

# Offshoring, Firm Performance and **KOF** Establishment-level Employment – Identifying Productivity and Downsizing Effects

Christoph Moser – ETH Zurich

Dieter Urban – RWTH Aachen and CESifo

Beatrice Weder di Mauro – University of Mainz and CEPR

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**ETH**

Eidgenössische Technische Hochschule Zürich  
 Swiss Federal Institute of Technology Zurich

# Agenda

- Motivation
- Literature review
- Data set
- Empirical strategy and results
- Discussion

## Motivation (I)

- The perception of job insecurity widespread.
- 51 percent of electorate in Germany fears that more jobs are lost than won due to free trade (German Marshall Fund of the United States, 2006).
- „There is little hard evidence of the extent of international outsourcing and offshoring, despite widespread media attention.“ (OECD, 2005).

## Motivation (II)

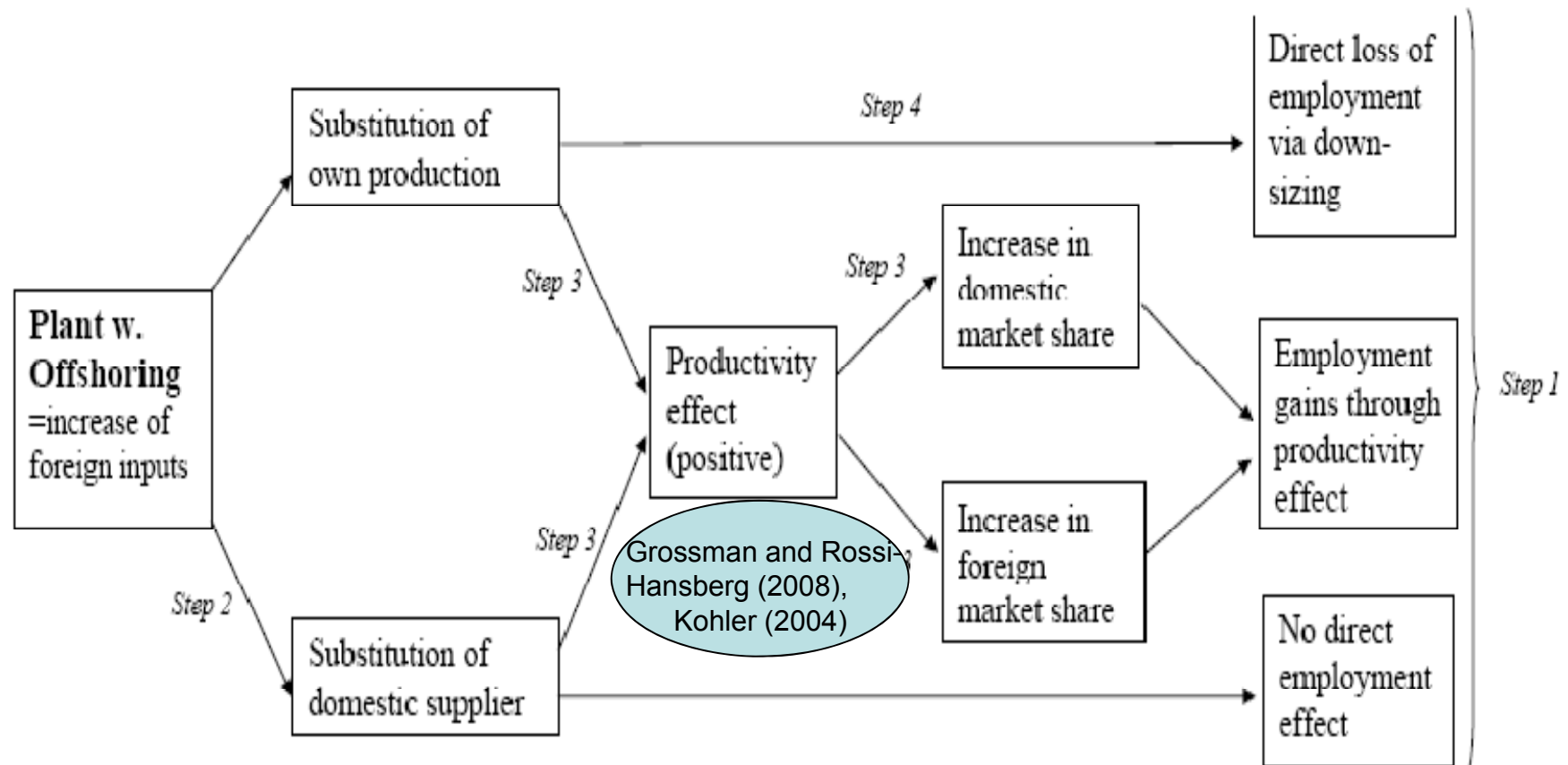
		control	
		<i>inhouse</i>	<i>arms-length</i>
location	<i>domestic</i>	Domestic production	National Outsourcing
	<i>foreign</i>	Vertical FDI	International Outsourcing

