

Unemployment Duration and Re-employment Wages: A Control Function Approach

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$$y_2 = \pi X + \beta z + v_2 \quad (2)$$

- 4 Add the generalized residuals to the 2nd stage

$$y_1 = \gamma_1 y_2 + \delta X + \rho v_2 + e_1 \quad (3)$$

Remember: $y_2 - v_2 = \hat{y}_2$

Control Function: Advantages

OLS

Control for endogenous variables

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	OLS	2SLS
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	OLS	2SLS	CF
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Non-linear First Stage						✓	✓
Binary Endogenous Variable						✓	✓
Non-binary Discrete Endogenous Variable							✓

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In the context of the our application, we can also obtain:

- Hausman Test
- Inverse Mills Ratio

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Unemployment Duration and Re-employment Wages

- There is not a single theory which justifies the earnings losses of displaced workers (Carrington and Fallick, 2015).
 - job-specific human capital (Becker, 1962)
 - matching (Jovanovic, 1979)
 - wage-productivity gap (Lazear, 1981)
 - signalling (Gibbons and Katz, 1989)
 - unionism (Hildreth and Oswald, 1997)
 - intra-household reallocation (Lundberg, 1985)
 - health (Kessler, House and Turner, 1987)

- Estimation issue: simultaneity present in the relationship between joblessness duration and re-employment wage

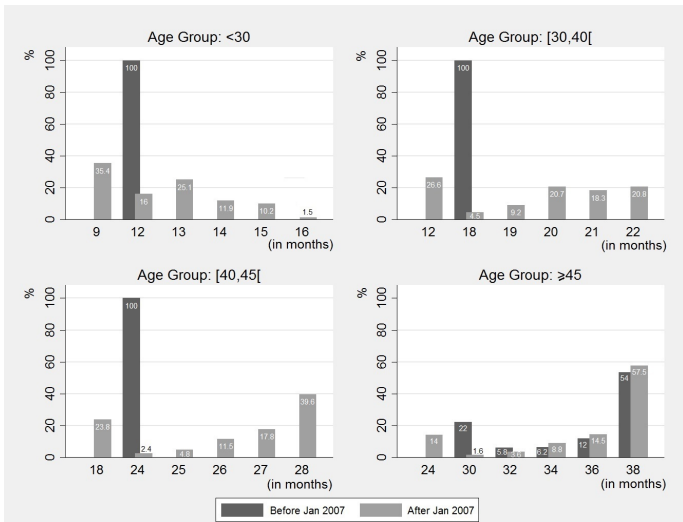
$$\log(PostW_i) = \alpha_0 + \alpha_1 \log(UD_i) + X_i' \beta + u_i$$

Unemployment Benefits Rules in Portugal

Unemployment insurance (UI)

- involuntarily unemployed
- working for a minimum period
- potential duration = f (age, job history)
- daily benefit based on remunerations of past 2 years

Figure: Percentage of individuals by age group and potential duration of unemployment benefit, before and after the 2007 reform



First Stage - Identification Strategies

Identify the exogenous variation in the joblessness duration:

- Potential Duration of Unemployment Benefits
 - Vast literature indicates strong correlation between potential duration of UB and joblessness duration. The rules are not directly related to the wage but include two of the determinants (age, experience).

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- Age Discontinuity in the Potential Duration of Unemployment Benefits
 - Individuals with 29 or 30 years old have, on average, similar labour supply characteristics but are entitled to different potential durations. There is room for enough difference on experience.
- Change in the Potential Duration of Unemployment Benefits
 - As the benefits require involuntary unemployment there is no room for strategic behaviour. The policy change did not affect all the individuals in the same way. Correlation with age is -0.03 and correlation with experience is 0.18 .

First Stage - Results

**Table Accelerated Failure Time
Unemployment Duration Equation**

Variable	(1)
Difference in Potential Rules	.089 (.0002)
Age (groups)	
[30,40[	.284 (.004)
[40,45[	.592 (.004)
≥ 45	1.449 (.004)
Log likelihood	-18 481
N	18 543

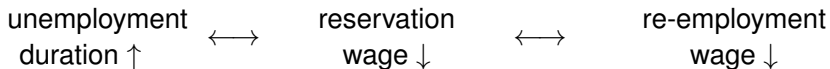
Notes: standard errors in parenthesis below the estimates. The equations also include gender dummy, tenure quadratic polynomial, reasons of unemployment dummies, unemployment rate and six region dummies.

