The Value of a Bangladeshi Woman's Time: An Econometric Analysis

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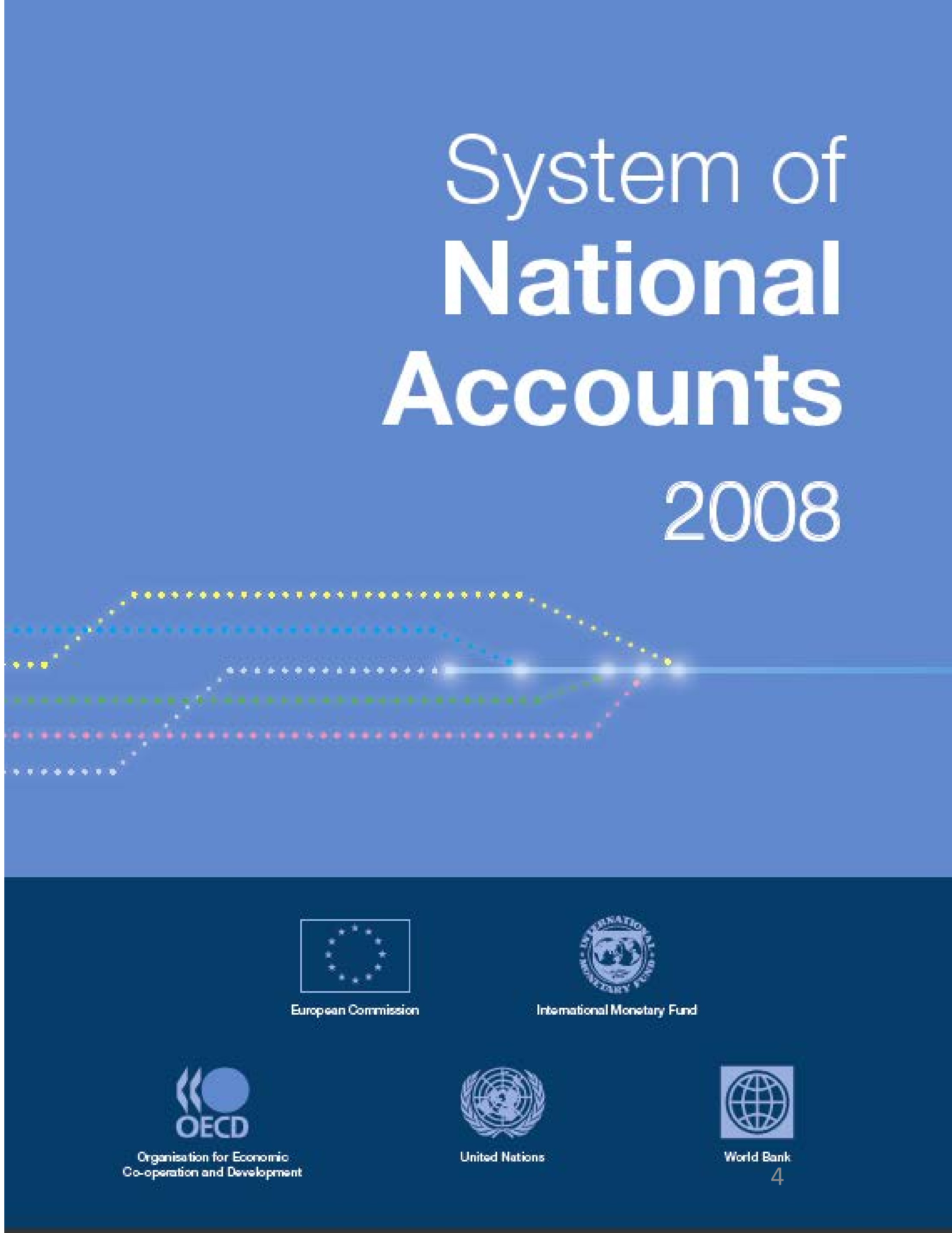
Introduction

“oikonomikos”

“management and care of the household”.

The System of National Accounts (SNA) is the internationally agreed standard set of recommendations on how to compile measures of economic activity.



The System of National Accounts includes

Production & trade of weapons

Prostitution

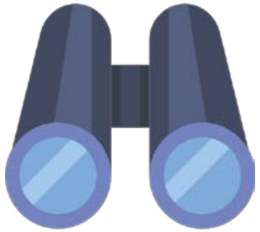
But excludes

Women's unpaid labour

Cake Model of the Economy

Monetised top parts of the cake account for all officially measured statistics of economic output

Unmonetised bottom parts of the cake subsidise the top parts with free labour and resources



- If women are not visible as contributors to a nation's economy, then they will not be visible in the distribution of benefits

- Value of housewife's labour can be used during divorce settlement or for estimating the extent of economic loss due to the wrongful death of a housewife

- Can complement time-use surveys to estimate economic contribution of housewives

Failure to recognize the value of women's unpaid work is failure to recognize the value of women themselves

SUSTAINABLE DEVELOPMENT GOALS

TARGET 5·2

END ALL VIOLENCE AGAINST AND EXPLOITATION OF WOMEN AND GIRLS

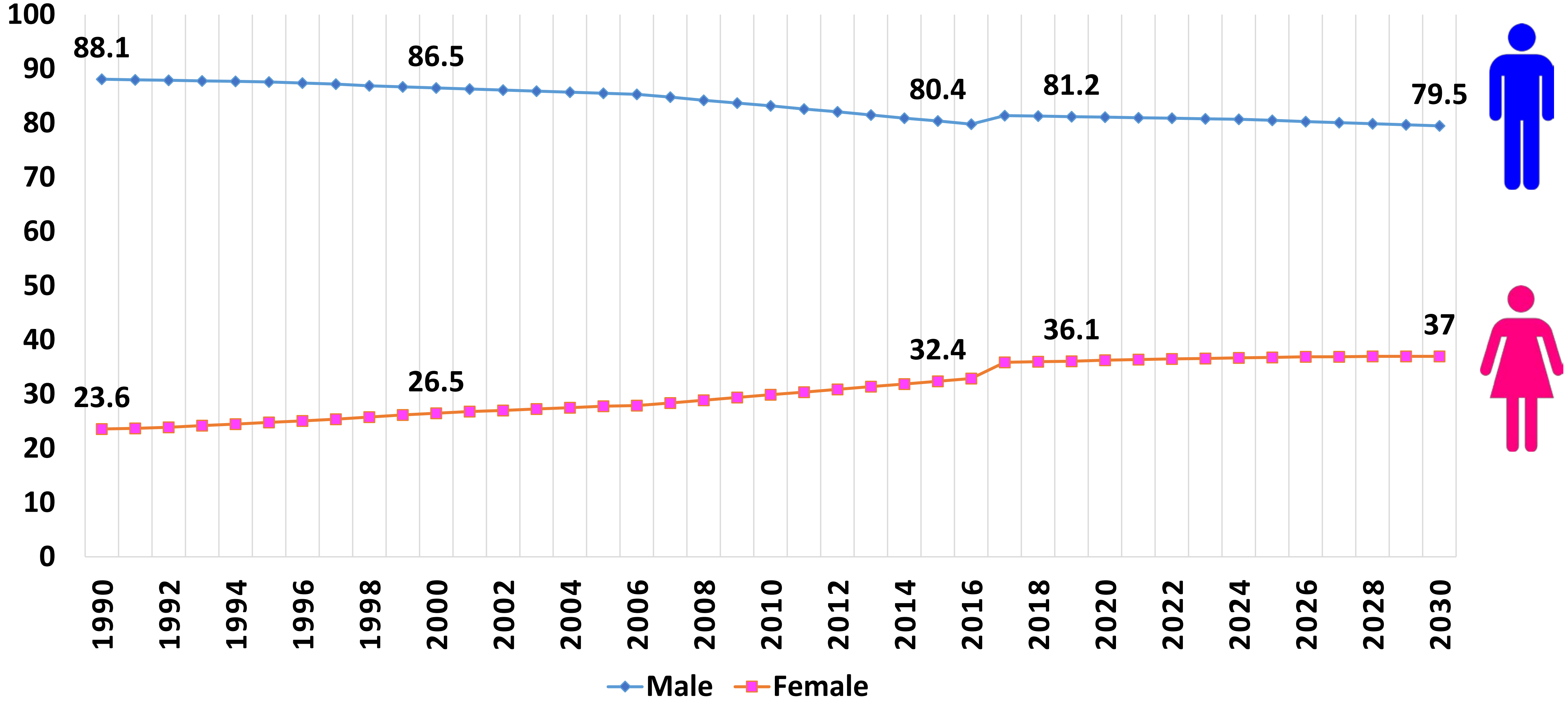
5 GENDER EQUALITY

TARGET 5·4

VALUE UNPAID CARE AND PROMOTE SHARED DOMESTIC RESPONSIBILITIES

Labour Force Participation Rate in Bangladesh

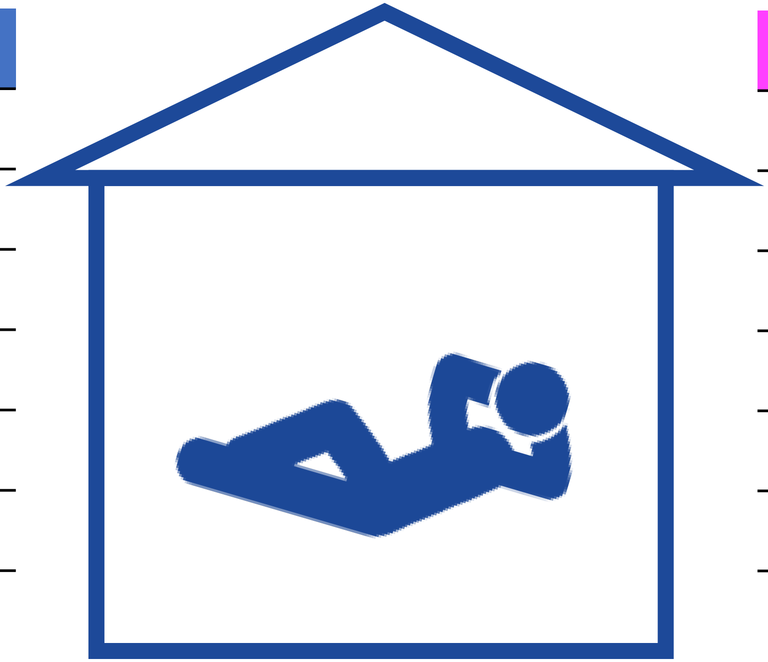
(ILO modelled estimates and projections)



Source: ILOSTAT

Average number of hours spent per week doing household tasks

MALE	
Barisal	8.2 hrs/week
Chittagong	9.4 hrs/week
Dhaka	9.4 hrs/week
Khulna	8.4 hrs/week
Rajshahi	6.9 hrs/week
Rangpur	7.6 hrs/week
Sylhet	12 hrs/week