- ***International outsourcing***: importing intermediate inputs from foreign firm.
- ***Vertical FDI***: importing intermediate inputs from own foreign affiliate abroad.
- ***Offshoring***: international outsourcing or vertical FDI (Helpman, 2006; Blinder, 2007; Olsen, 2006).

## Theoretical Concept (I)

- ***Offshoring on aggregate data (Feenstra and Hanson, 1996, 1999):***
  - Increase of intermediate goods imported from abroad within an industry (narrow industry measure of offshoring).
  - Increase of intermediate inputs imported from all industries abroad (broad measure of offshoring).
- ***Offshoring on establishment data from IAB:***
  - (Qualitative) increase of intermediate goods imported from abroad by an establishment.

## Theoretical Concept (II)



## Theoretical Concept (III)

**Table 1: Steps of Empirical Analysis**

*First step: Identification of employment effect*

Offshoring<sub>i</sub> → Δ Employment<sub>i</sub>

*Second step: Finding prevalent channel*

Offshoring<sub>i</sub> → Δ Intermediate\_Inputs<sub>i</sub>

*Third step: Identification of productivity effect*

Offshoring<sub>i</sub> → Δ Productivity<sub>i</sub>

Offshoring<sub>i</sub> → Δ Sales<sub>i</sub>

Offshoring<sub>i</sub> → Δ Exports<sub>i</sub>

*Fourth step: Identification of direct employment effect via downsizing*

Offshoring\_cum\_Restructuring<sub>i</sub> → Δ Employment<sub>i</sub>

Notes: Indices are plants *i* at time *t*. → is causality relation; Δ is time difference operator;

## Main Findings and Contributions

- Positive offshoring effect, since offshoring *causes* higher employment in firms that offshore relative to those that abstain from doing so.
  - Difference-in-Differences matching estimator.
  - Indication for *substitution effect* of domestic intermediate good suppliers by foreign ones.
  - Evidence for *productivity effect*: offshoring plants increase average productivity and gain domestic and foreign market share (Grossman and Rossi-Hansberg, 2008).
  - Negative employment effect if offshoring and restructuring occur simultaneously (*downsizing effect*).
- Paper seeks to carefully distinguish between different channels that determine the employment effect.

## Literature Review (I)

- ***Offshoring and labor market outcomes:***
  - *Aggregate data:* Feenstra and Hanson (1996, 1999), Egger and Egger (2003, 2005), Hsieh and Woo (2005), Hijzen, Görg and Hines (2005).
  - *Micro-macro data:* Geishecker (2006, 2008), Geishecker and Görg (2008), Geishecker, Görg and Munch (2007), Egger, Pfaffermayr and Weber (2003), Marin (2006), Munch and Skaksen (2005), Buch and Lipponer (2007), Buch et al. (2007), Munch (2008).
  - *Micro-micro data:* Becker and Muendler (2008), Sethupathy (2009), Biscourp and Kramarz (2007), Debaere, Lee and Lee (2009).

## Literature Review (II)

- ***Main caveat:***

- Firm- or plant-level measures of offshoring very rare.
- Hence, such studies can only state:  
„firms (employees) in sectors that are more inclined to offshoring have more/less employment (job security), sales, exports, etc.“
  - ➔ cannot be interpreted as causal effect of offshoring.

## Literature Review (III)

- ***Becker and Muendler (2008):***
  - Data set:
    - Employer-employee matched data from Germany.
    - Social-security records of the German Federal Labor Agency.
    - Micro database Direct Investment of Deutsche Bundesbank.
    - MARKUS database of Verband der Vereine Creditreform.
  - „Vertical FDI“ measure:
    - FDI expansion defined as an increase in employment in a company's foreign affiliates.
  - Estimation method:
    - Propensity-score matching.
  - Surprising result:
    - FDI expansion makes worker separation less likely at multinational enterprises' home plants compared to domestic competitors without FDI expansion.

