Bundling and exporting: evidence from German SMEs

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Motivation

Firms increasingly adopt hybrid business models, whereby they sell bundles of product and services (Cusumano et al., 2015).

- *Servitization*. Manufacturers set out to grow their revenues and profits around services rather than products alone (Vandermerwe and Rada, 1988; Baines and Lightfoot, 2013).

  - French train manufacturer Alstom has introduced *train life services*, offering maintenance and parts supply services to transport companies.

- *Productization*. Service firms add tangible components to their offering. (Harkonen et al, 2015).

  - Embed sensors or other forms of hardware.

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Discussion
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Literature

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Servitization

- Margins (Visjnic and Van Looy, 2013; Suarez et al., 2013).
- Overall performance (Bustinza et al., 2016).
- Evolution of the manufacturing sector (Cusumano et al., 2015).
- Productivity (Fuss, Blanchard, Mathieu, 2017).

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- Exports of services boost exports of goods (Ariu et al., 2018).

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- is primarily a B2B activity.
- is a relatively rare activity among German SMEs, the intensity of which varies considerably across sectors.
- is positively associated to productivity and export intensity.

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2. We focus specifically on the effect of bundling on SMEs' exporting activities: the results suggest that bundling is not only a strategy for large firms and can be viable also for very small firms.

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Data for a representative sample of the German manufacturing sector collected by the Cologne Institute for Economic Research (CIER) for German firms.

- Time: 2011 and 2014.
- 4,646 firms (574 surveyed in both years).
- Questions asked to respondents in key managerial positions who have a good understanding of firm strategies.
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    - The answer rate 7.8% in the first wave and 6.7% in the second wave.
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▸ Weights

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Facts 1&2: B2B; sector heterogeneity

Fact 1: 87% of the firms which bundle sell to other firms (B2B).

Fact 2: On average only 22% of firms sell bundles of products and services. Their presence vary considerably across sectors.

Bundling across sectors

Sector	Description	Share of firms	Share of sales	Observations
58-63	Information and communication	39.24	16.72	443
35	Electricity, gas, steam, etc...	26.48	12.37	143
10-33	Manufacturing	23.00	8.85	1877
45-47	Wholesale and retail trade, repair	22.16	7.54	282
69-75	Professional, scientific and technical	18.91	7.76	896
64-66	Financial and insurance activities	16.08	6.19	21
77-82	Administrative and support service	14.13	6.04	402
37-39	Water supply, sewerage, waste	13.61	1.40	19
68	Real estate activities	11.60	2.37	36
41-43	Construction	9.27	1.49	237
49-53	Transportation and storage	8.70	3.86	161
	Aggregate	21.81	8.66	4,566

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Fact 3&4: Bundling; productivity; exporting.

Fact 3: Firms that sell integrated solutions are more productive.
Fact 4: Firms that sell integrated solutions export more.

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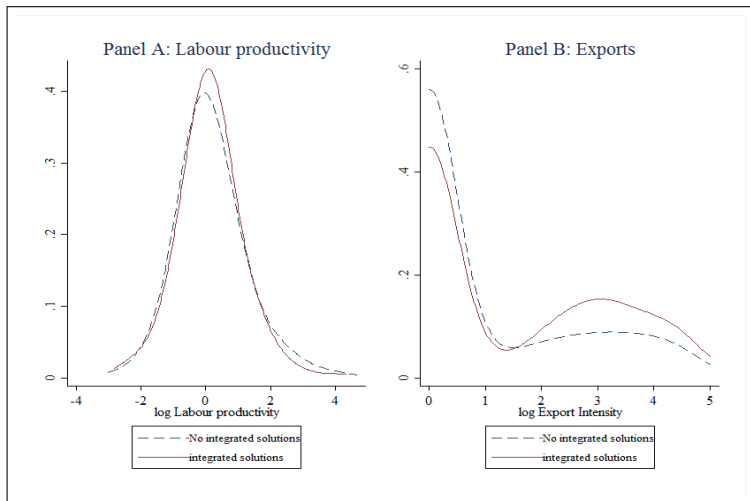
Regression Results

Bundling and Exporting: Regression Results

$$e_{kjt}^f = \alpha_0 + \alpha_1 s_{kst}^f + \mathbf{\Omega}_{kjt}^f + \vartheta_f + \vartheta_k + \vartheta_j + \vartheta_m + \vartheta_t + \varepsilon_{kjt}^f \qquad (1)$$

1. e_{kjt}^f is the export intensity of firm f in sector k and state j, at time t, computed as as the ratio between sales in foreign markets over total turnover

2. s_{ijt}^f is the variable of interest, i.e. the share of firm turnover generated by selling integrated solutions: we expect α_1 to be positive and significant.

