

Migration and Wage Effects of Taxing Top Earners: Evidence from Denmark

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Motivation

- Many countries/states tempted to lower tax rates to keep/attract high-skilled labor
- Triggered important debates:
 - ① **Migration:**
Are location decisions of high-skilled labor responsive to tax differentials?
 - ② **Incidence:**
Who benefits from lower tax rates on high-skilled labor?
 - ③ **Spillovers:**
Are natives hurt by lower tax rates on foreign high-skilled labor?

Why do migration responses matter?

- Migration responses...
 - ① increase the efficiency cost of taxation
 - ② limit the redistributive ability of governments
 - ③ induce socially suboptimal labor tax competition between countries/jurisdictions
- Very scarce empirical research on migration responses to taxation compared to standard labor supply responses:
 - ▶ Lack of good micro data containing citizenship information
 - ▶ Issues about how to identify causal effects on migration

Why does incidence matter?

- Incidence of income taxes on high-skilled labor...
 - ① determines redistributive impact of such taxes
 - ② sheds light on functioning of labor market for high-skilled individuals
- Little empirical evidence on income tax incidence and impact of taxes on wage setting process
 - ▶ Lack of within ability-level variations in tax rates

This paper

- Use Danish Foreigners' Tax Scheme, with presence of large discontinuities in tax liability depending on:
 - ① Contract start date (before and after June 1, 1991)
 - ② Duration of stay (3-year rule)
 - ③ Earnings level (earnings eligibility threshold)
- Main findings:
 - ① Large positive migration responses
 - ② Increase in gross earnings for stayers after 3 years
 - ③ Bunching just above scheme threshold
 - ④ No hole below scheme threshold
 - ⑤ No evidence of spillover effects
- Develop a simple matching frictions model to rationalize findings 1 to 4

Outline

- ① Institutional background and data
- ② Theoretical framework
- ③ Migration Responses
 - Extensive Margin
 - Duration
 - Policy implications
- ④ Incidence
- ⑤ Spillovers

Foreigners' Tax Scheme in Denmark:

- Passed in 1992; applicable to contracts signed after 1 June, 1991
- Flat tax of 30% (25% after 1995) in lieu of the regular progressive income tax (top rate of above 60%)
- Up to 3 years after which taxpayer subject to ordinary income tax
- Eligibility requirements:
 - ▶ No tax liability in Denmark in the 3 years prior to going on the scheme
 - ▶ Annual earnings of at least 103,000 Euros (as of 2009, indexed):
≈ top .5% of the income distribution

Data:

- Administrative files for the full population living in Denmark:
 - ▶ Complete socio-economic info
- Complete tax data and researchers' tax scheme info
- Migration information:
 - ▶ Dates of entry and exit, country of in/out migration, citizenship

▶ Composition

▶ Take-up

Table 1 : Descriptive statistics

	(1) mean	(2) standard dev
Scheme employees 1991-2010		
Number of scheme spells=11642		
Fraction with proof of residence	.949	.220
Duration of stay (yrs)	2.345	1.448
<i>fraction > 3 yrs</i>	.251	.434
Scheme earnings (2009 DK1000s)	1217.8	2094.7
<i>as a fraction of thresh.</i>	1.53	2.67
Average tax rate	.308	.003
Age	39.97	8.80
Scheme take-up rate: .81		
Firms 1991-2010		
Number of scheme participating firms=2235		
# of employees	438.06	2316.47
average gross wage (2009 DK1000s)	437.6	305.0
# of scheme employees	1.8	3.2
# of native employees above thresh.	13.99	61.65

① Institutional background and data

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Standard Model vs. Matching Frictions Model

- Four main findings:
 - ① Positive migration responses
 - ② Increase in gross earnings for stayers after 3 years
 - ③ Bunching just above scheme threshold
 - ④ No hole below scheme threshold
- Standard model can explain 1 and 3
- Model with matching frictions can explain 1, 2, 3 and 4

Common features: Migration

- Individuals have productivity y
- **Reservation wage** y_0 for working in Denmark

$$y_0 = \frac{z_h(1 - \tau_h) + \nu}{1 - \tau} = \frac{y_0^{\tau=0}}{1 - \tau}$$

- ① z_h, τ_h wage and average tax rate in home country
- ② ν net cost of migrating
- ③ τ average tax rate in Denmark: $\tau^S < \tau^D$

■ Migration:

- ▶ Worker migrates in if and only if $y_0 \leq y$
- ▶ Scheme reduces y_0 and causes migration when $y_0^S \leq y < y_0^D$

Standard Model vs. Matching Model

- **Standard model**, workers paid their marginal product y
- **Model with matching frictions**
 - ▶ Workers and firms expend resources to create a match
 - ▶ When matched, surplus \Rightarrow band of acceptable wages (y_0, y)
- Pretax wage z splits the surplus:
 - ▶ Nash bargaining maximizes:

