

| Dep. var. | Indep. var. | Model                                     | Interpret $\hat{\beta}_1$ of $\beta_1$                                                                                            |
|-----------|-------------|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| $y$       | $x$         | $y = \beta_0 + \beta_1 x + u$             | $\hat{\beta}_1 = 0.1$<br>$\Delta x = 1$<br>$\Delta y = 0.1$                                                                       |
| $\log(y)$ | $x$         | $\log(y) = \beta_0 + \beta_1 x + u$       | $\hat{\beta}_1 = 0.0001$<br>$\Delta x = 1$ <i>approximate effect</i><br>$\therefore \Delta y = 100 \times \hat{\beta}_1 = 0.01\%$ |
| $\log(y)$ | $\log(x)$   | $\log(y) = \beta_0 + \beta_1 \log(x) + u$ | <i>exact effect</i><br>$\hat{\beta}_1 = 0.7 \approx 0.01\%$<br>$\therefore \Delta x = 1$<br>$\therefore \Delta y = 0.7$           |

Estimate the effect of educ. on wages  
using a constant elasticity model

$$\log(\text{wage}) = \beta_0 + \beta_1 \log(\text{educ.}) + u$$

Why logs? constant % effects may be more  
credible than e.g. const. \$ effects

variables where taking logs is reasonable  
& some where logs isn't

✓ Binary indicator  $\begin{cases} \nearrow 0 \text{ not employed} \\ \searrow 1 \text{ employed} \end{cases}$

✓ population

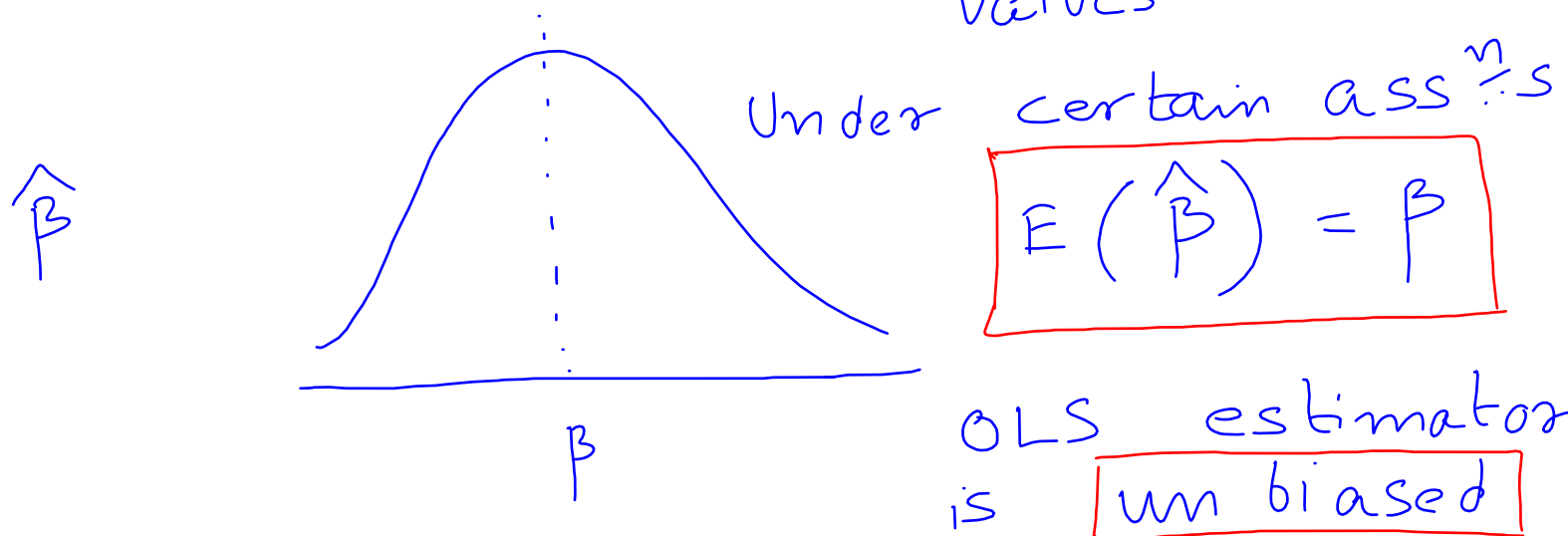
✓ share of expenditure  $\in [0, 1]$

# agreements

| Reasonable | Not reasonable   |
|------------|------------------|
| population | Binary indicator |
| share      | # agreements     |