## Literature review (IV)

### ■ ***Main criticism:***

- Expansion of employment abroad for reasons other than offshoring:
  - Positive demand shock.
  - Expansion of employment abroad and at home.
  - Hence, less job separation not necessarily induced by offshoring.
- No *direct* measure of offshoring, but rather rough proxy for vertical FDI.

## Literature Review (V)

- ***International offshoring and firm performance (productivity):***

- Görg and Hanley (2004), Egger and Egger (2006), OECD (2006), Moser and Urban (2007), Hijzen, Inui and Todo (2007), Görg, Hanley and Strobl (2008), Jabbour (2010), Farinas and Martin-Marcos (2010).

- ***Propensity score matching:***

- Rosenbaum and Rubin (1983, 1985), Blundell and Costa Dias (2000), Imbens (2002), Lechner (2002), Leuven and Sianesi (2003), Black and Smith (2004), Dehejia (2005), Smith and Todd (2005), Caliendo and Kopeinig (2008), Abadie and Imbens (2008).

## Dataset

### ■ ***Main data source IAB establishment panel:***

- Institute for Employment Research of German Labor Agency.
- Representative, stratified sample of German establishments of all sectors included in the employment statistics register from 1993 to 2005.
- Stratum defined over 16 industries, 10 categories of establishment size and 16 German regions (Laender).
- Participation of firms voluntary.
- Surveyed by professional interviewers (response rate quite high).
- Establishments that refuse to answer are replaced by random draws from the same stratum.
- Question on intermediate inputs from abroad for the business years 1998, 2000 and 2002.

## Empirical Methodology (I)

### ■ ***Basic idea of matching estimator.***

- Comparison of outcomes of establishments whose pre-treatment characteristics have made it equally likely to offshore or not.  
→ Treatment is „purely random“ for similar (ideally identical) establishments.

### ■ ***Propensity-score matching:***

- Estimating propensity score.
- Matching algorithm.
- Matching quality.
- Estimating the variance of the treatment effects.
- Robustness.

### ■ ***On the methodological side:***

- Propose alternative to stable unit treatment value assumption (SUTVA) → important for interpretation of the results.

## Empirical Methodology (II)

### ■ *Estimating the Propensity Score - Logit specification:*

$$\begin{aligned} \text{Offshoring}_{i,t} = & \alpha + \beta_1 \text{Employment}_{i,t-1} + \beta_2 \text{Technology}_{i,t-1} + \\ & + \beta_3 \text{Wage\_employee}_{i,t-1} + \beta_4 \text{High\_skilled}_{t-1} + \\ & + \beta_5 \text{Foreign} + \beta_6 \text{year2003} + D_B + v_{i,t}, \end{aligned}$$

### ■ *Treatment variable I: Offshoring*

- Binary variable that takes the value of one, if the firm increases its intermediate inputs from abroad in 2001-2002 or 1999-2000, and zero otherwise.
- An increase in intermediate goods from abroad measured as an upgrade from „not at all“ to „partly“ or from „partly“ to „predominantly“.

### ■ *Treatment variable II: Offshoring cum restructuring*

- Offshoring as above interacted with restructuring (=closure or sell-off of part of plant).

## Empirical methodology (III)

### ■ ***Matching algorithm:***

- Kernel matching: bandwidths of 0.05, 0.01 and 0.005.
- Robustness check: Nearest neighbor matching.

### ■ ***Matching quality - balancing tests:***

- Standardised difference between treatment and matched-control group (Rosenbaum and Rubin, 1985).
- Mean-difference t-test with standard deviations differing in treatment and matched-control group.
- Hotelling test on quintiles tests balancing within each quintile over all variables jointly.
- Sensitivity test of the matching estimates (Dehejia, 2005).
- Heckman and Hotz (1989) pre-program test.

### ■ ***Estimating the variance of the treatment effects:***

- Standard errors computed via *bootstrapping* (Lechner, 2002; Black and Smith, 2004; Abadie and Imbens, 2008).