$$W = (y - z)^{1-\beta}((1 - \tau)z - y_0^{\tau=0})^\beta$$

- ▶ $\beta \in [0, 1]$, bargaining power of worker

$$z = \beta y + (1 - \beta)y_0$$

- Nests standard model: case $\beta = 1$

Bargaining theory predictions

■ Pretax wage increases with τ

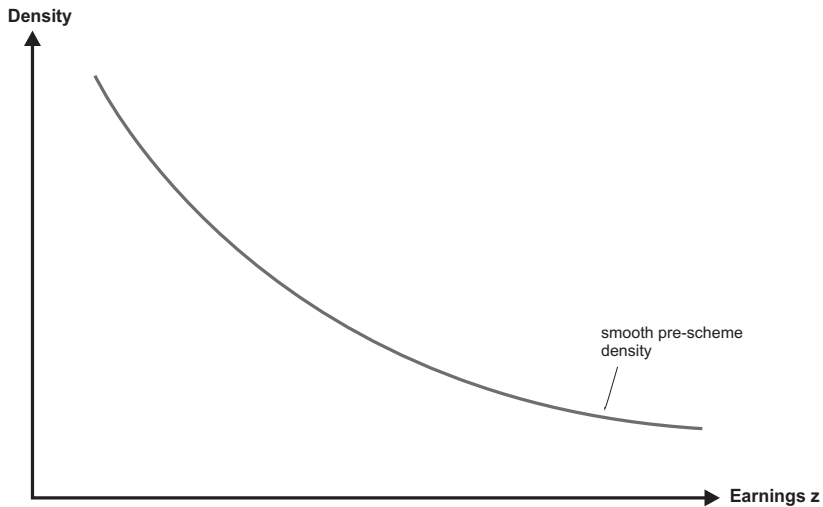
If $\beta < 1$, scheme **reduces** pretax wage z

$$\underbrace{z^S}_{\beta y + (1-\beta)y_0^S} < \underbrace{z^D}_{\beta y + (1-\beta)y_0^D}$$

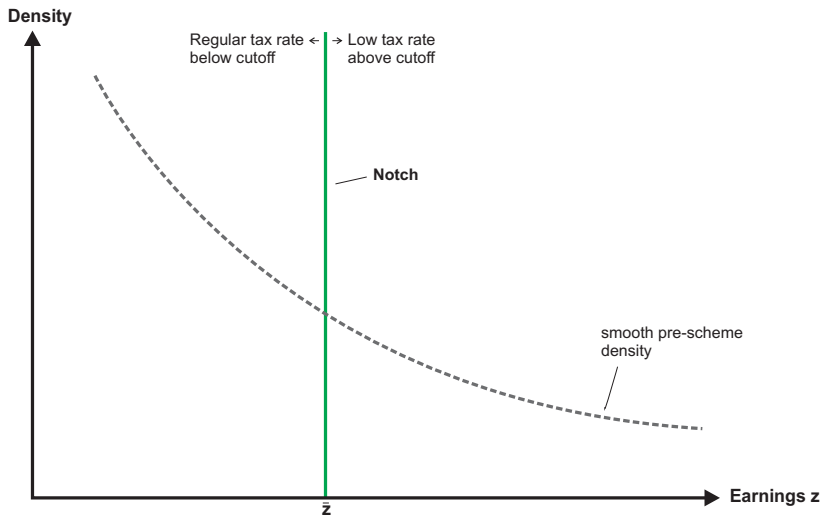
■ Bunching at \bar{z} :

- ▶ Bunching from above when bargaining power of firm $1 - \beta > 0$
- ▶ Bunching from below when bargaining power of workers $\beta > 0$

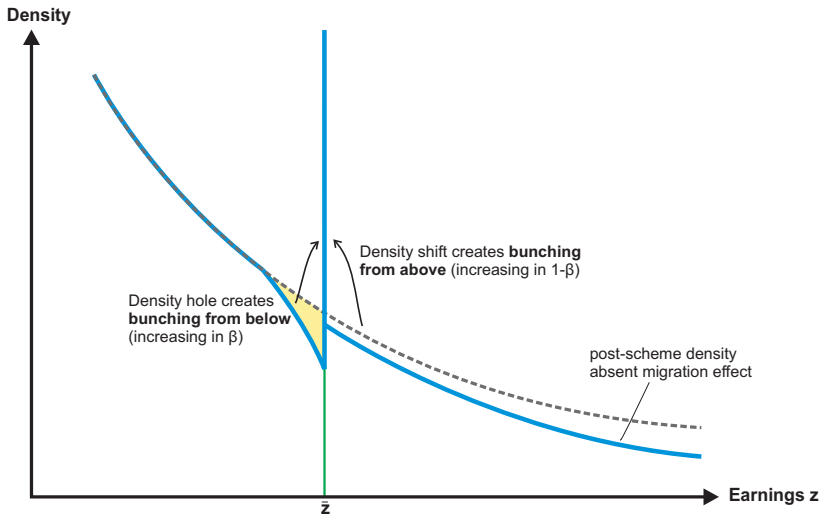
Panel A: Pre-Scheme Earnings Distribution for Foreigners



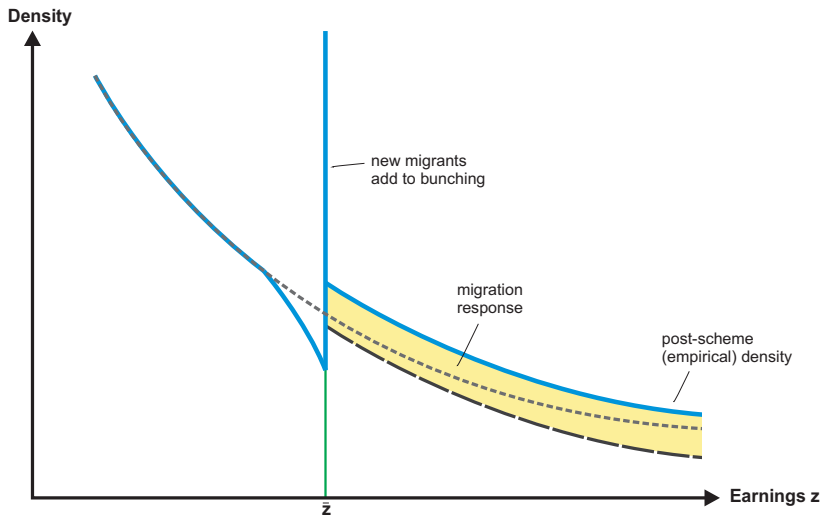
Panel B: Preferential Tax Scheme to High-Income Foreigners



