ECONOMIC POLICY ISSUES

Gender Pay Gap – Laws, Regulations, Human Capital
Sample Teaching Slides IV

Women's Pay in Australia, Great Britain, and the United States: The Role of Laws, Regulations, and Human Capital

Gregory, Anstie, Daly and Ho (1989)

Overview

- 1970s were a remarkable time for women. Female LFP increased throughout the OECD countries.
- Australia and the US were similar with respect to their male-female earnings ratio at the start of the decade. Britain was worse.
- Women's pay increased relative to that of men in Australia (30%) and Britain (20%, allowing Britain to catch up with the US), but NOT in the US.

Overview

- 1970s were a remarkable time for women. Female LFP increased throughout the OECD countries.
- Australia and the US were similar with respect to their male-female earnings ratio at the start of the decade. Britain was worse.
- Women's pay increased relative to that of men in Australia (30%) and Britain (20%, allowing Britain to catch up with the US), but NOT in the US.

- Compare labour markets in the three countries to answer 3 sets of questions:
    1. Why are female earnings ratios different among the 3 countries?
    2. Why a sudden and sharp changes in female pay in Australia and Britain? What is the role of institutions?
    3. What are the relationships between changes in female earnings ratio and changes in employment of women? What can we infer about the supply and demand elasticities for female labour?

The evolution of female-male pay ratios in 3 countries

The figure shows ratios of female to male average weekly earnings based on:

- **Australia**: Average weekly earnings for FT (> 35 hours)
- **Britain**: Average weekly earnings for FT (> 30 hours) for males age 21+ and female 18+
- **US**: Median usual weekly earnings for FT (> 35 hours)

Methodology: The Human Capital Model

Combine male and female earnings equations from human capital theory

$$\boldsymbol{E_i = \sum_{j=1}^{n} B_j\, X_{ij} + \sum_{j=1}^{n} \gamma_j\, X_{ij}^{F} + U_i}$$

Where

- E_i is $\log(weekly\ earnings_i)$
- X_{ij} comprises human capital, experience and other control variables
- X_{ij}^F can be understood as an **interaction** $\boldsymbol{X_{ij} \times Female_i}$
- U_i is the error term

Methodology: The Human Capital Model

Combine male and female earnings equations from human capital theory

$$\boldsymbol{E_i = \sum_{j=1}^{n} B_j\, X_{ij} + \sum_{j=1}^{n} \gamma_j\, X_{ij}^{F} + U_i}$$

Thus, male earns B_j and female earns $B_j + \gamma_j$ per unit increase in X_{ij}.

Methodology: The Human Capital Model

Combine male and female earnings equations from human capital theory

$$\boldsymbol{E_i = \sum_{j=1}^{n} B_j\, X_{ij} + \sum_{j=1}^{n} \gamma_j\, X_{ij}^F + U_i}$$

Thus, male earns B_j and female earns $B_j + \gamma_j$ per unit increase in X_{ij}.

Following the KBO decomposition technique, the gap in mean earnings is

$$\bar{E}^F - \bar{E}^M = \sum_{j=1}^{n} \hat{B}_j\left(\bar{X}_j^F - \bar{X}_j^M\right) + \sum_{j=1}^{n} \bar{X}_j^F \left(\underbrace{\hat{B}_j - \hat{\gamma}_j}_{female} - \underbrace{\hat{B}_j}_{male}\right)$$

Methodology: The Human Capital Model

Combine male and female earnings equations from human capital theory

$$\boldsymbol{E_i = \sum_{j=1}^{n} B_j X_{ij} + \sum_{j=1}^{n} \gamma_j X_{ij}^F + U_i}$$

Thus, male earns B_j and female earns $B_j + \gamma_j$ per unit increase in X_{ij}.

Following the KBO decomposition technique, the gap in mean earnings is

$$\bar{E}^F - \bar{E}^M = \sum_{j=1}^{n} \hat{B}_j \left(\bar{X}_j^F - \bar{X}_j^M\right) + \sum_{j=1}^{n} \bar{X}_j^F \left(\underbrace{\hat{B}_j - \hat{\gamma}_j}_{female} - \underbrace{\hat{B}_j}_{male}\right)$$

$$\boldsymbol{= \sum_{j=1}^{n} \hat{B}_J \left(\bar{X}_j^F - \bar{X}_j^M\right) + \sum_{j=1}^{n} \bar{X}_j^F \hat{\gamma}_j}$$

The Human Capital Model

Following the KBO decomposition technique, the gap in mean earnings is

$$\bar{\boldsymbol{E}}^{\boldsymbol{F}} - \bar{\boldsymbol{E}}^{\boldsymbol{M}} = \sum_{\boldsymbol{j}=\mathbf{1}}^{\boldsymbol{n}} \widehat{\boldsymbol{B}}_{\boldsymbol{J}}\left(\bar{\boldsymbol{X}}_{\boldsymbol{j}}^{\boldsymbol{F}} - \bar{\boldsymbol{X}}_{\boldsymbol{j}}^{\boldsymbol{M}}\right) + \sum_{\boldsymbol{j}=\mathbf{1}}^{\boldsymbol{n}} \bar{\boldsymbol{X}}_{\boldsymbol{j}}^{\boldsymbol{F}} \widehat{\boldsymbol{\gamma}}_{\boldsymbol{j}}$$

Since $\bar{E}^{F} - \bar{E}^{M} = \log(\mathrm{e}^{\mathrm{F}}) - \log(\mathrm{e}^{\mathrm{M}}) = \log\left(\frac{e^{F}}{e^{M}}\right)$, we can think of it as the log male-female mean earnings ratio.

The Human Capital Model

Following the KBO decomposition technique, the gap in mean earnings is

$$\overline{\boldsymbol{E}}^{\boldsymbol{F}} - \overline{\boldsymbol{E}}^{\boldsymbol{M}} = \sum_{\boldsymbol{j=1}}^{\boldsymbol{n}} \widehat{\boldsymbol{B}}_{\boldsymbol{J}}\left(\overline{\boldsymbol{X}}_{\boldsymbol{j}}^{\boldsymbol{F}} - \overline{\boldsymbol{X}}_{\boldsymbol{j}}^{\boldsymbol{M}}\right) + \sum_{\boldsymbol{j=1}}^{\boldsymbol{n}} \overline{\boldsymbol{X}}_{\boldsymbol{j}}^{\boldsymbol{F}} \widehat{\boldsymbol{\gamma}}_{\boldsymbol{j}}$$

$\sum_{j=1}^{n} \hat{B}_J\left(\bar{X}_j^F - \bar{X}_j^M\right)$ is referred to as **the endowment differences** (i.e., human capital endowment differences).

The Human Capital Model

Following the KBO decomposition technique, the gap in mean earnings is

$$\bar{\boldsymbol{E}}^{\boldsymbol{F}} - \bar{\boldsymbol{E}}^{\boldsymbol{M}} = \sum_{\boldsymbol{j}=\mathbf{1}}^{\boldsymbol{n}} \widehat{\boldsymbol{B}}_{\boldsymbol{J}}\left(\bar{\boldsymbol{X}}_{\boldsymbol{j}}^{\boldsymbol{F}} - \bar{\boldsymbol{X}}_{\boldsymbol{j}}^{\boldsymbol{M}}\right) + \sum_{\boldsymbol{j}=\mathbf{1}}^{\boldsymbol{n}} \bar{\boldsymbol{X}}_{\boldsymbol{j}}^{\boldsymbol{F}} \widehat{\boldsymbol{\gamma}}_{\boldsymbol{j}}$$

$\sum_{j=1}^{n} \hat{B}_J\left(\bar{X}_j^F - \bar{X}_j^M\right)$ is referred to as **the endowment differences** (i.e., human capital endowment differences).

$\sum_{j=1}^{n} \bar{X}_j^F \hat{\gamma}_j$ is referred to as **the coefficient differences**.

The latter is either
(i) pay discrimination to be explained by noneconomic factors, or
(ii) omitted factors/mismeasurements that cause earnings gap.

Results: Cross-Country Earnings Gaps

Row 1 lists the earnings ratio that would have prevailed in the three countries under the British pay structure (i.e., using the estimated coefficients of the British earnings equations).

TABLE 10-2 Explaining the Pay Gap Among the United States, Great Britain, and Australia: The Ratio of female to Male Full-Time Average Weekly Earnings

Measure	Great Britain	United States	Australia
Aggregate			
British pay structure	64.2	64.0	68.6
U.S. pay structure	60.6	61.7	63.6
Australian pay structure	76.3	77.6	79.3
Earnings gap to be explained (compared with Australia)	15.1	17.6	
Attributable to Endowments	4.4	1.9	
Coefficients	10.7	15.7	

SOURCES: Australia: Australian Bureau of Statistics, 1981 Census, Household Sample file, full-time wage and salary earners, ages 15 to 54. Great Britain: 1981 General Household Survey (data tape available from Her Majesty's Stationery Office), full-time wage and salary earners, ages 16 to 54. United States: Bureau of the Census, Current Population Survey, March 1982 (data tape), full-time wage and salary earners, ages 15 to 54.

Results: Cross-Country Earnings Gaps

Row 1 lists the earnings ratio that would have prevailed in the three countries under the British pay structure (i.e., using the estimated coefficients of the British earnings equations).

E.g., for the US in column 2, following the British pay structure means:

$$\hat{E}_i^{US|Brit} = \sum_{j=1}^{n} \hat{B}_j^{Brit} X_{ij}^{US} + \sum_{j=1}^{n} \hat{\gamma}_j^{Brit} X_{ij}^{F,US}$$

TABLE 10-2 Explaining the Pay Gap Among the United States, Great Britain, and Australia: The Ratio of female to Male Full-Time Average Weekly Earnings

Measure	Great Britain	United States	Australia
Aggregate			
British pay structure	64.2	64.0	68.6
U.S. pay structure	60.6	61.7	63.6
Australian pay structure	76.3	77.6	79.3
Earnings gap to be explained (compared with Australia)	15.1	17.6	
Attributable to Endowments	4.4	1.9	
Coefficients	10.7	15.7	

SOURCES: Australia: Australian Bureau of Statistics, 1981 Census, Household Sample file, full-time wage and salary earners, ages 15 to 54. Great Britain: 1981 General Household Survey (data tape available from Her Majesty's Stationery Office), full-time wage and salary earners, ages 16 to 54. United States: Bureau of the Census, Current Population Survey, March 1982 (data tape), full-time wage and salary earners, ages 15 to 54.