## Empirical Methodology (IV)

### ■ *Difference-in-Differences (Heckman et al., 1997):*

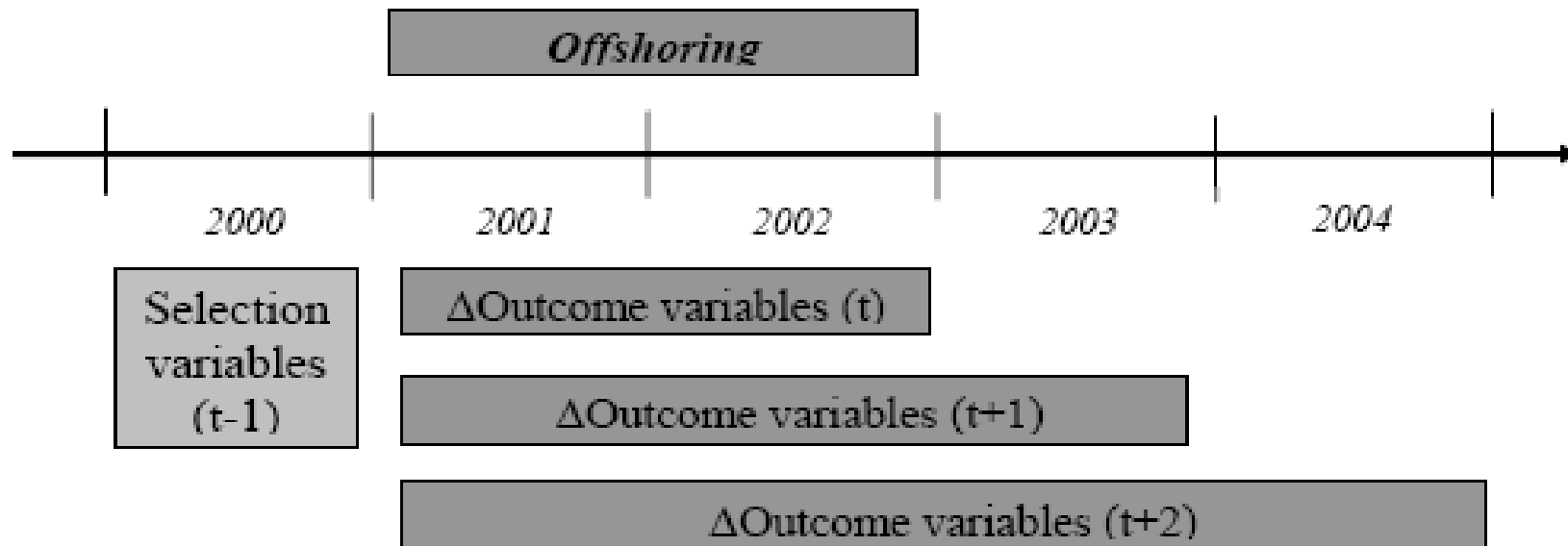
$$\hat{\delta} = \sum_i D_{i1} \left( \Delta y_{i1} - \sum_j \{ (1 - D_{j1}) g(p_i, p_j) \Delta y_{j1} \} \right),$$

with  $\Delta y$  being the difference in the outcome variable before and after offshoring (Girma and Görg, 2008; Blundell and Costa Dias, 2000; Smith and Todd, 2005).

### ■ *Outcome variables* – four different types:

- $y_{it+s}^1$  represents outcome variable at time  $t+s, s \geq 0$ , following the offshoring event.
- $y_{it+s}^0$  denotes outcome variable for plants that do not offshore.
- **Employment:** (log) total employment at plant  $i$  at time period  $t$ .
- **Sales:** (log) total turnover at plant  $i$  at time period  $t$ .
- **Exports:** share of turnover abroad relative to total turnover at plant  $i$  at period  $t$ .
- **Productivity:** (log) total turnover relative to total employment at plant  $i$  at time period  $t$ .

## Empirical Strategy (V) – *Timing in Data*



## Empirical methodology (VI)

### ■ **Propensity-score matching with difference in differences:**

- SUTVA assumption replaced → may contradict GE resource constraints

$$y_{it}^T = g(x_{i0})t + f^T(x_{i0}, M_0)t + \delta_{it}^T(M_0)t + \gamma_i + U_{it}t + \varepsilon_{it}$$

$$y_{it}^{NT} = g(x_{i0})t + f^{NT}(x_{i0}, M_0)t + \delta_{it}^{NT}(M_0)t + \gamma_i + U_{it}t + \varepsilon_{it}$$

- Assume that General Equilibrium effects depend only on  $M_0$ .
- ATT is conditional on a fixed  $M_0$ .
- i.i.d.
- Overlap assumption.
- Conditional independence assumption (common average time trend  $U_{it}$ ).

$$E[y_{i1}^T - y_{i1}^{NT} | D_{i1} = 1, M_0] = E[f^T(x_{i0}, M_0) + \delta_{i1}^T(M_0) - f^{NT}(x_{i0}, M_0) - \delta_{i1}^{NT}(M_0) | D_{i1} = 1, M_0]$$

→ ATT is relative effect, not absolute effect, conditional on  $M_0$ .

