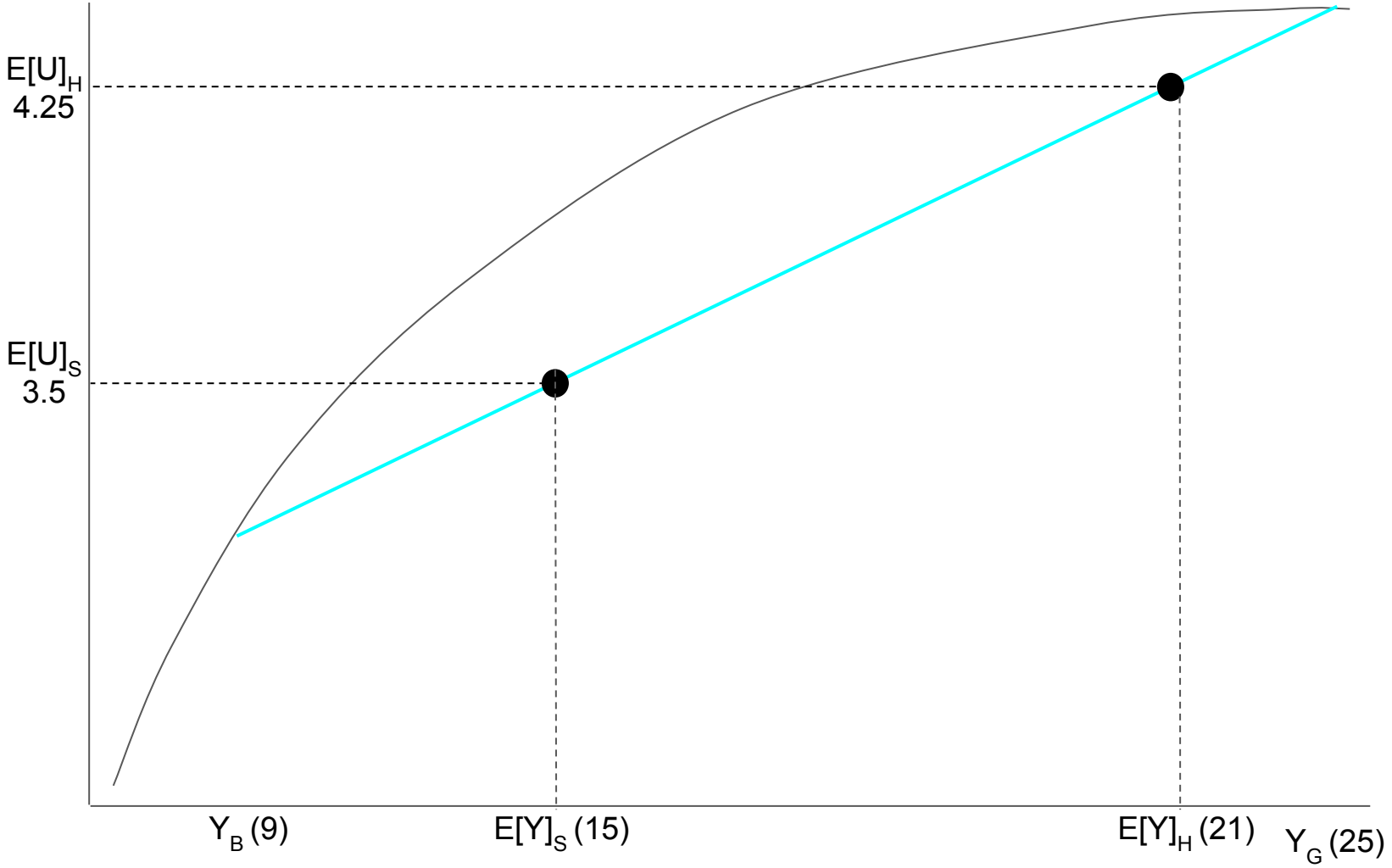
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- Now consider potential insurers. They will collect a premium (T) from all clients, and then pay out a claim (C = 16) to all who got sick.
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- What premium yields 0 profits assuming all patients sign up for insurance?

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$$T - \frac{1}{2} \cdot \frac{3}{8} \cdot 16 - \frac{1}{2} \cdot \frac{3}{4} \cdot 16 = 0$$