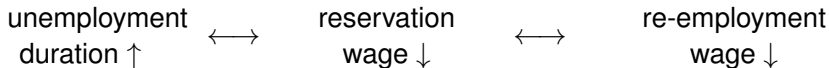
Second Stage - Results

Variable	OLS	CF
Ln(Duration)	-.076 (.005)	-.049 [.012]
1st stage residuals		-.068 [.028]
Ln(Previous Wage)	.566 (.011)	.568 [.016]
Age (groups)		
[30,40[	.016 (.012)	.012 [.012]
[40,45[	-.008 (.018)	-.020 [.019]
≥45	.007 (.017)	-.021 [.021]
Constant	3.084 (.091)	3.109 [.111]
Adj R ²	.264	.265
N	8 423	

Notes: bootstrapped standard errors in squared parenthesis below the estimates. The equations also include the controls of the first stage.

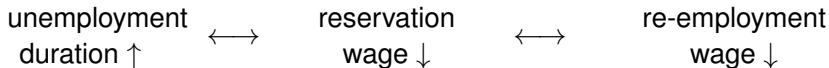
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Solution: Include the generalized residuals from the first stage ✓

Statistic: Hausman test

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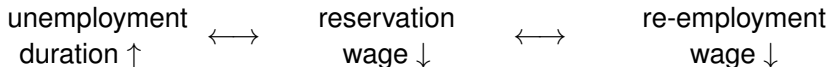
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Statistic: Hausman test

Problem: Selection

Individuals who got a job \neq individuals who did not get a job

Problem: **Simultaneity**



Solution: Include the generalized residuals from the first stage ✓

Statistic: Hausman test

Problem: **Selection**

Individuals who got a job \neq individuals who did not get a job

Solution: Include the hazard rate from the first stage

Statistic: Inverse Mills ratio

Second Stage - with selection control

Variable	OLS	CF	CF+S
Ln(Duration)	-.076 (.005)	-.049 [.012]	-.052 [.012]
1st stage residuals		-.068 [.028]	-.072 [.029]
1st stage hazard			-.310 [.292]
Ln(Previous Wage)	.566 (.011)	.568 [.016]	.569 [.016]
Age (groups)			
[30,40[	.016 (.012)	.012 [.012]	.008 [.013]
[40,45[	-.008 (.018)	-.020 [.019]	-.028 [.022]
≥45	.007 (.017)	-.021 [.021]	-.037 [.028]
Constant	3.084 (.091)	3.109 [.111]	3.157 [.117]
Adj R ²	.264	.265	.265
N		8 423	

Notes: bootstrapped standard errors in squared parenthesis below the estimates. The equations also include the controls of the first stage.

Selection direction

The **hazard rate** is the ratio between the density and the cumulative density functions. That is, it can be interpreted as an **Inverse Mills Ratio**. From the estimated coefficient we can then calculate the correlation between the two residuals.

$$\hat{\sigma}^2 = \frac{1}{N} \sum_i \left[\hat{v}_i^2 + \hat{\alpha} \hat{\lambda}_i \right] \quad (4)$$

\hat{v}_i^2 - squared individual residuals from second stage

$\hat{\alpha}$ - estimated coefficient of the hazard rate in the second stage

$\hat{\lambda}_i$ - estimated individual hazard rate from the first stage

$$\hat{\rho} = \frac{\hat{\alpha}}{\hat{\sigma}} \quad (5)$$

Provides the correlation between the two residuals, which in this case is 0.21 but not statistically significant.

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- It allows for both linear and non-linear first stage
- Namely for the estimation of survival analysis models which can include more individuals than those used for the second stage
- Provides a test for endogeneity
- Provides a test for selectivity

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Note: Stata command to be constructed soon

Thank you!

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