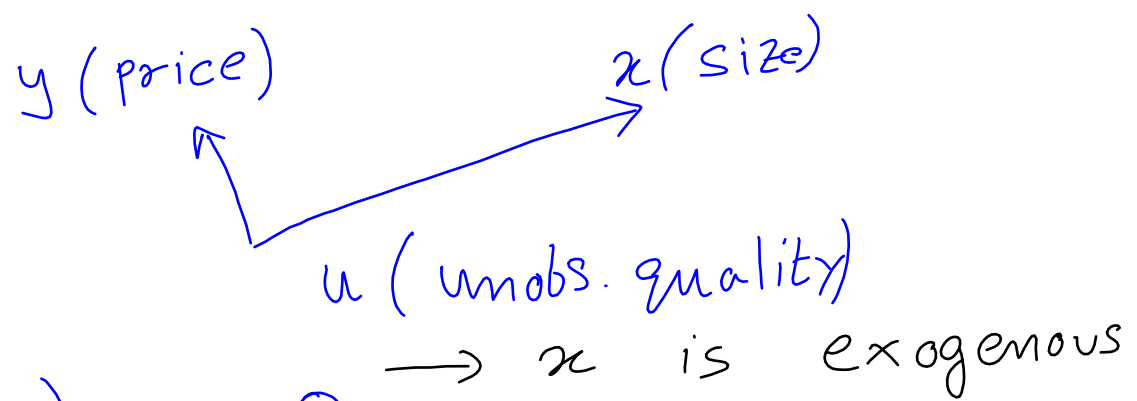
# Expected value of OLS estimators

$\beta \rightarrow$  effect of size on property values



ass<sup>n</sup>s :

- ① linear model in param.
- ② random sample  $\beta$ 's e.g. not just properties > \$1M
- ③ variation in  $x$
- ④  $u \times x \rightarrow$  not correlated



$$E(u|x) = 0$$

$$E(\text{qual.} | 1200 \text{ sq.ft.}) = E(\text{qual.} | 2500 \text{ sq.ft.})$$

If  $E(u|x) \neq 0 \rightarrow x$  is endogenous

$$y = \beta_0 + \beta_1 x + u$$

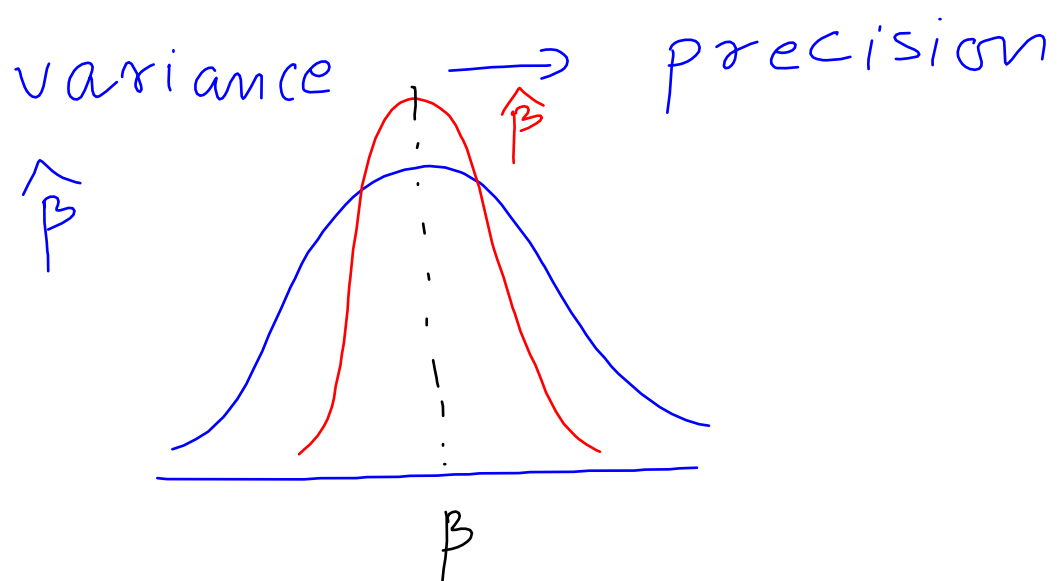
$$E(y|x) = \beta_0 + \beta_1 x$$

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Does everyone with  $educ = 8$   
have same wage?

$$wage = \beta_0 + \beta_1 educ + u$$

## Variance of OLS estimators



Ass<sup>n</sup> of homoskedasticity

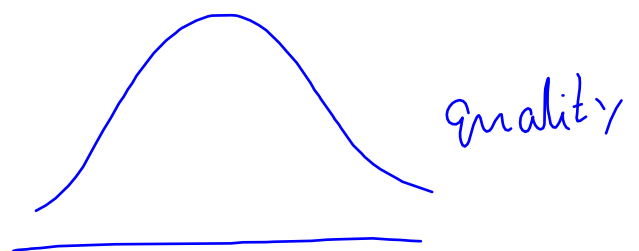
$$\text{var}(u|x) = \text{var}(u) = \sigma^2$$

$u$ : quality

1000 sq.ft

$x$ : size

$$\Rightarrow \text{var}(y|x) = \sigma^2$$



600 sq.ft