3. $\mathbf{\Omega}_{kjt}^f$ is a vector of time-varying firm characteristics

4. ϑ_f are firm fixed-effects (FEs). ϑ_k indicates sector dummies/FEs. ϑ_j refers to state dummies/FEs. ϑ_m are size dummies/FEs. ϑ_t are time dummies/FEs.

5. ε_{kjt}^f is the error term.

Bundling and Exporting: Regression Results

$$e_{kjt}^f = \alpha_0 + \alpha_1 s_{kjt}^f -$$
$$+\mathbf{\Omega}_{kjt}^f + \vartheta_f + \vartheta_k + \vartheta_j + \vartheta_m + \vartheta_t + \varepsilon_{kjt}^f \qquad (2)$$

e_{kjt}^f	OLS (Full sample)				OLS (Fixed-effects)	
	(1)	(2)	(3)	(4)	(5)	(6)
s_{kjt}^f	0.087***	0.092***	0.084***	0.077***	0.069***	0.089**
	(0.010)	(0.011)	(0.013)	(0.014)	(0.020)	(0.035)
lp_{kjt}^f		1.677**	1.341**	1.783***		
		(0.627)	(0.518)	(0.514)		
inv_{kjt}^f			21.329***	20.746***		
			(2.562)	(2.473)		
rd_{kjt}^f				0.205***		
				(0.050)		
Observations	4,094	3,999	3,985	3,877	1,077	1,077
R^2	0.066	0.075	0.153	0.166	0.047	0.096
$\vartheta_k, \vartheta_j, \vartheta_m, \vartheta_t$	Yes	Yes	Yes	Yes	No	No
$\vartheta_f, \vartheta_{k \times t}, \vartheta_{m \times t}$	No	No	No	No	Yes	No
$\vartheta_f, \vartheta_{k \times t}, \vartheta_{m \times t}, \vartheta_{j \times t}$	No	No	No	No	No	Yes

A 1% increase in e_{kjt}^f is associated to a 7-9 pps increase in export intensity.

Bundling and Exporting: Manufacturers vs. ICT

$$e_{kjt}^f = \alpha_0 + \alpha_1 s_{kjt}^f + \alpha_2 \mu_{kjt}^f + \alpha_3 \mu_{kjt}^f \times s_{kjt}^f -$$
$$+ \boldsymbol{\Omega}_{kjt}^f + \vartheta_f + \vartheta_k + \vartheta_j + \vartheta_m + \vartheta_t + \varepsilon_{kjt}^f$$

(3)

e_{kjt}^f	(1)	(2)	(3)	(4)
s_{kjt}^f	0.092***	0.087***	0.086***	0.059**
	(0.018)	(0.016)	(0.013)	(0.018)
μ_{kjt}^f	5.438***	5.571***	4.289**	5.722**
	(0.585)	(0.626)	(1.365)	(1.618)
$\mu_{kjt}^f \times s_{kjt}^f$	0.009	0.015	-0.001	0.029**
	(0.013)	(0.013)	(0.009)	(0.009)
lp_{kjt}^f		-0.010***	-0.011**	-0.012*
		(0.001)	(0.004)	(0.005)
inv_{kjt}^f			21.706***	21.698***
			(3.593)	(3.870)
rd_{kjt}^f				0.201**
				(0.049)
Observations	2,061	2,019	2,010	1,950
R^2	0.075	0.075	0.159	0.177
$\vartheta_k, \vartheta_j, \vartheta_m, \vartheta_t$	Yes	Yes	Yes	Yes

Bundling and Exporting: Manufacturers vs. ICT

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Bundling and Exporting: Drivers

Objective	Percentage
Acquisition of new customers	78%
Increase in sales per customer	70%
Increase in earnings per customer	67%
Increase in customer loyalty	91%

Bundling is likely to increase firms' competitive advantage either through product differentiation or by locking in customers in long-term agreements, or through a combination of the two.

