

Innovation Support and Firm Performance: An Assessment of Turkey's Manufacturing and Service Sectors

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THE WORLD BANK

**CBRT - World Bank Joint Conference:
Drivers of Firm Performance in Turkey**

10 January 2019

Presentation Plan

Motivation

An Overview of Micro Data

Assessing the Impact of Public Support on Firm Performance

Difference-in-Difference Propensity Score Matching (DiD-PSM)

Production Function Estimation

Conclusions

Research Questions

- ▶ What are the effects of public support programs on firms';
 - ▶ Employment (Firm Size)
 - ▶ Innovation
 - ▶ R&D expenditures
- ▶ Are there any total factor productivity (TFP) gains from;
 - ▶ Innovation
 - ▶ Investing on R&D
 - ▶ Receiving Public Support

Borders of the Study

- ▶ The aim is to empirically assess micro underpinnings of firm innovation and productivity.
- ▶ Empirical analysis is based on the Entrepreneur Information System at the Ministry of Industry and Technology.
 - ▶ Final sample is a combination of several different data sources.
 - ▶ Outlier detection and data cleaning procedures are applied on the matched sample.
- ▶ The focus is on the grants provided by KOSGEB and TUBITAK.

Table: Innovation in Manufacturing

NACE	Desc.	#Firms	#Patent	#Trademark	#Model	#Design
10	Food	20618	291	24061	139	1746
13	Textiles	14941	415	8502	281	2792
14	Wearing Apparel	23768	117	10067	156	1232
15	Leather	4957	18	3236	53	1070
16	Wood	6264	41	1447	110	262
17	Paper	2918	73	1815	188	399
18	Printing	8273	56	2260	110	180
20	Chemiclas	5871	274	11784	146	784
22	Rubber and Plastic	12146	505	6269	1144	2841
23	Oth. Non-Met. Minerals	9703	342	5685	203	1529
24	Basic Metals	5338	113	1678	148	397
25	Fabricated Metals	24588	819	7473	1508	2856
26	Comp., Elec. and Optic.	1353	435	1502	315	281
27	Electrical Equipment	5768	3211	4423	699	1914
28	Mac. and Equip. n.e.c.	13296	1578	6838	1749	1481
29	Motor Vehicles	3898	2744	1788	486	611
30	Other Transport Equip.	944	130	517	72	90
31	Furniture	12811	204	5725	566	8043
32	Other Manufacturing	8439	239	3331	400	846

Table: Innovation in Services and Construction

NACE	Desc.	#Firms	#Patent	#Trademark	#Model	#Design
41	Construction of Buildings	76641	116	12561	124	219
42	Civil Engineering	5671	19	1079	49	20
43	Specialised Construction	38455	100	5375	213	291
45	Wh. and Ret. Trade of Motor V.	35202	63	6759	123	369
46	Wh. Trade Except Motor V.	171547	974	70168	1592	5599
61	Telecommunications	3053	308	4129	36	42
62	Comp. Prog. and Consultancy	7724	1376	5571	116	95
69	Legal and Accounting Act.	3831	102	1226	8	22
70	Activities of Head Offices	6037	133	6210	37	115
71	Archit.and Engineering Act.	23934	151	3485	114	173
72	Sci. Research and Dev.	715	107	309	17	42

Figure: Distribution of KOSGEB and TUBITAK Grants in Manufacturing

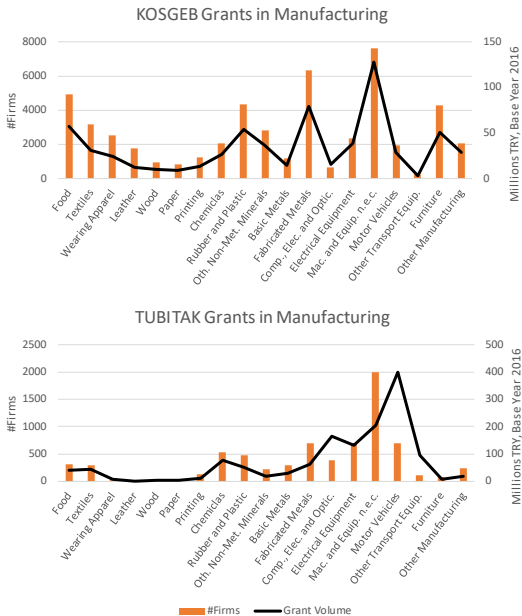
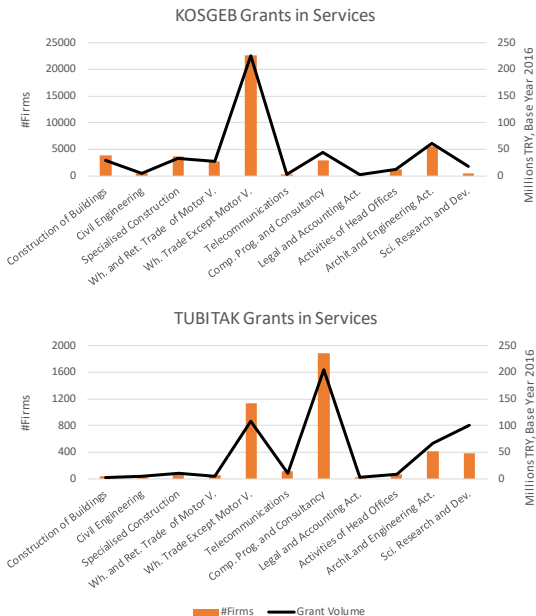