$$T = 9$$

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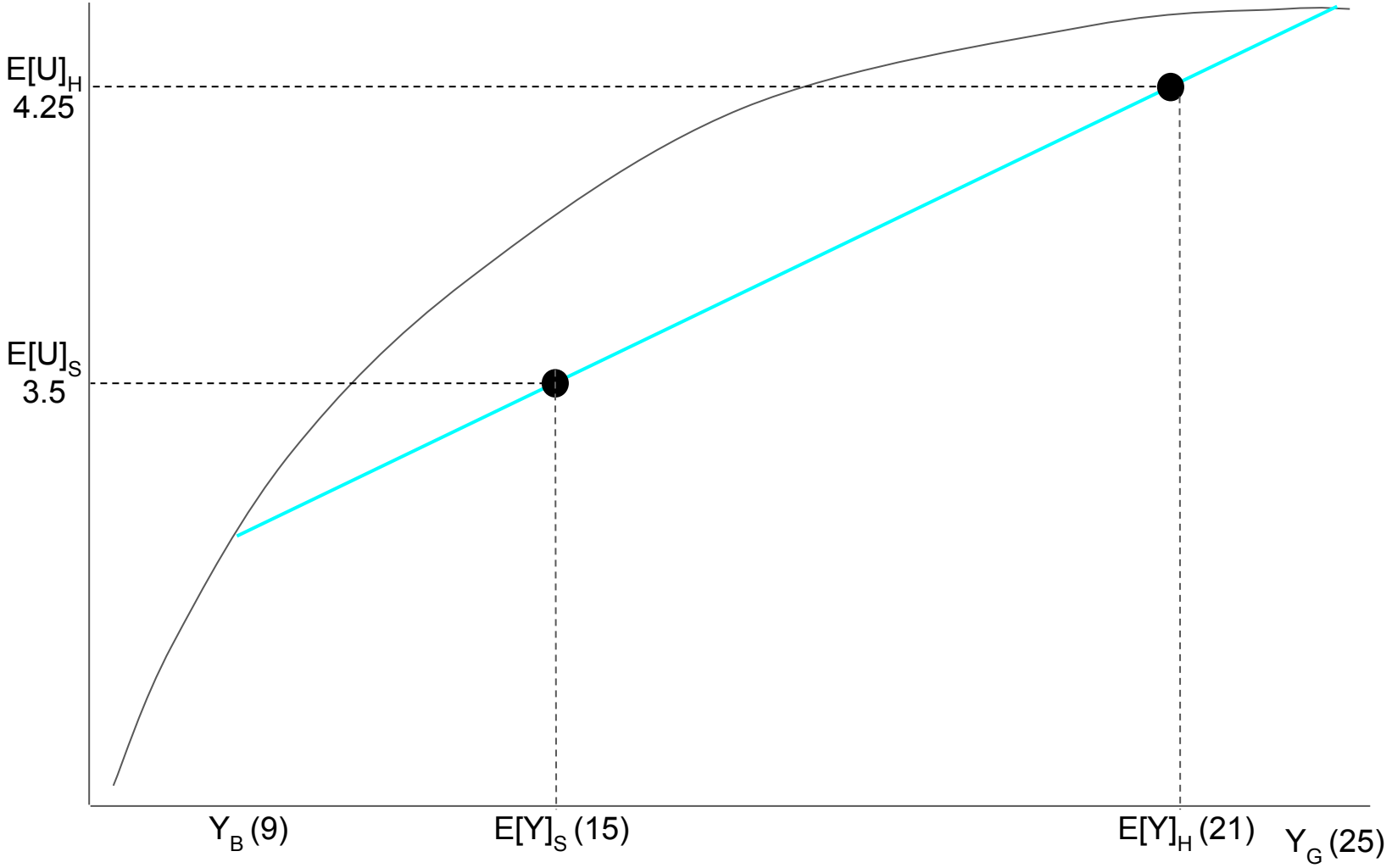
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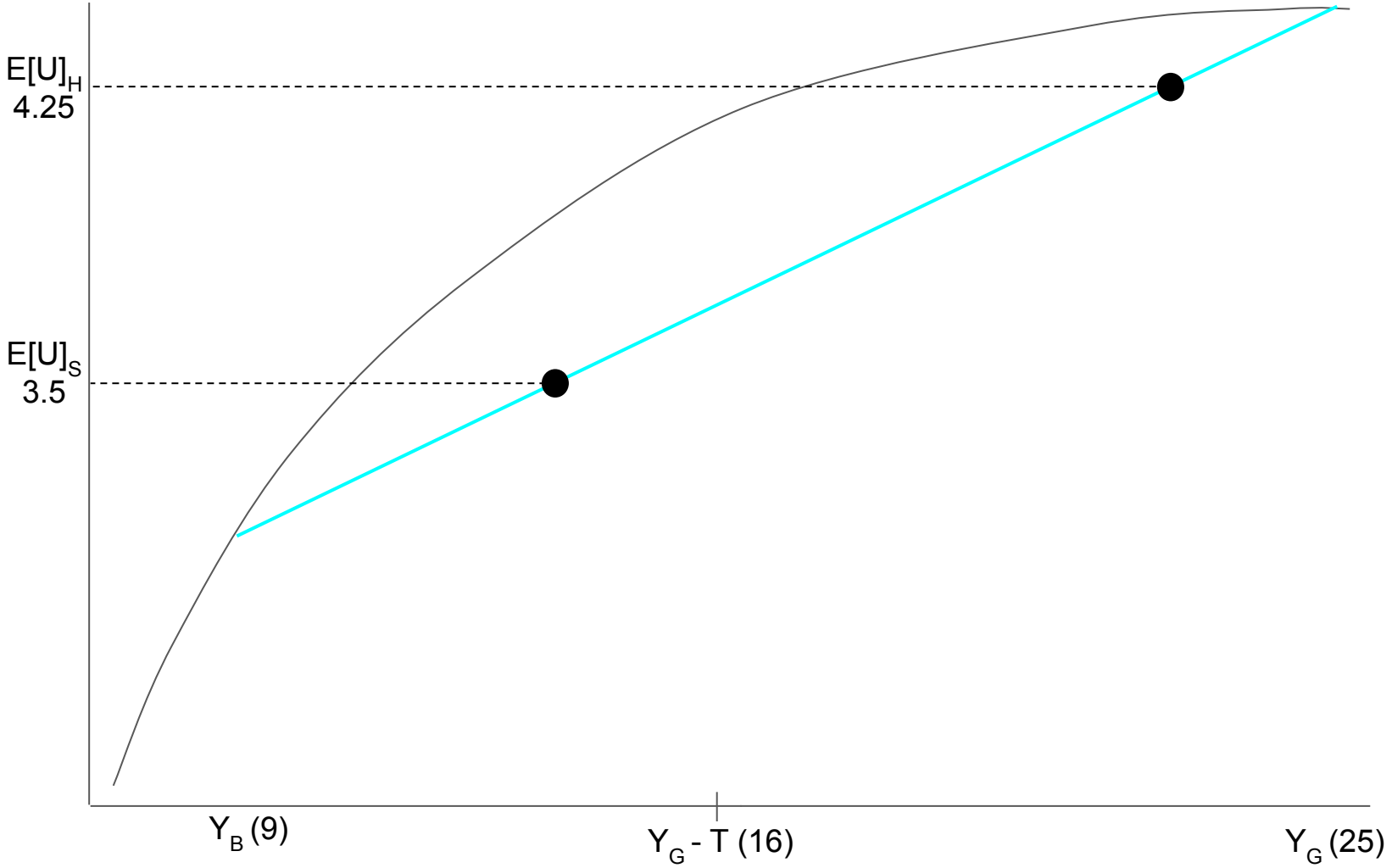
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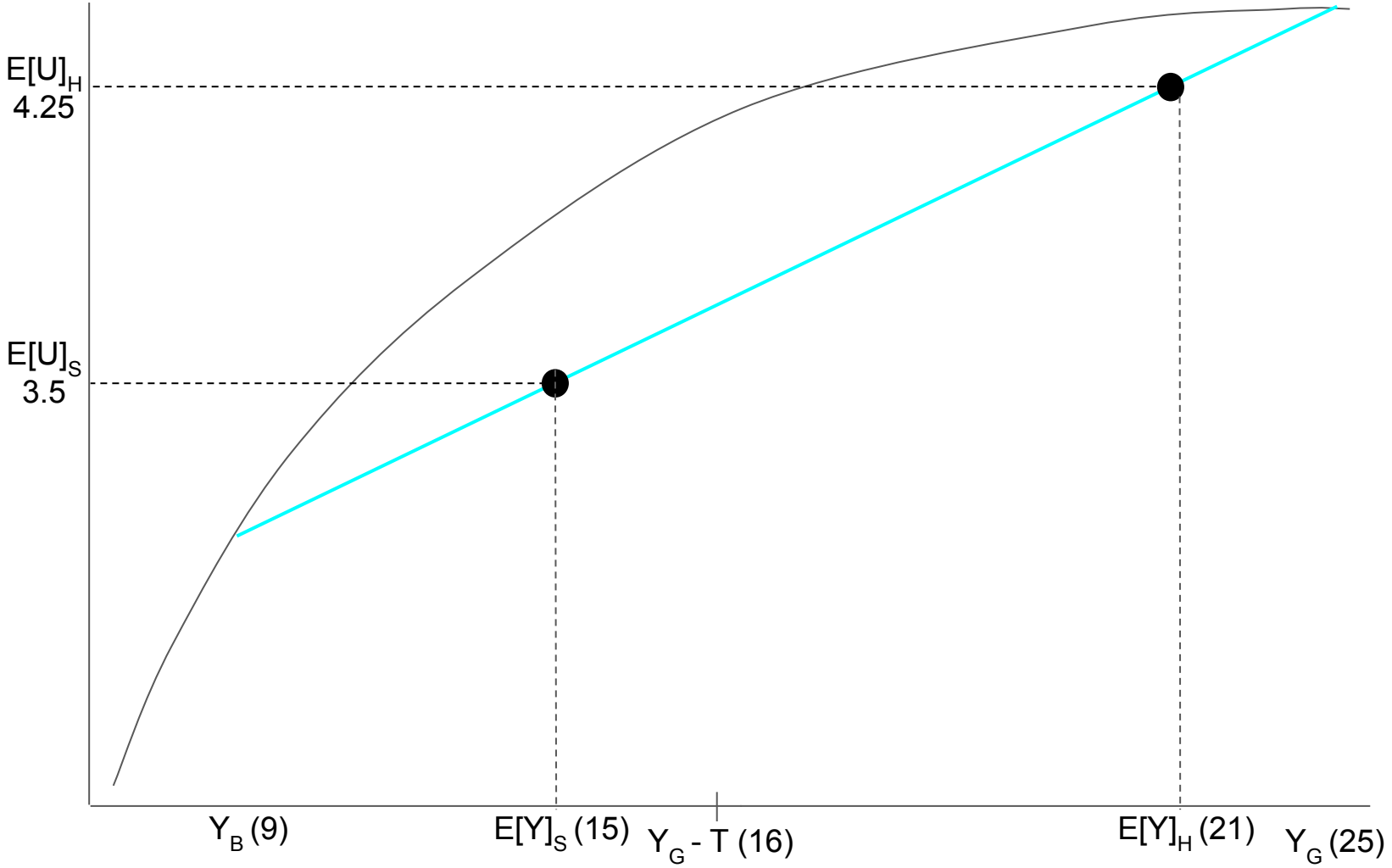