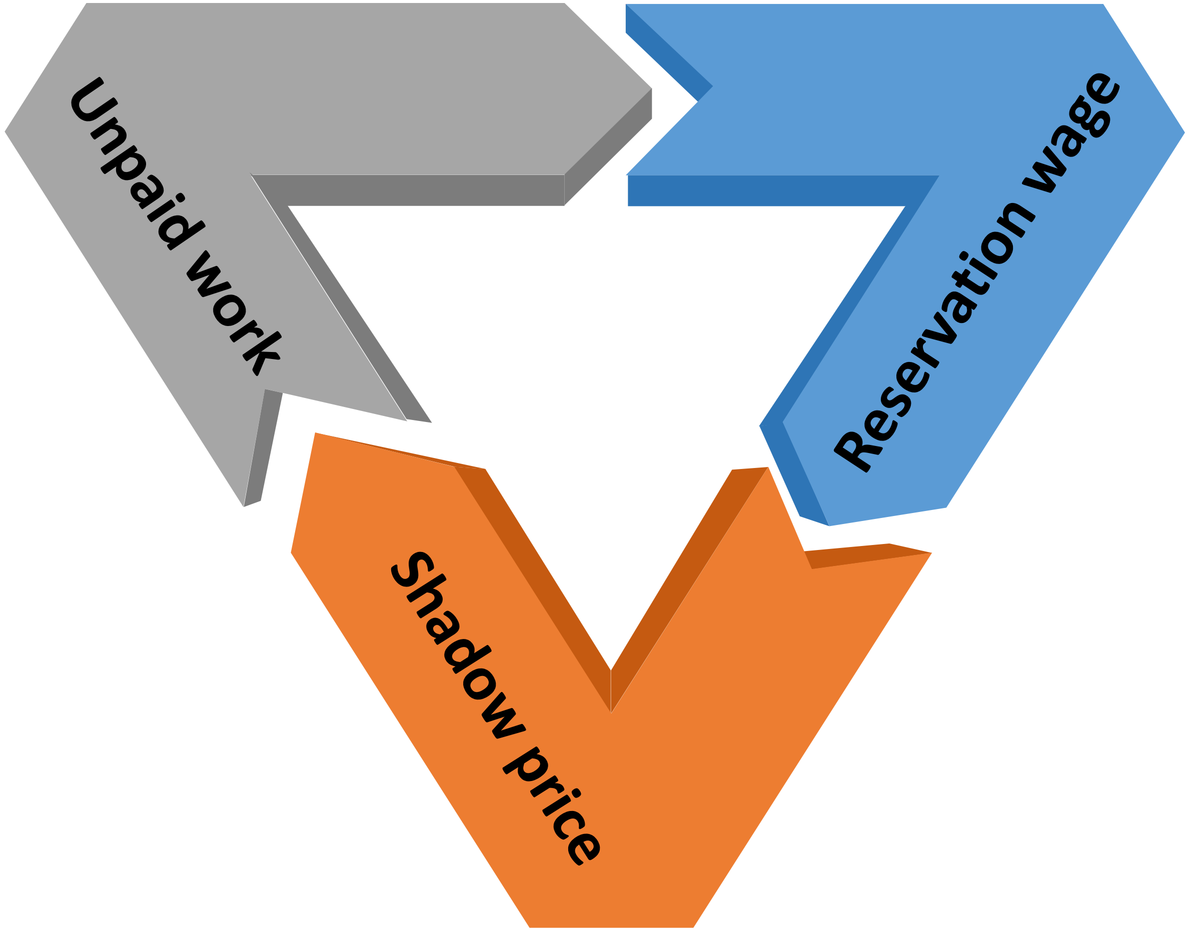


FEMALE	
Barisal	24 hrs/week
Chittagong	27 hrs/week
Dhaka	28 hrs/week
Khulna	27 hrs/week
Rajshahi	25 hrs/week
Rangpur	27 hrs/week
Sylhet	31 hrs/week

On average, women spend 3 times more hours doing household work than men

Source: LFS 2015-16, BBS

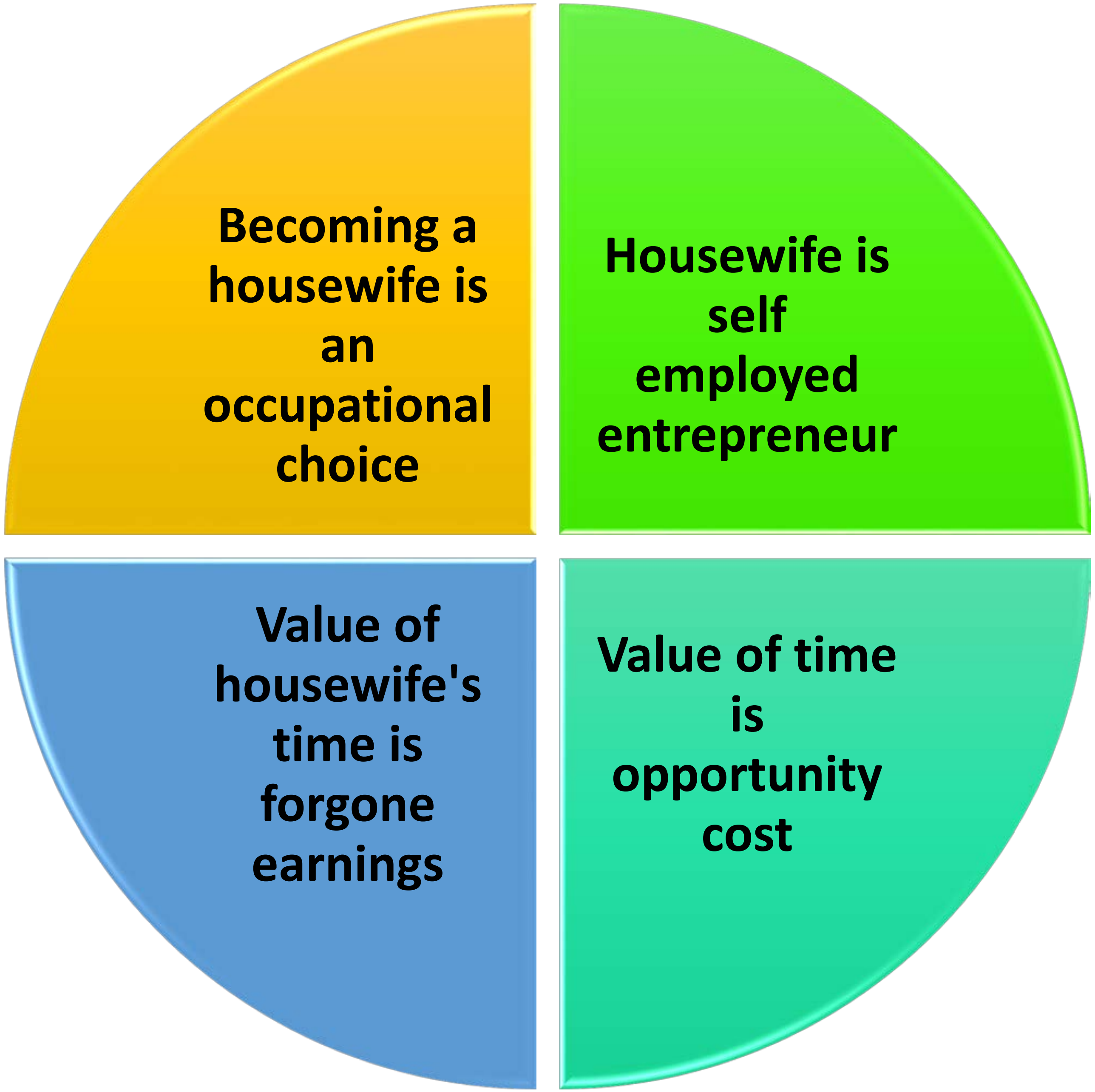
Unpaid work refers to the production of goods or services that are consumed by those within or outside a household, but not for sale in the market

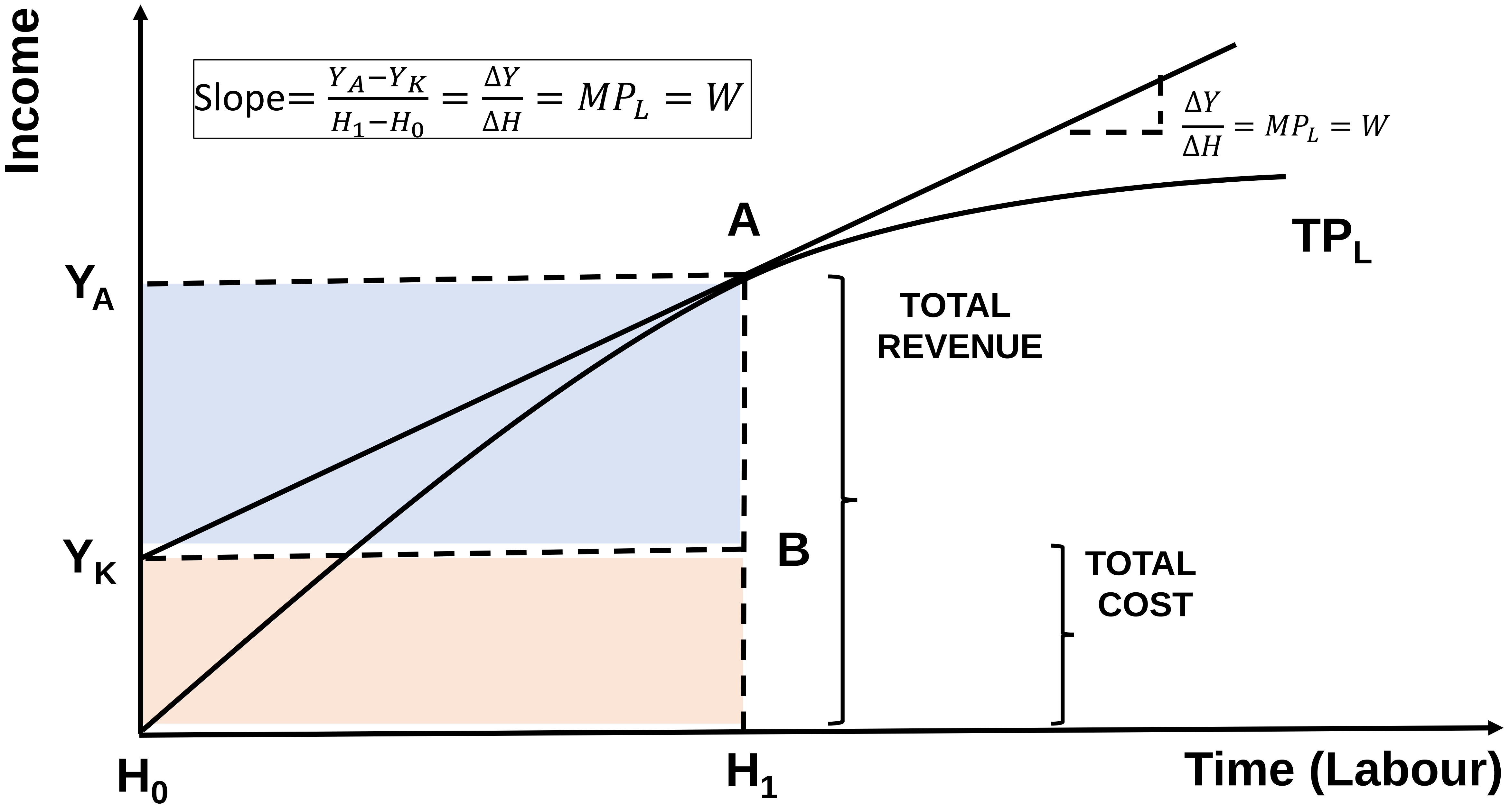


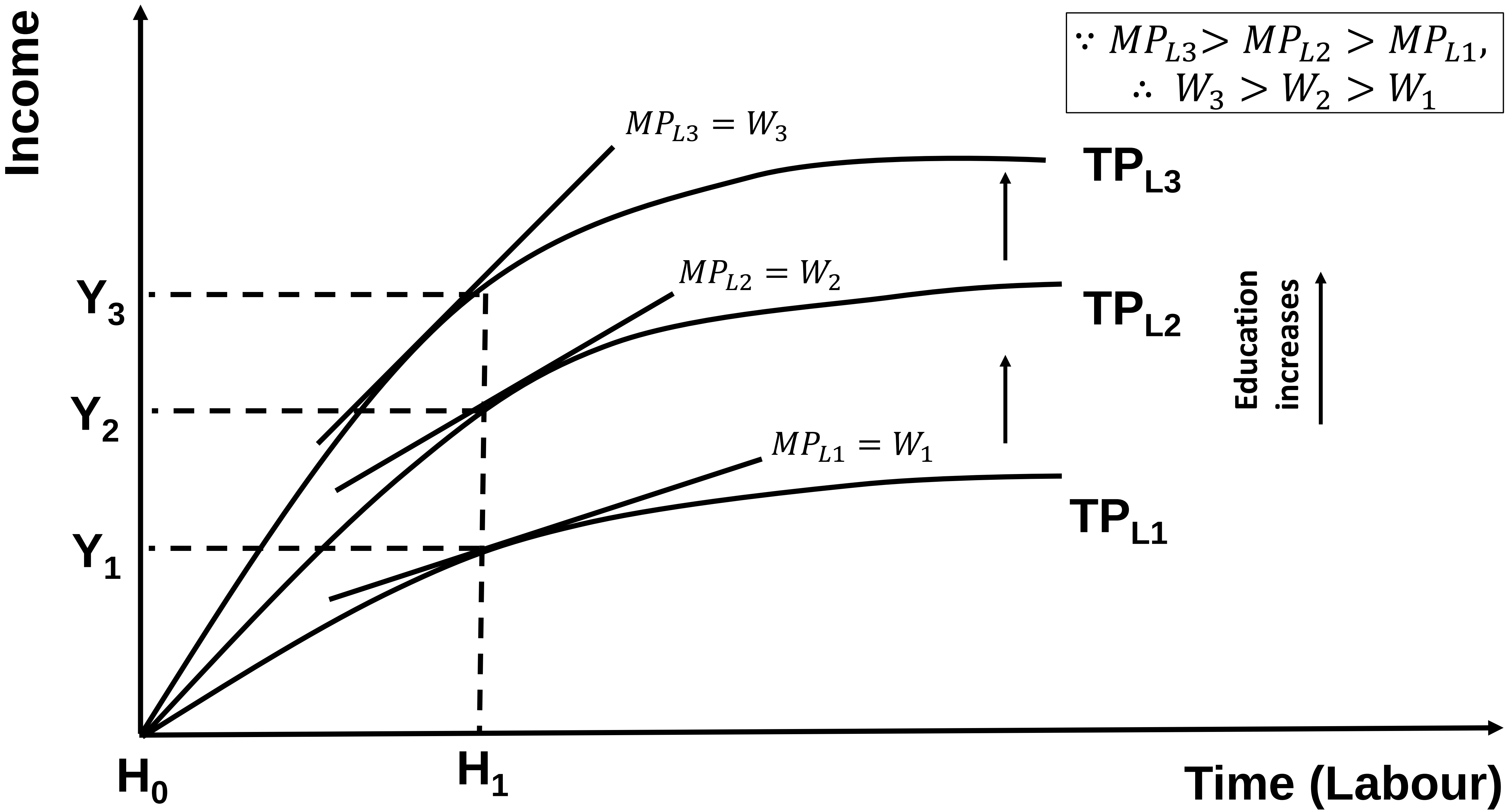
The reservation wage is the wage below which a person will not work, and in the labour/leisure context represents the value placed on an hour of lost leisure time