Figure: Distribution of KOSGEB and TUBITAK Grants in Services



Assessing the Impact of Public Support on Firm Performance

Difference-in-Difference Propensity Score Matching (DiD-PSM)

- ▶ The average treatment effect

$$E \{ z_{it+k}^1 - z_{it+k}^0 \mid TR_{it} = 1 \} = E \{ z_{it+k}^1 \mid TR_{it} = 1 \} - E \{ z_{it+k}^0 \mid TR_{it} = 1 \} \quad (1)$$

- ▶ Counterfactual: $E \{ z_{it+k}^0 \mid TR_{it} = 0 \}$
- ▶ Estimating propensity scores through probit

$$P (TR_{it} = 1) = F (X_{it-1}) \quad (2)$$

- ▶ General DiD-PSM estimator is in the following form

$$\beta = \frac{1}{N} \sum_{i \in T} \left[\Delta z_i - \frac{1}{N} \sum_{j \in C} \Delta z_j \right] \quad (3)$$

Variable Set for DiD-PSM Estimation

- ▶ Treatment variables (TR_{t-1}):
 - ▶ Receiving KOSGEB grant
 - ▶ Receiving TUBITAK grant
 - ▶ Innovation measured by patent, trademark, design or model applications
- ▶ Cofactors (X_{t-2}):
 - ▶ Firm age
 - ▶ Employment
 - ▶ Labor productivity
 - ▶ Capital intensity
- ▶ Firm performance indicators ($z_t - z_{t-2}$):
 - ▶ Employment (firm size)
 - ▶ R&D expenditures
 - ▶ Innovation

Table: Probit Estimation on KOSGEB Support and Balance Tests

Sector	<i>age</i>	<i>age</i> ²	<i>size</i> _{<i>t</i>-2}	<i>size</i> _{<i>t</i>-2} ²	<i>prod</i> _{<i>t</i>-2}	<i>capint</i> _{<i>t</i>-2}
Textiles	-0.366***	0.062***	0.677***	-0.049***	0.042**	0.101***
	(0.0987)	(0.0236)	(0.0548)	(0.0081)	(0.0171)	(0.0111)

		Mean			
		Treated	Control	t-stat	p-value
<i>age</i>	Unmatc.	2.124	2.048	6.140	0.000
	Matched	2.128	2.111	1.030	0.304
<i>age</i> ²	Unmatc.	4.843	5.563	5.510	0.000
	Matched	4.852	4.780	1.080	0.281
<i>size</i> _{<i>t</i>-2}	Unmatc.	3.603	2.558	44.780	0.000
	Matched	3.588	3.579	0.290	0.773
<i>size</i> _{<i>t</i>-2} ²	Unmatc.	14.088	7.838	45.450	0.000
	Matched	13.970	13.903	0.330	0.741
<i>prod</i> _{<i>t</i>-2}	Unmatc.	11.325	10.971	18.270	0.000
	Matched	11.316	11.341	-1.090	0.278
<i>capint</i> _{<i>t</i>-2}	Unmatc.	11.322	10.481	25.040	0.000
	Matched	11.307	11.324	-0.480	0.629