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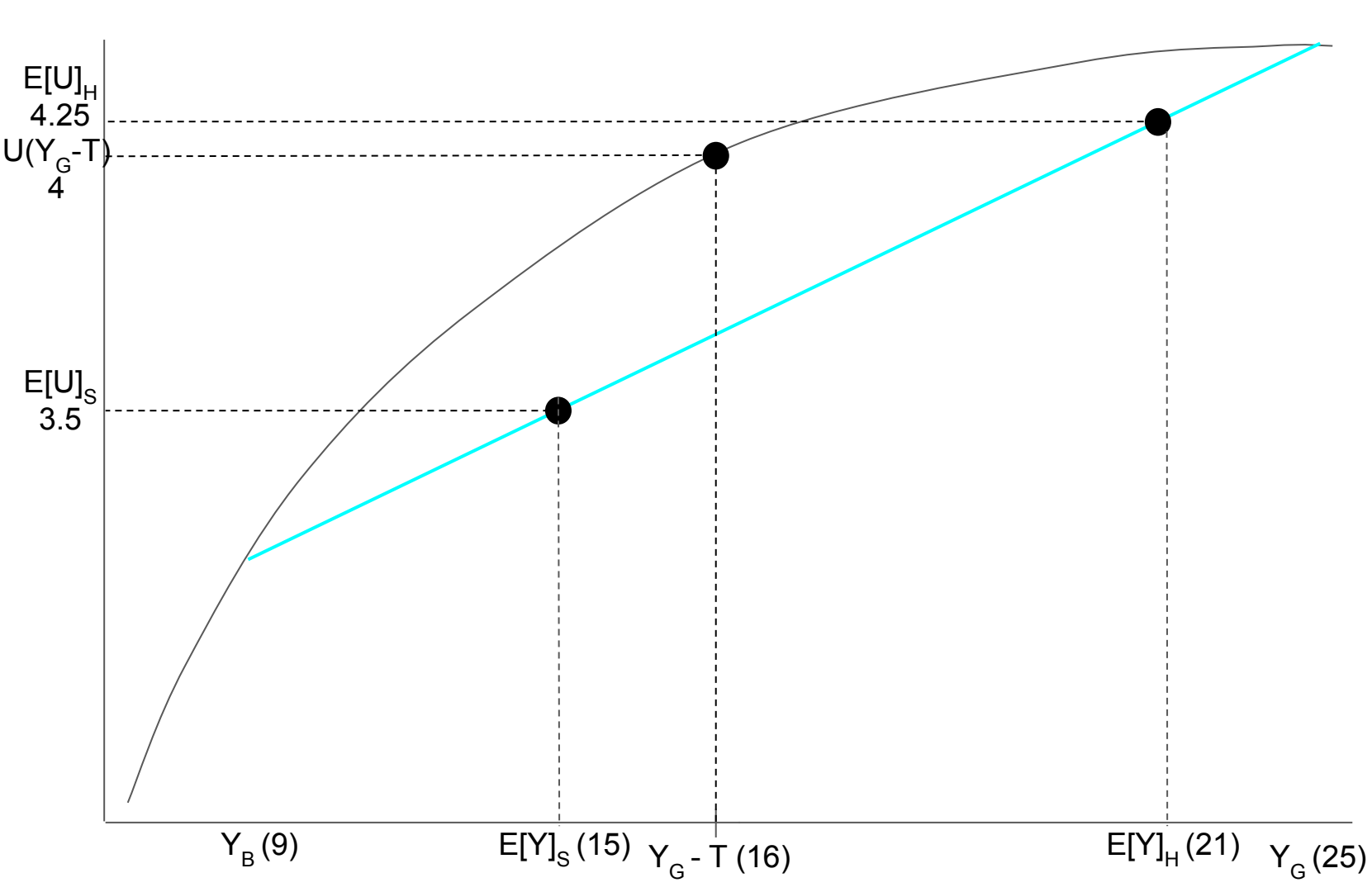
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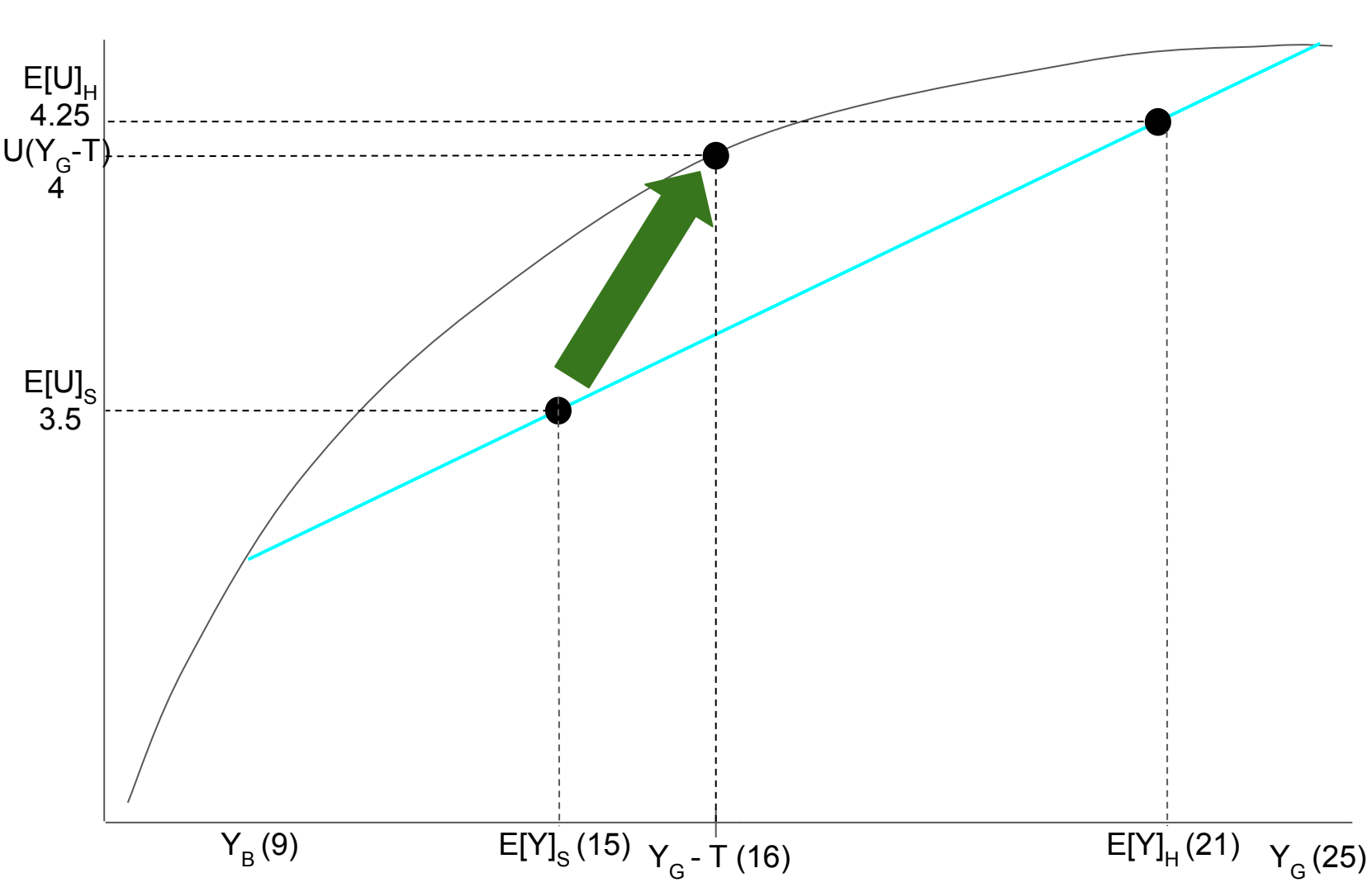
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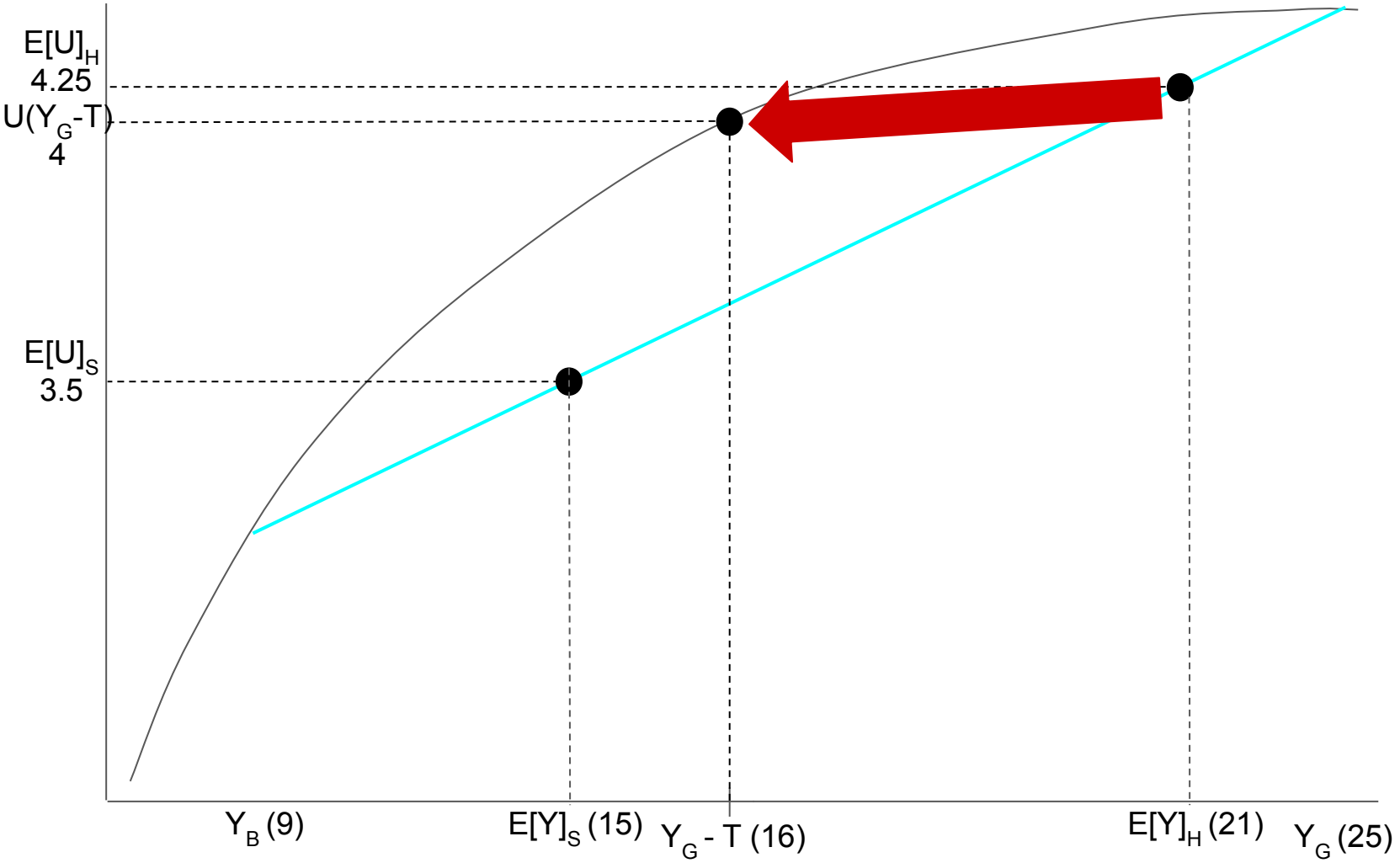
- Would Healthy people sign up?
  - No: $4 < 4.25 = E[U]_H$
  - They had to subsidize the claims of the Sickly types, which resulted in too large a premium – while they appreciate the certainty, they are giving up too much on average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Health insurance example – equilibrium