Results: Cross-Country Earnings Gaps

Row 1 lists the earnings ratio that would have prevailed in the three countries under the British pay structure (i.e., using the estimated coefficients of the British earnings equations).

E.g., for the US in column 2, following the British pay structure means:

TABLE 10-2 Explaining the Pay Gap Among the United States, Great Britain, and Australia: The Ratio of female to Male Full-Time Average Weekly Earnings

Measure	Great Britain	United States	Australia
Aggregate			
British pay structure	64.2	64.0	68.6
U.S. pay structure	60.6	61.7	63.6
Australian pay structure	76.3	77.6	79.3
Earnings gap to be explained (compared with Australia)	15.1	17.6	
Attributable to Endowments	4.4	1.9	
Coefficients	10.7	15.7	

SOURCES: Australia: Australian Bureau of Statistics, 1981 Census, Household Sample file, full-time wage and salary earners, ages 15 to 54. Great Britain: 1981 General Household Survey (data tape available from Her Majesty's Stationery Office), full-time wage and salary earners, ages 16 to 54. United States: Bureau of the Census, Current Population Survey, March 1982 (data tape), full-time wage and salary earners, ages 15 to 54.

$$\hat{E}_i^{US|Brit} = \sum_{j=1}^{n} \hat{B}_j^{Brit} X_{ij}^{US} + \sum_{j=1}^{n} \hat{\gamma}_j^{Brit} X_{ij}^{F,US}$$

Earnings gap relative to Australia is obtained by comparing numbers on the diagonal.

The study finds that women in Australia are relatively well paid compared with their American and British counterparts.

Results: Cross-Country Earnings Gaps

If you fix the pay structure, then the only way to generate different earnings ratios across countries is for women's human capital endowments to be different in each country.

TABLE 10-2 Explaining the Pay Gap Among the United States, Great Britain, and Australia: The Ratio of female to Male Full-Time Average Weekly Earnings

Measure	Great Britain	United States	Australia
Aggregate			
British pay structure	64.2	64.0	68.6
U.S. pay structure	60.6	61.7	63.6
Australian pay structure	76.3	77.6	79.3
Earnings gap to be explained (compared with Australia)	15.1	17.6	
Attributable to Endowments	4.4	1.9	
Coefficients	10.7	15.7	

SOURCES: Australia: Australian Bureau of Statistics, 1981 Census, Household Sample file, full-time wage and salary earners, ages 15 to 54. Great Britain: 1981 General Household Survey (data tape available from Her Majesty's Stationery Office), full-time wage and salary earners, ages 16 to 54. United States: Bureau of the Census, Current Population Survey, March 1982 (data tape), full-time wage and salary earners, ages 15 to 54.

Results: Cross-Country Earnings Gaps

If you fix the pay structure, then the only way to generate different earnings ratios across countries is for women's human capital endowments to be different in each country.

TABLE 10-2 Explaining the Pay Gap Among the United States, Great Britain, and Australia: The Ratio of female to Male Full-Time Average Weekly Earnings

Measure	Great Britain	United States	Australia
Aggregate			
British pay structure	64.2	64.0	68.6
U.S. pay structure	60.6	61.7	63.6
Australian pay structure	76.3	77.6	79.3
Earnings gap to be explained (compared with Australia)	15.1	17.6	
Attributable to Endowments	4.4	1.9	
Coefficients	10.7	15.7	

SOURCES: Australia: Australian Bureau of Statistics, 1981 Census, Household Sample file, full-time wage and salary earners, ages 15 to 54. Great Britain: 1981 General Household Survey (data tape available from Her Majesty's Stationery Office), full-time wage and salary earners, ages 16 to 54. United States: Bureau of the Census, Current Population Survey, March 1982 (data tape), full-time wage and salary earners, ages 15 to 54.

There is **little difference in the earnings ratios across columns**. It suggests that **the human capital endowments of women relative to those of men are similar** across countries.

The US pay structure, for example, show that only **1.9** (i.e., 63.6 – 61.7) percentage point difference in earnings ratios between the US and Australia can be attributed to human capital endowment. The rest (**15. 7 percentage points**) comes from the coefficients.

→ The different earnings ratios must come from the difference in pay structure (i.e., the coefficients).

Results: The Role of Institution (Australia)

In Australia, a complex network of federal and state tribunals set minimum wages. When an occupation is determined to be female, they made the calculations as though it were a male occupation and then adjusted the payment rate downward.

Between 1969-1975, there was a movement towards equal pay.

Since more women were in low paid work while men tended to stay above the award rates, this change affected women's pay more.

TABLE 10-3 Female to Male Awards and Earnings Ratios

	Australian Ratios			British Ratios		
Year	Awards	Earnings, Private Sector	Awards/ Earnings 1976 = 100	Awards, Manual Workers	Earnings, Manual Workers	Awards/ Earning (1976 = 100)
1964	72.0	59.2	98.6	83.1	59.8	101.0
1969	72.0	58.4	97.2	83.3	59.5	100.1
1970	73.2	59.1	96.8	82.6	60.1	102.1
1971	74.6	60.7	97.6	84.9	60.6	100.1
1972	77.4	63.2	99.6	85.6	60.7	99.4
1973	79.4	65.9	99.5	87.4	62.5	100.3
1974	85.2	70.9	99.7	92.1	67.0	102.1
1975	90.8	75.7	100.0	95.1	68.0	100.3
1976	92.4	77.1	100.0	100.0	71.3	100.0
1977	93.2	76.6	98.6	100.0	71.8	100.2
1979	92.1	74.1	96.5	100.0	70.7	99.2

NOTES: Australia: Awards = adult average minimum award rates for a full week's work, all industry groups, average of four quarters to December 31 each year (Gregory et al., 1985). Earnings = adult average weekly earnings for full-time (more than 30 hours) nonmanagerial employees in the private sector (Gregory et al., 1985). Great Britain: Awards = weighted average of minimum rates laid down in collective agreements (Tzannatos and Zabalza, 1984). Earnings = relative hourly earnings of full-time manual workers (Tzannatos and Zabalza, 1984).

Results: The Role of Institution (Britain)

In Britain, trade union and national agreements set minimum pay rates for a wide ranges of industries, but the coverage is not as wide as in Australia (41% compared to 90% of the female workforce).

The Equal Pay Act was introduced in 1970, to be effective by Dec 1975.

Most effective in raising the earnings ratio in Britain was **the clause that the lowest pay in any agreement must be shared by men and women**

By 1985, the prop of women below 60% avg male wage dropped from 67.4% to 48.1%).

TABLE 10-3 Female to Male Awards and Earnings Ratios

	Australian Ratios			British Ratios		
Year	Awards	Earnings, Private Sector	Awards/ Earnings 1976 = 100	Awards, Manual Workers	Earnings, Manual Workers	Awards/ Earning (1976 = 100)
1964	72.0	59.2	98.6	83.1	59.8	101.0
1969	72.0	58.4	97.2	83.3	59.5	100.1
1970	73.2	59.1	96.8	82.6	60.1	102.1
1971	74.6	60.7	97.6	84.9	60.6	100.1
1972	77.4	63.2	99.6	85.6	60.7	99.4
1973	79.4	65.9	99.5	87.4	62.5	100.3
1974	85.2	70.9	99.7	92.1	67.0	102.1
1975	90.8	75.7	100.0	95.1	68.0	100.3
1976	92.4	77.1	100.0	100.0	71.3	100.0
1977	93.2	76.6	98.6	100.0	71.8	100.2
1979	92.1	74.1	96.5	100.0	70.7	99.2

NOTES: Australia: Awards = adult average minimum award rates for a full week's work, all industry groups, average of four quarters to December 31 each year (Gregory et al., 1985). Earnings = adult average weekly earnings for full-time (more than 30 hours) nonmanagerial employees in the private sector (Gregory et al., 1985). Great Britain: Awards = weighted average of minimum rates laid down in collective agreements (Tzannatos and Zabalza, 1984). Earnings = relative hourly earnings of full-time manual workers (Tzannatos and Zabalza, 1984).

Results: The Role of Institution

Conclusion

- The quick pay changes was driven largely by the institutional changes, and
- The changes could NOT be explained by the human capital framework.

Evidence on the earnings ratios in Australia and Britain points to the effectiveness of the initiatives. The stable Awards-Earnings ratios in both countries further suggest that there was no development of uncovered/secondary markets.

But, the US also introduced equal pay under the Equal Pay Act of 1963 with very different outcomes. The effect on relative earnings was minimal.

Results: Employment Ratio

- No break in trends for Britain and Australia despite the increase in earnings ratio.