Table: Firm Characteristics, Innovation and Public Support in Manufacturing

Industry	Innovation		TUBITAK		KOSGEB	
	age	size	age	size	age	size
Food	-	+	-	+	-	+
Textiles	-	+	+		-	+
Wearing Apparel	-	+			-	+
Leather	-	+		+	-	+
Wood	-	+			-	+
Paper	-	+		+	-	+
Printing	-	+	+	+	-	+
Chemicals	-	+	+	+	-	+
Rubber and Plastic	-	+		+	-	+
Other Non-Metallic Minerals	-	+				+
Basic Metals	-	+		+	-	+
Fabricated Metals	-	+		+	-	+
Computer, Elec. and Optical	-	+				+
Electrical Equipment	-	+	-	+	-	+
Machinery and Equipment	-	+	-	+	-	+
Motor Vehicles and Trailers	-	+	-	+	-	+
Other Transport Equipment		+	-		-	+
Furniture	-	+		+	-	+
Other Manufacturing	-	+	-	+		+

Table: Firm Characteristics, Innovation and Public Support in Services

Industry	Innovation		TUBITAK		KOSGEB	
	age	size	age	size	age	size
Construction of Buildings	-	+			-	+
Civil Engineering	-	+				+
Specialised Construction	-	+	+	+	-	+
Wh. & Retail Trade of Motor Veh.	-	+		+	-	+
Wholesale Tr. Ex. Motor Veh.	-	+		+	-	+
Telecommunications				+		
Comp. Program. and Consult.	-	+	-	+	-	+
Legal and Accounting Act.	-	+		+		
Activities of Head Offices	-	+				+
Archit. and Engineering Act.	-	+			-	+
Scientific R&D						

Effect of public support is heterogeneous across industries

Average Treatment Effect

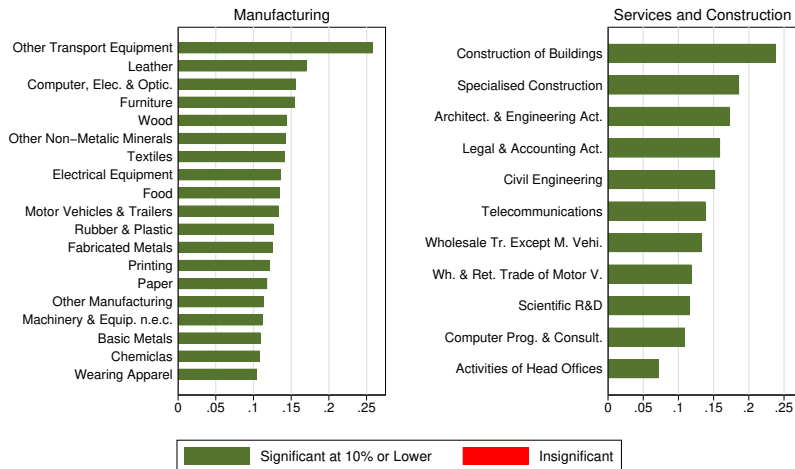
Table: Impact of KOSGEB Support in Textile Manufacturing^a

Dep. Var.	Employment	R&D	Innovation
coef	0.135***	0.0869***	0.0024
std	(0.0107)	(0.0235)	(0.0067)

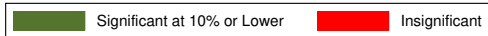
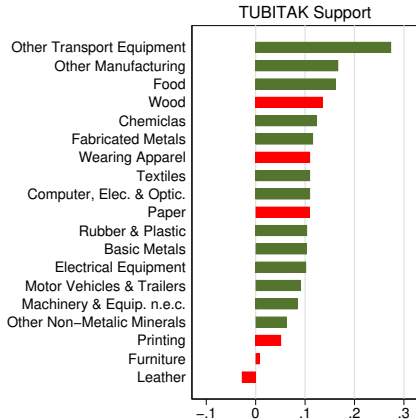
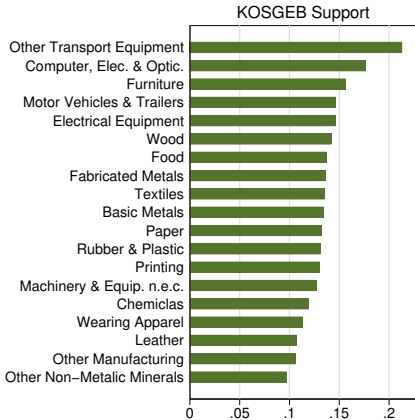
^aTime dummies are included in all equations. *** significant at 1%. ** significant at 5%. * significant at 10%. Robust standard errors are in parentheses. Dependent variable is 2-year differenced.