Panel C: Intensive (Bargaining) Responses Conditional on Migration



Panel D: Intensive and Migration Responses



① Institutional background and data

② Theoretical framework

③ Migration Responses

Extensive Margin

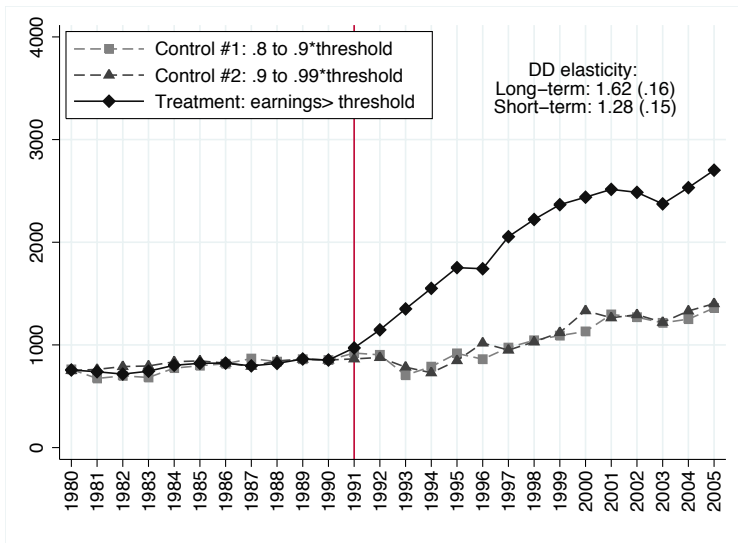
Duration

Policy implications

④ Incidence

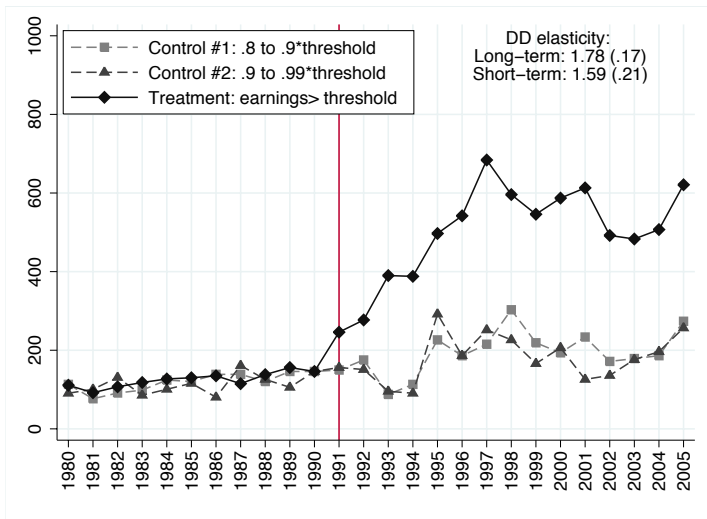
⑤ Spillovers

Figure 1 : Total number of foreigners in different income groups



Control 1= annualized income between .8 and .9 of threshold
Control 2= annualized income between .9 and .995 of threshold.

Figure 2 : Number of arrivals of foreigners in different income fractiles (1980-2005)

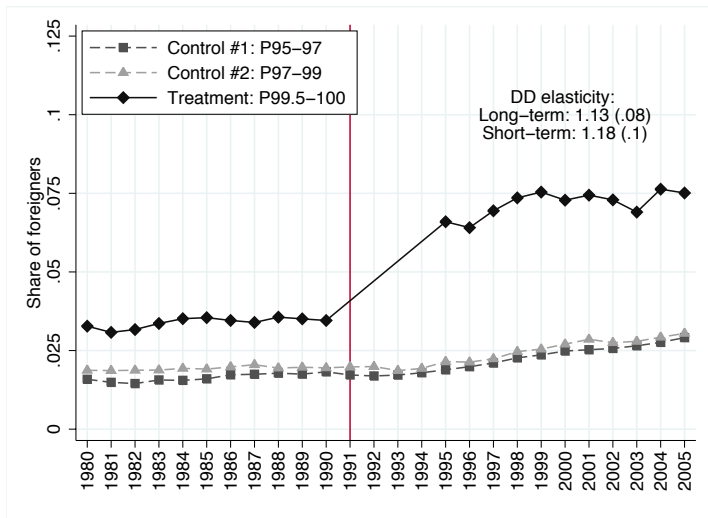


NOTE: All groups levels are adjusted to be equal in 1990 to the 1990 level for the treatment group.

Potential confounders

- DD identification assumption: parallel trend
- Confounder 1: **Fanning-out of income distribution**
 - ▶ High income increase faster than rest of the distribution
 - ▶ More foreigners cross the threshold \bar{z}
- Confounder 2: **Bunching from below** (Hole)
 - ▶ Bargaining with large β
 - ▶ Standard labor supply response

Figure 3 : Fraction of foreigners in different income fractiles (1980-2005)



Scheme threshold always between the 99.5th and the 99th percentile of the income distribution.