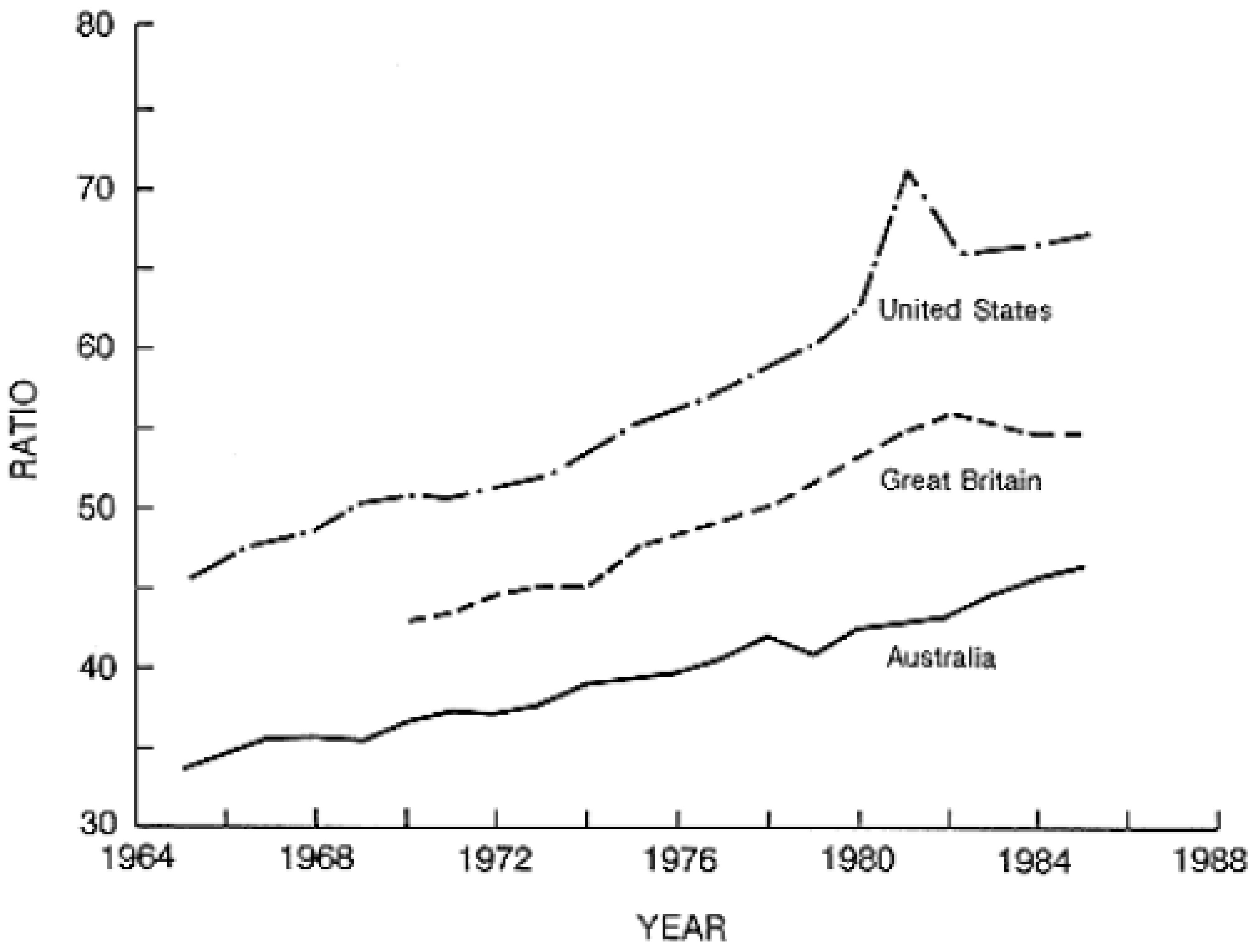


Figure 10-2
Ratio of female to male aggregate weekly hours worked. Sources: Australian Bureau of Statistics, *Labour Force*, Cat. No. 6303, August. U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings Monthly Bulletin*, annual averages. Great Britain, *Annual Abstract of Statistics*, mid-June.

Results: Employment Ratio

- No break in trends for Britain and Australia despite the increase in earnings ratio.

- Assuming a Cobb-Douglas function (elasticity of substitution, $\varepsilon = -1$), a 20-30% change in pay ratio suggests a 20-30% change in employment ratio.

  The fact that we do not observe such a decline indicates that **the elasticity of substitution between men and women is very low.**

  This could be partly due to labour market segregation into male and female jobs.

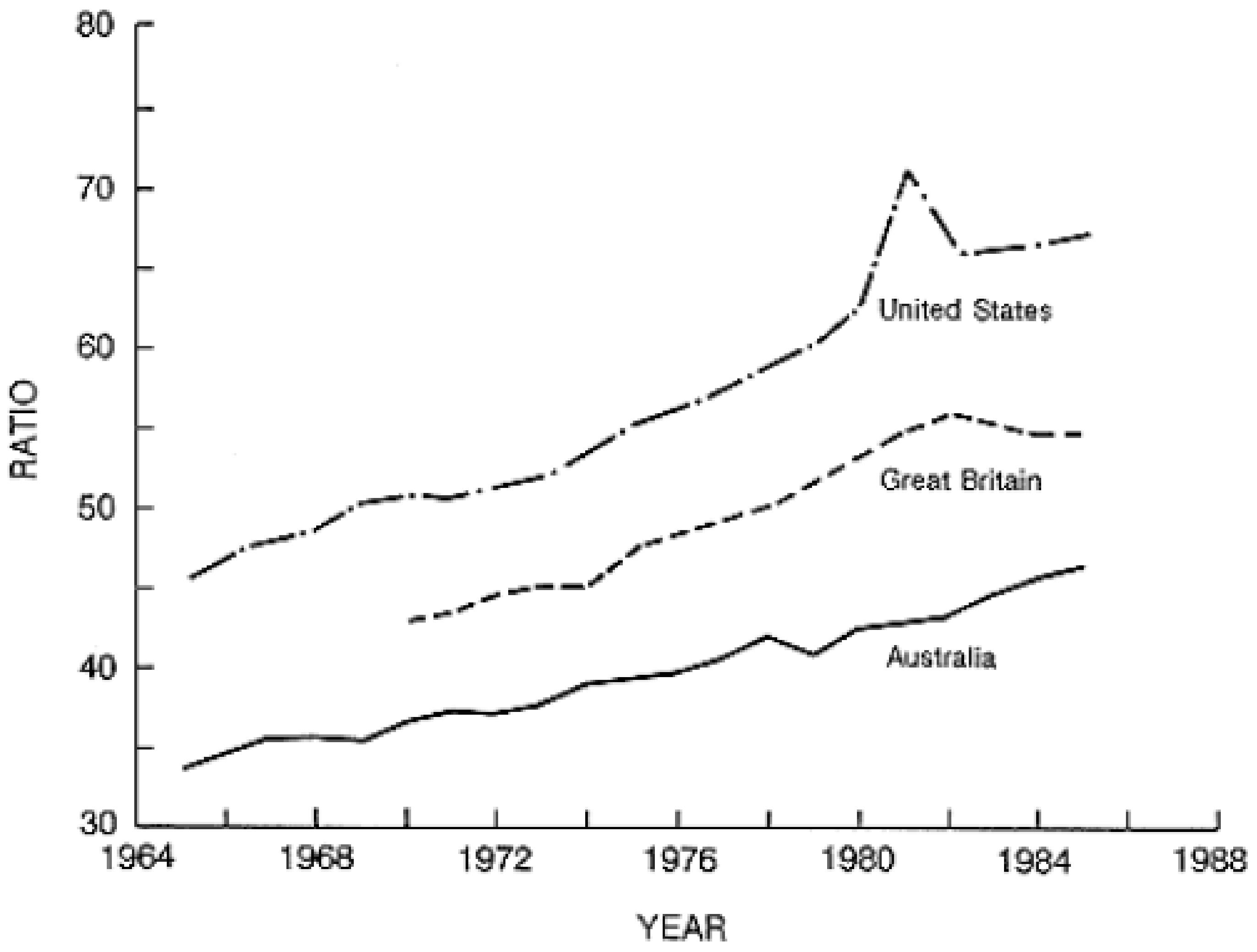


Figure 10-2
Ratio of female to male aggregate weekly hours worked. Sources: Australian Bureau of Statistics, *Labour Force*, Cat. No. 6303, August. U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings Monthly Bulletin*, annual averages. Great Britain, *Annual Abstract of Statistics*, mid-June.

Results: Employment Ratio

Note on elasticity of substitution (ε):

What is elasticity of substitution? By definition,

$$\varepsilon = -\frac{\%\Delta\left(\frac{E_F}{E_M}\right)}{\%\Delta\left(\frac{W_F}{W_M}\right)}$$

Results: Employment Ratio

<u>**Note on elasticity of substitution (ε)**</u>:

What is elasticity of substitution? By definition,

$$\varepsilon = -\frac{\%\Delta\left(\frac{E_F}{E_M}\right)}{\%\Delta\left(\frac{W_F}{W_M}\right)}$$

A Cobb-Douglas production function has a constant $\varepsilon = -1$. In other words, a 1% rise in pay ratio suggests a 1% fall in employment ratio.

Given that the pay ratio was raised by 20-30%, the employment ratio should fall by the same proportion, but this did not happen.

Results: Unemployment Ratio

Comparing female-male unemployment ratio in Australia with that in the US suggests that the impact of the higher earnings ratio on female employment in Australia was marginal.

