Do Commuting Subsidies Drive Workers to Better Firms?

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NBER SI 2024

Motivation: Commuting is Important!

- Despite the negative externalities of commuting (congestion and environmental impacts), many governments around the world subsidize commuting at substantial fiscal cost.
  - Presumably policymakers aim to improve other outcomes in local labor markets (e.g., help low income households in rural areas)

- Neglected aspect: Commuting subsidies expand the choice set of workers in a way that facilitates a match with a "better quality" employer
  - Particular relevant when labor markets have frictions and low residential mobility
  - Our paper sheds light on local labor market sorting and assortative matching

Challenges and Contribution

- Key question: How do commuting subsidies causally affect commuting distance and through this workers' earnings and the quality of the firm?
- This paper studies commuting subsidies in Germany
  - quasi-natural experiment: large reforms of tax deductibility of commuting expenses
  - deductible price of commuting changes over time in a way that its value depending on worker's marginal tax rate (income) and commuting distance
  - rich data: geocoded information on residence and employment, as well as labor market data including worker and firm (wage) quality
- We provide the first causal estimates of the elasticity of commute distance on AKM firm effects.

Literature: Taxes and Commuting

1. Commuting - wage elasticity
   - Manning (2003), Mulalic et al (2014), Dauth and Haller (2020) => no subsidies
2. Commuting and labor markets
   - Abowd et al (1999, 2003); Schmutte 2014; Dauth et al (2022) => assortative matching
   - Fackler et al (2021), Schmieder et al (2023), Bertheau et al (2023) => 50 - 70% of wage change due to firm FE, but use job separations to identify
3. Commuting and spatial mismatch
   - Card, Rothstein and Yi (2024) => geographic distribution of workers/jobs and access to firms with higher earnings premiums
4. Commuting subsidies and taxes
   - Heuermann et al. (2017), Paetzold (2019) => incidence effects on wages and distances affected, only at low level income level
   - Wildasin (1985), Agrawal and Hoyt (2019) => effect of income taxes on commuting time (via opportunity costs of time)

Our Approach in a Nutshell

- Take 50% random sample of the universe of German workers who change jobs 2003-2015
- Exploit tax reforms to "commuting price" in 2004, 2007, 2009
- Calculate person-specific measure of tax changes using tax calculator
- Estimate how commuter subsidies affect distance to workplace using simulated instrument
- Estimate how changes in distance affects wages and firm quality using AKM decomposition
- Determine how these effects vary by gender and over the person-component of wages.

Preview Results

1. A decrease in taxes by 100 Euro (i.e., more generous commuting deduction) increases commuting distance by 2.4 kilometer (or 11% at the mean commute)

2. Increases in distance raise wages by 172 Euro per year or 0.45%

3. More generous commuting subsidy induces workers to switch to better firms that pay 0.29% higher wages overall (AKM firm effect)
   - "better" firm component explains 65% of earnings increase!

4. Elasticity of firm component of wages with respect to distance is 0.025, similar to the observational estimates from Card et al (2024).

5. Commuting subsidies reinforce assortative matching
   - effect increases almost monotonically in deciles of the person-specific wage component, which contributes to increased earnings inequality

Outline

- Theoretical model and results (briefly)
- Institutional background, tax calculator
- Data and empirical strategy
- Results
  - Distance, Earnings, AKM
  - Assortativity changes

Model: Motivation

- Standard spatial models, such as the monocentric city, assume that households optimize by changing residential location but still commute to the same firm downtown.

- But job changes are more frequent than residential relocations.
  - Individuals moving from one city to another in past 5 years is less than 5% in Germany (Esipova et al., 2013)
  - 86% of people in Germany who change jobs keep the same residence!

Sketch of Theoretical Model

- Fixed residential location, two different job locations $i = 1, 2$ that workers can choose from
- Trade off: further job distance, $d_2 > d_1 \geq 0$, has more productive firm, $\psi_2 > \psi_1$
- Wage

$$w = \alpha\psi$$

- Workers differ in ability $\alpha \in [\underline{\alpha}, \overline{\alpha}]$ and commuting cost ud, $u \in [\underline{u}, \bar{u}]$
- Commuting is costly, but tax deductible. After-tax consumption y_i is

$$y_i = w - ud_i - T(z_i) = \alpha\psi_i - ud_i - T(\alpha\psi_i - cd_i).$$

- Workers choose work location that gives highest after-tax consumption

Results

Under mild conditions on the convexity of the tax function and the distribution function of commuting costs $f(u)$:

1. *(Subsidies and Commuting) Larger commuting subsidies induce more long distance commuting, and the effect is larger for higher ability types.*

2. *(Subsidies and Assortative Matching) A rise in commuting subsidies increases assortative matching, i.e. average ability of workers at the more (less) productive firm goes up (down).*

3. (Subsidies and Market Power) *A rise in commuting subsidy c raises raises the wage at both locations but more so at the closer location.*

Institutional Background

- Work related expenses deductible, two options
  - lump sum deductible S (around 1000 Euro) or
  - itemized deductions $R = C + D$ for commuting C and other purposes D
- Commuting deduction = (commuting days n) x (distance d) x ("price" p)

$$C = ndp$$

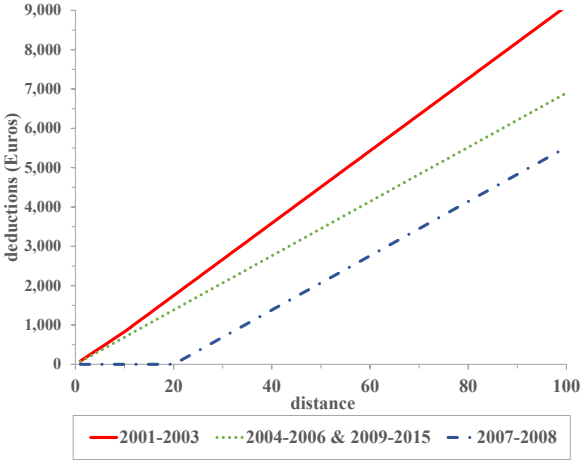
- Deductions sizable in Germany: $C \sim$21 billion Euros in 2011 (gross wages 931 billion; total work related deductions 36 billion)

Reforms of Commuting Deductibility ("Commuting Price")

Table 1: Commuting Deduction Reforms

	$d \leq 10$	$10 < d \leq 20$	$d > 20$
2001-2003	$0.36nd$	$3.6n + 0.4(d-10)n$	$3.6n + 0.4(d-10)n$
2004-2006	$0.3nd$	$0.3nd$	$0.3nd$
2007-2008	0	0	$0.3n(d-20)$
2009-2015	$0.3nd$	$0.3nd$	$0.3nd$

Graph of Commuting Deduction Reforms



- Example: d=20km, z=25.000 Euros, MTR=0.3: 2007 reform raises taxes by 372 Euros

Tax Calculator (similar to NBER TAXSIM)

- Tax calculator accounts for commuting expenses (C), other deductible expenses (D), basic allowance (S), and MTR schedule
  - Taxable income $z = m - max\{C + D, S\}$
  - Tax function $T_t(z_{it}) = T_t(m_{it}, c(d_{it}, p_{it}), S_t, D_{it})$
- Code key provisions of German tax law from 2002-2015
- Construct a simulated measure of tax changes $\Delta\overline{tax_{it}}$ that exploits variation in the tax code due to commuting reforms only (constant wages and distances at old job, constant MTR and S)

$$\triangle\overline{tax_{it}} = \triangle\overline{T}(\overline{m_i}, c(\overline{d_i}, p_{it}), \overline{S}, \overline{D_i}) \quad (1)$$

- Assume various other deductible schemes for (unobservable) D using aggregate data by income bins

Estimating the Effect of Subsidies

- First stage: Estimate the effect of commuting subsidies on distance

$$\triangle \ln d_{it} = \beta_1 \triangle \overline{tax_{it}} + X_i\theta + \zeta_t + \zeta_c + \varepsilon_{it}$$

- Second Stage: Estimate the effect of commuting subsidies on job quality

$$\triangle lnw_{it} = \beta_2 \triangle \ln d_{it} + X_i\theta + \zeta_t + \zeta_c + \varepsilon_{it}$$

$$\triangle \psi^{AKM}_{f(it)} = \beta_3 \triangle \ln d_{it} + X_i\theta + \zeta_t + \zeta_c + \varepsilon_{it}$$

- We instrument $\triangle \ln d_{it}$ with $\triangle \overline{tax_{it}}$ to see how a change in distance, induced only by variation in commuting deduction changes, affects workers job quality