The imputed price or value of a good or service where such a price or value cannot be accurately determined because of the absence of an ordinary market determined price

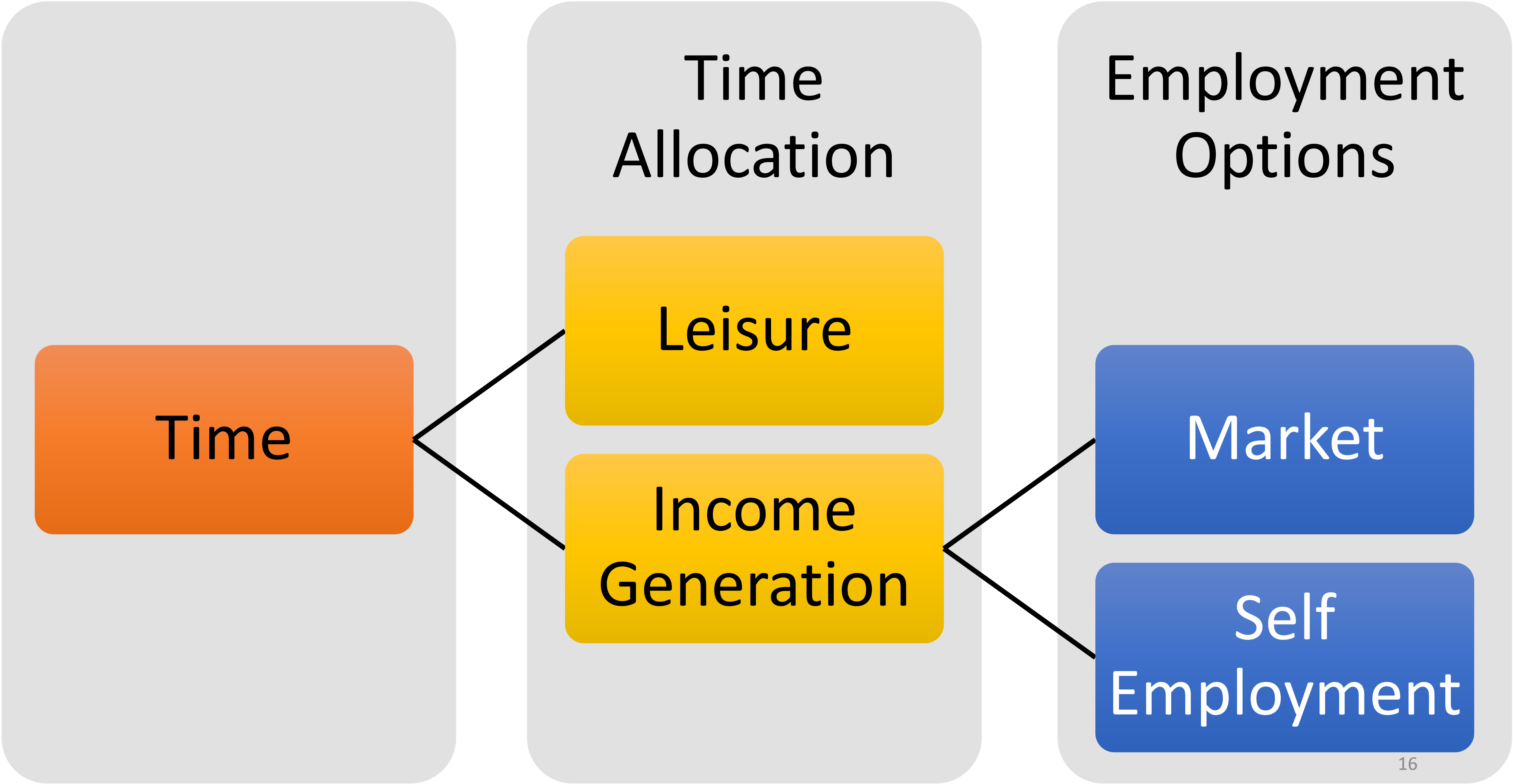
THEORETICAL FRAMEWORK

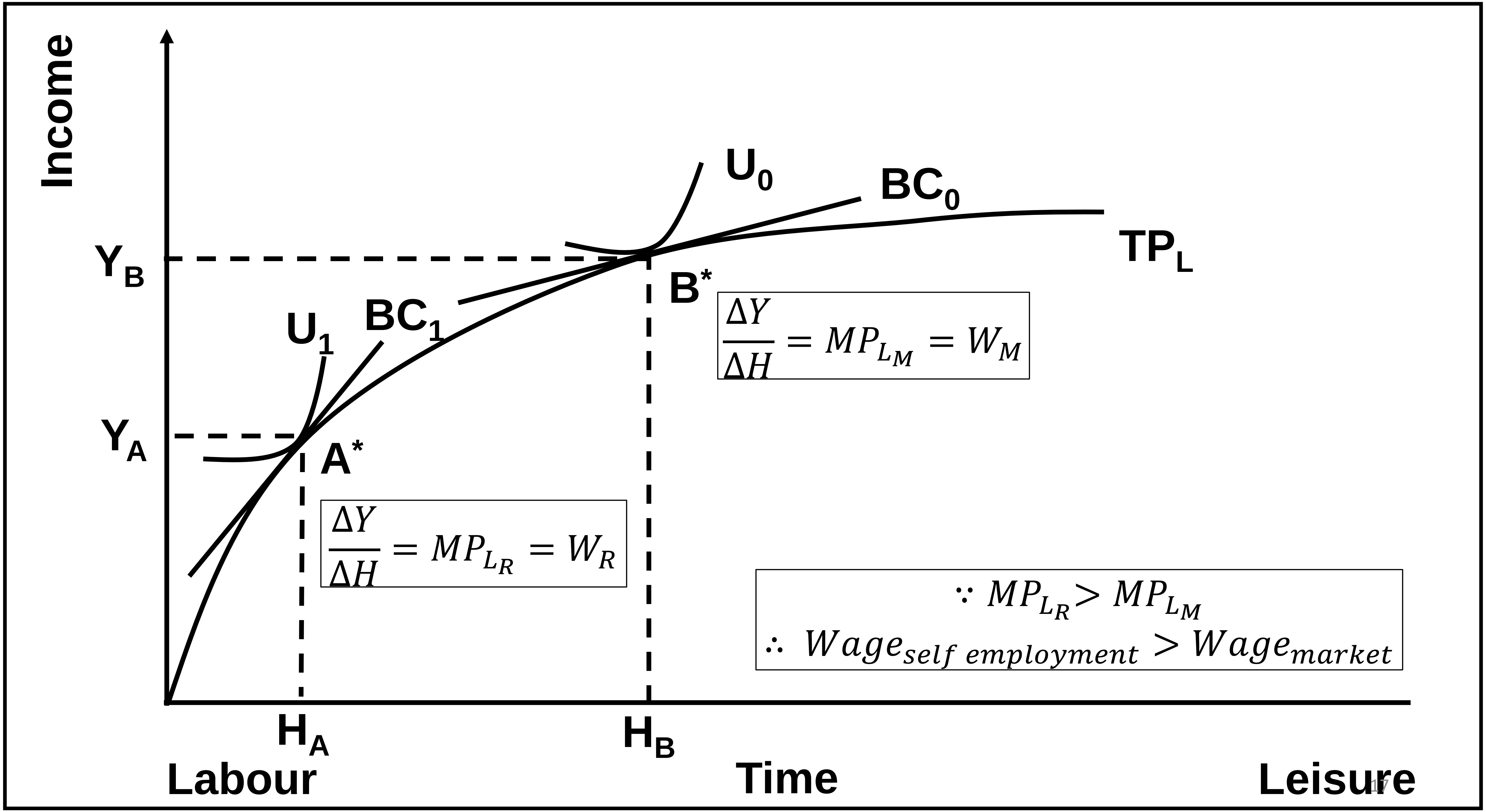

Becoming a housewife is an occupational choice
Housewife is self employed entrepreneur
Value of housewife's time is forgone earnings
Value of time is opportunity cost


Income
Slope= $\frac{Y_A - Y_K}{H_1 - H_0} = \frac{\Delta Y}{\Delta H} = MP_L = W$
$\frac{\Delta Y}{\Delta H} = MP_L = W$
A
TP_L
Y_A
TOTAL REVENUE
Y_K
B
TOTAL COST
H_0
H_1
Time (Labour)


$\because MP_{L3} > MP_{L2} > MP_{L1},$
$\therefore W_3 > W_2 > W_1$
Income
$MP_{L3} = W_3$
TP_{L3}
$MP_{L2} = W_2$
TP_{L2}
Education increases
Y_3
Y_2
Y_1
$MP_{L1} = W_1$
TP_{L1}
H_0
H_1
Time (Labour)

$$Utility = f(Leisure, Income)$$



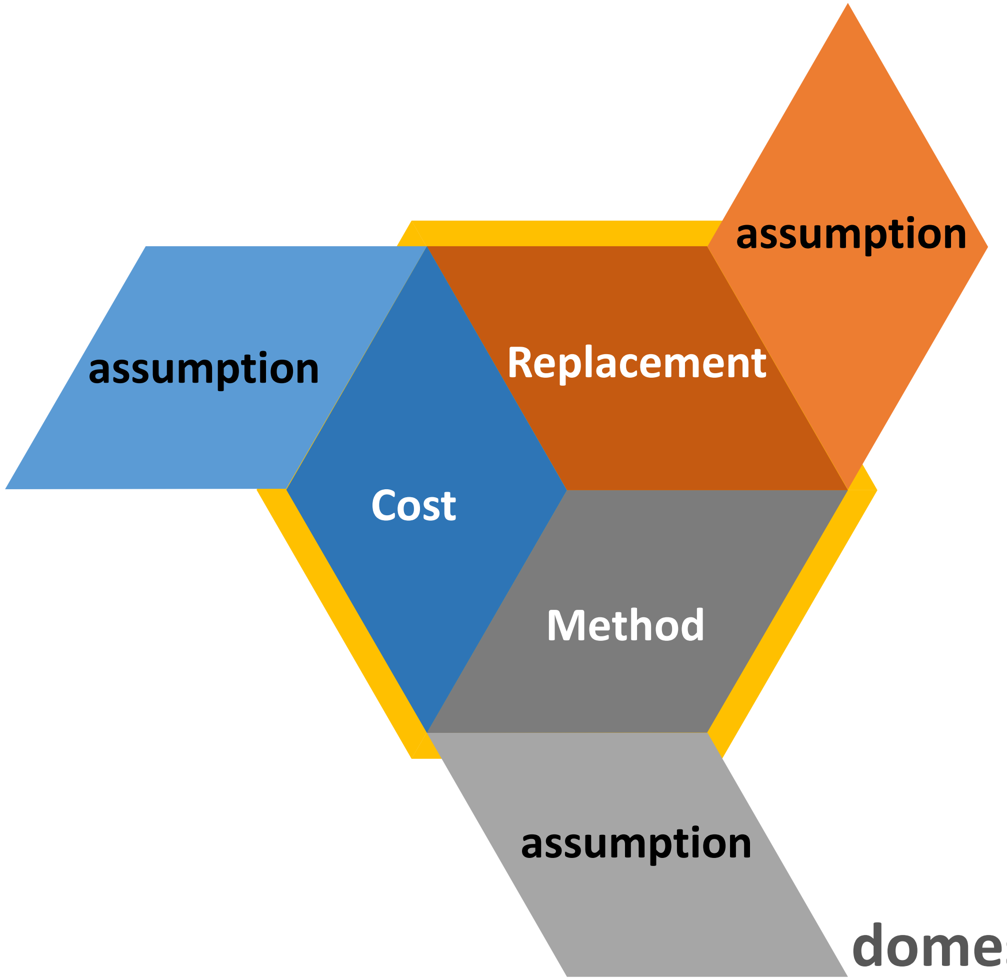

Income
Y_B
Y_A
U_0
BC_0
TP_L
B^*
$\frac{\Delta Y}{\Delta H} = MP_{L_M} = W_M$
U_1
BC_1
A^*
$\frac{\Delta Y}{\Delta H} = MP_{L_R} = W_R$
$\because MP_{L_R} > MP_{L_M}$
$\therefore\ Wage_{self\ employment} > Wage_{market}$
H_A
H_B
Labour
Time
Leisure