Figure 4 : Earnings Density for Foreigners

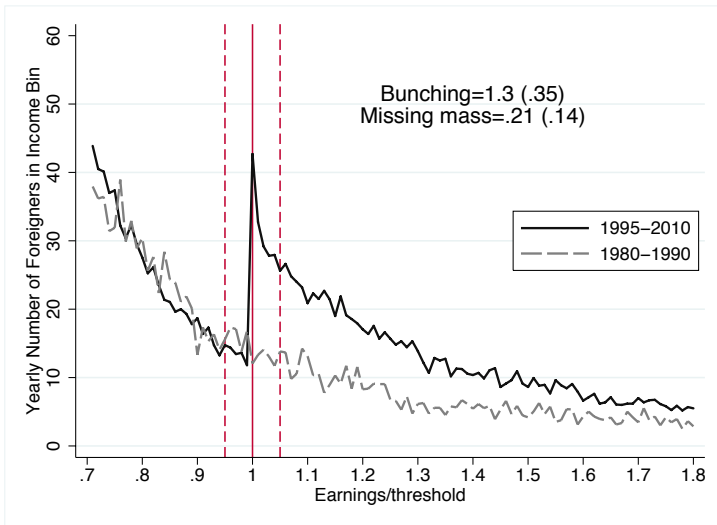


Table 2 : Migration Elasticity Estimates

	(1) Total number of foreigners	(2) Number of arrivals	(3) Number of foreigners with less than 3 years of presence
Treatment: Earnings above threshold, Control: Earnings between 80% and 99% of threshold			
<i><u>A1. Baseline</u></i>			
ε_{lt} (long-term)	1.625*** (0.162)	1.779*** (0.168)	2.049*** (0.148)
ε_{st} (short-term)	1.280*** (0.151)	1.590*** (0.228)	1.756*** (0.170)
<i><u>A2. Control for pre-existing trends</u></i>			
ε_{lt} (long-term)	1.756*** (0.176)	1.771*** (0.168)	2.152*** (0.158)
<i><u>A3. Placebo</u></i>			
ε_{lt} (long-term)	-0.0602 (0.0823)	-0.0101 (0.245)	0.0796 (0.161)
<i><u>A5. Nordic countries</u></i>			
ε_{lt} (long-term)	1.442*** (0.166)	1.805*** (0.287)	2.208*** (0.257)
<i><u>A6. English-speaking countries</u></i>			
ε_{lt} (long-term)	1.852*** (0.222)	2.186*** (0.246)	2.281*** (0.206)
<i><u>A7. Danish expatriates</u></i>			
ε_{lt} (long-term)	0.0185 (0.0280)	-0.0913 (0.0708)	-0.0998 (0.0613)

Figure 5 : Density of the Duration of Stay of Foreigners: 1980-1990

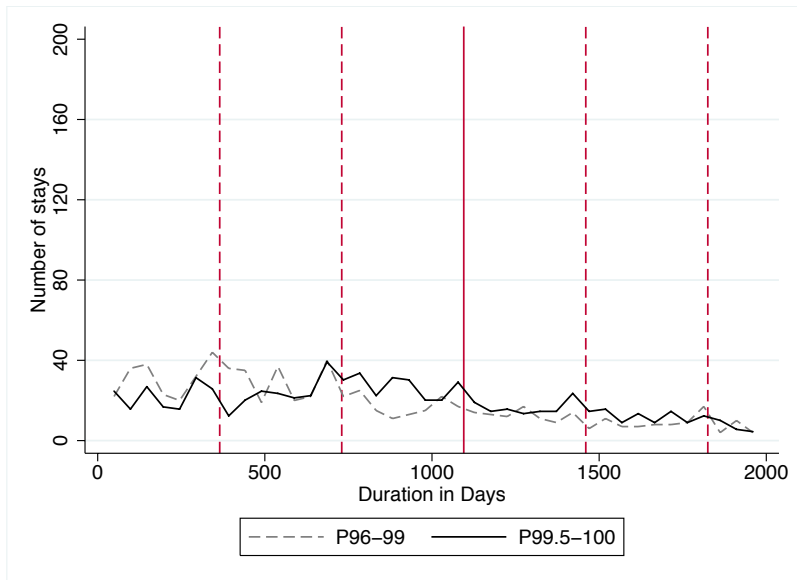
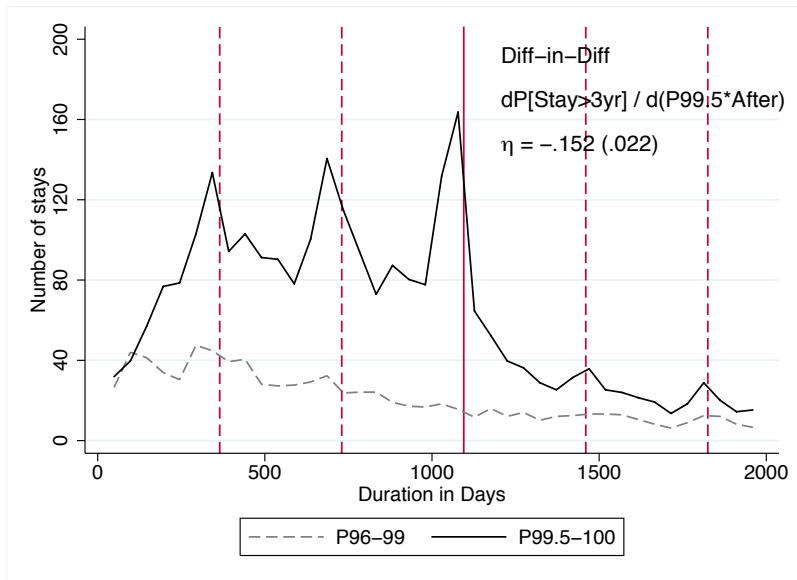