AKM-Effects: Workers and Firms Decomposition

- To capture heterogeneity by workers and firms, we use the firm and worker wage effects of a fixed-effects wage decomposition suggested by Abowd, Kramarz and Margolis (1999)

$$w_{it} = \alpha_i + \psi_{f(i,t)} + \beta x_{it} + u_{it}$$

  - α_i: worker i's time-invariant wage premium across firms
  - $\psi_{f(i,t)}$: wage premium enjoyed by every worker employed at firm f
  - βx_{it}: worker i's time-variant characteristics (human capital)
  - u_{it}: idiosyncratic log wage component

Instrument Validity

- Relevance: Changes in the price of commuting will be a strong predictor of distance travelled.
- Validity: The instrument relies on largerly unexpected tax reforms. Not based on responses to the reform.
  - Person-specific variation comes from lagged variation in distance travelled and income (progressivity).
  - Average job tenure is aprox 10 years, implies lags were determined more than 1 year in past.
- Use of simulated tax instruments shares similarities with the elasticity of taxable income literature.
  - Given the relatively long tenure in jobs, using longer lags of distance (as in Weber 2014) leaves instrument unchanged.

Issue 1: Mechanical correlation via instrument

- Simulated tax instruments rely on lagged characteristics, that may introduce a mechanical correlation with the outcome variable even if no relationship truly exists.
- Our solution: conduct placebo estimations by dropping all individuals who change jobs in reform years. We then take untreated individuals, randomly assign them a reform year, recalculate their implied tax change in that year (given their income and distance from non-reform year); repeat this by doing 500 randomizations and regressions.
- Estimated coefficient then determines the mechanical bias in our coefficients, which we estimate to be less than 30 %.
  - The entire distribution of the placebo estimates is well outside our actually estimated effects
  - Adjusting for this bias would still yield effects that are economically meaningful and statistically significant.

Issue 2: Selection

- Our paper conditions on the sample of job switchers, potentially raising issues with respect to whether the policy induced individuals to change jobs.
- Selection bias likely most apparent in our first stage, but less so in the second stage as non-switchers have changes in distance and changes in plant AKM's that are both zero.

Data

- Integrated Employment Biographies (IEB) and IEB GEO from IAB
  - longitudinal information on plants and workers' job duration, separations, hirings, daily wages (deflated), and socio-economic characteristics of workers
  - 50% of universe of wage and salary workers changing jobs but not residence
  - commuting driving distance in km / minutes
  - imputed wages above social security contribution ceiling
- Sample Selection
  - full time workers aged 18-60
  - maximum commuting distance 100 km
  - change jobs within 31 days

Initial Evidence: Effect of Distance on Job (Wage) Quality

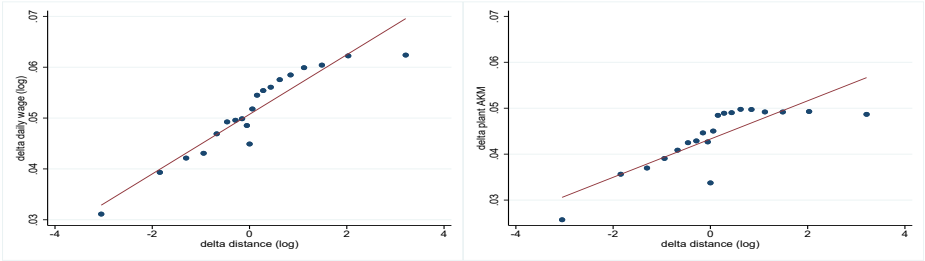


Figure 1: a) Daily wages (log), b) Plant AKM

More Generous Commuting Subsidies Increase Distance

	(1)	(2)	(3)	(4)	(5)
			Panel A: Effect on Distance		
$\triangle \overline{tax_{it}}$ (hundreds)		-0.1139***	-0.1139***	-0.1141***	-0.1155***
		(0.0037)	(0.0037)	(0.0037)	(0.0038)
Observations	2,575,724	2,575,724	2,575,724	2,575,724	2,575,724
OLS or IV (Panel B/C)	OLS	IV	IV	IV	IV
Year FE	Y	Y	Y	Y	Y
LMR FE	N	N	Y	Y	Y
Worker controls	N	N	N	Y	Y
Person AKM	N	N	N	N	Y