Literature Review

Some Methods of Measuring Value of Housewife's Time

- Replacement Cost Approach
- Opportunity Cost Approach
- Willingness to Accept Approach

Flawed assumptions of replacement cost method



there are suitable persons in the labor market who can be paid to do every task in the household that the housewife does

the productivity of a housewife is the same as that of a person paid to do household work

domestic household production is as capital intensive as production in the market

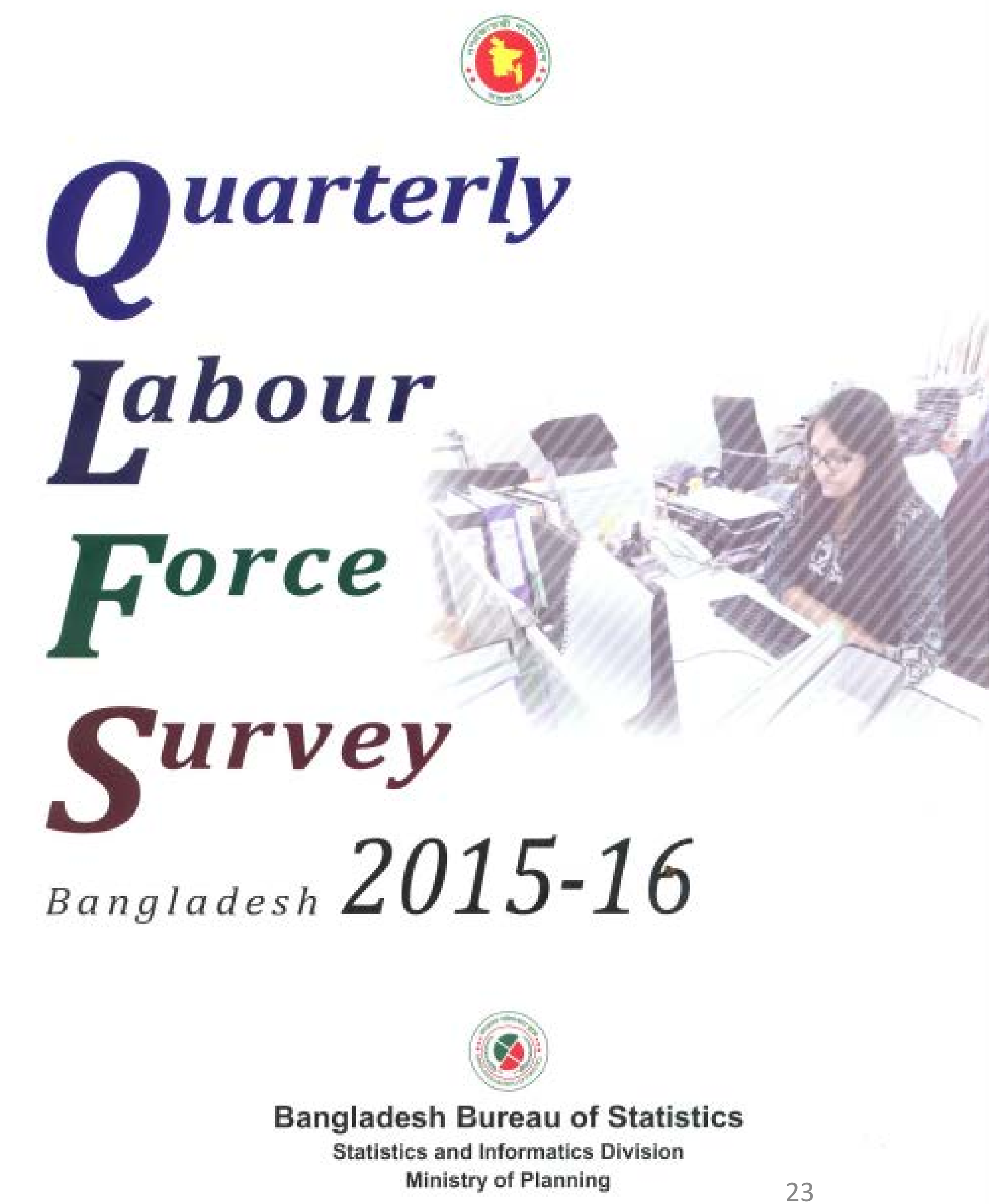
Review of past studies

Authors	Year	Sampling strategy	Methodology	Results
Shamim Hamid	1996	Time budget survey through cluster sampling of 30 villages	Replacement cost	Inclusion of non-market work in official calculations would have increased national GDP 1989-90 by 29 per cent.
Debra Efroymson, Buddhadeb Biswas, and Shakila Ruma	2007	Survey of 630 men and women	i)Replacement cost ii)Government salaries	i) US $131 billion ii) US $ 152 billion
Debra Efroymson, Julia Ahmed, Shakila Ruma	2013	Survey of 630 men and women	i)Replacement cost ii)Government salaries	i) US $227.93 billion per year ii) US $258.82 billion per year
Rashed Al Mahmud Titumir, K.M. Mustafiqur Rahman	2014	Survey of 520 households in 7 districts	i) Replacement cost ii) Opportunity cost	i) 3.25 percent of FY2012-2013 GDP ii) 10.75 percent of FY2012-2013 GDP
Fahmida Khatun, Towfiqul Islam Khan, Shahida Pervin, Hosna Jahan	2015	Survey of 5,670 households	i) Replacement cost ii) Willingness to accept	i) 76.8 percent of FY2013-2014 GDP ii) 87.2 percent of FY2013-2014 GDP

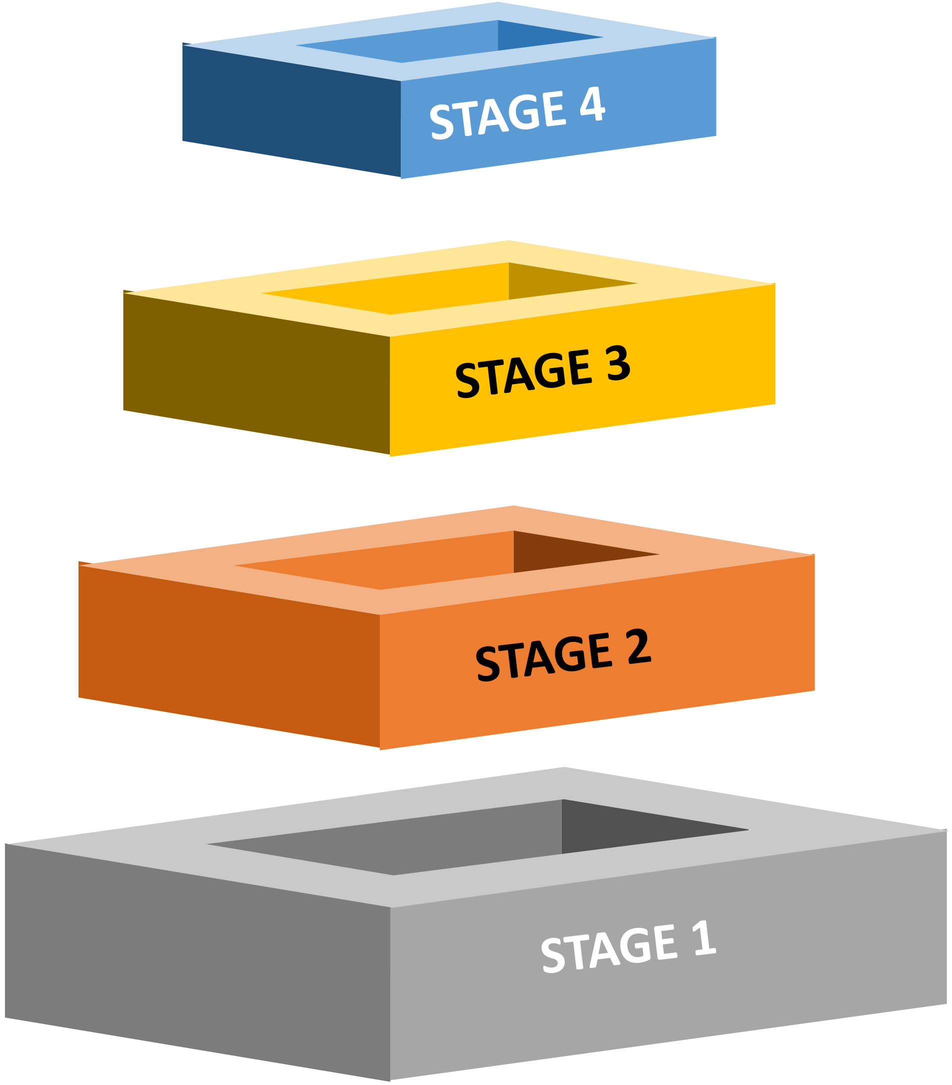
DATA

Nationally representative cross sectional data

All variables from QLFS 2015, except inflation (which is from Bangladesh Bank)



Sampling strategy



Systematic random sampling of clusters of 24 households from each of the 1284 PSUs/EAs. Exactly 30,816 households are selected at this stage. Dataset has 503,756 observations

Random selection of 1284 PSUs/EAs from all of the 64 districts and 21 regional strata. Approximately 300,000 households are selected at this stage.

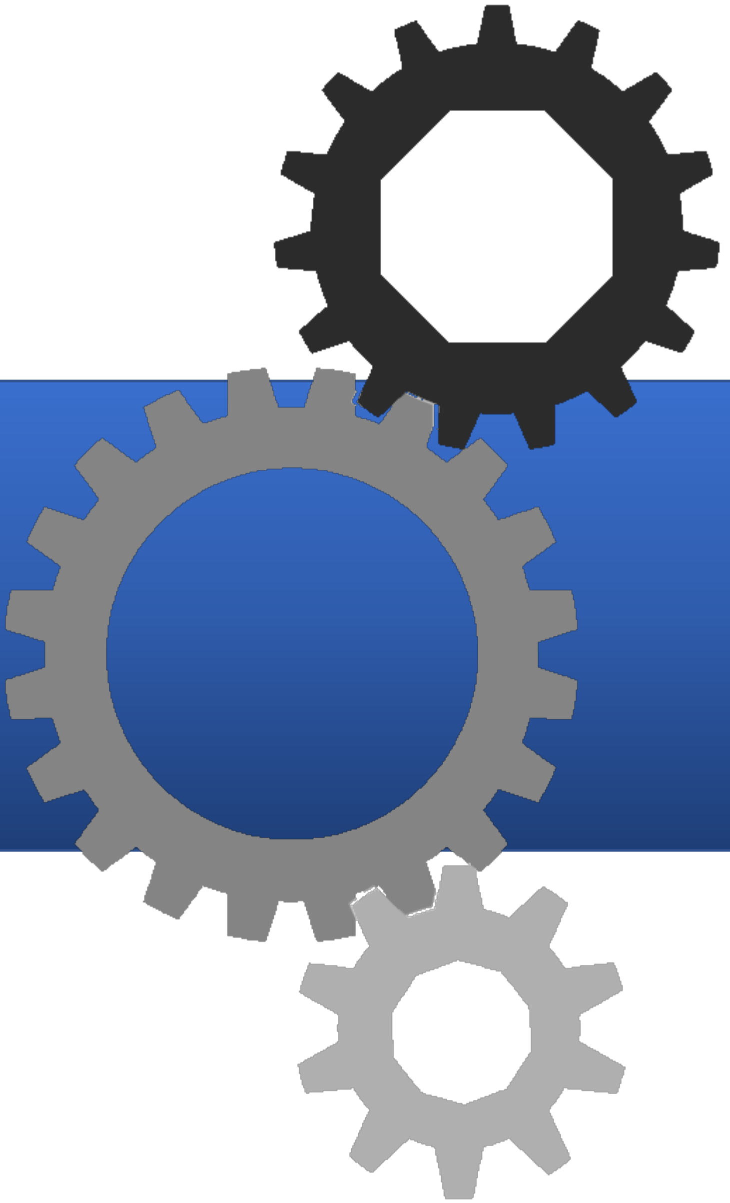
7 divisions: Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, and Sylhet. 3 kinds of localities: City Corporation, Urban, and Rural.