- In this example, the health insurance market unraveled
- Because of asymmetric information, the insurer can't charge separate premiums to the different types
- Because the insurers charge a single premium, adverse selection causes the Sickly types to sign up, driving the premium up
- Healthy types did not want to subsidize the Sickly types by paying such a high premium, so they withdrew from the market
- As a result, that premium would generate negative profits, and the insurers will have to shut down (or hike up premiums a lot)

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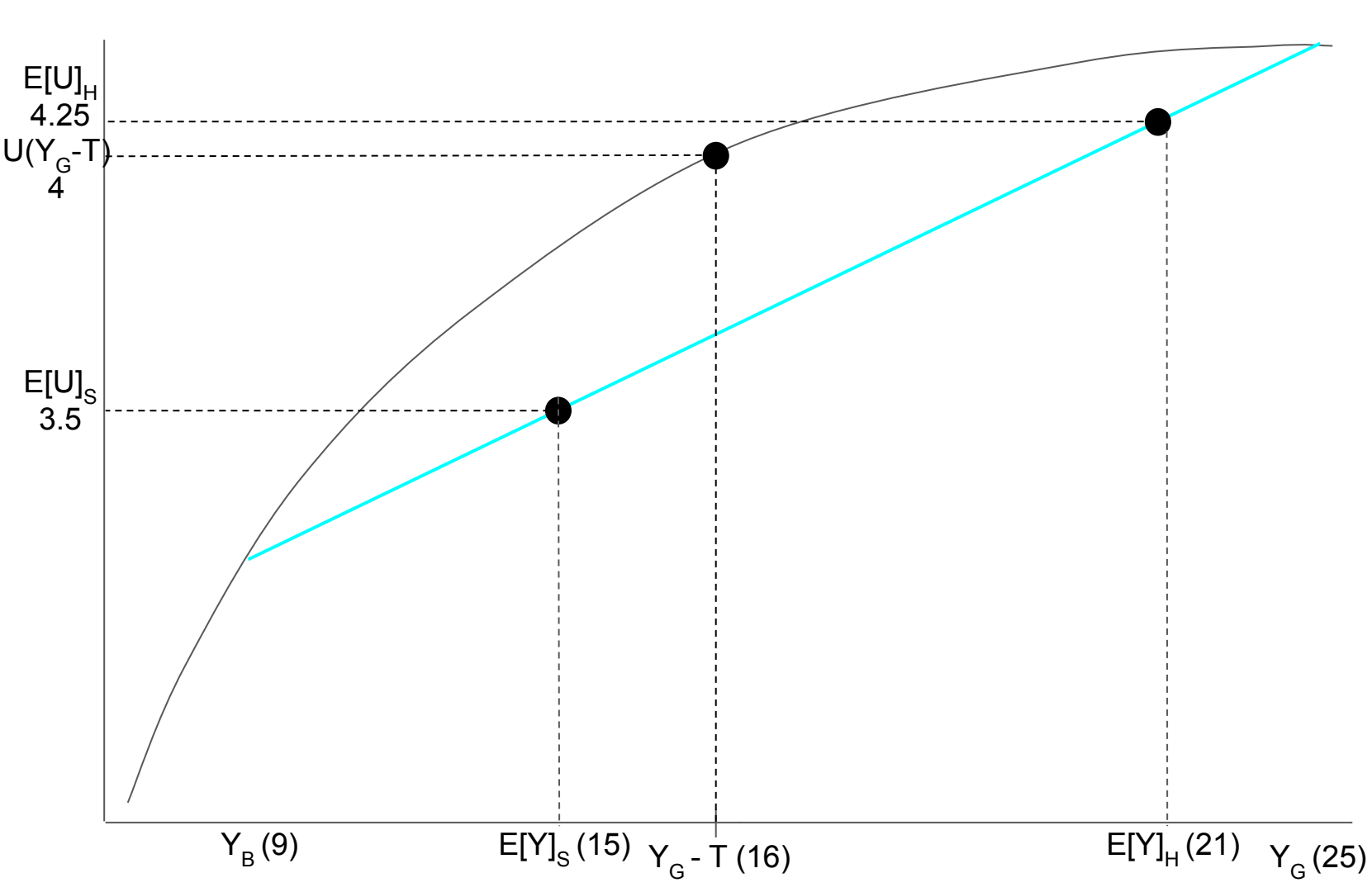
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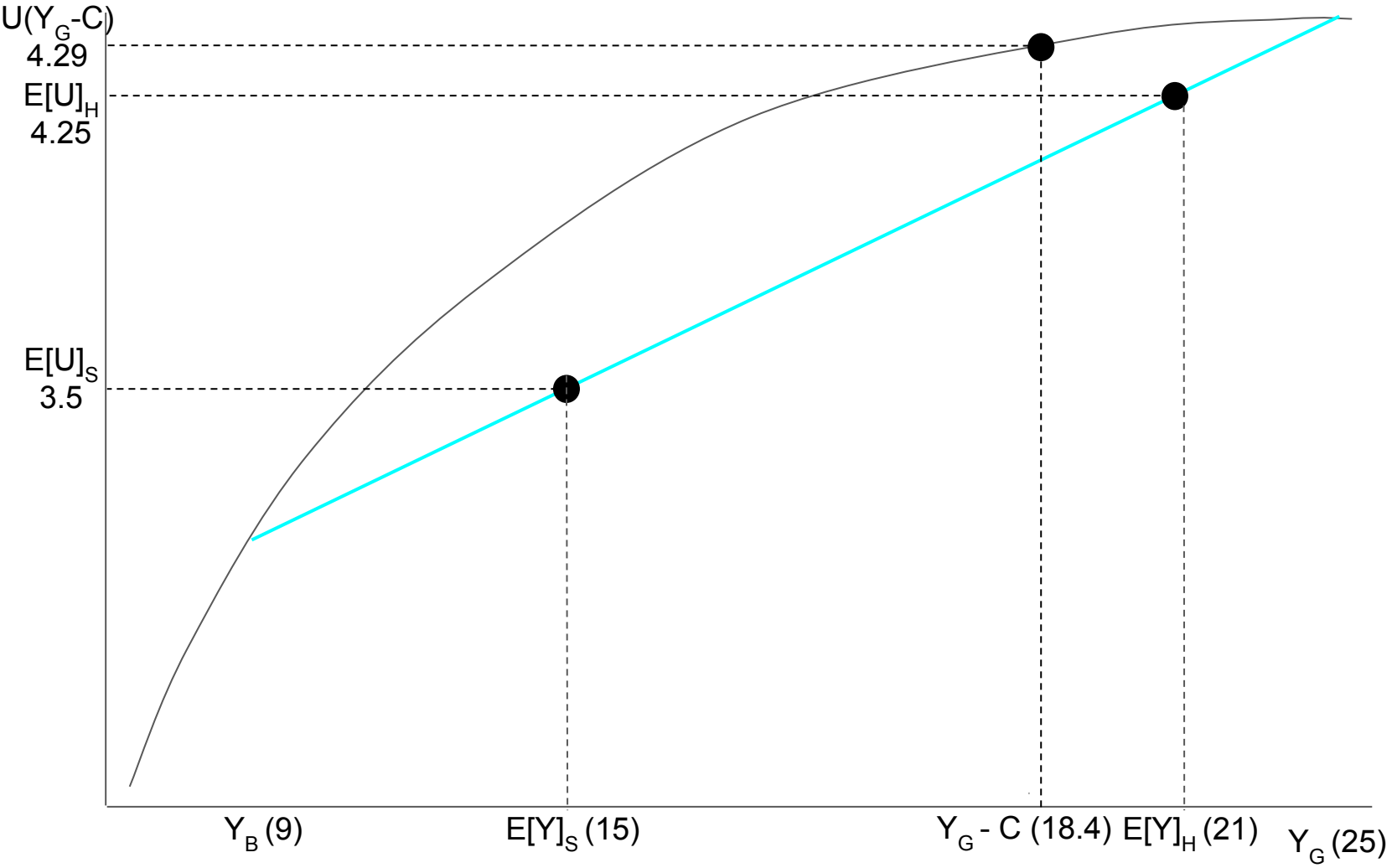
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  - So Healthy people will buy the insurance, and the market will work!
    - Actual premium is less than the risk premium – they will lose income on average in order to avoid the bad outcome