Innovation leads to higher employment

Effect of Innovation on Employment

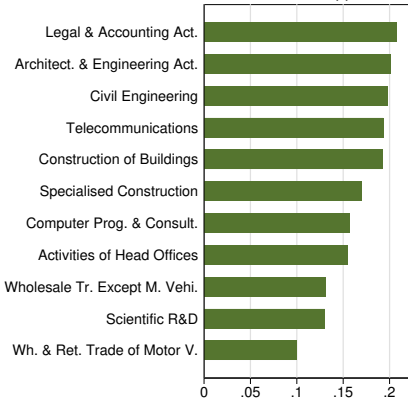


Effect of Public Support on Employment in Manufacturing

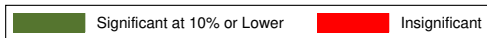
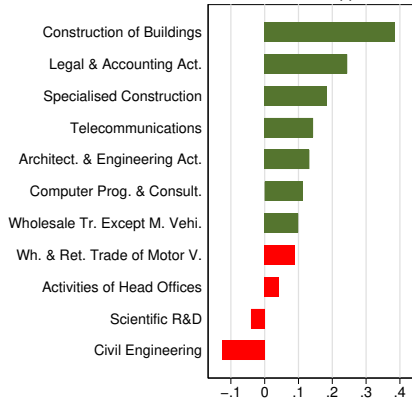


Effect of Public Support on Employment in Services

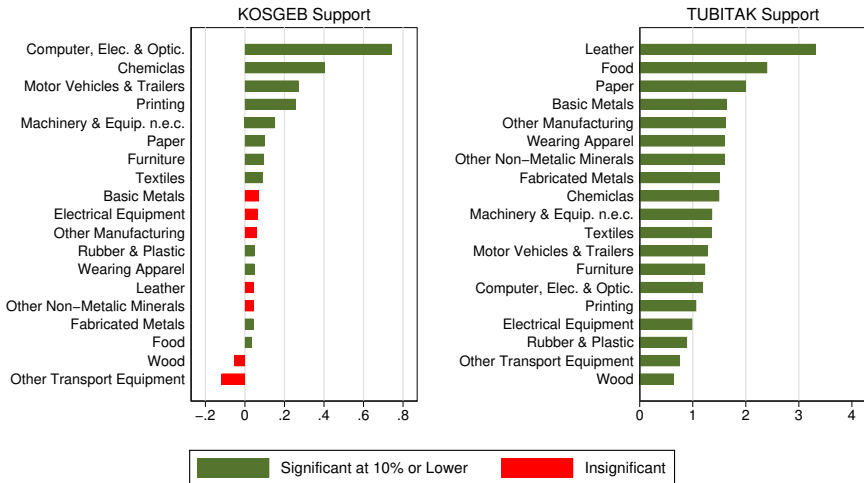
KOSGEB Support



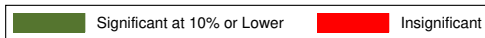
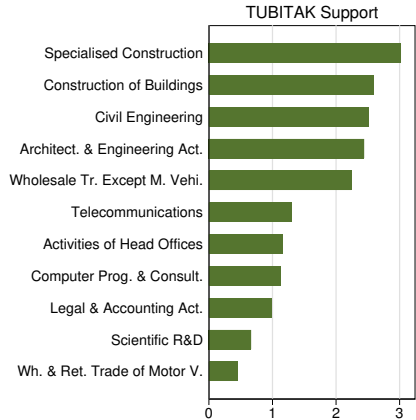
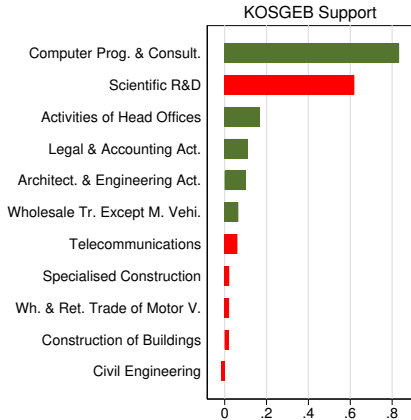
TUBITAK Support



Effect of Public Support on R&D in Manufacturing



Effect of Public Support on R&D in Services



Assessing the Impact on Total Factor Productivity

Production Function Estimation with Endogenous Productivity

- ▶ The unobserved productivity (θ_{it}) is replaced by a control function $\phi_{it}(m_{it}, k_{it})$.

$$q_{it} = \alpha_0 + \alpha_l l_{it} + \alpha_m m_{it} + \alpha_k k_{it} + \phi_{it}(m_{it}, k_{it}) + \varepsilon_{it} \quad (4)$$