1284 primary sampling units (primary sampling units) or enumeration areas (EAs). Each PSU/EA had approximately 225 households.

Variables used in the study

Variable	Name	Definition	Mean	Std. Dev.
fwage	**WAGE**	weekly wage of married spouse present women in cash & kind from both primary & secondary job	2479.155	1936.994
feducation	**EDUCATION**	years of schooling for females up to 12 years 0 = no education; 6 = class-VI 1 = class-I; 7 = class-VII 2 = class-II; 8 = class-VIII 3 = class-III; 9 = class-IX 4 = class-IV; 10 = SSC 5 = class-V; 11 = HSC	4.259556	3.88348
fexperience	**EXPERIENCE**	potential experience of females experience = [female age] – [6] (based on similar approach in Oaxaca, 1973)	31.26629	11.93601
fhours1	**LABOR SUPPLY**	total number of hours worked per week at both primary & secondary job	31.88131	21.37751
mwage	**HUSBAND WAGE**	weekly husband wage in cash & kind from both primary & secondary job	2747.009	2154.392
fCPI (BB Data)	**GOODS PRICES**	Consumer price index (CPI) fCPI = 220.12 if rural fCPI = 219.37 if urban fCPI = 219.86 if neither rural or urban (national)	219.9138	.1692468
fchildren	**CHILDREN**	number of children aged less than 6 per household	.1664183	.4758965
fasset	**ASSETS**	female asset dummy measured as total amount of land owned by households, measured in acres		
		fasset1; 1 = no land, 0 = all else	.1890322	.3915362
		fasset2; 1 = 0.01-0.04 acres land, 0 = all else	.4180809	.4932461
		fasset3; 1 = 0.05-2.49 acres land, 0 = all else	.3434959	.4748777
		fasset4; 1 = 2.50-7.49 acres land, 0 = all else	.0407771	.1977744
		fasset5; 1 = 7.50 acres or more land, 0 = all else	.0086139	.0924108

Econometric Model



Asking wage function

$$W^* = g(h, W_m, P, A, Z) \ (1)$$

where,

W^* = asking wage rate (shadow price of time)

h = hours of work

W_m = wage of husband

P = vector of goods prices

A = asset income of the household

Z = number of children aged less than six

Asking wage model specification

$$ln(W_i^*) = \beta_0 + \beta_1 h_i + \beta_2 (W_m)i + \beta_3 P_i + \beta_4 A_i + \beta_5 Z_i + \varepsilon_i \quad (3)$$

where,

$\ln(W_i^*)$	=	natural logarithm of asking wage rate (shadow price of time)
h	=	hours of work
W_m	=	wage of husband
P	=	vector of goods prices
A	=	asset income of the household
Z	=	number of children aged less than six

Market wage function

$$W = B\,(E, S)\ (2)$$

where,

W = market wage rate (offered wage rate)

E = extent of labour market experience

S = number of years of schooling

Note that $B_E>0$ and $B_S>0$ from previous research

Market wage model specification

$$\ln(W_i) = b_0 + b_1 S_i + b_2 E_i + u_i \quad (4)$$

where,

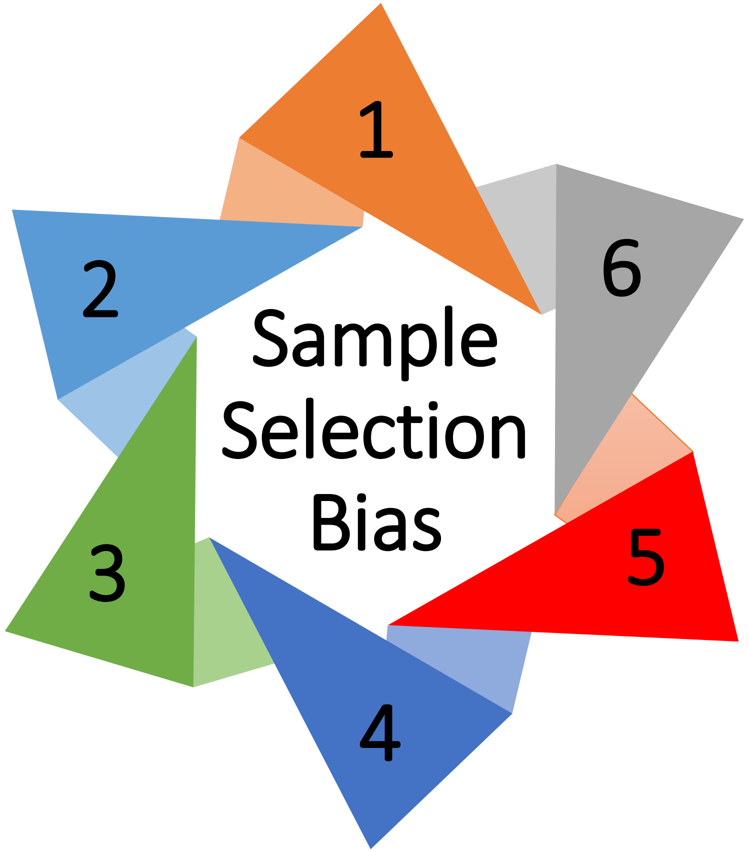
$\ln(W_i)$	=	natural logarithm of market wage rate (offered wage rate)
E	=	extent of labour market experience
S	=	number of years of schooling

METHODOLOGY

Equation (4) suffers from unobserved heterogeneity or the problem of omitted variables.

The effect of these unobserved variables is captured through the error terms, and so the errors of the equation (4) are correlated with the independent variables.

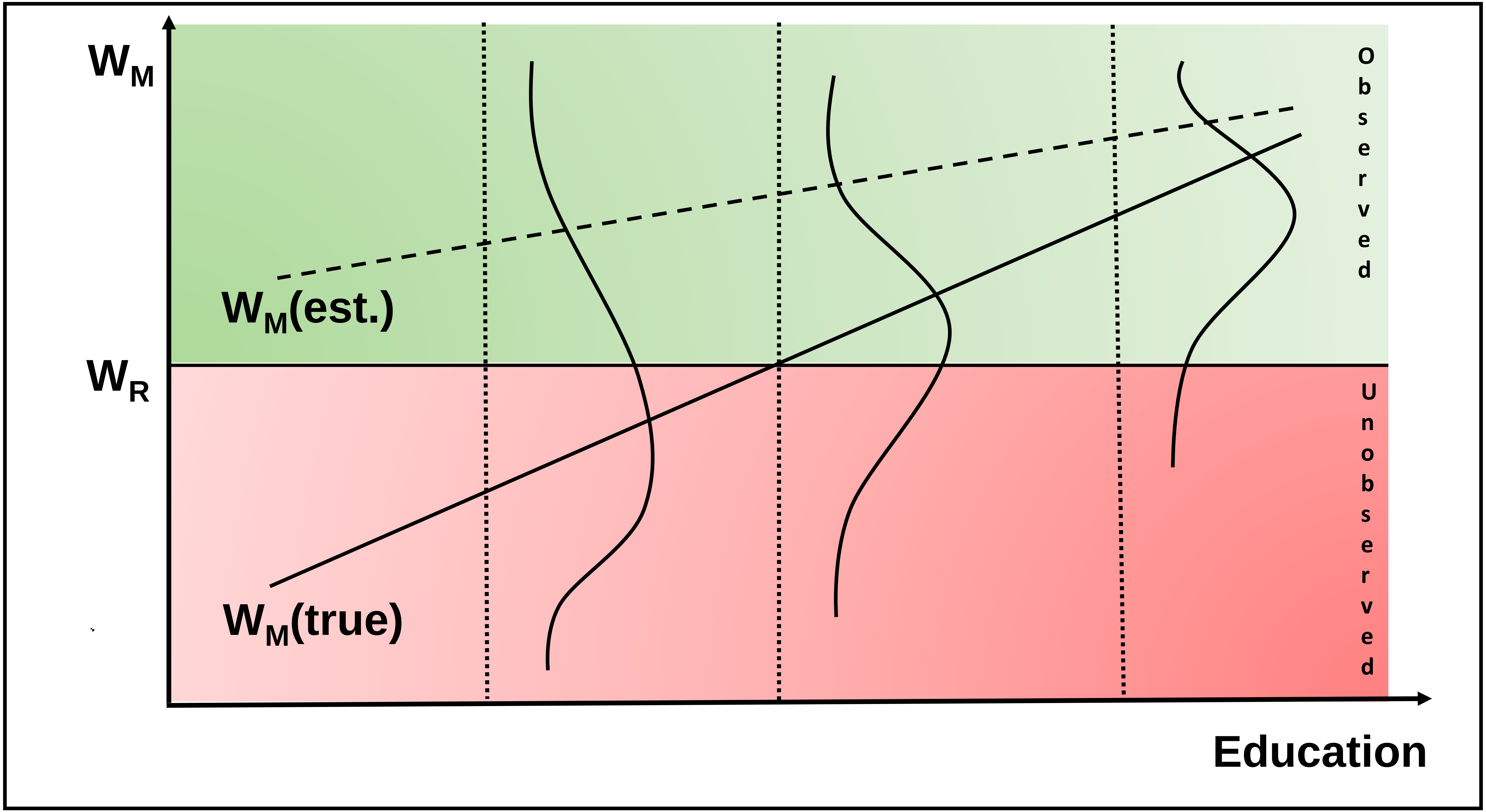
The underlying reason behind this is the fact that the samples used for estimating these equations were not randomly collected.



Market wages are only observed for women who are working.

However, women’s decision to work is not a random decision, but rather a rational choice.

Hence women who choose to work self-select themselves into the sample.



W_M
W_R
W_M(est.)
W_M(true)
Observed
Unobserved
Education

Strict exogeneity assumption of the OLS model is

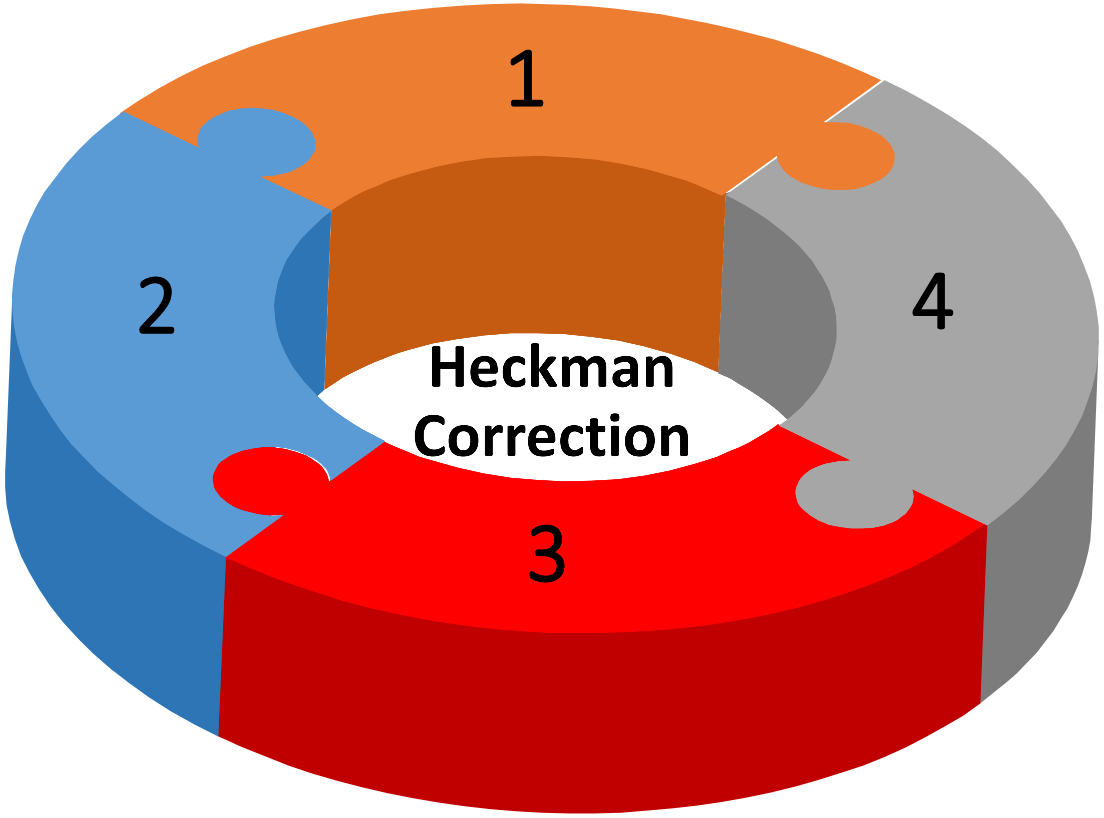
$$\boldsymbol{E\ (\varepsilon_i|X) = 0, \qquad \forall\ i = 1, \dots, n}$$

Violation of the strict exogeneity assumption has several implications:

- $\boldsymbol{E\ (\varepsilon_i) \neq\ 0, \forall\ i = 1, \dots, n}$
- (The unconditional mean of the error term (ε) is not zero.)
- $\boldsymbol{E\left(X_{jk}, \varepsilon_i\right) \neq\ 0, \forall\ ijk = 1, \dots, n}$
- (The independent variables (X) are not orthogonal to the errors (ε) for all observations)
- $\boldsymbol{COV\ \left(X_{jk}, \varepsilon_i\right) \neq\ 0, \forall\ ijk = 1, \dots, n}$
- (The independent variables (X) and errors (ε) are not uncorrelated for all observations.)