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- While that example showed a failure of a market, different scenarios can lead to better outcomes
- If the share Healthy types were higher (e.g. 90% rather than 50%):
  - Then the zero-profit premium would be T = 6.6…
  - So the new guaranteed income would be 25 - 6.6 = 18.4…
  - And guaranteed utility would be 4.29 > 4.25…
  - So Healthy people will buy the insurance, and the market will work!
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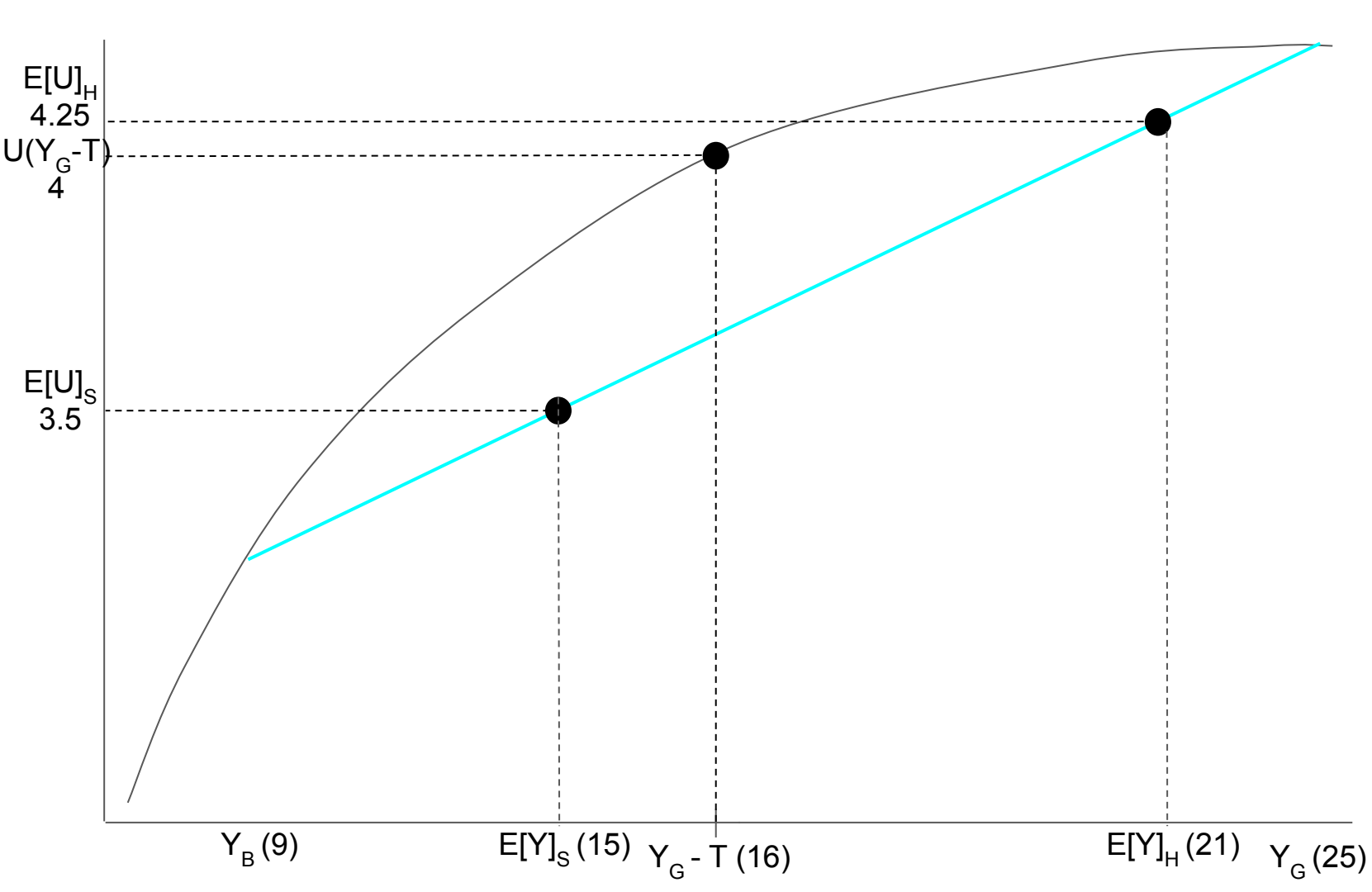
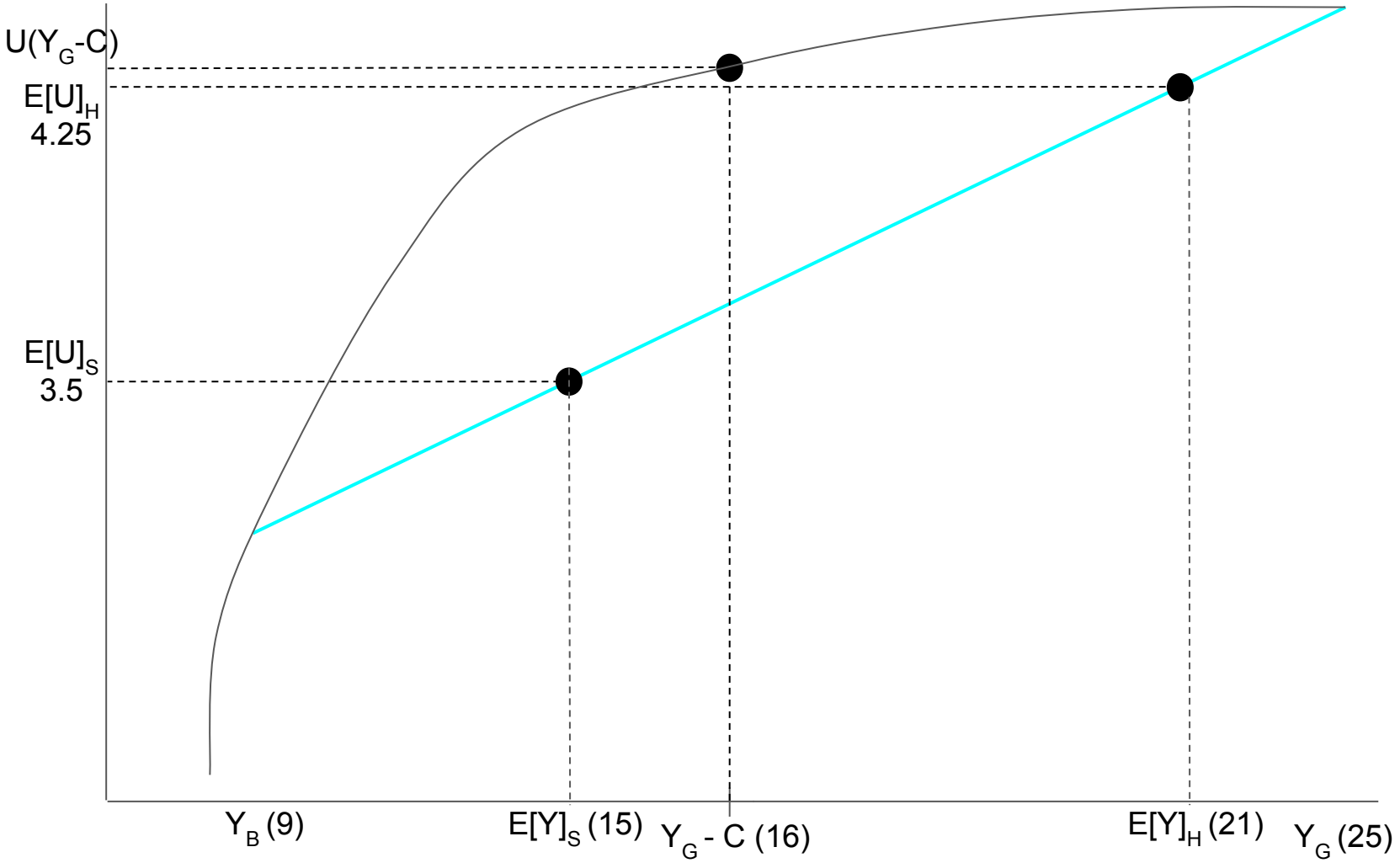
- Or, if people are more risk averse, the market may function


E[U]H
4.25
U(YG-T)
4
E[U]S
3.5
YB (9)
E[Y]S (15)
YG - T (16)
E[Y]H (21)
YG (25)


U(Y_G-C)
E[U]_H
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- Or, if people are more risk averse, the market may function
  - Again, the market works because Healthy types are willing to pay "too much" and subsidize Sickly types in order to avoid the bad outcome

Private health insurance in practice

- In the real world, some private health insurance markets work okay, others don’t
- If you’re a 30-year-old looking for long-term care insurance, you can likely find it at a reasonable premium
- But if you’re a 70-year-old looking for LTC insurance, you probably can’t
- As a result, many government programs have been created to try to fill the gaps that emerge

Government and health insurance

- There is a large set of government health programs, with different populations, functions, and justifications
  - Medicare
  - Medicaid
  - VHA
  - CHIP
  - IHS
- Let’s discuss the Affordable Care Act (ACA), sometimes known as “Obamacare,” which was passed in 2010

Pre-existing conditions

- A key problem the ACA sought to address was that people with pre-existing conditions found health insurance either unavailable or unaffordable
    - For instance, if you had a history of kidney problems, health insurers could refuse to insure you or charge a very high premium based on that condition
- So, one of ACA's most important provisions was a banning of that practice, so a pre-existing condition was not a justification for higher premiums or denial of insurance

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- So then insurers would just be left with the Sickly types, and they would go out of business if they charged low premiums
- So ACA included a mandate that everyone had to buy health insurance
    - This meant that insurers would continue to get business from Healthy types, allowing them to cover the costs of the Sickly types and allow the whole system to work