Magnitudes

- Distance effect of -0.114
  - A 100 Euro decrease in taxes (resulting from a increase in generosity of commuting deduction) increases distances by 11%.
  - At the mean pre-reform commute, this is a 2.4 km increase.
  - Note: 100 Euro change is approximately 0.5 std dev change.
- Comparison to Paetzold 2019 (100 Euro change => 1.6 km increase), only a local effect at the 11,000 Euro tax bracket, switchers and non-switchers

Longer Commutes Raise Wages

	(1)	(2)	(3)	(4)	(5)
			Panel B: Effect on Wages		
$\triangle \ln d_{it}$	0.0062***	0.0452***	0.0448***	0.0394***	0.0325***
	(0.0003)	(-0.0028)	(0.0027)	(0.0024)	(0.0023)
F-stat		928.342	948.677	969.853	942.493
Observations	2,575,724	2,575,724	2,575,724	2,575,724	2,575,724
OLS or IV (Panel B/C)	OLS	IV	IV	IV	IV
Year FE	Y	Y	Y	Y	Y
LMR FE	N	N	Y	Y	Y
Worker controls	N	N	N	Y	Y
Person AKM	N	N	N	N	Y

Magnitudes

- Wage effect
  - A 1% increase in distance increases the real wage by 0.04%
  - More generous commuting deduction, lower taxes, increases commuting distance, raising the wage.
  - Note: At the mean a 100 Euro change in taxes raises earnings 172 Euros annually

Longer Commutes Induce Workers to Switch to Better (Paying) Firms

	(1)	(2)	(3)	(4)	(5)
			Panel C: Effect on Plant AKM		
$\triangle \ln d_{it}$	0.0046***	0.0312***	0.0303***	0.0258***	0.0200***
	(0.0003)	(0.0021)	(0.0021)	(0.0020)	(0.0019)
F-stat		928.342	948.677	969.853	942.493
Observations	2,575,724	2,575,724	2,575,724	2,575,724	2,575,724
OLS or IV (Panel B/C)	OLS	IV	IV	IV	IV
Year FE	Y	Y	Y	Y	Y
LMR FE	N	N	Y	Y	Y
Worker controls	N	N	N	Y	Y
Person AKM	N	N	N	N	Y

Magnitudes

- Plant AKM effect: firm-specific wage premium
  - A 1% increase in distance increases the plant component of the wage by 0.03%
  - Note: At the mean a 100 Euro change in taxes raises plant AKM 0.29%

- Most people actually move very little through the plant effect distribution over time.
  - However, we find that the percent change in plant quality is 65% (0.0258/0.0394) of the percent increase in earnings.
  - Plant effect in job displacements: Schmieder, von Wachter and Heining (2023) — 70%; Bertheau et al. (2023) — 35% to 100%; Woodcock (2008) — 60%; Lachowska, Mas and Woodbury (2020) — 15%

Causal Effect of Distance on Plant-Component

- Ours is the first causal estimate of the effect of commute distances on the workplace pay premiums.
  - Estimates are similar to the observational estimates (0.02 to 0.03) of Card, Rothstein, Yi (2024)

- Job proximity is an important determinant of the ability to work at "good" jobs, as measured by the employer pay premium
- Confirms the intuition in Card, Rothstein, Yi (2024) that individuals with relatively short commuting distances will have lower firm-specific pay premiums.