If the unobserved heterogeneity can be modelled separately, and the resulting information can be incorporated into the main model, then the problem can be resolved.

Heckman proposed that the specification of the original biased model could be improved by using the estimated values of the omitted variables as additional regressors.



Heckman outlined an ingenious two step estimation technique to correct sample selection bias (Heckman, 1979).

By doing so, the model could be estimated using ordinary least squares, without violating the strict exogeneity assumption.

In the first step, we model the factors that influence a woman's decision to work by using a probit model. The general form of the sample likelihood function for probit analysis is:

$$\mathcal{L} = \prod_{i=1}^{T} [F(\phi_i)]^{1-d_i} [1 - F(\phi_i)] d_i$$

where, d is a random variable, which is equal to one if the dependent variable is observed and equal to zero if the dependent variable is not observed.

Suppose we use a sample of T married spouse present women, K of who work and T-K who do not work.

Then, in the case of our model, the aforementioned likelihood function becomes:

$$\mathcal{L} = \prod_{i=1}^{K} j(h_i, ln(W_i)|(W_i > W_i^*)_{h=0}).pr([W_i > W_i^*]_{h=0}) \times \prod_{i=K+1}^{T} pr([W_i < W_i^*]_{h=0})$$

$$\textbf{Inverse Mills Ratio} = \frac{\textbf{standard normal probability distribution function}}{\textbf{standard normal cumulative distribution function}}$$

$$\lambda_i = \frac{f(\phi_i)}{1 - F(\phi_i)}$$

where,

λ = inverse Mills ratio

f = standard normal probability distribution function of the selection equation

F = standard normal cumulative distribution function of the selection equation.

For our model, the Inverse Mills Ratio can be defined as:

$$\boldsymbol{\lambda = j(h_i, \ln(W_i)|(W_i^* < W_i)_{h=0} = \frac{n(h_i, \ln(W_i))}{pr([W_i > W_i^*]_{h=0})} \because \varepsilon_i, u_i \sim N(0)}$$

By using this Inverse Mills Ratio in our original likelihood function, we can further simplify it to:

$$\boldsymbol{\mathcal{L} = \prod_{i=1}^{K} n(h_i, ln(W_i)) \prod_{i=K+1}^{T} pr([W_i < W_i^*]_{h=0})}$$

We now maximize this likelihood function with respect to the parameters of the model, including the variances and covariances of the errors in equations (3) and (4) to get **consistent**, asymptotically **unbiased**, and **efficient** parameter estimates which are asymptotically normally distributed.

Thus, our selection bias corrected now becomes:

$$\mathbf{ln}(\boldsymbol{W_i}) = \boldsymbol{b_0} + \boldsymbol{b_1 S_i} + \boldsymbol{b_2 E_i} + \boldsymbol{b_3 \lambda_i} + \boldsymbol{u_i} \textbf{(5)}$$

RESULTS

Results from Ordinary Least Squares Estimation

VARIABLES	Natural log of female wage
Education	0.0458***
	(0.00134)
Experience	0.00303***
	(0.000513)
Constant	7.426***
	(0.0175)
Prob > F	0.0000
R-squared	0.129
Adj R-squared	0.1289

Note: (i) Standard errors in parentheses (ii) *** p<0.01, ** p<0.05, * p<0.1

Ramsey Regression Specification Error Test (RESET)

Null hypothesis = model is correctly specified
Alternative hypothesis = model is incorrectly specified

Decision rule: if $p < 0.05$ then the model is incorrectly specified

Results from Ramsey RESET test

$F(3, 7949) =$ 120.01
Prob > F = 0.0000

Interpretation: The model is incorrectly specified

Link Test

- Link Test is based on the idea that if a regression is properly specified, one should not be able to find any additional independent variables that are significant except by chance.
- Link Test creates two new variables, the variable of prediction, and the variable of squared prediction.
- We wouldn't expect the squared prediction to be a significant predictor if our model is specified correctly.

Results from Link Test

VARIABLES	lnfwage
Prediction	-47.66363***
	(3.02233)
Squared prediction	3.146831***
	(0.1954301)
Constant	188.0395***
	(11.68005)
Prob > F	0.0000
R-squared	0.1566
Adj R-squared	0.1564

Interpretation: The model is incorrectly specified

Variance Inflation Factor

Variance inflation factor measures the linear association between an independent variable and all other independent variables.

Decision rule:

VIF > 10 : perfect multicollinearity is highly likely

5 < VIF < 10 : perfect multicollinearity is somewhat likely

0 < VIF < 5 : perfect multicollinearity is unlikely

Variance Inflation Factor

Variable	VIF	1/VIF
feducation	1.10	0.911845
fexperience	1.10	0.911845
Mean VIF	1.10	

Interpretation: Perfect multicollinearity is unlikely

Breusch-Pagan and Cook-Weisberg Test

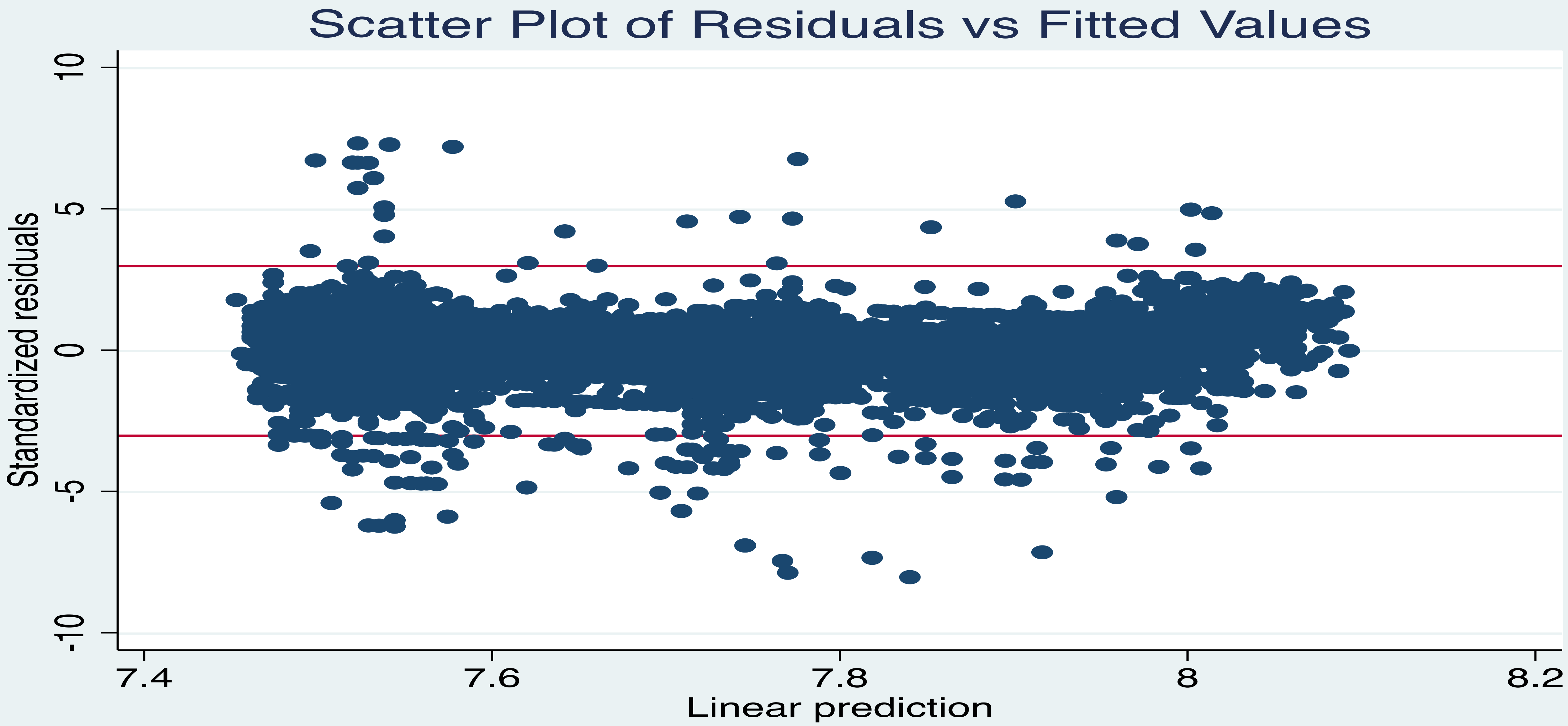
Null hypothesis = homoskedastic,
Alternative hypothesis = heteroskedaticity
Decision rule: if $p < 0.05$ then there is heteroskedasticity.

Results from Breusch-Pagan / Cook-Weisberg Test for Heteroskedasticity

chi2(1) =	0.00	F(1 , 7953) =	0.00
Prob > chi2 =	0.9930	Prob > F =	0.9970

Interpretation: There is no heteroskedasticity

Graphical Check of Heteroskedasticity



White Test

Breusch-Pagan (1979) and Cook-Weisberg (1983) test for heteroskedasticity assumes that the heteroskedasticity is a linear function of the independent variables.