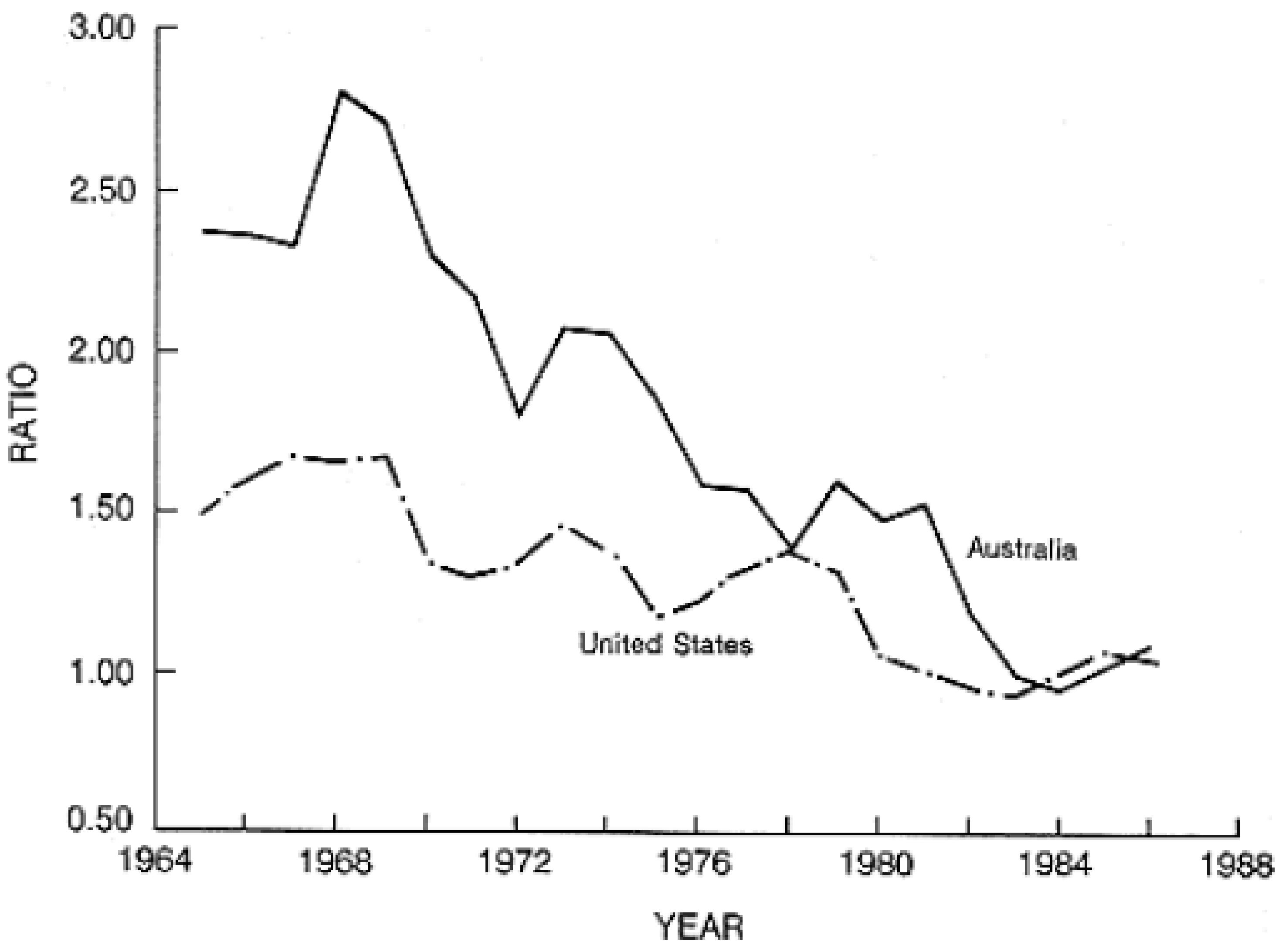


Figure 10-3 Ratio of female to male unemployment rates. Sources: Australian Bureau of Statistics, *The Labour Force, Historical Summary*, Cat. No. 6204, August. U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings Monthly Bulletin* , annual averages.

Conclusion

- Human capital model could not account for the changes.
- The pay gap narrowed significantly in Australia and Britain, but not in the US.
- Interventions were effective in the former countries, but ineffective in the latter.
- In Britain and Australia, narrower pay gaps did not seem to have any significant adverse impact on the relative employment. Female employment increased relative to male in all three countries during the 70s.

The Kitagawa-Blinder-Oaxaca (KBO) Decomposition

Overview

The Kitagawa-Blinder-Oaxaca (**KBO**) decomposition is **a counterfactual decomposition technique** introduced by Evelyn Mae Kitagawa (an American sociologist and demographer) and later popularized by Blinder (1973, Journal of Human Resources) and Oaxaca (1973, International Economic Review).

Commonly known as the Blinder-Oaxaca or Oaxaca-Blinder decomposition, the technique is used to study mean outcome differences between group. For instance, it is used widely in the study of labour outcome and health inequalities.

Overview

The Kitagawa-Blinder-Oaxaca (**KBO**) decomposition is **a counterfactual decomposition technique** introduced by Evelyn Mae Kitagawa (an American sociologist and demographer) and later popularized by Blinder (1973, Journal of Human Resources) and Oaxaca (1973, International Economic Review).

Commonly known as the Blinder-Oaxaca or Oaxaca-Blinder decomposition, the technique is used to study mean outcome differences between group. For instance, it is used widely in the study of labour outcome and health inequalities.

In this tutorial, we will refer to this technique as the **KBO decomposition**.

More specifically, the goal is to separate the gap in mean outcomes into two primary parts:

1. The part explained by the differences in the observed characteristics
2. The part NOT explained by such differences

Intuition

Consider the study of wage differential between two groups, men and women. Suppose we observe the following variables

- **Outcome** (dependent variable): Wage
- **Productivity characteristics** (independent variables): Work experience

Assume that men have 2 more years of work experience than women on average.

What to do next?

First, pick a reference/base group. Suppose we pick **men as the base group.**

Intuition

The KBO decomposition then separates the wage differential into two components:

1. **The explained wage differential**:
   The difference in mean wages between men and women explained by their gap in work experience.

   More precisely, it asks a counterfactual question: "If the average man had 2 more years of experience, how much more would he earn?"

Intuition

The KBO decomposition then separates the wage differential into two components:

1. **The explained wage differential**:
   The difference in mean wages between men and women explained by their gap in work experience.

   More precisely, it asks a counterfactual question: "If the average man had 2 more years of experience, how much more would he earn?"

2. **The unexplained wage differential**:
   The residual part that cannot be accounted for by the two-year experience gap.

   It answers the question: "For the average man with identical experience as the average woman, how much more would he be paid (i.e., based on male coefficients)?"

The Model

Suppose we have the following model of wages as a linear function of a collection of observed characteristics

$$\boldsymbol{W_i = \beta_0 + \beta_0^F \times F_i + \sum_{k=1}^{K} \beta_k X_{k,i} + \sum_{k=1}^{K} \beta_k^F X_{k,i} \times F_i + v_i}$$

Where

- W_i is the log($wage_i$) for individual i
- $X_{k,i}$ is some observed characteristic k for individual i
- F_i is a dummy variable for female (1 if female, 0 otherwise)
- v_i is the error term

The Model

We can also write separate linear functions for male (M) and female (F):

$$\boldsymbol{W_{M_i} = \beta_{M_0} + \sum_{k=1}^{K} \beta_{M_k} X_{M_{k,i}} + v_{M_i}}$$

$$\boldsymbol{W_{F_i} = \beta_{F_0} + \sum_{k=1}^{K} \beta_{F_k} X_{F_{k,i}} + v_{F_i}}$$

The gap in mean wages can therefore be understood as

$$\boldsymbol{\Delta\overline{W} = \overline{W}_M - \overline{W}_F}$$

The Model

The gap in mean wages can therefore be understood as

$$\boldsymbol{\Delta \overline{W} = \overline{W}_M - \overline{W}_F}$$

- $\overline{\mathrm{W}}_{\boldsymbol{M}} = \boldsymbol{\widehat{\beta}_{M_0}} + \sum_{\boldsymbol{k=1}}^{\boldsymbol{K}} \boldsymbol{\widehat{\beta}_{M_k} \overline{X}_{M_k}}$
- $\overline{\mathrm{W}}_{\boldsymbol{F}} = \boldsymbol{\widehat{\beta}_{F_0}} + \sum_{\boldsymbol{k=1}}^{\boldsymbol{K}} \boldsymbol{\widehat{\beta}_{F_k} \overline{X}_{F_k}}$

We get

$$\Delta \overline{W} = \left(\boldsymbol{\widehat{\beta}_{M_0}} - \boldsymbol{\widehat{\beta}_{F_0}}\right) + \sum_{\boldsymbol{k=1}}^{\boldsymbol{K}} \boldsymbol{\widehat{\beta}_{M_k} \overline{X}_{M_k}} - \sum_{\boldsymbol{k=1}}^{\boldsymbol{K}} \boldsymbol{\widehat{\beta}_{F_k} \overline{X}_{F_k}}$$

The Model

We can derive a more useful form on the LHS:

$$\Delta\overline{W} = \left(\widehat{\boldsymbol{\beta}}_{\boldsymbol{M}_{\boldsymbol{0}}} - \widehat{\boldsymbol{\beta}}_{\boldsymbol{F}_{\boldsymbol{0}}}\right) + \sum_{\boldsymbol{k}=\boldsymbol{1}}^{\boldsymbol{K}} \widehat{\boldsymbol{\beta}}_{\boldsymbol{M}_{\boldsymbol{k}}} \overline{\boldsymbol{X}}_{\boldsymbol{M}_{\boldsymbol{k}}} - \sum_{\boldsymbol{k}=\boldsymbol{1}}^{\boldsymbol{K}} \widehat{\boldsymbol{\beta}}_{\boldsymbol{F}_{\boldsymbol{k}}} \overline{\boldsymbol{X}}_{\boldsymbol{F}_{\boldsymbol{k}}}$$

The Model

We can derive a more useful form on the LHS:

$$\Delta\overline{W} = (\widehat{\boldsymbol{\beta}}_{\boldsymbol{M}_\mathbf{0}} - \widehat{\boldsymbol{\beta}}_{\boldsymbol{F}_\mathbf{0}}) + \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{\boldsymbol{M}_{\boldsymbol{k}}} \overline{\boldsymbol{X}}_{\boldsymbol{M}_{\boldsymbol{k}}} - \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{\boldsymbol{F}_{\boldsymbol{k}}} \overline{\boldsymbol{X}}_{\boldsymbol{F}_{\boldsymbol{k}}}$$

$$= (\widehat{\boldsymbol{\beta}}_{\boldsymbol{M}_\mathbf{0}} - \widehat{\boldsymbol{\beta}}_{\boldsymbol{F}_\mathbf{0}}) + \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{\boldsymbol{M}_{\boldsymbol{k}}} \overline{\boldsymbol{X}}_{\boldsymbol{M}_{\boldsymbol{k}}} - \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{\boldsymbol{M}_{\boldsymbol{k}}} \overline{\boldsymbol{X}}_{\boldsymbol{F}_{\boldsymbol{k}}} + \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{\boldsymbol{M}_{\boldsymbol{k}}} \overline{\boldsymbol{X}}_{\boldsymbol{F}_{\boldsymbol{k}}} - \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{\boldsymbol{F}_{\boldsymbol{k}}} \overline{\boldsymbol{X}}_{\boldsymbol{F}_{\boldsymbol{k}}}$$

The Model

We can derive a more useful form on the LHS:

$$\Delta\overline{W} = (\widehat{\boldsymbol{\beta}}_{M_0} - \widehat{\boldsymbol{\beta}}_{F_0}) + \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{M_k} \overline{\boldsymbol{X}}_{M_k} - \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{F_k} \overline{\boldsymbol{X}}_{F_k}$$

$$= (\widehat{\boldsymbol{\beta}}_{M_0} - \widehat{\boldsymbol{\beta}}_{F_0}) + \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{M_k} \overline{\boldsymbol{X}}_{M_k} - \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{M_k} \overline{\boldsymbol{X}}_{F_k} + \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{M_k} \overline{\boldsymbol{X}}_{F_k} - \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{F_k} \overline{\boldsymbol{X}}_{F_k}$$

$$= (\widehat{\boldsymbol{\beta}}_{M_0} - \widehat{\boldsymbol{\beta}}_{F_0}) + \left(\sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{M_k} \overline{\boldsymbol{X}}_{M_k} - \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{M_k} \overline{\boldsymbol{X}}_{F_k}\right) + \left(\sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{M_k} \overline{\boldsymbol{X}}_{F_k} - \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{F_k} \overline{\boldsymbol{X}}_{F_k}\right)$$

$$= (\widehat{\boldsymbol{\beta}}_{M_0} - \widehat{\boldsymbol{\beta}}_{F_0}) + \sum_{k=1}^{K} \widehat{\boldsymbol{\beta}}_{M_k} (\overline{\boldsymbol{X}}_{M_k} - \overline{\boldsymbol{X}}_{F_k}) + \sum_{k=1}^{K} (\widehat{\boldsymbol{\beta}}_{M_k} - \widehat{\boldsymbol{\beta}}_{F_k}) \overline{\boldsymbol{X}}_{F_k}$$