**Table 1: Logit Estimates of Propensity Score**

	Offshoring (preferred)	Offshoring (modified)	Offshoring <i>cum</i> restructuring
<i>Log total employment (t-1)</i>	0.1303*** (5.72)	0.3966*** (4.92)	0.4572*** (7.19)
<i>Log total employment<sup>2</sup> (t-1)</i>		-0.0327*** (3.44)	
<i>Log wage per employee (t-1)</i>	0.2275*** (3.11)	0.1636** (2.15)	0.6957*** (2.59)
<i>Technology (t-1)</i>	0.2194*** (3.08)	0.2208*** (3.10)	-0.5223*** (2.60)
<i>High-skilled (t-1)</i>	0.3564*** (2.75)	0.4563*** (3.42)	1.0755** (2.54)
<i>Foreign ownership</i>	0.4166*** (3.49)	0.4360*** (3.65)	0.1826 (0.62)
<i>Time dummy</i>	-0.0486 (0.57)	-0.0497 (0.58)	-0.2289 (0.80)
<i>Industry dummies</i>	yes	yes	yes
<i>Regional dummies</i>	yes	yes	yes
<i>Pseudo R-squared</i>	0.06	0.06	0.16
<i>Observations</i>	8466	8466	7315

## Matching Quality (I)

**Table 2: Balancing Tests from Kernel Matching**

Covariate	Mean treatment group	Mean control group	Percent bias	Percent bias reduction	Mean-diff. t-stat (p-value)	Regression- based tests F- stat (p-value)
<i>Total employment</i>	3.7338	3.7142	1.2	96.5	0.26 (0.79)	0.83 (0.51)
<i>Wage per employee</i>	7.3771	7.3779	0.2	99.5	-0.04 (0.97)	1.24 (0.29)
<i>Technology</i>	0.7389	0.7338	1.1	91.2	0.27 (0.79)	0.63 (0.63)
<i>High-skilled</i>	0.3801	0.3818	0.6	59.4	-0.14 (0.89)	1.54 (0.19)
<i>Foreign ownership</i>	0.0968	0.0867	4.0	82.0	0.81 (0.41)	2.15 (0.07)

Notes: Definition of variables included in the matching: *Total employment*: log of number of employees per plant, *Wage per employee*: log of average wage per employee, *Technology*: Dummy=1 if plant has above average or state-of-the art technology, *High-skilled*: share of high-skilled workers of total employment, *Foreign ownership*: Dummy=1 if plant is majorly held by a foreign owner. Balancing of industry, regional and time dummies is not reported; all dummies have a percent bias below 3; mean-diff. is mean difference test with standard deviations differing between treatment and control group.

## Matching Quality (II)

**Table 3: Hotelling's T-squared Tests by Propensity Score Quintile**

Quintile	T-squared statistics	F-test statistics	p-value
First	41.000	1.254	0.157
Second	20.536	0.609	0.961
Third	40.495	1.200	0.202
Fourth	31.485	0.905	0.626
Fifth	35.927	1.065	0.369

## Step 1: Identification of Employment Effect

**Table 4: Impact of Offshoring on Log Employment  
(Kernel Matching)**

Time	OLS	<i>ATT Preferred Model</i>	ATT Modified Model
	(1)	(2)	(3)
1	0.0195 (0.0157)	0.0214** (0.0103)	0.0200** (0.0102)
2	0.0241** (0.0914)	0.0418*** (0.0130)	0.0401*** (0.0129)
3	0.0561** (0.0249)	0.0439*** (0.0150)	0.0453*** (0.0151)

Notes: Standard errors in parentheses. For the matched sample standard errors are generated via bootstrapping (500 replications); \*\*\* denotes 99% significance level, \*\* 95% significance level, \* 90% significance level.