Subsidies

- But the individual mandate created a separate issue
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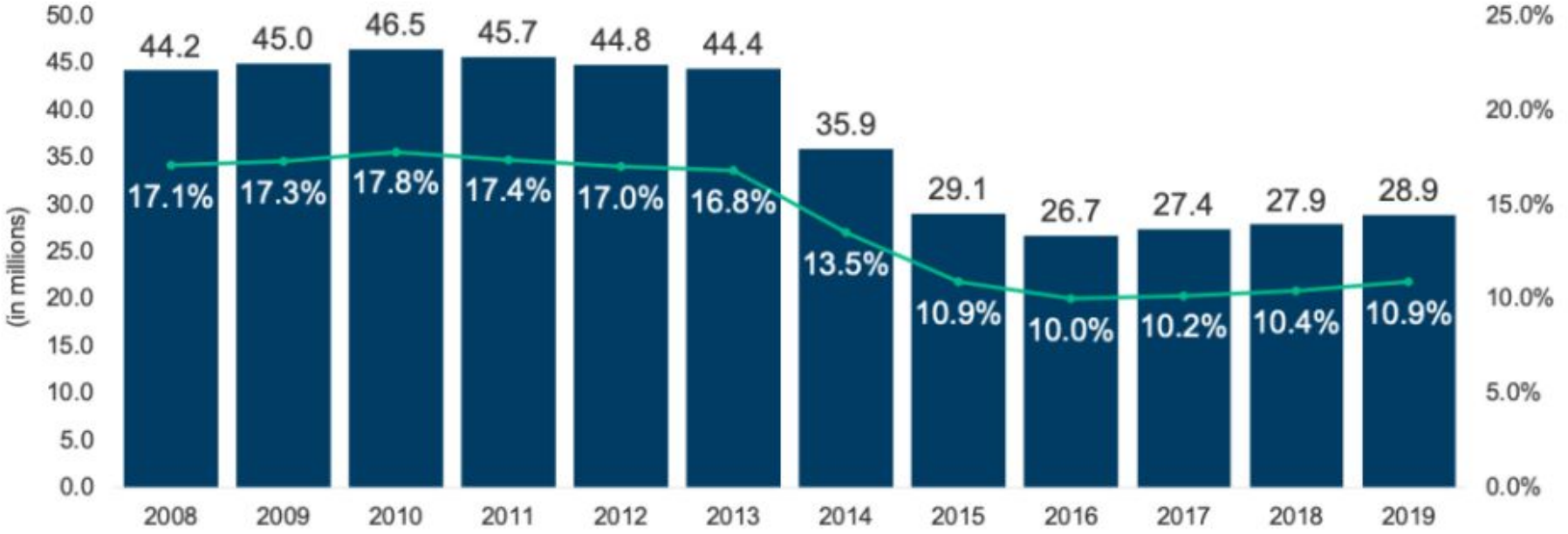
- Some people didn't buy health insurance because they legitimately felt they could not afford it
- So the ACA also had a system of income-based subsidies, so that people with low incomes would get assistance in paying their premiums

“The three-legged stool”

- The resulting policy worked as a 3-legged stool
  - **No denials based on pre-existing conditions**
  - **Individual mandate**
  - **Subsidies**
- In concert, these features assured that insurance companies could stay in business while offering (relatively) affordable health insurance to everyone, regardless of pre-existing conditions

Figure 1

Number of Uninsured and Uninsured Rate among the Nonelderly Population, 2008-2019



NOTE: Includes nonelderly individuals ages 0 to 64.

SOURCE: KFF analysis of 2008-2019 American Community Survey, 1-Year Estimates.

KFF

2017 reform

- In 2017, the individual mandate was removed.
- This caused a lot of concern because it removes one of the stool's legs
- However, the system has survived
  - The number of people opting to go without insurance did not jump back to pre-ACA levels
  - Ultimately, the "mandate" is just a tax, and so while it's a loss of tax revenue, it doesn't fundamentally alter the viability of the system

Moral Hazard

Another manifestation of asymmetric information

- Adverse Selection referred to an instance when one party had additional information *prior to a transaction*
  - Saw that it could potentially unravel/destroy a market
- Moral Hazard refers to situations where one party has additional information *after an agreement is reached*
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- As with Adverse Selection, we can study Moral Hazard with an example

Driving risk

- Imagine a driver with initial income of 100
- She drives a car, and there is a risk that she crashes, which will cost her 64
- She can lower this risk by exerting Effort
  - If she exerts Effort, probability of crash is $p_E = 0.25$
  - If she exerts No Effort, probability of crash is $p_N = 0.5$
- Utility is given by $U = Y^{1/2} - e$
  - $e = 0.5$ for Effort
  - $e = 0$ for No Effort

Solution without insurance

$p_E = 0.25$; $p_N = 0.5$; $U = Y^{1/2} - e$; $e = 0.5$ if $p = p_E$, $e = 0$ if $p = p_N$

- Expected utility of Effort:
- Expected utility of No Effort:

Solution without insurance

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- Expected utility of Effort: $0.75*(100)^{1/2} + 0.25*(36)^{1/2} - 0.5 = 8.5$
- Expected utility of No Effort: $0.5*(100)^{1/2} + 0.5*(36)^{1/2} - 0 = 8$

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Solution: drive carefully!

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- Wrong…

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- Expected utility of Effort:
- Expected utility of No Effort:

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- Expected utility of being uninsured: 8.5
- Expected utility of Effort: $0.75*(84)^{1/2} + 0.25*(84)^{1/2} - 0.5 = 8.7$
- Expected utility of No Effort:

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Solution: don't put in effort because, hey, you're insured!

The problem with full insurance

- Because driver no longer bears the cost of her actions, she has no incentive to put in effort
  - Moral Hazard
- Insurance company would lose money
  - Receives premium of T = 16, but has to pay claim of C = 64 50% of the time
    - Profit = 16 - 0.5*64 = -16 < 0
  - Will not offer insurance, or will offer insurance with higher premium (T = 32)
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- Regardless, a fully-insured driver will never give High effort – an inefficient outcome
- How might we be able to get the driver to give High effort, while also insuring her?

Solution with partial insurance

$p_E = 0.25$; $p_N = 0.5$; $U = Y^{1/2} - e$; $e = 0.5$ if $p = p_E$, $e = 0$ if $p = p_N$

- Suppose insurer offers fair-but-incomplete coverage: T = 7, C = 28
  - Fair if driver exerts Effort, because $T = p_E * C$
  - Incomplete because driver still bears risk: loss would be 64, but claim is only 28

- Expected utility of being uninsured: 8.5
- Expected utility of Effort:
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- Expected utility of being uninsured: 8.5
- Expected utility of Effort: $0.75*(100-7)^{1/2} + 0.25*(100 - 7 -64 + 28)^{1/2} - 0.5 = 8.62$
- Expected utility of No Effort:

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Solution: drive carefully because you bear enough risk from a crash!

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Solution: drive carefully because you bear enough risk from a crash!

- What if we make policy more complete?