The Model

We can derive a more useful form on the LHS:

$$\Delta\overline{W} = (\hat{\beta}_{M_0} - \hat{\beta}_{F_0}) + \sum_{k=1}^{K}\hat{\beta}_{M_k}\overline{X}_{M_k} - \sum_{k=1}^{K}\hat{\beta}_{F_k}\overline{X}_{F_k}$$

$$= (\hat{\beta}_{M_0} - \hat{\beta}_{F_0}) + \sum_{k=1}^{K}\hat{\beta}_{M_k}\overline{X}_{M_k} - \sum_{k=1}^{K}\hat{\beta}_{M_k}\overline{X}_{F_k} + \sum_{k=1}^{K}\hat{\beta}_{M_k}\overline{X}_{F_k} - \sum_{k=1}^{K}\hat{\beta}_{F_k}\overline{X}_{F_k}$$

$$= (\hat{\beta}_{M_0} - \hat{\beta}_{F_0}) + \left(\sum_{k=1}^{K}\hat{\beta}_{M_k}\overline{X}_{M_k} - \sum_{k=1}^{K}\hat{\beta}_{M_k}\overline{X}_{F_k}\right) + \left(\sum_{k=1}^{K}\hat{\beta}_{M_k}\overline{X}_{F_k} - \sum_{k=1}^{K}\hat{\beta}_{F_k}\overline{X}_{F_k}\right)$$

$$= (\hat{\beta}_{M_0} - \hat{\beta}_{F_0}) + \sum_{k=1}^{K}\hat{\beta}_{M_k}(\overline{X}_{M_k} - \overline{X}_{F_k}) + \sum_{k=1}^{K}(\hat{\beta}_{M_k} - \hat{\beta}_{F_k})\overline{X}_{F_k}$$

Hence,

$$\Delta\overline{W} = \underbrace{(\hat{\beta}_{M_0} - \hat{\beta}_{F_0}) + \sum_{k=1}^{K}(\hat{\beta}_{M_k} - \hat{\beta}_{F_k})\overline{X}_{F_k}}_{\textit{Unexplained}} + \underbrace{\sum_{k=1}^{K}\hat{\beta}_{M_k}(\overline{X}_{M_k} - \overline{X}_{F_k})}_{\textit{Explained}}$$

The Model

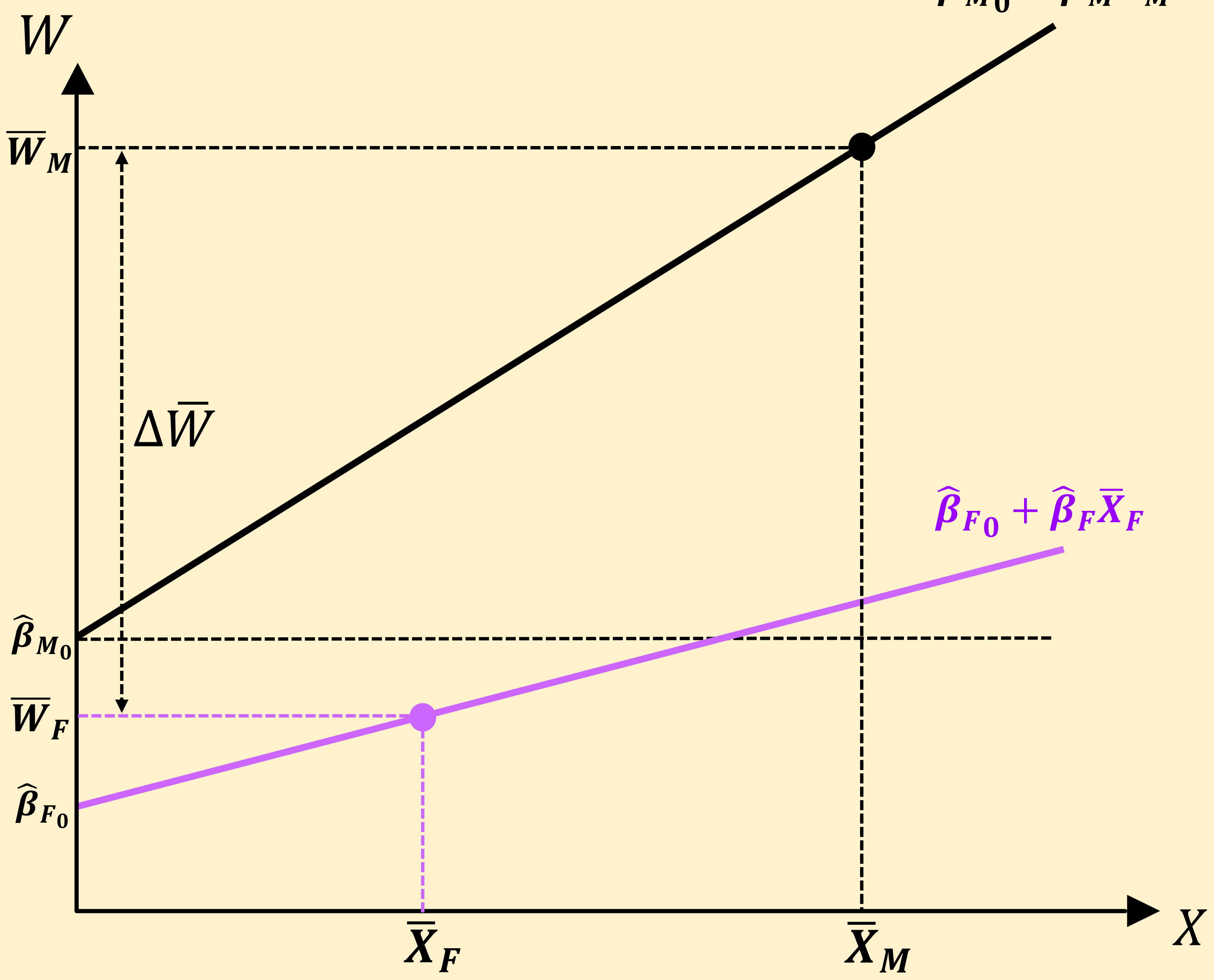
Hence,

$$\Delta\overline{W} = \underbrace{\left(\hat{\boldsymbol{\beta}}_{M_0} - \hat{\boldsymbol{\beta}}_{F_0}\right) + \sum_{k=1}^{K}\left(\hat{\boldsymbol{\beta}}_{M_k} - \hat{\boldsymbol{\beta}}_{F_k}\right)\overline{\boldsymbol{X}}_{F_k}}_{\textit{Unexplained}} + \underbrace{\sum_{k=1}^{K}\hat{\boldsymbol{\beta}}_{M_k}\left(\overline{\boldsymbol{X}}_{M_k} - \overline{\boldsymbol{X}}_{F_k}\right)}_{\textit{Explained}}$$

Consider a simple example with one observed characteristic, work experience X.

$$\Delta\overline{W} = \underbrace{\left(\hat{\boldsymbol{\beta}}_{M_0} - \hat{\boldsymbol{\beta}}_{F_0}\right) + \left(\hat{\boldsymbol{\beta}}_{M} - \hat{\boldsymbol{\beta}}_{F}\right)\overline{\boldsymbol{X}}_{F}}_{\textit{Unexplained}} + \underbrace{\hat{\boldsymbol{\beta}}_{M}\left(\overline{\boldsymbol{X}}_{M} - \overline{\boldsymbol{X}}_{F}\right)}_{\textit{Explained}}$$