## Step 2: Identification of Prevalent Channel

**Table 5: Impact of Offshoring on Intermediate Goods (Kernel Matching)**

Time	OLS	<i>ATT Preferred Model</i>	<i>ATT Modified Model</i>
	(1)	(2)	(3)
1	1.2183 (0.9871)	0.3117 (0.6199)	0.3708 (0.6261)
2	0.8404 (1.4643)	-0.5948 (0.7137)	-0.4279 (0.7223)
3	0.2168 (1.2686)	-0.6902 (0.7776)	-0.5486 (0.7915)

Notes: Standard errors in parentheses. For the matched sample standard errors are generated via bootstrapping (500 replications); \*\*\* denotes 99% significance level, \*\* 95% significance level, \* 90% significance level.

## Step 3: Identification of Productivity Effect (I)

**Table 6: Impact of Offshoring on Productivity  
(Kernel Matching)**

Time	OLS	<i>ATT Preferred Model</i>	ATT Modified Model
	(1)	(2)	(3)
1	0.0446** (0.0134)	0.0362*** (0.0136)	0.0366*** (0.0137)
2	0.0449** (0.0150)	0.0298* (0.0168)	0.0308* (0.0170)
3	0.0475** (0.0160)	0.0256 (0.0191)	0.0254 (0.0188)

Notes: Standard errors in parentheses. For the matched sample standard errors are generated via bootstrapping (500 replications); \*\*\* denotes 99% significance level, \*\* 95% significance level, \* 90% significance level.

## Step 3: Identification of Productivity Effect (II)

**Table 7: Impact of Offshoring on Log Sales  
(Kernel Matching)**

Time	OLS	<i>ATT Preferred Model</i>	ATT Modified Model
	(1)	(2)	(3)
1	0.0446*** (0.0134)	0.0502*** (0.0144)	0.0495*** (0.0144)
2	0.0455*** (0.0131)	0.0583*** (0.0175)	0.0611*** (0.0175)
3	0.0529*** (0.0157)	0.0743*** (0.0199)	0.0769*** (0.0196)

Notes: Standard errors in parentheses. For the matched sample standard errors are generated via bootstrapping (500 replications); \*\*\* denotes 99% significance level, \*\* 95% significance level, \* 90% significance level.

## Step 3: Identification of Productivity Effect (III)

**Table 8: Impact of Offshoring on Exports  
(Kernel Matching)**

Time	OLS	<i>ATT Preferred</i>	ATT Modified
		<i>Model</i>	Model
	(1)	(2)	(3)
1	1.2985*** (0.4400)	0.9359*** (0.3570)	0.9175** (0.3575)
2	1.7321*** (0.5155)	1.1623*** (0.4384)	1.2177*** (0.4561)
3	2.6114*** (0.7538)	1.3176** (0.5578)	1.4682*** (0.5653)

Notes: Standard errors in parentheses. For the matched sample standard errors are generated via bootstrapping (500 replications); \*\*\* denotes 99% significance level, \*\* 95% significance level, \* 90% significance level.

## Step 4: Identification of Downsizing Effect

**Table 9: The Impact of Offshoring *cum* Restructuring on Log Employment, Log Sales, Exports and Log Productivity (Kernel Matching)**

Time	Employment	Sales	Exports	Productivity
1	-0.0871* (0.0494)	0.0318 (0.0567)	4.2855*** (1.633)	0.1065** (0.0456)
2	-0.1873*** (0.0629)	-0.0361 (0.0796)	5.3028*** (2.059)	0.1189* (0.0645)
3	-0.1691** (0.0704)	-0.0541 (0.0869)	3.9936 (3.1173)	0.0909 (0.0846)

Notes: Standard errors in parentheses. For the matched sample standard errors are generated via bootstrapping (500 replications); \*\*\* denotes 99% significance level, \*\* 95% significance level, \* 90% significance level.

- Offshoring *cum* restructuring in 1/8 cases out of all offshoring.

## Further results

- Self-selection into offshoring appears unlikely (Heckman and Hotz, 1989; Imbens, 2004; Smith and Todd, 2005a).
- Robust to matching within industries.
- Robust to other matching algorithm.
- Qualitative similar results for manufacturing sectors.
- Non-EU offshoring exhibits neutral (not positive) employment effect.

## Robustness (I)

**Table 10: Heckman and Hotz (1989): Evidence for Self-selection into Offshoring? Log Employment, Log Sales, Exports and Log Productivity (t=-1)**

Time	Employment	Sales	Exports	Productivity
Kernel Matching	-0.0094 (0.0126)	0.0071 (0.0176)	0.6515 (0.5076)	0.0184 (0.0173)
OLS	0.0082 (0.0154)	0.0213 (0.0168)	0.3350 (0.3561)	0.0213 (0.0168)

Notes: Standard errors in parentheses. For the matched sample standard errors are generated via bootstrapping (500 replications); \*\*\* denotes 99% significance level, \*\* 95% significance level, \* 90% significance level.