Solution with partial insurance

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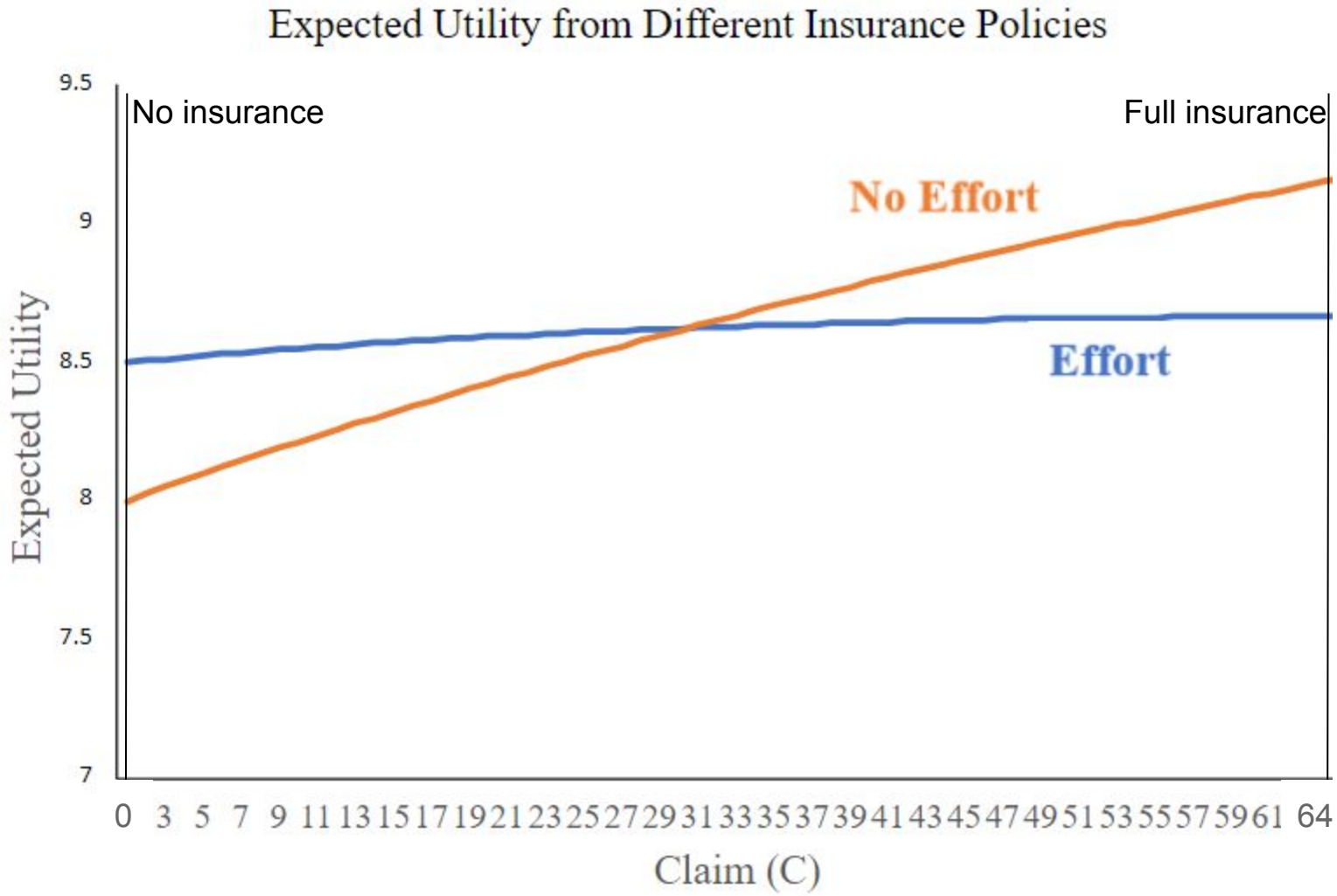
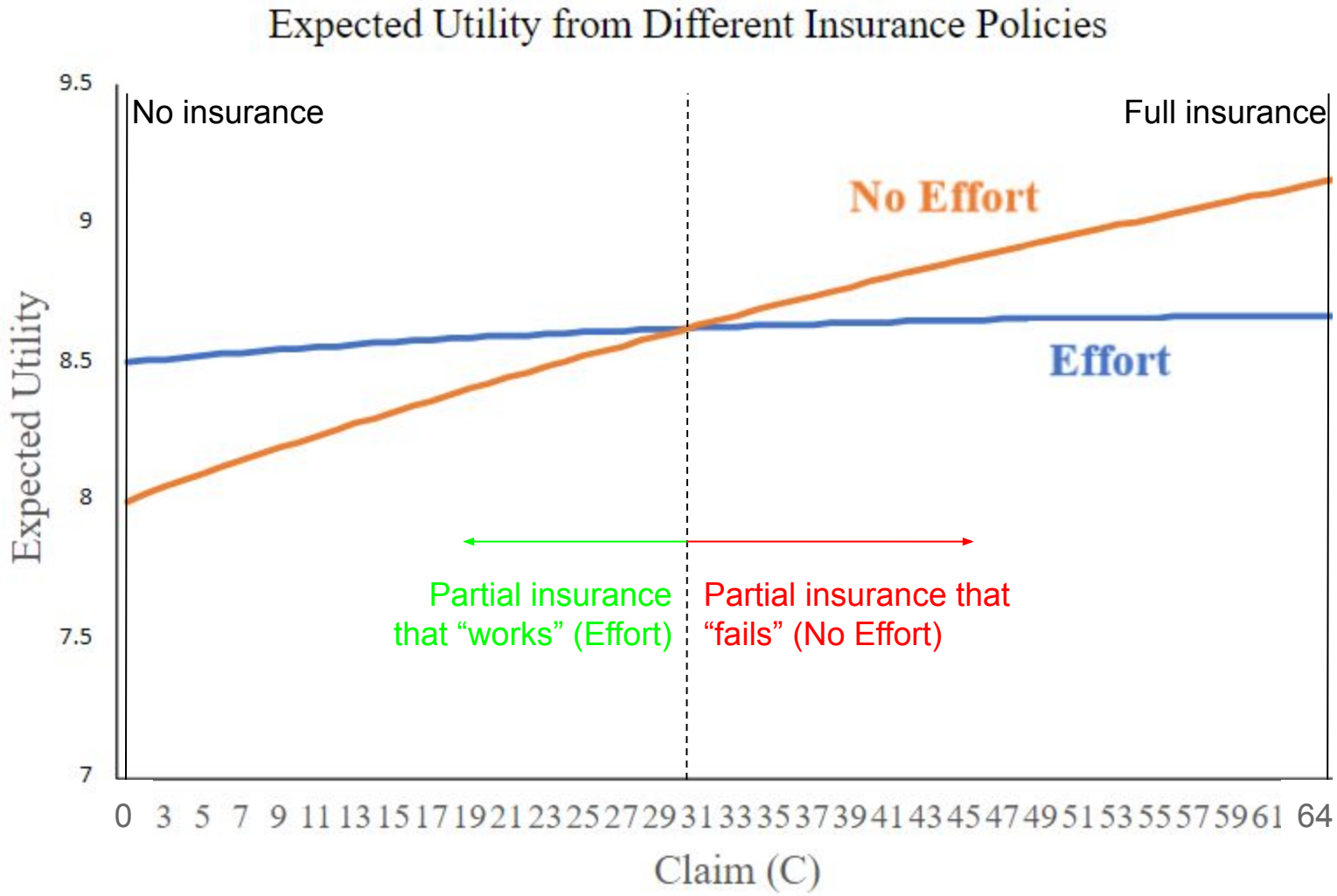
- Suppose insurer offers fair-but-incomplete coverage: T = ~~7~~ 8, C = ~~28~~ 32
  - Fair if driver exerts Effort, because $T = p_E * C$
  - Incomplete because driver still bears risk: loss would be 64, but claim is only ~~28~~ 32

- Expected utility of being uninsured: 8.5
- Expected utility of Effort: $0.75*(100-8)^{1/2} + 0.25*(100 - 8 - 64 + 32)^{1/2} - 0.5 = 8.63$
- Expected utility of No Effort: $0.5*(100-8)^{1/2} + 0.5*(100 - 8 - 64 + 32)^{1/2} - 0 = 8.67$

Solution: don't exert effort because you don't bear enough risk from a crash!


Expected Utility from Different Insurance Policies
No insurance
Full insurance
No Effort
Effort
Expected Utility
9.5
9
8.5
8
7.5
7
0 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41 43 45 47 49 51 53 55 57 59 61 64
Claim (C)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Effort
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Partial insurance in practice

- Coinsurance rate
  - Insurer only covers a certain percentage of the bill; you cover the rest

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- Coinsurance rate
  - Insurer only covers a certain percentage of the bill; you cover the rest
- Copay
  - You have to pay a fee every time you make a claim
- Deductible
  - You cover the first $X of damage before insurer starts chipping in

Other settings of Moral Hazard

- Employee compensation
  - Company profits depend on CEO Effort
  - If she gets a flat wage, she will not work hard
  - So give her a performance-based bonus
  - But if her compensation is too bonus-heavy, she bears a lot of risk (external factors also determine company profits) – may not want to work there
  - Need to strike the right balance
- Hiring a contractor
  - If you agree to pay for materials, they have no incentive to find good prices
  - If you pay a flat fee, they bear all risk on costs, may not to want to take the job
  - Need to strike the right balance

Conclusion

- Private/asymmetric information can hinder or even destroy markets
  - Inefficient – lost gains from trade!
- Adverse Selection
  - Undesirable types will be overrepresented in the market
  - Other side of the market will understand this and pull back
  - Prices may be low (or insurance premiums high), if market functions at all
- Moral Hazard
  - People may not exert effort if insulated from the risk
  - Other side of market will understand this and not provide full insurance
    - If the insurer could monitor you as you drive, the problem would be solved…
- Asymmetric information might not have any of these effects – depends on how strong the incentives are!
  - Details matter