Figure 6 : Density of the Duration of Stay of Foreigners: 1991-2006



Policy implications

- Global elasticity from DD estimates:

$$e = \frac{1 - \tau}{N} \frac{\partial N}{\partial(1 - \tau)} \simeq 1.5$$

- Tax Revenue maximizing rate for foreigners in scheme:

$$\tau^* = 1/(1 + e) = 40\%$$

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Extensive Margin

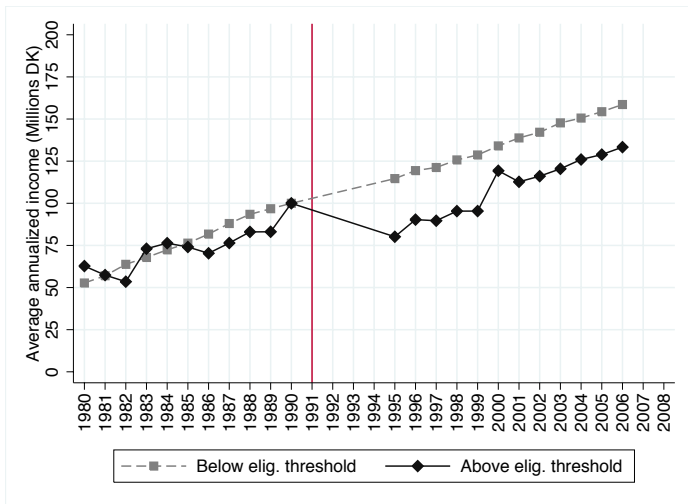
Duration

Policy implications

④ Incidence

⑤ Spillovers

Figure 7 : Effects of the Tax Scheme on Pre-tax Earnings: Repeated Cross-Section Evidence



Sample: all individuals arrived in Denmark staying less than 3 yrs, with gross earnings in year 1 between .7 and 4 times the eligibility threshold

Table 3 : Repeated Cross-section Estimates of the Effects of the Tax Scheme on Pre-tax Earnings

	(1)	(2)	(3) DD: Less than 3 years of presence	(4)	(5)	(6) DDD: More than 3 years as control
	<i>Grouped estimator</i>			<i>With bunchers</i>		
Reduced form estimate	-0.0476*** (0.0103)	-0.0476** (0.0138)	-0.0566*** (0.0117)	-0.130* (0.0535)	-0.0951*** (0.0103)	-0.0946*** (0.0205)
Elasticity $\frac{d \log z}{d \log(1-\tau)}$ estimate	-0.180*** (0.0371)	-0.180** (0.0498)	-0.171*** (0.0342)	-0.390* (0.156)	-0.296*** (0.0345)	-0.297*** (0.0604)
Industry, Age, Citizenship			×	×	×	×
Differential time trends				×		
<i>N</i>	18518	46	18518	18518	21245	22382

Notes: Robust standard errors clustered at the group \times year level in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. For year t , the sample includes foreigners who arrive during year $t - 1$, stay the full calendar year t in Denmark, and stay for a duration of less than 3 years in Denmark. The sample includes years 1980-2006 but excluding years 1991-1994 (data for years 1991-1994 are not available). The control group are foreigners with earnings between 70% and 95% of the scheme eligibility threshold while the treatment group are foreigners with earnings above 105% of the scheme eligibility threshold.

Empirical Test

- Previous graph potentially confounded by self-selection in the scheme
- More powerful test: migrants who stay 4+ years face increase from τ_S to τ_D in year 3
 - ▶ **Controls for individual f-e**
 - ▶ Under standard model: no change / decrease in z if standard labor supply response
 - ▶ Under bargaining model: increase in z

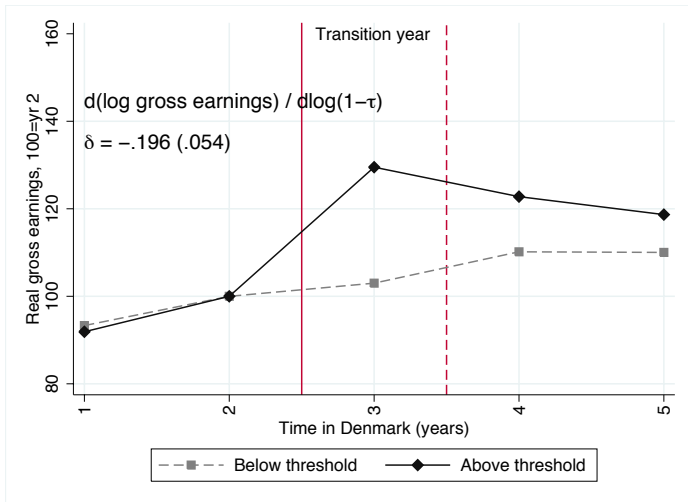
Empirical Test: Implementation

- Estimate for foreigners staying 4+ yrs DD individual f-e model:

$$z_{id} = \alpha_i + \sum_{d=0}^T \gamma_d + \delta(\mathbb{1}[z_{i,d=1} > \bar{z}] \cdot \mathbb{1}[d \geq 3]) + \varepsilon_{id}$$