Our data allow us to look closer into what leads firms to bundle.

- Demand motives. 91% of firms sell integrated solutions to increase customer loyalty and 78% to acquire new customers (in line with (Ariu et al., 2018).
- Supply motives. 70% (67%) of firms declare that bundling is implemented to increase sales (earnings) per customer.

DR-PSM Results

Bundling and Exporting: DR-PSM

The effect of bundling on exporting can be verified by looking at the following difference:

$$[\eta_{kjt}^{1,f} - \eta_{kjt}^{0,f}]$$

where $\eta_{kjt}^{1,f}$ ($\eta_{kjt}^{0,f}$) is the outcome (exporting) for firm f in sector k and state j, at time t that sells (does not sell) product-service bundles.

$$E[\eta_{kjt}^{1,f} - \eta_{kjt}^{0,f}] = E[\eta_{kjt}^{1,f}] - E[\eta_{kjt}^{0,f}] \tag{4}$$

the probability model of bundling (the propensity score) can be written as

$$Pr[\eta_{kjt}^{0,f} = 1] = \Phi[g(\mathbf{\Omega}^*)] \tag{5}$$

where $\mathbf{\Omega}^*$ is a vector of firm, sector and state characteristics covariates.

Bundling and Exporting: DR-PSM

Bundling is not a characteristic that is randomly assigned to firms but a strategy they choose to increase their competitiveness.

- The matching procedure relies on conditional independence: the treatment (bundling product and services) is as good as randomly assigned after conditioning on a set of covariates

Imposing common support, if balancing property holds, in each block the average propensity score is not different for treated and untreated. Within each sub-sample, we can then analyze the data as if they came from a completely randomized experiment.

- We have to show that after conditioning on a set of covariates, the treatment does not affect the means of the potential outcomes.

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Bundling and Exporting: DR-PSM

Pearl's back-door criterion: two chances to get things right:

- either block the back-door path by matching and eliminating any association between covariates and treatment assignment
- or block the back-door path with regression by controlling for other causes of the outcome that are correlated with treatment.

As long as one of the two models are correctly specified, the effect of the treatment on the outcome will be correctly estimated.
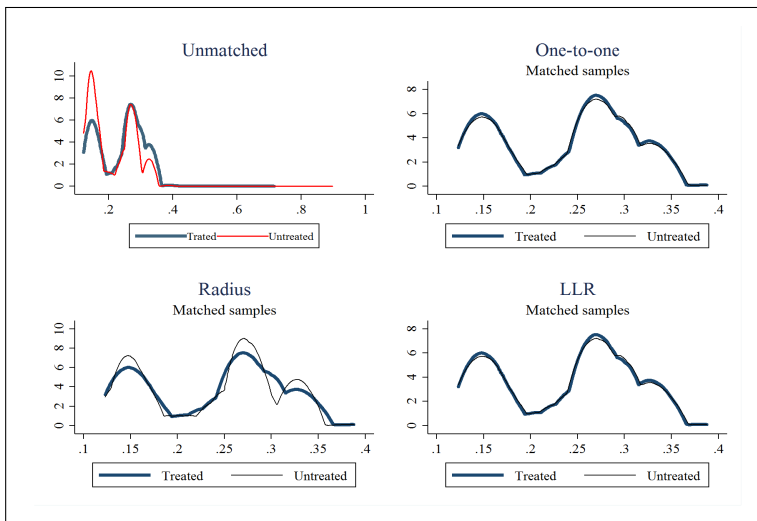
Bundling and exporting: DR-PSM Results