## Robustness (II)

**Table 11: The Impact of Offshoring on Log Employment, Log Sales, Exports and Log Productivity  
(Kernel Matching within Industries)**

Time	Employment	Sales	Exports	Productivity
1	0.0229* (0.0125)	0.0458*** (0.0174)	1.0392*** (0.3542)	0.0307* (0.0166)
2	0.0400** (0.0163)	0.0567*** (0.0194)	1.0393** (0.4454)	0.0291 (0.0191)
3	0.0529*** (0.0186)	0.0680*** (0.0234)	1.3492** (0.5579)	0.0142 (0.0219)

Notes: Standard errors in parentheses. For the matched sample standard errors are generated via bootstrapping (500 replications); \*\*\* denotes 99% significance level, \*\* 95% significance level, \* 90% significance level.

## Conclusions

- Positive offshoring effect, since offshoring *causes* higher employment in firms that offshore relative to those that abstain from doing so.
  - Difference-in-Differences matching estimator.
  - Indication for *substitution effect* of domestic intermediate good suppliers by foreign ones.
  - Evidence for *productivity effect*: offshoring plants increase average productivity and gain domestic and foreign market share (Grossman and Rossi-Hansberg, 2008).
  - Negative employment effect if offshoring and restructuring occur simultaneously (*downsizing effect*).
- Paper seeks to carefully distinguish between different channels that determine the employment effect.

Thank you for your attention.

**Table B1: The Impact of Offshoring on Log Employment, Log Sales, Exports and Log Productivity (Nearest Neighbor Matching)**

Time	Employment	Sales	Exports	Productivity
1	0.0315** (0.0136)	0.0515*** (0.0172)	1.1129** (0.4447)	0.0333* (0.0177)
2	0.0532*** (0.0178)	0.0612*** (0.0229)	1.3401** (0.5406)	0.0172 (0.0216)
3	0.0539*** (0.0182)	0.0833*** (0.0266)	1.2853* (0.6991)	0.0228 (0.0252)

Notes: Standard errors in parentheses. For the matched sample standard errors are generated via bootstrapping (500 replications); \*\*\* denotes 99% significance level, \*\* 95% significance level, \* 90% significance level.

## Table B2: The Impact of Offshoring on Log Employment, Log Sales, Exports and Log Productivity – Manufacturing only (Kernel Matching)

Time	Employment	Sales	Exports	Productivity
1	0.0240* (0.0139)	0.0733*** (0.0222)	1.0462 (0.6495)	0.0596*** (0.0192)
2	0.0381** (0.0167)	0.0809*** (0.0267)	1.5793** (0.7953)	0.0577*** (0.0216)
3	0.0317* (0.0193)	0.0952*** (0.0305)	1.8756** (0.9048)	0.0544** (0.0238)

Notes: Standard errors in parentheses. For the matched sample standard errors are generated via bootstrapping (500 replications); \*\*\* denotes 99% significance level, \*\* 95% significance level, \* 90% significance level.

## Table B3: The Impact of Offshoring on Log Employment, Log Sales, Exports and Log Productivity – Further Results (Kernel Matching)

Time	Employment	Sales	Exports	Productivity
Baseline Offshoring (Tables 3;5-7, t=1)	0.0214** (0.0103)	0.0502*** (0.0144)	0.9359*** (0.3570)	0.0362*** (0.0136)
EU Offshoring	0.0466*** (0.0125)	0.0433** (0.0186)	0.7049 (0.4782)	0.0340** (0.0168)
Non-EU Offshoring	-0.0043 (0.0172)	0.0295 (0.0237)	1.2008 (0.7810)	0.0539** (0.0230)

Notes: Standard errors in parentheses. For the matched sample standard errors are generated via bootstrapping (500 replications); \*\*\* denotes 99% significance level, \*\* 95% significance level, \* 90% significance level.

**Table B4: Frequency Distribution of Treated and Non-treated plants by Propensity Score Quintile**

Quintile	Outsourcing plants	Non-outsourcing plants
First	76	1380
Second	124	1331
Third	201	1255
Fourth	300	1155
Fifth	383	1072