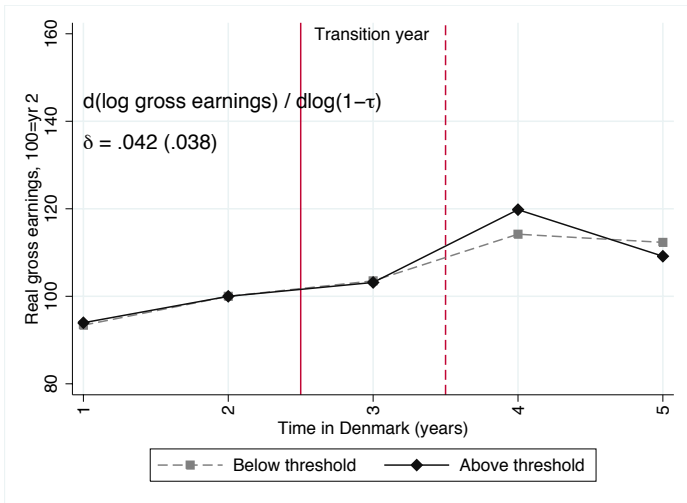
- ▶ d : year since arrival in Denmark
- ▶ $z_{i,d=1}$: earnings in year 1 in Denmark
- **Identifying assumption:** no unobservable correlated with both being in the scheme and earnings growth right in year 3
- Control groups:
 - ① Double-diff: migrants below scheme threshold
 - ② Triple-diff: migrants before reform

Figure 8 : Effects of the Tax Scheme on Pre-tax Earnings: Panel Evidence: After introduction of the scheme



Sample: all individuals arrived in Denmark between 1995 and 2002 and staying at least 4 yrs or more in Denmark, with gross earnings in year 1 between .7 and 1.5 of the eligibility threshold

Figure 9 : Effects of the Tax Scheme on Pre-tax Earnings: Panel Evidence: Before introduction of the scheme



Sample: all individuals arrived in Denmark between 1995 and 2002 and staying at least 4 yrs or more in Denmark, with gross earnings in year 1 between .7 and 1.5 of the eligibility threshold

Table 4 : Panel Estimates of the Effects of the Tax Scheme on Pre-tax Earnings

	(1)	(2)	(3)	(4)
	Treatment Entry after 1991		Placebo Entry 1980 to 1990	
	OLS (stayers only)	Heckman 2-step	OLS (stayers only)	Heckman 2-step
Reduced form estimate	0.0925*** (0.0256)	0.0829** (0.0265)	-0.0229 (0.0228)	0.0314 (0.0245)
Elasticity $\frac{d \log z}{d \log(1-\tau)}$ estimate	-.196*** (.054)	-.176** (.056)	.049 (.048)	-.067 (.052)
Exclusion restrictions:		Average tax rate in home country + citizenship		Average tax rate in home country + citizenship
<i>N</i>	2943	5616	2341	3508
λ		0.187 (0.0149)		0.152 (0.0162)
LR test of independence		$\chi^2 = 118.5$ Prob > $\chi^2 = .00$		$\chi^2 = 91.35$ Prob > $\chi^2 = .00$

Notes: Robust standard errors clustered at the individual level in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. All specifications are fixed-effects models on a balanced panel of stayers. Column (2) controls for potential selection on the earnings profile using the average tax rates in the home country at the time scheme elapses and citizenship dummies as exclusion restrictions in the selection equation for staying more than 3 years. λ is the estimated inverse Mills ratio.

Spillover effects of the scheme

- Potential effects of the scheme on native earnings distribution
 - ▶ **Productivity spillovers:** increase (?) in earnings
 - ▶ **Market level incidence:** decrease in equilibrium earnings / displacement of locals
- Scheme-induced influx of foreigners:
 - ▶ From 3.5 to 7.5% of top .5% of the income distribution
 - ▶ \approx 1.8 scheme foreigners in scheme firms vs 14 top natives
 - ▶ Small influx relative to total stock of high-skill natives
⇒ Cannot expect to find large spillover effects
- Investigate effect of scheme at industry and firm level
 - ▶ Instrument *a la Bartik* to control for endogeneity of scheme use

Figure 10 : Evidence on Spillovers Effects of the Scheme: Industry Level

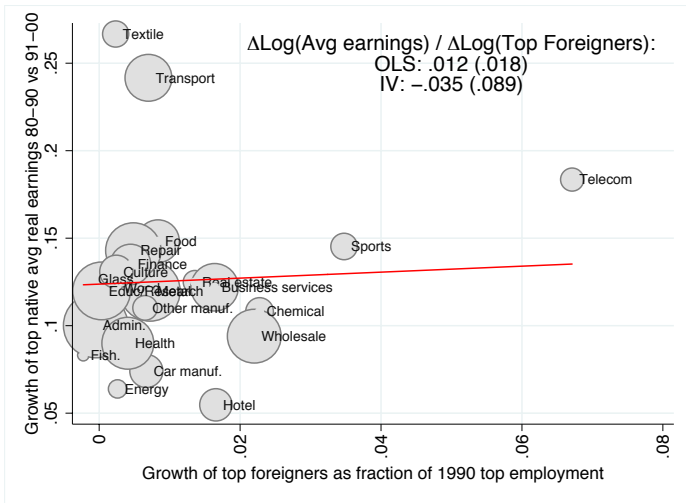


Table 5 : Regression-Based Estimates of Spillovers Effects of the Scheme: Industry Level