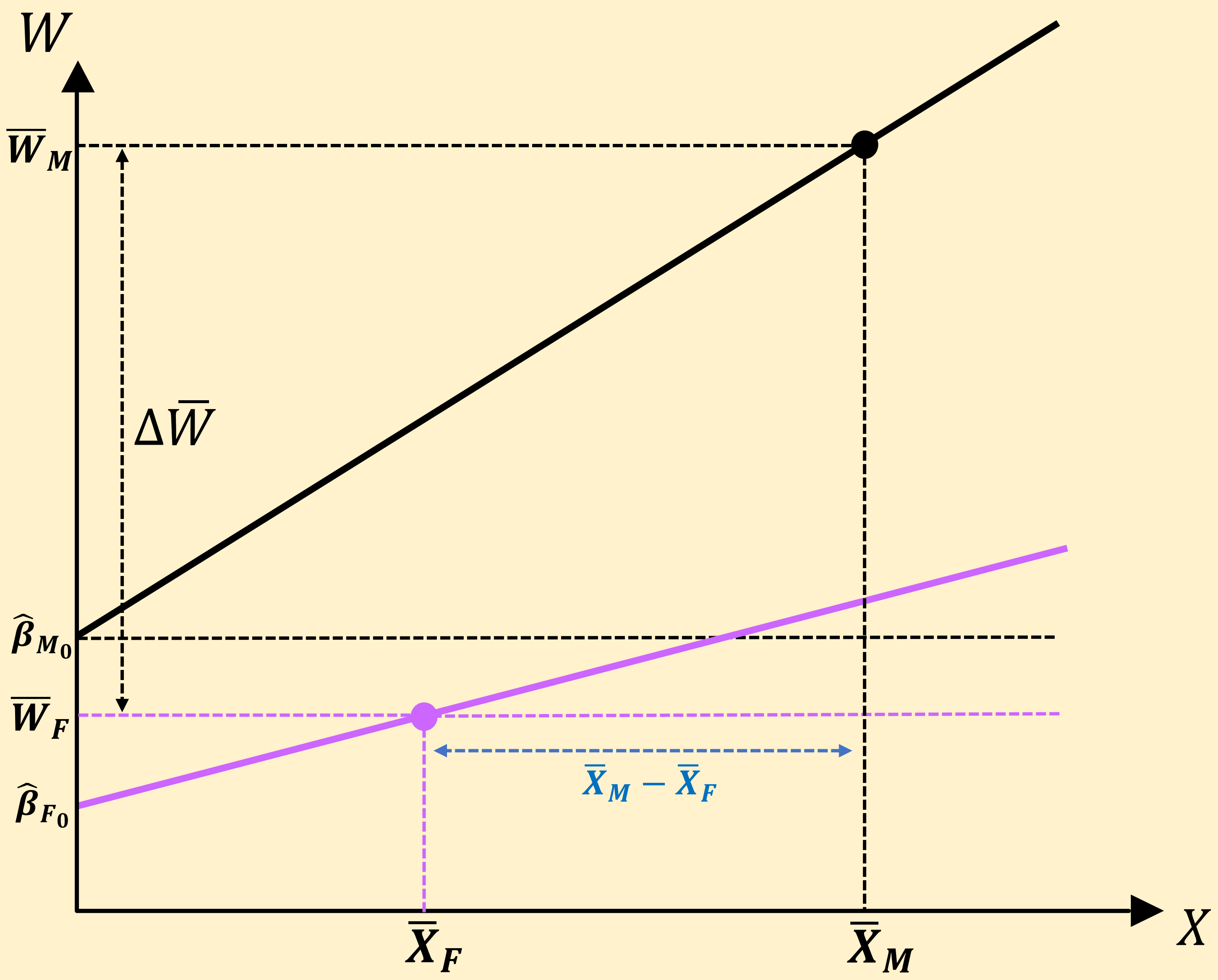
The Model



We know that:

$$\Delta\overline{W} = \underbrace{\left(\hat{\beta}_{M_0} - \hat{\beta}_{F_0}\right) + \left(\hat{\beta}_M - \hat{\beta}_F\right)\overline{X}_F}_{Unexplained} + \underbrace{\hat{\beta}_M\left(\overline{X}_M - \overline{X}_F\right)}_{Explained}$$

The Model



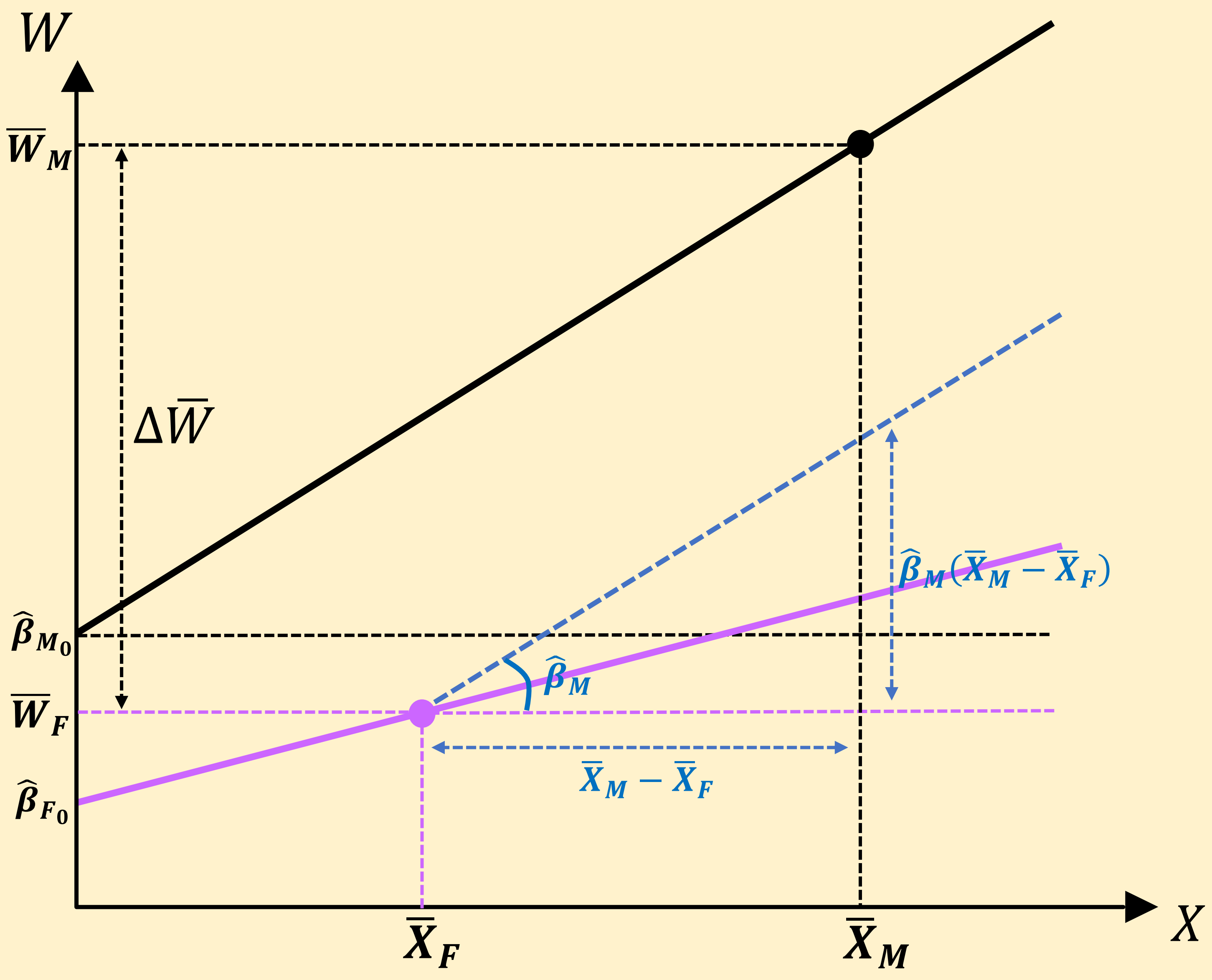
We know that:

$$\Delta\overline{W} = \underbrace{\left(\widehat{\beta}_{M_0} - \widehat{\beta}_{F_0}\right) + \left(\widehat{\beta}_M - \widehat{\beta}_F\right)\overline{X}_F}_{Unexplained} + \underbrace{\widehat{\beta}_M\left(\overline{X}_M - \overline{X}_F\right)}_{Explained}$$

Which can be broken down into answers to two questions:

1. For the average man, how much more would he earn if he had $(\bar{X}_M - \bar{X}_F)$ more experience?

The Model



We know that:

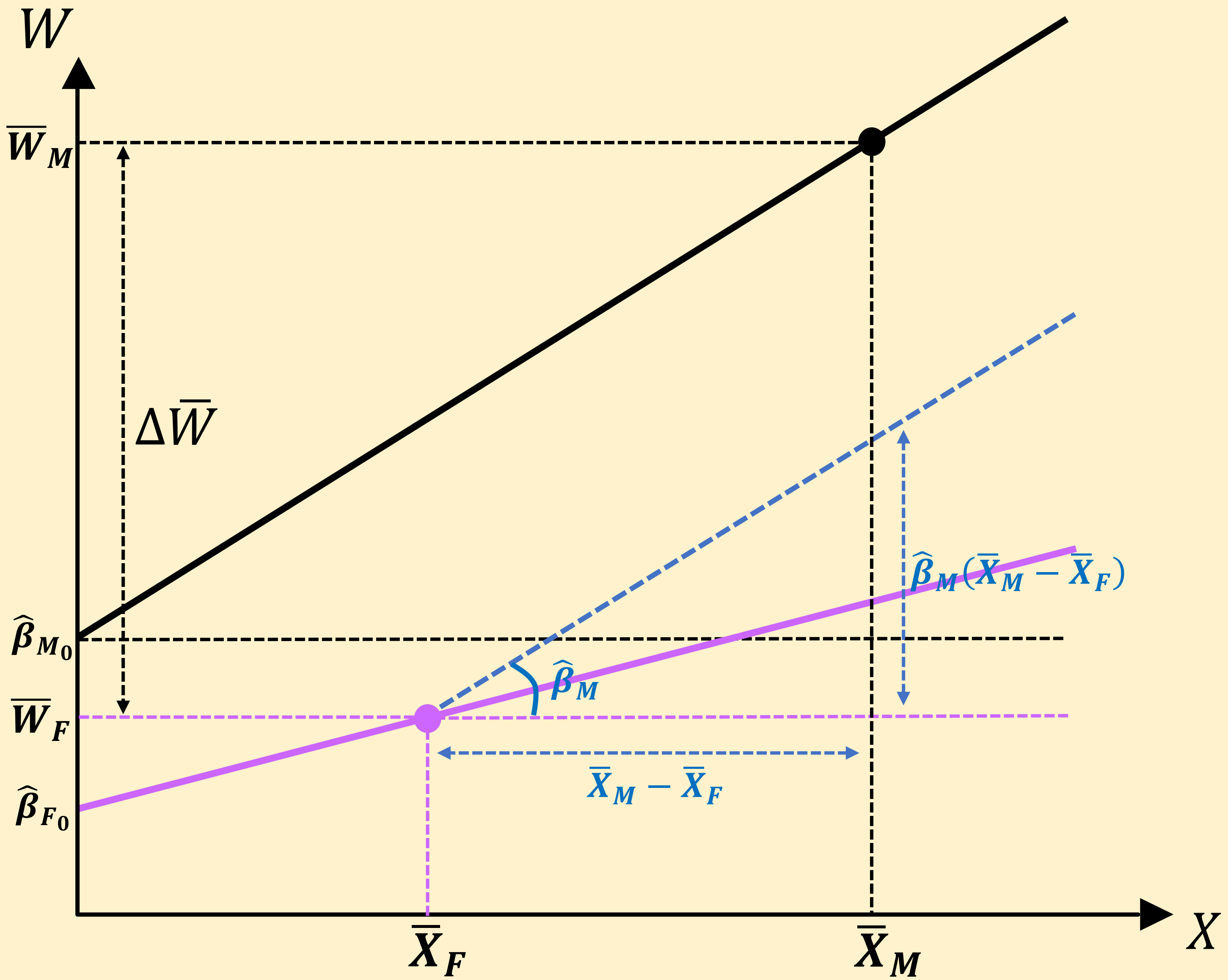
$$\Delta\overline{W} = \underbrace{(\hat{\beta}_{M_0} - \hat{\beta}_{F_0}) + (\hat{\beta}_M - \hat{\beta}_F)\overline{X}_F}_{Unexplained} + \underbrace{\hat{\beta}_M(\overline{X}_M - \overline{X}_F)}_{Explained}$$