Heterogeneity: Effect on Wage Components

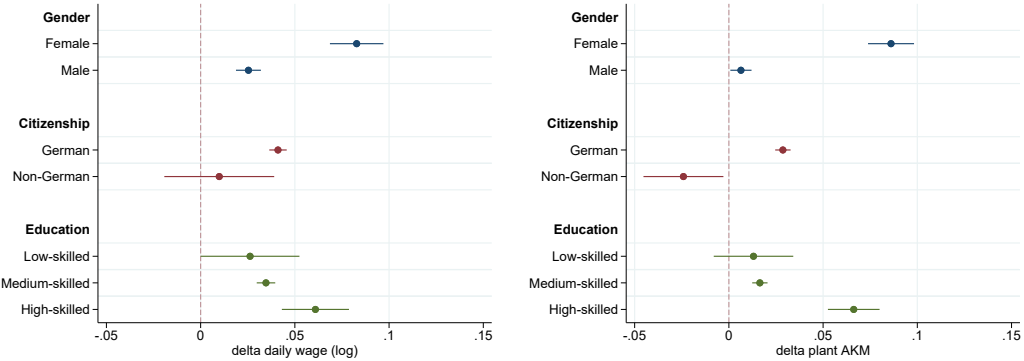


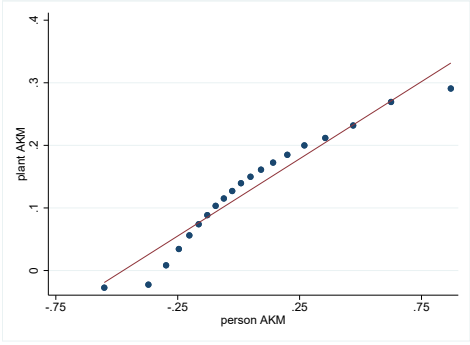
Figure 2: Daily wages (left) - Firm AKM (right)

Interpretation

- Key differences by gender
  - Le Barbanchon, Rathelot, and Roulet (2021) show that gender differences in willingness to commute can explain a large part of the the gender wage gap in France.
  - Mulalic, van Ommeren and Borghorst (2022) show that women with children are more likely to leave their job when they have a long commute and these women are less likely to be compensated for commuting than males.
  - Caldwell and Danieli (2022) find that a larger "outside option set" leads to higher wages, and lower outside options of women explain about 20% of gender wage gap in Germany.

Assortativity

- Descriptive evidence on assortative matching



- Estimate the effect of commuting subsidies over the person-specific distribution:

$$\triangle \psi^{AKM}_{f(it)} = \gamma_q 1^{PE}_q + \beta_{3,q} 1^{PE}_q \times \triangle \ln d_{it} + X_i\theta + \zeta_t + \zeta_c + \varepsilon_{it} \quad (2)$$

Assortativity by Deciles of Person Fixed effects: Earnings and Firm Effect

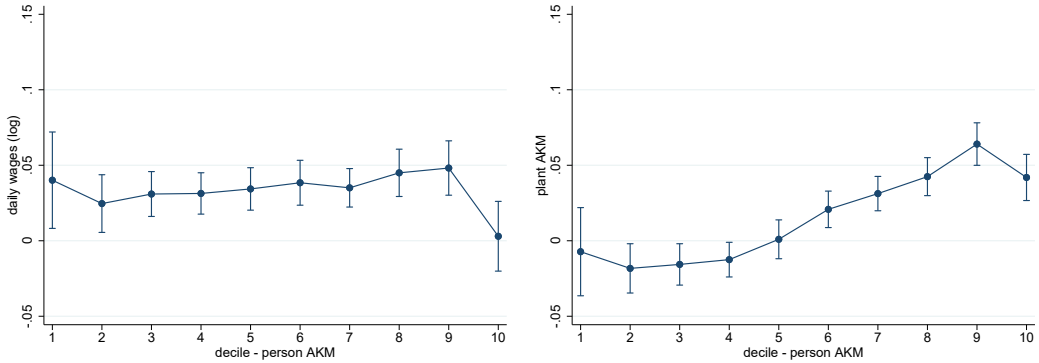


Figure 3: Daily wages (left) - Firm AKM (right)

Interpretation

- A one-percent increase in distance induced by the commuting subsidy has a larger positive effect on the plant-specific component when a high "ability" worker moves
- Commuting subsidies induce high-ability individuals to move up the firm (wage) quality distribution more so than lower-ability individuals, which reinforces positive assortative matching.
- Estimates in the top two deciles are statistically different from those in the second and third deciles from the bottom of the person-specific wage distribution.
- For individuals at the very top of the person-specific wage distribution, their percent movement up in the plant-specific wage distribution is larger than the percent increase in their earnings.

Interpretation II

- However, some of this might be undercut by the fact that the first-stage responses differ.
- 100 Euro decrease in taxes paid due to a more generous commuting deduction increase commuting distance by 3.28 kilometers for lower ability workers and 2.49 kilometers for high ability workers
- A more generous commuting deduction that saves 100 Euros of taxes lowers the plant AKM by 0.104% for individuals in the second decile but raises the plant AKM by 0.616% for individuals in the ninth decile.
- Thus the difference in the mean plant AKM of the deciles of the ability distribution widens.