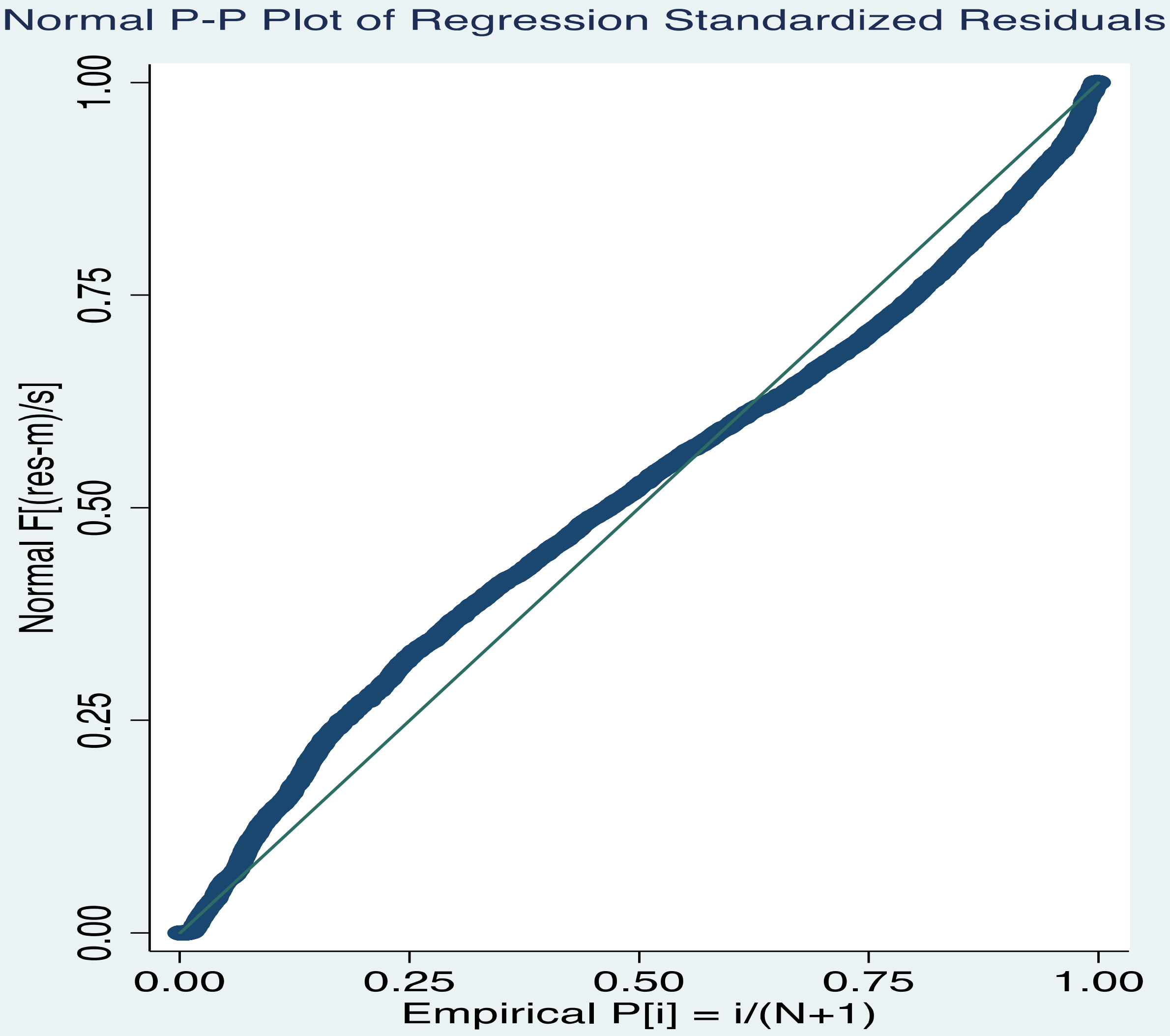
The White test allows the heteroskedasticity process to be a function of one or more independent variables. It allows the independent variable to have a non-linear and interactive effect on the error variance.

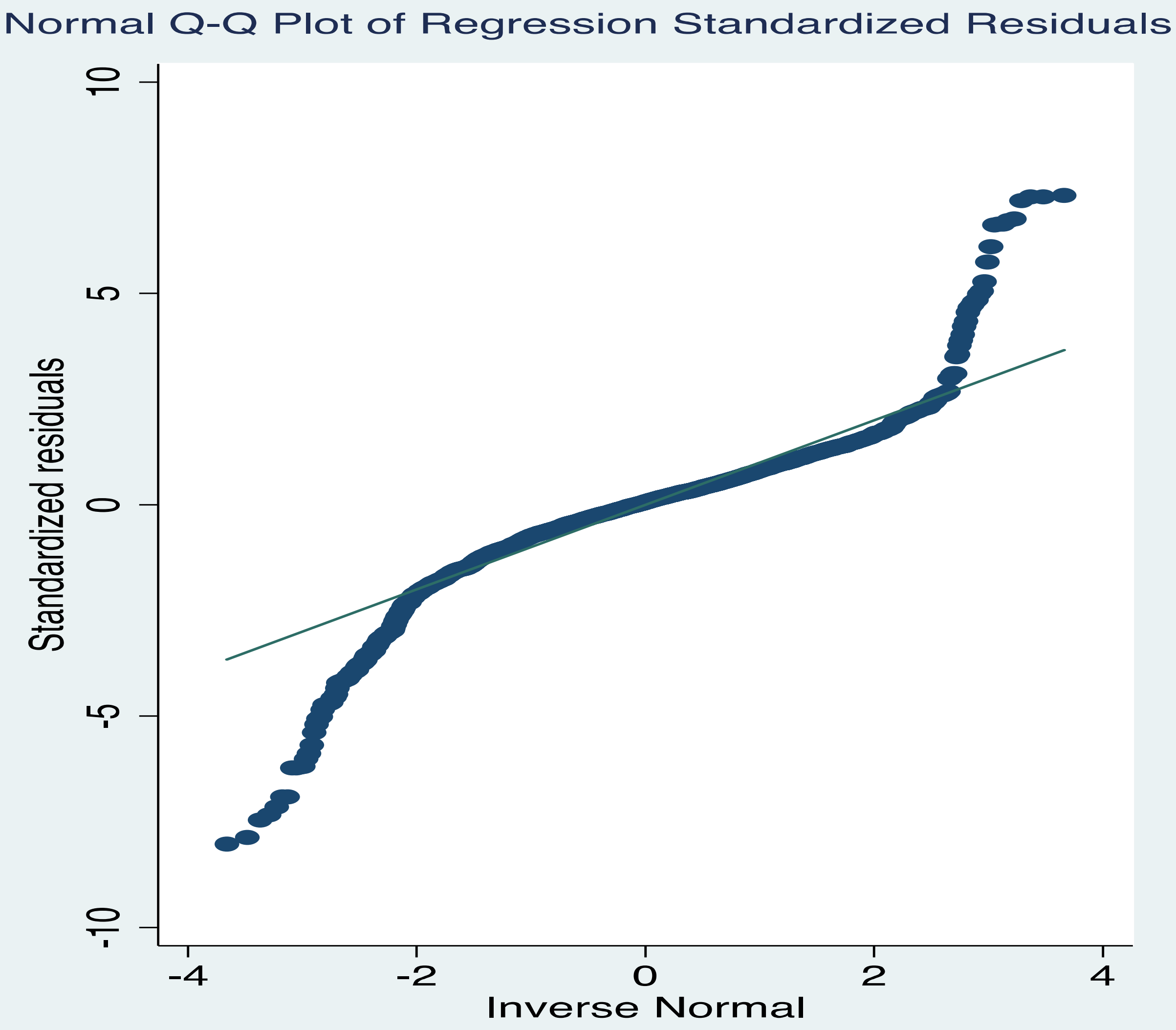
Null hypothesis = homoscedastic; Alternative hypothesis = heteroskedaticity
Decision rule: if $p < 0.05$ then there is heteroskedasticity.

Results from White's Test for Heteroskedasticity		
chi2(5)	=	39.34
Prob $>$ chi2	=	0.0000

Interpretation: There is heteroskedasticity

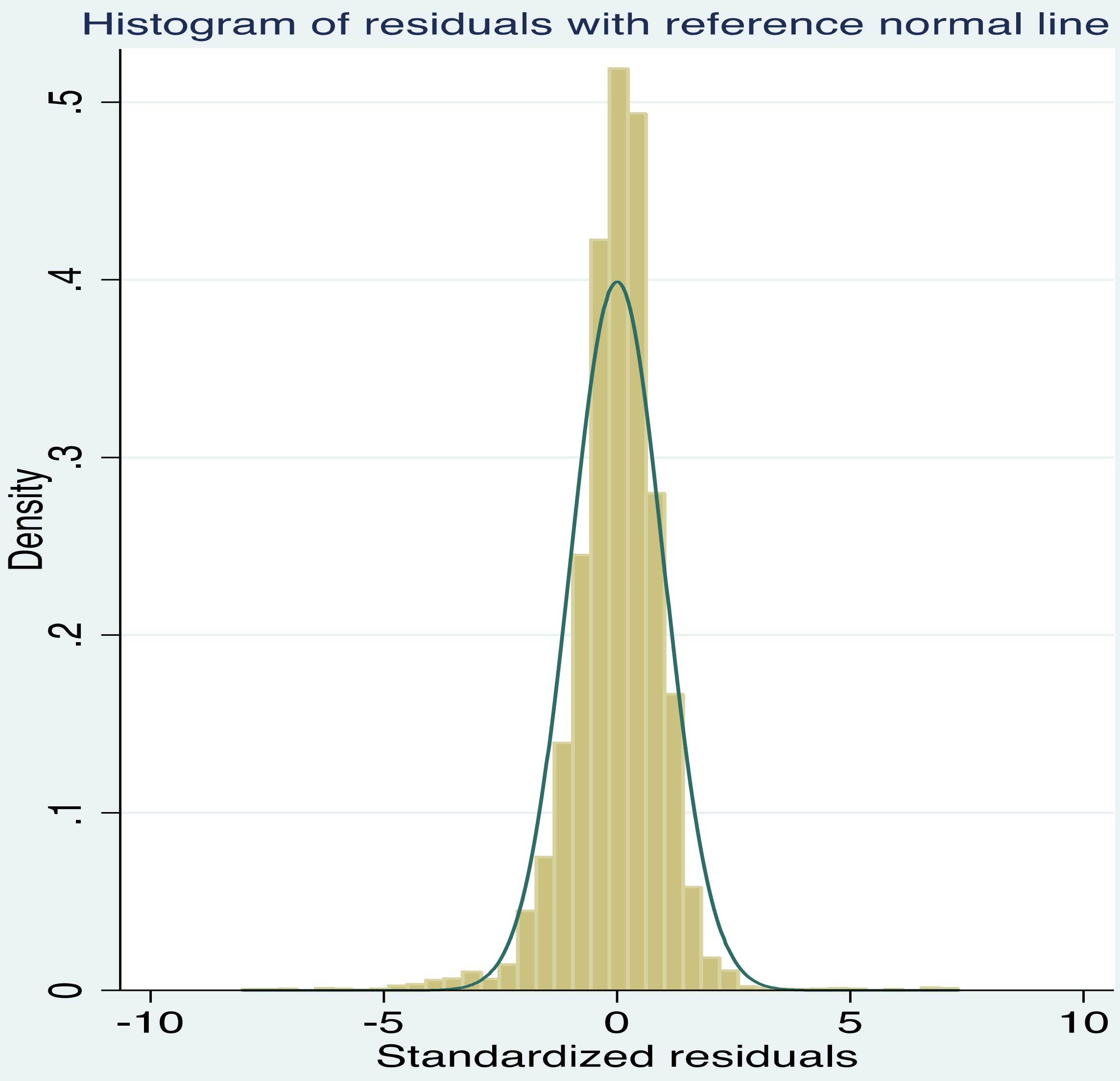
Graphical Check of Normality of Errors (PP & QQ)

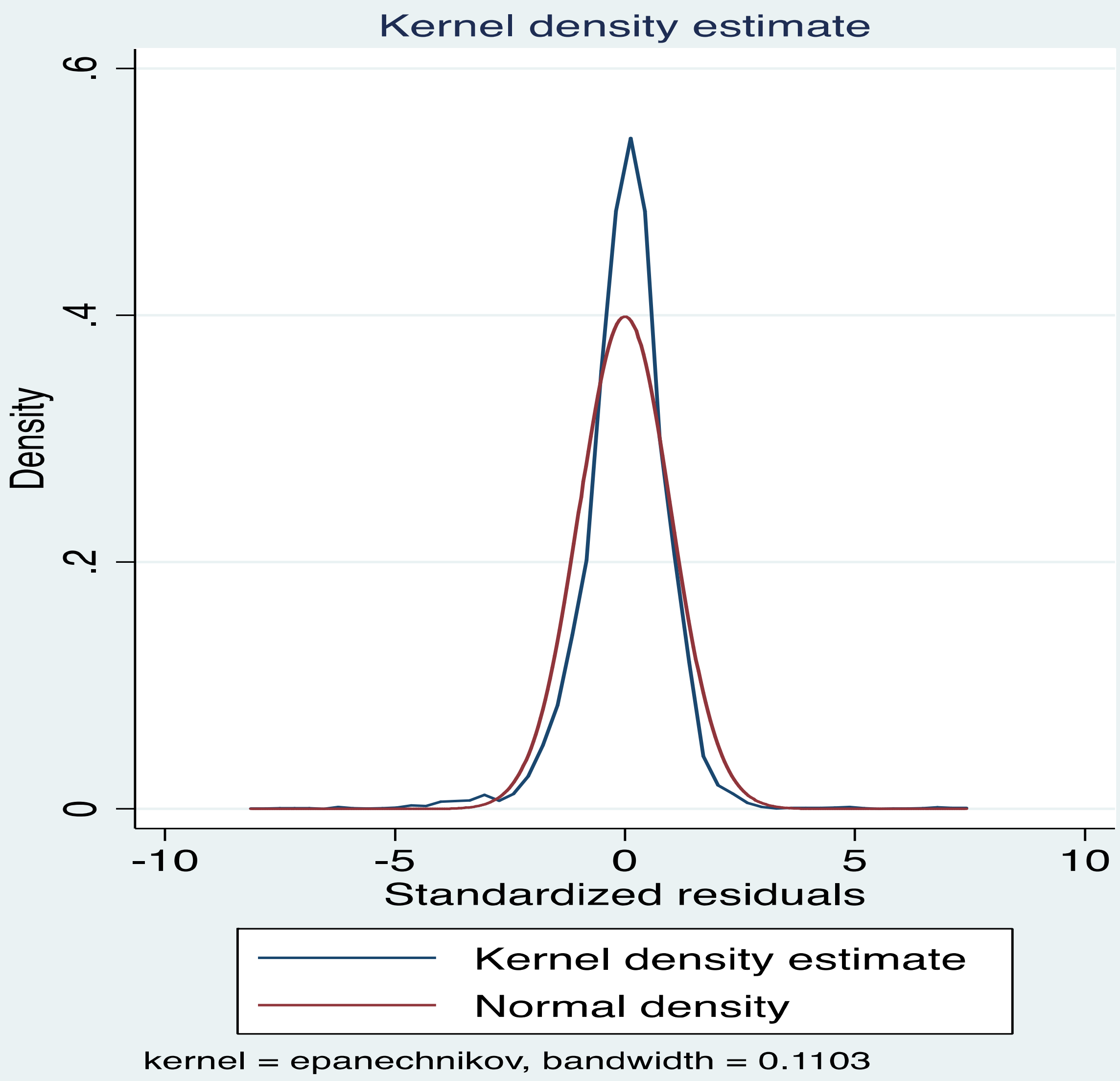




PP plot is more sensitive in the center; QQ plot is more sensitive at the two tails

Graphical Check of Normality of Errors (Histogram and Kernel Density)





Shapiro Wilk Test

Null hpyothesis = errors normal

Alternative hypothesis = errors not normal

Decision rule: If p value < 0.05 then reject null hypothesis that errors are normal.