- ▶ Productivity follows a first order Markov process.

$$\theta_{it} = \beta_s + \beta g(\theta_{it-1}) + \varepsilon_{it} \quad (5)$$

- ▶ Introducing mean shifters in the process, $\beta_s = \beta_0 + \delta C_{it}$.

$$q_{it} = \alpha_1 + \alpha_l l_{it} + \alpha_m m_{it} + \alpha_k k_{it} + E(\widehat{\theta_{it}} | \widehat{\theta_{it-1}}) + \varepsilon_{it} + e_{it} \quad (6)$$

- ▶ Final stage minimizes the error terms jointly by GMM-IV.

$$\min_{\{\alpha_l, \alpha_m, \alpha_k\}} \sum_h^H \left[\frac{1}{T} \frac{1}{N} \sum_t^T \sum_i^N [(\varepsilon_{it} + e_{it}) Z_{it,h}] \right]^2 \quad (7)$$

Table: TFP Impact of R&D and Innovation, Textiles

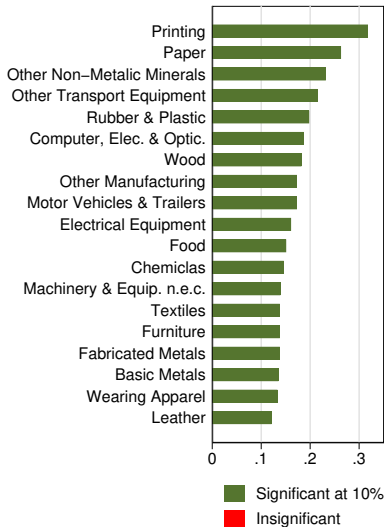
Nace	Sector	<i>labor</i>	<i>capital</i>	<i>int.input</i>	<i>R&D</i>	<i>innovation</i>
13	Textiles	0.318*** (0.00415)	0.116*** (0.00671)	0.591*** (0.00641)	0.138*** (0.00584)	0.0379*** (0.00367)

Table: TFP Impact of Public Support Programs, Textiles

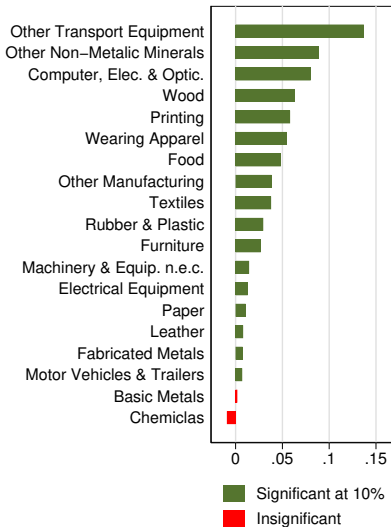
Nace	Sector	<i>labor</i>	<i>capital</i>	<i>int.input</i>	<i>KOSGEB</i>	<i>TUBITAK</i>
13	Textiles	0.313*** (0.00724)	0.112*** (0.00880)	0.604*** (0.00990)	0.00539 (0.00415)	0.153*** (0.00782)

Production Function Estimation Results, Manufacturing

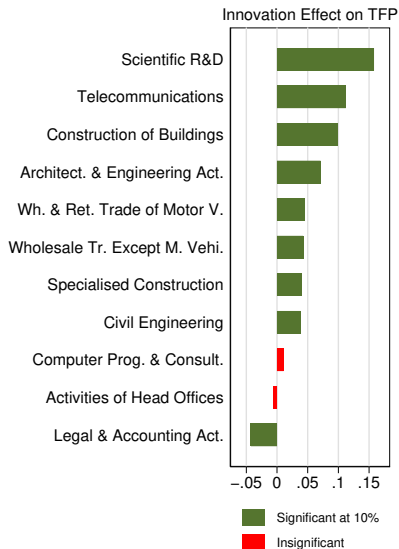
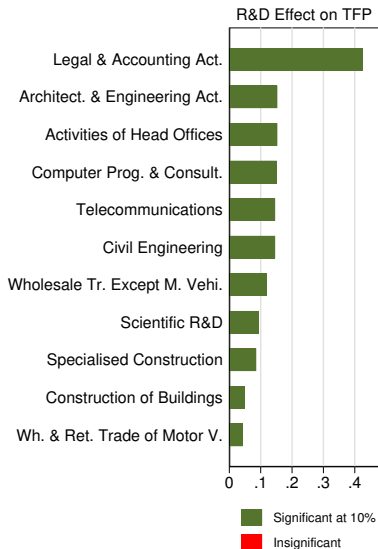
R&D Effect on TFP