Robustness

- Heterogeneity by occupation, industry, and task
- Alternative maximum distances to workplace
- Alternative deduction schemes, varying D
- Leave-one-out connected set, limited mobility bias

Conclusion: Commuting Subsidies Are Important, But Not in the Way Policymakers Expected

- Commuting subsidies enhances the geographic scope of job search.
- The larger geographic scope of job search raises wages by 172 Euros per year on average.
- More generous commuting subsidies allow workers to move to firms with a higher wage policy (0.29%); firm effect explains 65% of earnings increase.
- Results indicate that high wage workers benefit most from the subsidy
- Commuting subsidy reinforces positive assortative matching for high-ability workers to high paying firms, increasing inequality.
- Overall welfare effects are likely not large or possibly even negative.

Backup slides

Summary Statistics

	Mean	SD
Male	0.704	0.456
Foreign	0.071	0.258
Age (years)	37.701	9.786
Medium-skilled	0.752	0.432
High-skilled	0.206	0.404
Drive distance to new job	21.964	20.160
Drive distance to old job	20.914	19.769
Daily wage (new job real imputed in Euro)	108.688	52.727
Daily wage (old job real imputed in Euro)	104.755	54.546
AKM plant fixed effect new job	0.172	0.204
AKM plant fixed effect old job	0.128	0.218
AKM person fixed effect	0.047	0.341
Change in subsidy in 100 Euro (abs. values reform periods)	2.738	2.063
Observations	2,575,724	

Instrument: Mechanical correlation

- in 2007 negative correlation:

$$lnd_{i,2007} - lnd_{i,2006} = \beta_1[T(m_{i,2006} - 0) - T(m_{i,2006} - 0.3nd_{2006})] + X_i\theta + \zeta_{2007} + \zeta_c + \varepsilon_{i,2007}$$

- in 2009 positive correlation:

$$lnd_{i,2009} - lnd_{i,2008} = \beta_1[T(m_{i,2008} - 0.3nd_{2008}) - T(m_{i,2008} - 0)] + X_i\theta + \zeta_{2009} + \zeta_c + \varepsilon_{i,2009}$$

Moving to a Better Firm is Increasing in Worker "Ability"

- Basic approach: changes in firm component of wages on person component and interaction in distance changes induced by subsidy (IV)

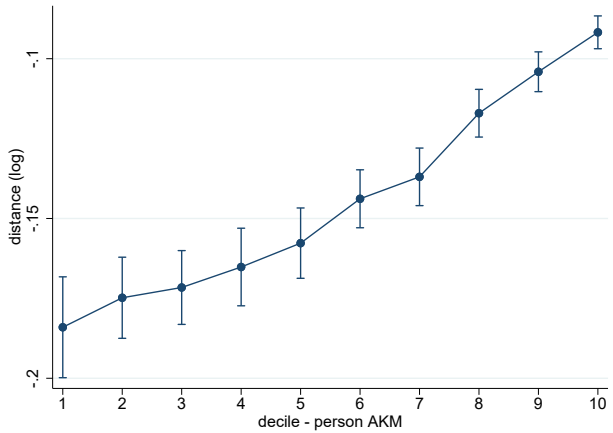
$$\triangle \psi_{f(it)}^{AKM} = \gamma_1 \alpha_i^{PE} + \gamma_2 \alpha_i^{PE} \times \triangle \ln d_{it} + X_i \theta + \zeta_t + \zeta_c + \varepsilon_i \quad (3)$$

	(1)	(2)	(3)	(4)
γ_1	-0.0564***	-0.0610***	-0.0612***	-0.0623***
	(0.0013)	(0.0019)	(0.0019)	(0.0016)
γ_2	0.0008	0.0590***	0.0563***	0.0534***
	(0.0007)	(0.0106)	(0.0104)	(0.0103)
F-stat		392.308	392.370	388.692
Observations	2,409,738	2,409,738	2,409,738	2,409,738
OLS or IV	OLS	IV	IV	IV
Year FE	Y	Y	Y	Y
LMR FE	N	N	Y	Y
Worker controls	N	N	N	Y

Interpretation

- There is a clear positive assortativity in the levels of person and plant AKM's
- But in our regression, the (base) *change* is negative:
  - Intuitively, as the change in distance to work become very small, the ability to find another high-quality plant with the same commuting costs declines substantially as the ability of the worker increases.
  - Mean reversion
- The interaction term is positive however:
  - moving to a better paying employer is increasing in the worker-specific component of wages as distance to work increases due to commuting subsidy generosity.

Assortivity by Deciles of Person Fixed Effects: Distance



Placebo Test