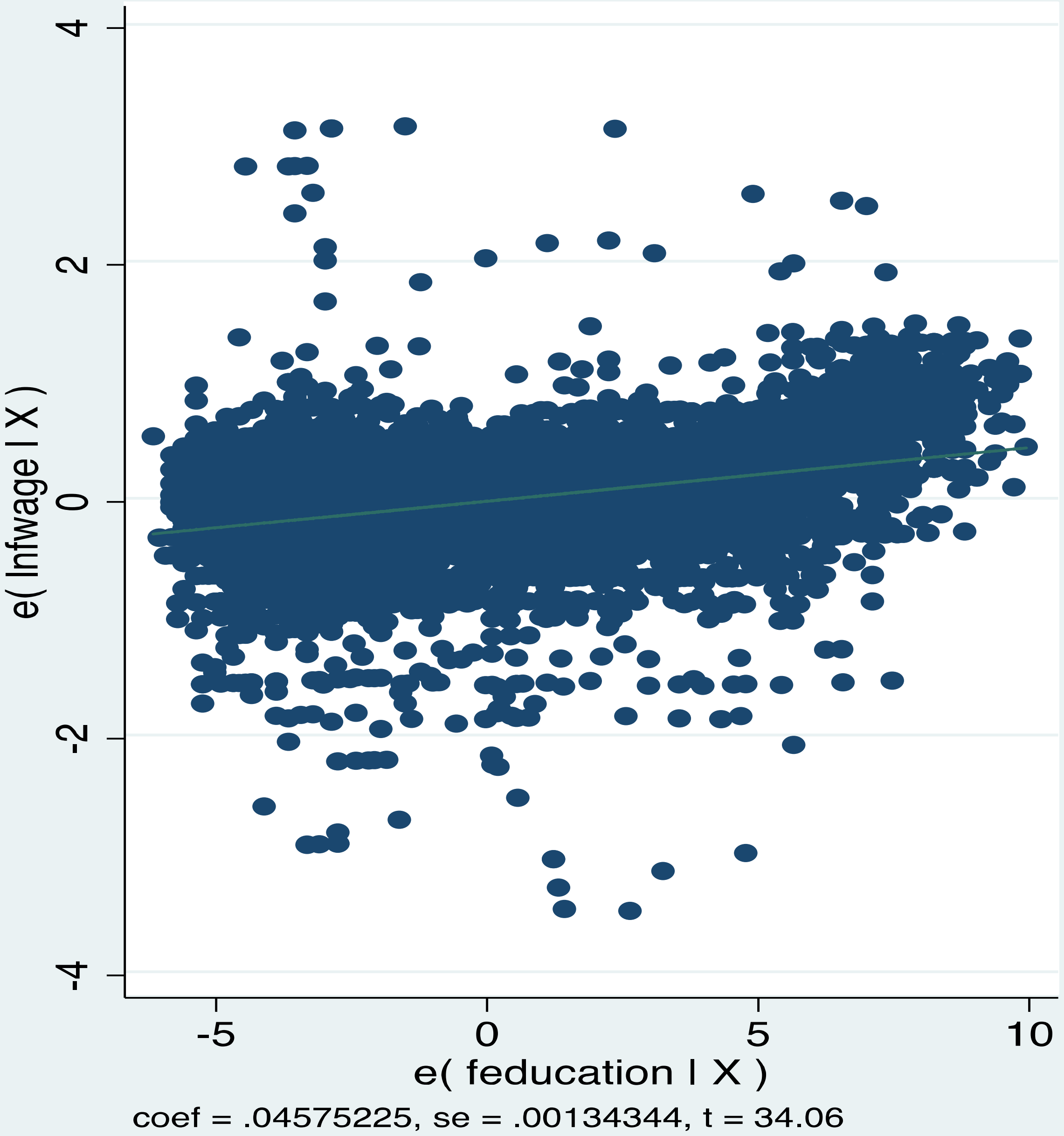
If p value > 0.05 then cannot reject null hypothesis that errors are normal.

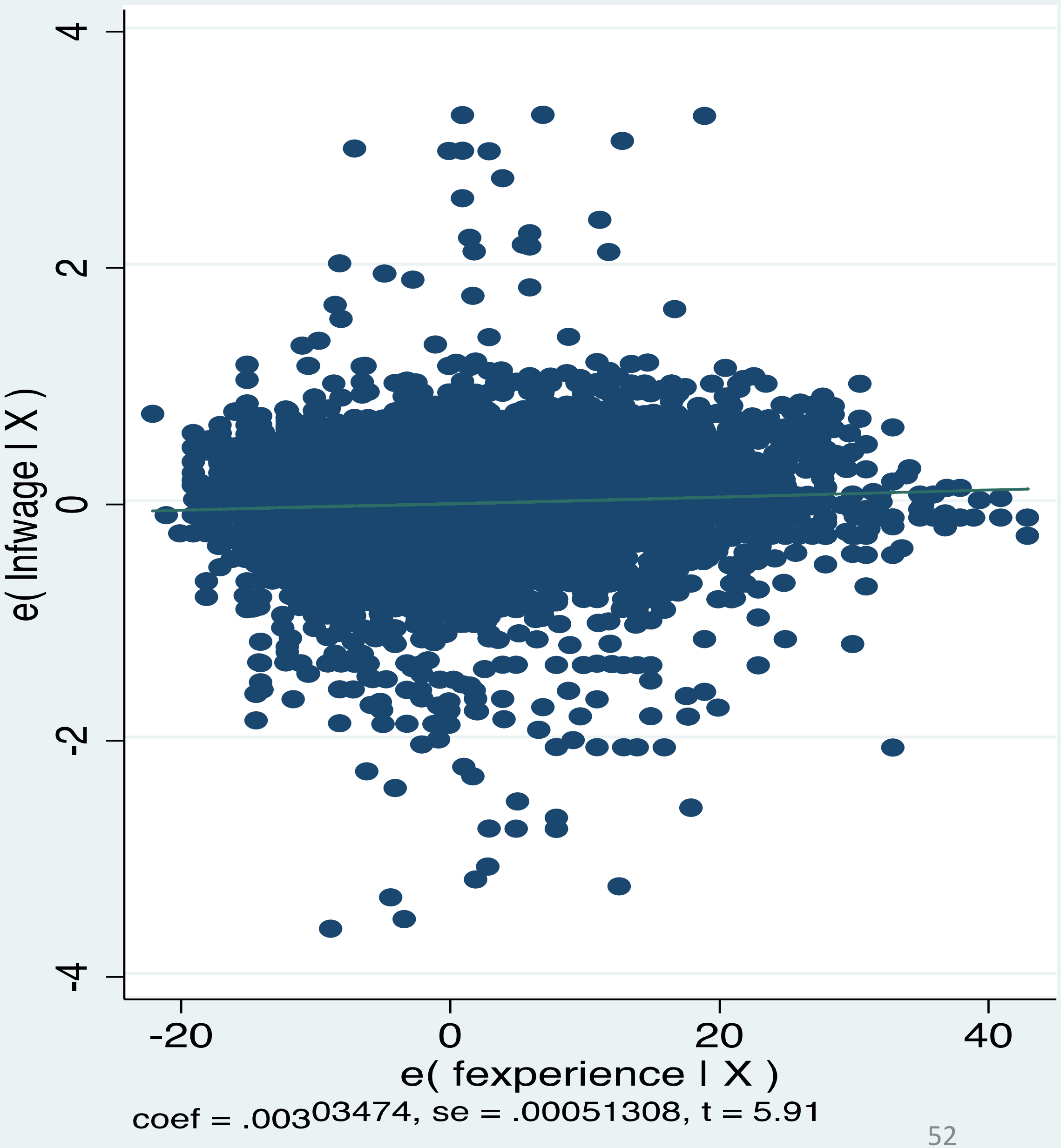
Results from Shapiro-Wilk Test for Normal Data

Variable	W	V	z	Prob>z
Residual	0.90892	371.790	15.744	0.00000

Interpretation: The joint distribution of the errors is not normal.

Graphical Check of Outliers in Regression Model





Summary of Post-estimation Diagnostic Tests of OLS Estimation

Test	Description	Result
Ramsey Regression Specification Error Test	Test of model specification	**Model is incorrectly specified; there is at least one omitted variable**
Link Test	Test of model specification	**Model is incorrectly specified**
Variance Inflation Factor	Test of multicollinearity	**Perfect multicollinearity is unlikely**
Breusch-Pagan and Cook-Weisberg Test	Test of heteroskedasticity	**There is no heteroskedasticity**
White Test	Test of heteroskedasticity	**There is heteroskedasticity**
Shapiro Wilk Test	Test of normality of errors	**The errors are not normally distributed**

Results from Heckman Two-step Estimation

	Probit	Heckman
VARIABLES	Natural log of female wage	Natural log of female wage
Husband wage	$-3.67*10^{-06}$ $(5.43*10^{-06})$	
Hours	0.0342*** (0.000667)	
Goods prices	0.700*** (0.0810)	
No land	0.616** (0.311)	
0.01-0.04 acres land	0.260 (0.311)	
0.05-2.49 acres land	-0.133 (0.311)	
2.50-7.49 acres land	-0.259 (0.335)	
7.50 acres or more land	(omitted)	
Children	-0.0793*** (0.0299)	
Education		0.0348*** (0.00203)
Experience		0.00108 (0.000810)
Lambda		-0.0897*** (0.0172)
Rho		-0.19942
sigma		0.44970462
Constant	-155.8*** (17.83)	7.592*** (0.0272)
LR chi2 (8)	3803.82	
Prob > chi2	0.0000	
Wald chi2 (2)		324.93
Prob > chi2		0.0000

Note: (i) Standard errors in parentheses (ii) *** p<0.01, ** p<0.05, * p<0.1

Estimated Reservation Wage of the Average Bangladeshi Housewife

Years of schooling	Average Monthly Reservation Wage of Housewife (in BDT)	Average Monthly Reservation Wage of Housewife as % of Husband's Average Monthly Wage	Standard error	P>|z|
0	8502.88	72.22%	0.026569	0.000
1	8803.63	74.78%	0.0254757	0.000
2	9115.00	77.42%	0.0245018	0.000
3	9437.40	80.16%	0.023662	0.000
4	9771.20	82.99%	0.0229711	0.000
5	10116.81	85.93%	0.0224428	0.000
6	10474.63	88.97%	0.0220889	0.000
7	10845.12	92.12%	0.0219177	0.000
8	11228.70	95.38%	0.0219335	0.000
9	11625.86	98.75%	0.022136	0.000
10	12037.06	102.24%	0.02252	0.000
11	12462.81	105.86%	0.0230766	0.000

Conclusion

Women’s unpaid labour

- Essential for the economy
- Priceless; not worthless
- What you can measure, you treasure
- Recognition is a stepping stone

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Disclaimer

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"I neither know nor think that I know"

- Socrates


THANK YOU