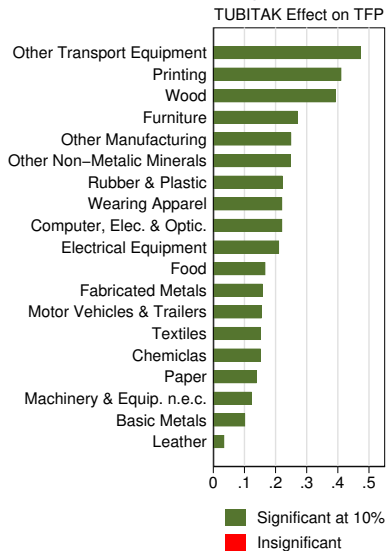
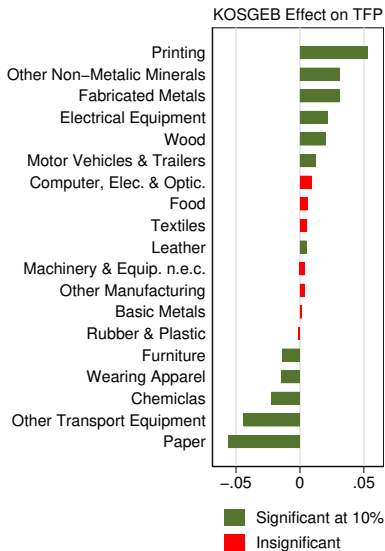
Innovation Effect on TFP



Production Function Estimation Results, Services

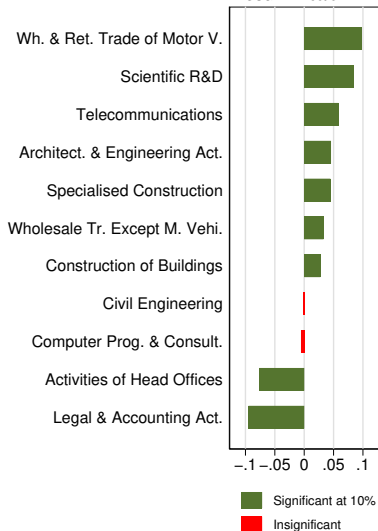


Production Function Estimation Results, Manufacturing

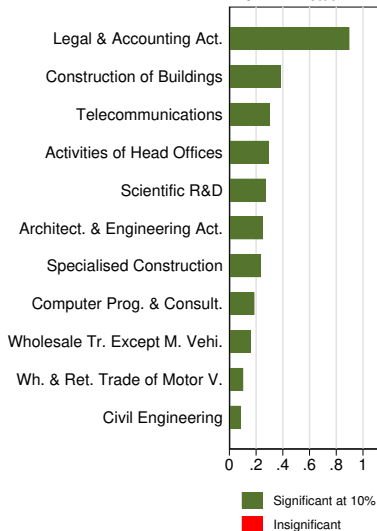


Production Function Estimation Results, Services

KOSGEB Effect on TFP



TUBITAK Effect on TFP



General Findings

- ▶ Innovation is an important determinant of productivity as well as firm employment in Turkey.
- ▶ Investing on R&D generates significant productivity gains.
- ▶ KOSGEB support programs have positive impact on "*employment*" but generally not on productivity.
- ▶ TUBITAK support has positive impact on R&D and innovation so on "*total factor productivity*", but not always on employment.
- ▶ The impact of support programs differs significantly across 2-digit industries. Heterogeneity is important.

Young firms are engines of growth

- ▶ Younger firms have a greater contribution into Turkey's innovation performance. This is in line with the empirical evidence.
 - ▶ Davis, S. J., Haltiwanger, J., & Schuh, S. (1996). Small business and job creation: Dissecting the Myth and reassessing the facts. *Small Business Economics*, 8(4), 297–315.
 - ▶ Haltiwanger, J. C., Jarmin, R. S., & Miranda, J. (2013). Who creates jobs? Small versus large versus young. *The Review of Economics and Statistics*, 95(2), 347–361.
 - ▶ "*Among small and medium-sized enterprises (SMEs), young firms play a central role in creating jobs and enhancing growth and innovation.*" (OECD, 2017, Dynemp Project, <http://www.oecd.org/sti/dynemp.htm>.)
- ▶ Young firms are not very likely to receive TUBITAK support especially in service sectors.