Defining $\eta_{kjt}^{1,f,DR}$ and $\eta_{kjt}^{0,f,DR}$ as the counterfactual responses (DR stands for Doubly Robust), we can then evaluate:

$$\zeta_{DR} = E[\eta_{kjt}^{1,f,DR}] - E[\eta_{kjt}^{0,f,DR}] =$$

$$= \frac{1}{f} \sum_f \left(\frac{s_{kjt}^{f,DR} \eta_{kjt}^f}{\lambda(\mathbf{\Omega}^*; \hat{\beta})} - \frac{s_{kjt}^{f,DR} - \lambda(\mathbf{\Omega}^*; \hat{\beta})}{\lambda(\mathbf{\Omega}^*; \hat{\beta})} \times \chi_1(\mathbf{\Omega}^*; \hat{\gamma}_1) \right) +$$

$$-\frac{1}{f} \sum_f \left(\frac{(1 - s_{kjt}^{f,DR}) \eta_{kjt}^f}{1 - \lambda(\mathbf{\Omega}^*; \hat{\beta})} - \frac{s_{kjt}^{f,DR} - \lambda(\mathbf{\Omega}^*; \hat{\beta})}{1 - \lambda(\mathbf{\Omega}^*; \hat{\beta})} \times \chi_0(\mathbf{\Omega}^*; \hat{\gamma}_0) \right) \qquad (6)$$

where f indexes firms as before; $\lambda(\mathbf{\Omega}^*; \hat{\beta})$ is a postulated model for the true propensity score; $\chi_0(\mathbf{\Omega}^*; \hat{\gamma}_0)$ and $\chi_1(\mathbf{\Omega}^*; \hat{\gamma}_1)$ are postulated regression models for the true relationship between the vector of covariates ($\mathbf{\Omega}^*$) and the outcome within each stratum of treatment.

DR-PSM: Balancing the Sample (s_{kjt}^{f} dummy)

Bundling and exporting: DR-PSM Results

e_{kjt}^f	PSM			DR-PSM		
	(1)	(2)	(3)	(4)	(5)	(6)
	1:1	Radius	Kernel	1:1	Radius	Kernel
$ATE_{kjt}^{s,f}$	4.49***	5.59***	5.16***			
ζ_{DR}				2.21**	3.23***	2.21**
Observations	3,984	3,984	3,984	3,889	3,863	1,123
R^2				0.21	0.20	0.21
	Sample trimmed at the 5th centile					
$ATE_{kjt}^{s,f,5}$	6.46***	6.10***	5.31***			
$\zeta_{DR,5}$				3.42***	3.96***	3.42***
Observations	3,727	3,727	3,727	3,889	3,692	1,159
R^2				0.26	0.19	0.27
	Sample trimmed at the 10th centile					
$ATE_{kjt}^{s,f,10}$	6.17***	6.53***	5.60***			
$\zeta_{DR,10}$				3.40**	4.36***	2.40**
Observations	3,611	3,611	3,611	3,529	3,501	1,088
R^2				0.23	0.18	0.23
lp_{kjt}^f	Yes	Yes	Yes	Yes	Yes	Yes
inv_{kjt}^f	No	No	No	Yes	Yes	Yes
rd_{kjt}^f	No	No	No	Yes	Yes	Yes
ϑ_k, ϑ_m	Yes	Yes	Yes	Yes	Yes	Yes
ϑ_j, ϑ_t	No	No	No	Yes	Yes	Yes

Discussion

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The good as a firm's core competence, and the service as a peripheral product.

- Manova and Zhang (2012) or Mayer et al. (2014, 2016).
- One-way complementarity between goods and services (Ariu et al., 2018)

Goods and services as (two-way) complements (e.g., Cusumano et al., 2015).

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- IM and EM of trade.
- Buyer-seller repeated interaction setting.
- Trust and reputation in locked-in buyer-seller relationship.

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Thank you!

Weights

Stratification by:

- size;
- sectors;

For each wave, the relative (rw) and absolute (aw) weights for firms in sector j and size class m is built as follows:

$$rw^{km} = \frac{\frac{\varphi^{km}}{\varphi}}{\frac{\varrho^{km}}{\varrho}} \quad aw^{km} = \left(\frac{\frac{\varphi^{km}}{\varphi}}{\frac{\varrho^{km}}{\varrho}}\right)\left(\frac{\varphi}{\varrho}\right) \tag{7}$$

Where φ^{km} is the number of firms in industry k and size class m for the population of German firms in a given wave and ϱ^{km} is the number of firms in industry k and size class m in our sample. φ and ϱ are the number of firms in the population and our sample respectively. ▸ Weights