	(1)	(2)	(3)	(4)
	<i>Log average earnings of top non-scheme employees</i>		<i>Log number of top non-scheme employees</i>	
	OLS	IV	OLS	IV
$\frac{d \log y}{d \log(\text{Top foreigners})}$.012 (.018)	-.035 (.089)	.471 (.07)	.564 (.312)
<i>N</i>	27	27	27	27

Notes: Robust s.e. in parentheses. Top native employees are defined as employees with earnings above 75% of the scheme threshold (which corresponds roughly to the top 3% of the distribution of earnings among the natives.) Column (1) regresses the difference in log average real gross earnings of top native employees between 1980-1990 and 1991-2000 for each industry on the difference in the log number of top foreign employees (defined as foreigners with annualized earnings above the scheme eligibility threshold) by industry between 1980-1990 and 1991-2000. Column (2) instruments for the difference in log number of top foreign employees using the log initial number of top foreign employees by industry. Column (3) and (4) repeat the same specifications using the log number of top native employees as an outcome. All specifications control for the log initial size of the industry, and in column (1) and (2) for the log initial number of top employees in the industry

Figure 11 : Evidence on Spillovers Effects of the Scheme: Firm Level

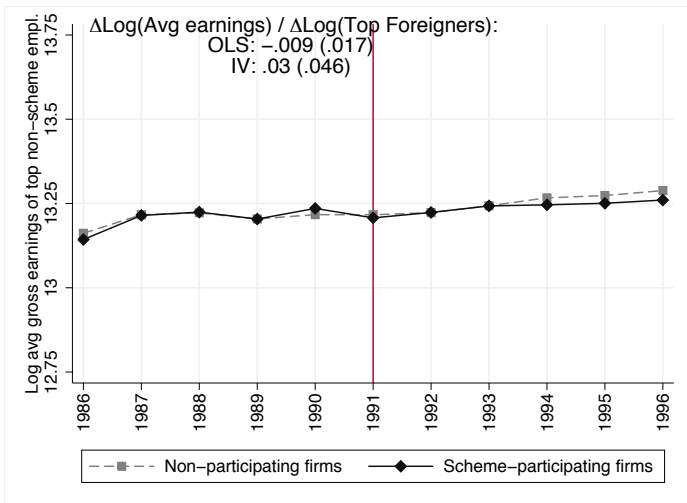


Table 6 : Regression-Based Estimates of Spillovers Effects of the Scheme: Firm Level

	(1)	(2)	(3)	(4)	(5)	(6)
	<i>Log average earnings of top non-scheme employees</i>			<i>Log number of top non-scheme employees</i>		
	OLS	Matching	IV	OLS	Matching	IV
Reduced form estimate	-0.002 (.013)	.018 (.017)	-.028 (.045)	.187 (.019)	.163 (.062)	-.006 (.051)
$\frac{d \log y}{d \log(\text{Top foreigners})}$	-0.009 (.017)	.036 (.033)	.03 (.046)	.573 (.022)	.32 (.122)	.012 (.104)
Post-estimation						
Durbin-Wu-Hausman test of endogeneity	$F(1, 2825) = 1.0799$ Prob > $F = .299$			$F(1, 26938) = 31.214$ Prob > $F = .00$		
Shea partial-R-square	.0941			.0446		
N	2852	2852	2852	26966	26966	26966

Notes: Robust s.e. in parentheses. Sample is a balanced panel of all firms active in Denmark in all years between 1986 and 1996. In columns (2) and (5), we present a matching estimator using the Mahalanobis distance based on the same controls as in the OLS regression. In columns (3) and (6), we instrument for scheme participation (reduced form) or for the difference in log number of top foreign employees using the log initial number of top foreign employees in the firm. All specifications control for firm size, industry, initial average earnings in the firm for all non-scheme employees and initial number of top earners.

Conclusions

■ Empirical findings:

- ① Identification of migration response to net-of-tax rate
- ② Negative effect of net-of-tax rate on gross earnings
- ③ Bunching above scheme threshold and no hole below
- ④ No evidence of massive spillover effects

■ Policy implications on migration:

- ▶ Elasticities potentially larger for small countries / tax base (Kanbur and Keen, 1993)
- ▶ Preferential tax schemes for skilled workers likely to generate severe tax competition in Europe

■ Theoretical implications for tax incidence:

Market-level incidence: competitive markets

Micro-level incidence: frictions and bargaining

BACK UP SLIDES

Figure 12 : Citizenship of Scheme Beneficiaries, 1991-2005

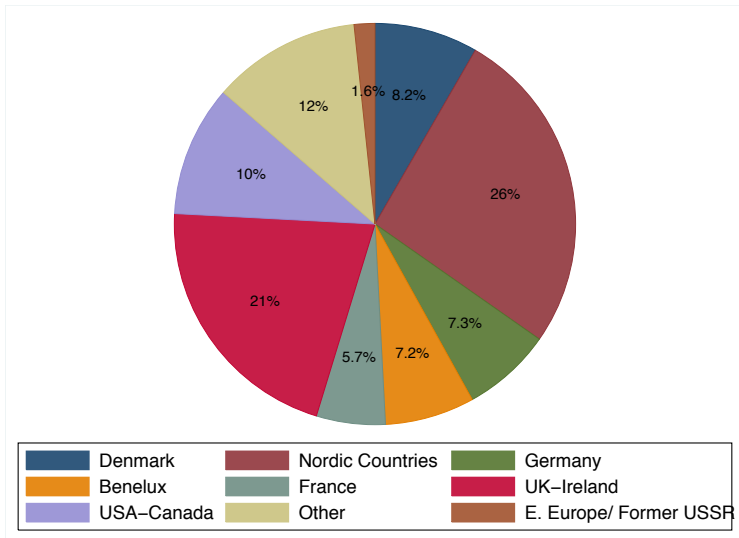


Figure 13 : Industry of Scheme Beneficiaries, 1991-2005

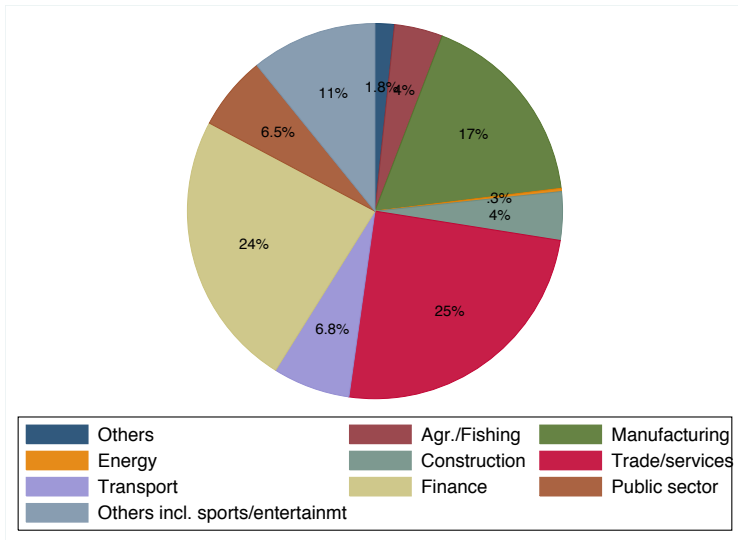
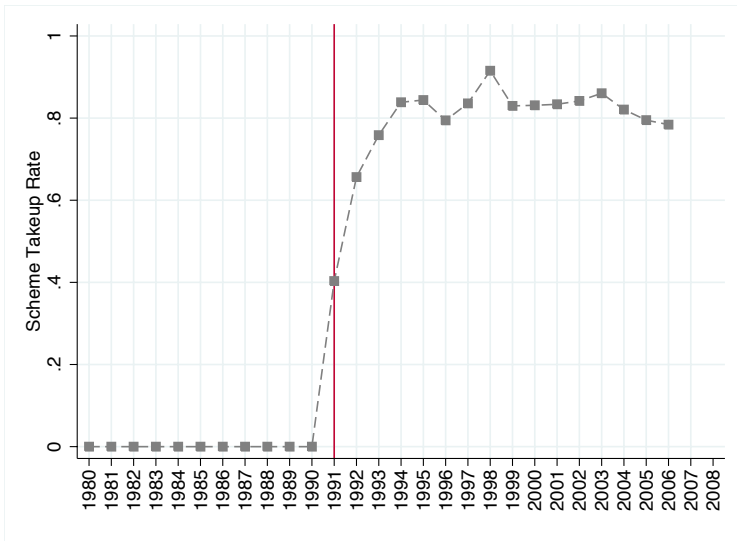


Figure 14 : Scheme Take-up rate for eligible foreigners upon arrival



Diff-in-Diff Estimation

$$\log N_{it} = \alpha_0 + \beta \cdot \mathbf{1}[i = 1] + \sum \gamma_t + e \cdot \log(1 - \tau_{it}) + \nu_{it},$$

■ Identification Assumption:

Absent the reform, number of foreigners has same trend in the control ($i = 0$) and treatment ($i = 1$) group

▶ Return

Specifications of bunching estimates

- Simple diff=Estimate models of the form:

$$c_j = \sum_{i=0}^p \alpha_i^- \cdot (z_j)^i + \sum_{i=0}^p \alpha_i^+ \cdot (z_j)^i \cdot \mathbb{1}[z > \bar{z}] + \sum_{i=l}^u \gamma_i \cdot \mathbb{1}[z_j = i] + \nu_j$$

where $[l, u]$ is the excluded range around the notch point

- Compute counterfactual distribution:

$$\hat{c}_j = \sum_{i=0}^p \hat{\alpha}_i^- \cdot (z_j)^i + \sum_{i=0}^p \hat{\alpha}_i^+ \cdot (z_j)^i \cdot \mathbb{1}[z > \bar{z}]$$

- Missing mass:

$$\hat{M} = \frac{\sum_{i=l}^{\bar{z}} (c_j - \hat{c}_j)}{\hat{c}_{\bar{z}}}$$

- Bunching:

$$\hat{B} = \frac{\sum_{i=\bar{z}}^u (\hat{c}_j - c_j)}{\hat{c}_{\bar{z}}}$$

Specifications (2): Diff-in-Diff bunching estimates

- Take advantage of counterfactual distribution prior to 1991:
- Estimate models of the form:

$$c_{j,t} = \underbrace{\sum_{i=0}^p \alpha_{i,t_1} \cdot (z_{j,t_1})^i}_{\text{baseline density before 1991}} + \underbrace{\alpha_{0,t_2}}_{\text{shift in the distribution over time}} + \sum_{i=0}^p \eta_{i,t_2} \cdot (z_{j,t_2})^i \cdot \mathbb{1}[z_{j,t_2} > \bar{z}] + \sum_{i=l}^u \gamma_i \cdot \mathbb{1}[z_{j,t_2} = i] + \nu_{jt} \quad (1)$$

- $t = t_1$ is before, and $t = t_2$ is after the scheme was introduced
- $[l, u]$ is the excluded range around the notch point

▶ Return