Which can be broken down into answers to two questions:

1. For the average man, how much more would he earn if he had $(\bar{X}_M - \bar{X}_F)$ more experience?

$$\Delta\overline{W}_{explained} = \hat{\beta}_M(\overline{X}_M - \overline{X}_F)$$

The Model



We know that:

$$\Delta\overline{W} = \underbrace{\left(\hat{\beta}_{M_0} - \hat{\beta}_{F_0}\right) + \left(\hat{\beta}_M - \hat{\beta}_F\right)\overline{X}_F}_{Unexplained} + \underbrace{\hat{\beta}_M\left(\overline{X}_M - \overline{X}_F\right)}_{Explained}$$

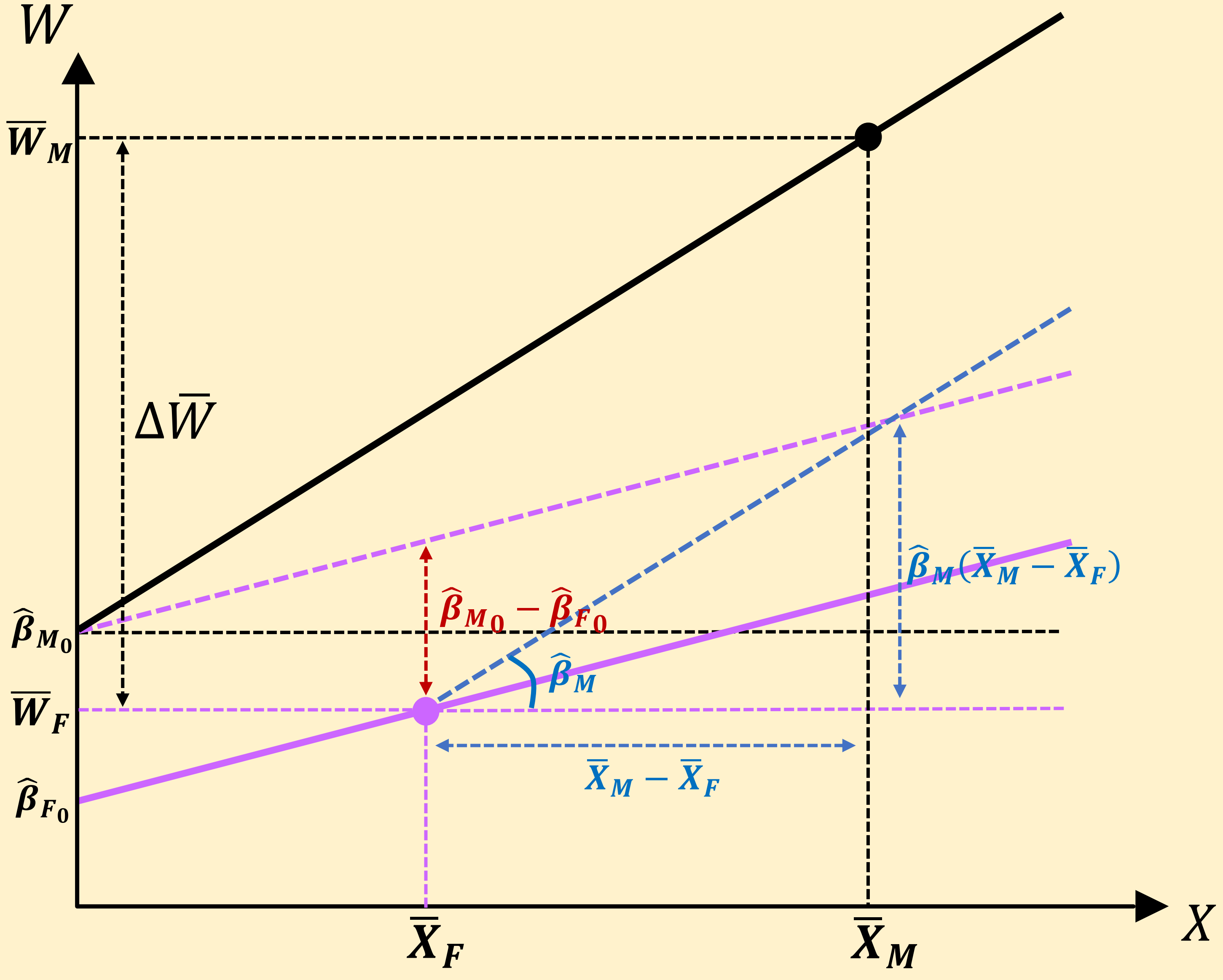
Which can be broken down into answers to two questions:

1. For the average man, how much more would he earn if he had $(\bar{X}_M - \bar{X}_F)$ more experience?

   $$\Delta\overline{W}_{explained} = \hat{\beta}_M\left(\overline{X}_M - \overline{X}_F\right)$$

2. If the average man had identical experience as the average women, how much more would he earn (i.e., based on male coefficients)?

The Model



We know that:

$$\Delta\overline{W} = \underbrace{(\widehat{\beta}_{M_0} - \widehat{\beta}_{F_0}) + (\widehat{\beta}_M - \widehat{\beta}_F)\overline{X}_F}_{Unexplained} + \underbrace{\widehat{\beta}_M(\overline{X}_M - \overline{X}_F)}_{Explained}$$

Which can be broken down into answers to two questions:

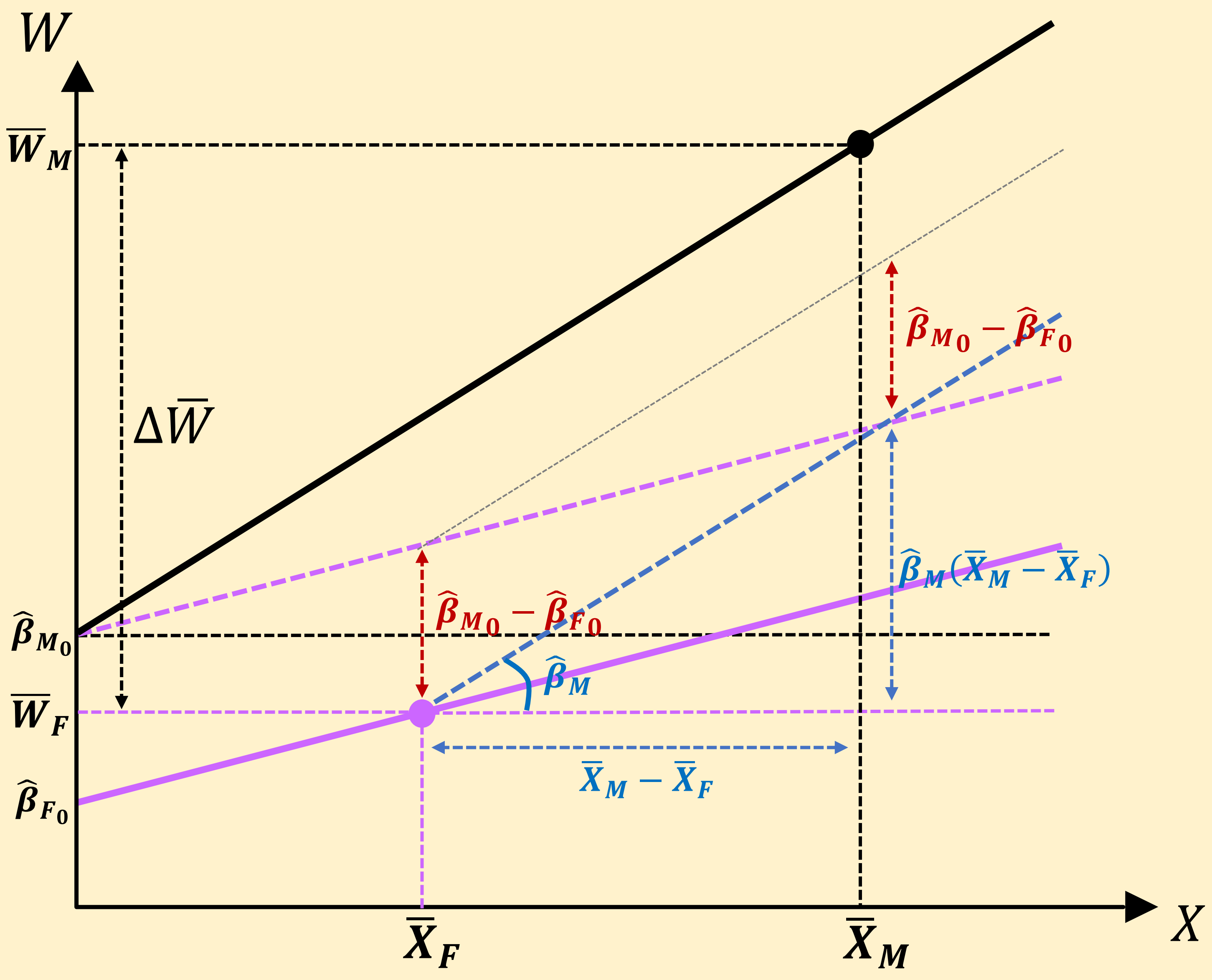
1. For the average man, how much more would he earn if he had $(\bar{X}_M - \bar{X}_F)$ more experience?

$$\Delta\overline{W}_{explained} = \widehat{\beta}_M(\overline{X}_M - \overline{X}_F)$$

2. If the average man had identical experience as the average women, how much more would he earn (i.e., based on male coefficients)?

$$\Delta\overline{W}_{unexplained} = (\widehat{\beta}_{M_0} - \widehat{\beta}_{F_0})$$

The Model



We know that:

$$\Delta\overline{W} = \underbrace{(\hat{\beta}_{M_0} - \hat{\beta}_{F_0}) + (\hat{\beta}_M - \hat{\beta}_F)\overline{X}_F}_{Unexplained} + \underbrace{\hat{\beta}_M(\overline{X}_M - \overline{X}_F)}_{Explained}$$

Which can be broken down into answers to two questions:

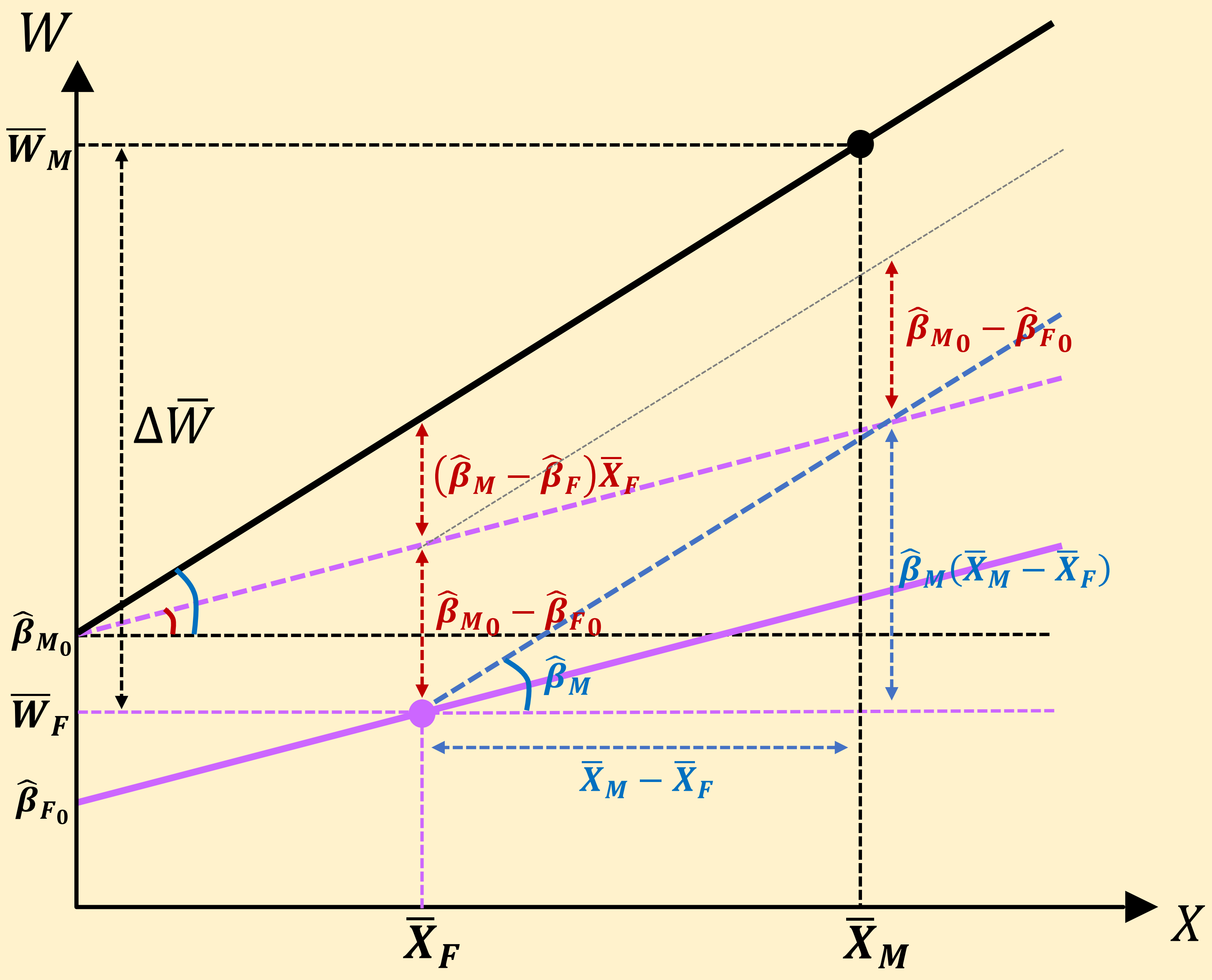
1. For the average man, how much more would he earn if he had $(\bar{X}_M - \bar{X}_F)$ more experience?

   $$\Delta\overline{W}_{explained} = \hat{\beta}_M(\overline{X}_M - \overline{X}_F)$$

2. If the average man had identical experience as the average women, how much more would he earn (i.e., based on male coefficients)?

   $$\Delta\overline{W}_{unexplained} = (\hat{\beta}_{M_0} - \hat{\beta}_{F_0})$$

The Model



We know that:

$$\Delta\overline{W} = \underbrace{(\hat\beta_{M_0} - \hat\beta_{F_0}) + (\hat\beta_M - \hat\beta_F)\overline{X}_F}_{Unexplained} + \underbrace{\hat\beta_M(\overline{X}_M - \overline{X}_F)}_{Explained}$$

Which can be broken down into answers to two questions:

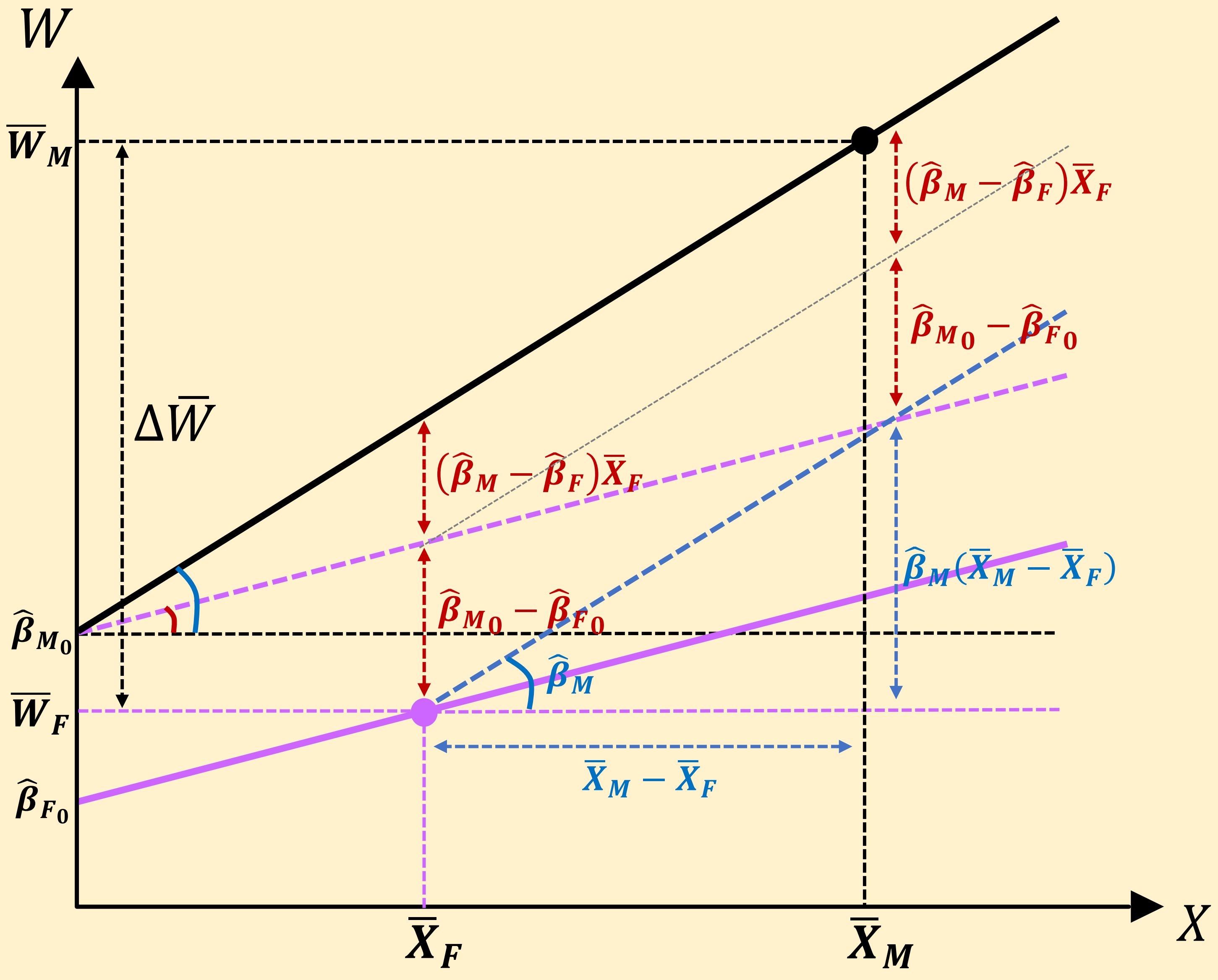
1. For the average man, how much more would he earn if he had $(\overline{X}_M - \overline{X}_F)$ more experience?

$$\Delta\overline{W}_{explained} = \hat\beta_M(\overline{X}_M - \overline{X}_F)$$

2. If the average man had identical experience as the average women, how much more would he earn (i.e., based on male coefficients)?

$$\Delta\overline{W}_{unexplained} = (\hat\beta_{M_0} - \hat\beta_{F_0}) + (\hat\beta_M - \hat\beta_F)\overline{X}_F$$

The Model



We know that:

$$\Delta\overline{W} = \underbrace{(\hat{\beta}_{M_0} - \hat{\beta}_{F_0}) + (\hat{\beta}_M - \hat{\beta}_F)\overline{X}_F}_{\textit{Unexplained}} + \underbrace{\hat{\beta}_M(\overline{X}_M - \overline{X}_F)}_{\textit{Explained}}$$

Which can be broken down into answers to two questions:

1. For the average man, how much more would he earn if he had $(\bar{X}_M - \bar{X}_F)$ more experience?

   $$\Delta\overline{W}_{explained} = \hat{\beta}_M(\overline{X}_M - \overline{X}_F)$$

2. If the average man had identical experience as the average women, how much more would he earn (i.e., based on male coefficients)?

   $$\Delta\overline{W}_{unexplained} = (\hat{\beta}_{M_0} - \hat{\beta}_{F_0}) + (\hat{\beta}_M - \hat{\beta}_F)\overline{X}_F$$

Caveats

1. **Unexplained difference**:
   The unexplained difference may involve unobserved factors that are non-institutional such as access to quality education prior to joining the labour market, difference in subfields of study, family dynamics, work hours and promotion (constant return to work hours?), etc.

Caveats

1. **Unexplained difference**:
   The unexplained difference may involve unobserved factors that are non-institutional such as access to quality education prior to joining the labour market, difference in subfields of study, family dynamics, work hours and promotion (constant return to work hours?), etc.

2. **Restrictive definition of work compensation**:
   There are other forms of compensation and trade-offs not captured by wages. For instance, fringe benefits and flexible hours.