

# DUAL-USE INNOVATION, PATTERNS ACROSS TIME AND SPACE

**Federico Caviggioli, Antonio De Marco, Giuseppe Scellato**

*Department of Management and Production Engineering (DIGEP), Politecnico di Torino*

**Petros Gkotsis**

European Commission - JRC

**Antonio Vezzani**

Roma Tre University, IT – [antonio.vezzani@uniroma3.it](mailto:antonio.vezzani@uniroma3.it)

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# Political Motivation

**Article 3 consolidated TEU:** In its relations with the wider world, the Union shall uphold and promote its values and interests and contribute to the protection of its citizens. It shall contribute to peace, security, the sustainable development of the Earth, solidarity and mutual respect among peoples ...

## **White Paper on the Future of Europe (2017)**

- Strengthening cooperation in Defence (4 out of 5 scenarios)
- Create a European Defence Union (2 out of 5 scenarios)

## **Launch of the European Defence Fund (2017)**

- 1.5 billion € in R&D per year post 2020 (about 0.5 in 2019-20 each)

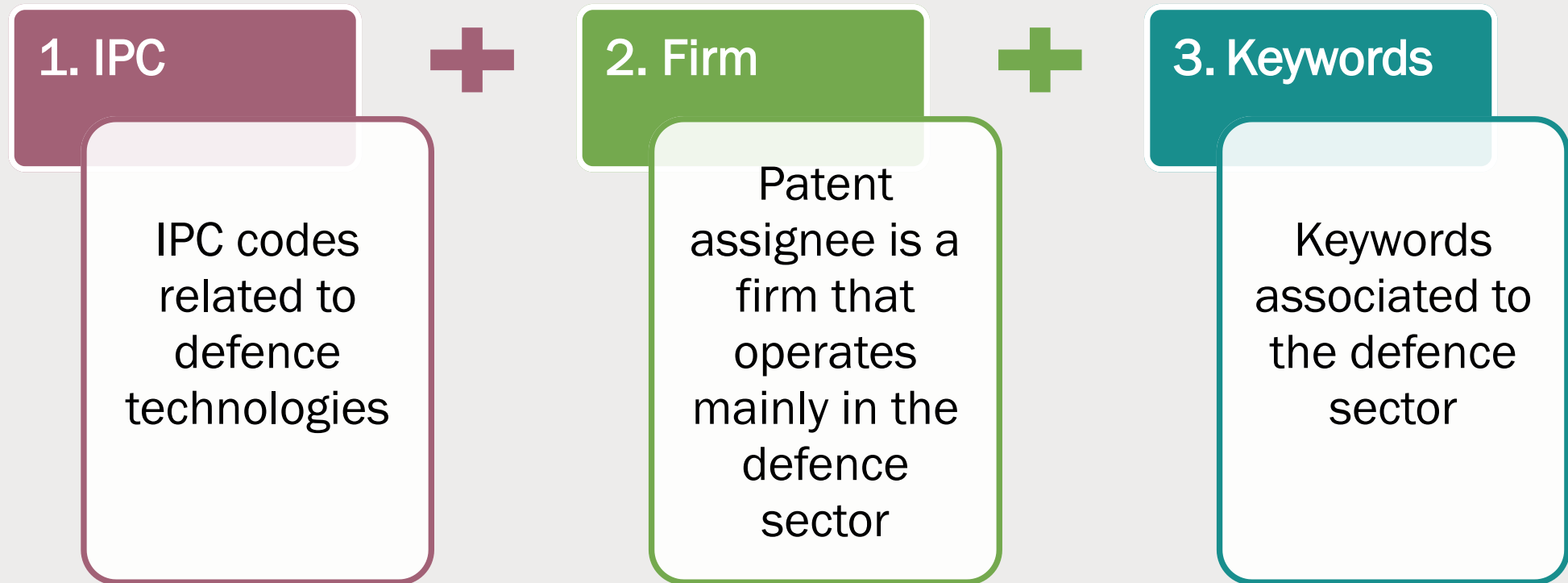
## Aim of the paper

Trying to measure the incidence of dual-use technologies and their determinants

To do so we:

- Develop a new methodology to identify military patents (*defence innovations*)
- Identify dual-use technologies  
(*we operationalize dual-use cases as informational effects*)

# Identification of defence innovations



## 1. IPC

IPC codes of  
«defence»  
technologies

Very robust to false positive but also very narrow definition

Main classes F41 “Weapons”, or F42 “Ammunition; Blasting”

Additional codes from previous works (Acosta et al., 2017) + from keywords in the descriptions of the IPC codes

### Exclusion criteria:

IPC: A63 “Sports; games; amusements”

(F42) and (B60R0021 or B60R0022) → identifies airbag patents (small charge to release gas)

“Stopwords” in title, abstract, or claims:

Game, toy, sport

Airbag, seatbelt, pretensioner

Company name including "airbag" or "toy"

## 2. Firm

Patent assignee  
is a firm that  
operates mainly  
in the defence  
sector

Firm in the Register of the Certified Defence-related Enterprises (**CERTIDER**), **29**

Firm **SIPRI** Database (Stockholm International Peace Research Institute) and has an average ratio of arms sales on the total sales > 50%, **149 firms**

Firm name includes any of the following:

- defence, tactical, weapon, armoured vehicle, ammunition (synonyms and variations included)
- national defence agencies/ministries (US Navy, US Air Force, etc)

### Exclusion criteria

- Stopwords in company name (eg. medical, health, and other specific confounding terms)

### 3. Keywords

Keywords  
associated to  
the “defence”  
sector

Number of keywords covering different concepts searched in the patent text fields  
*(spelling variations and word stemming considered)*

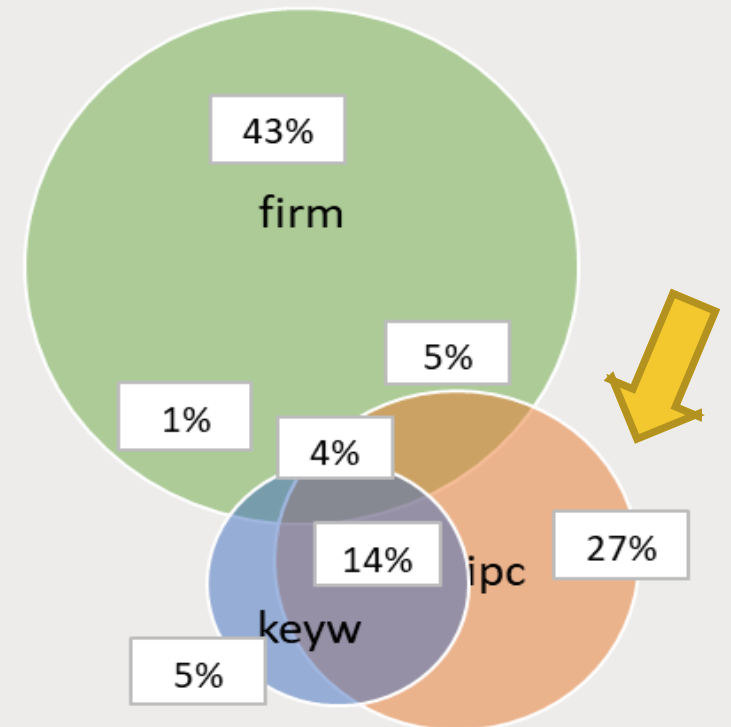
Exclusion criteria the results with any of the following:

- IPC code : A63 “Sports; games; amusements”
- Keywords in Title Abstract or Claims: "game“, "toy“, "sport"
- Checks to identify false positive *(eg. «warhead» is also common in metal industry; searching for «militar\*» returns patents about Cordyceps militaris, a mushroom)*

# Composition of defence innovations

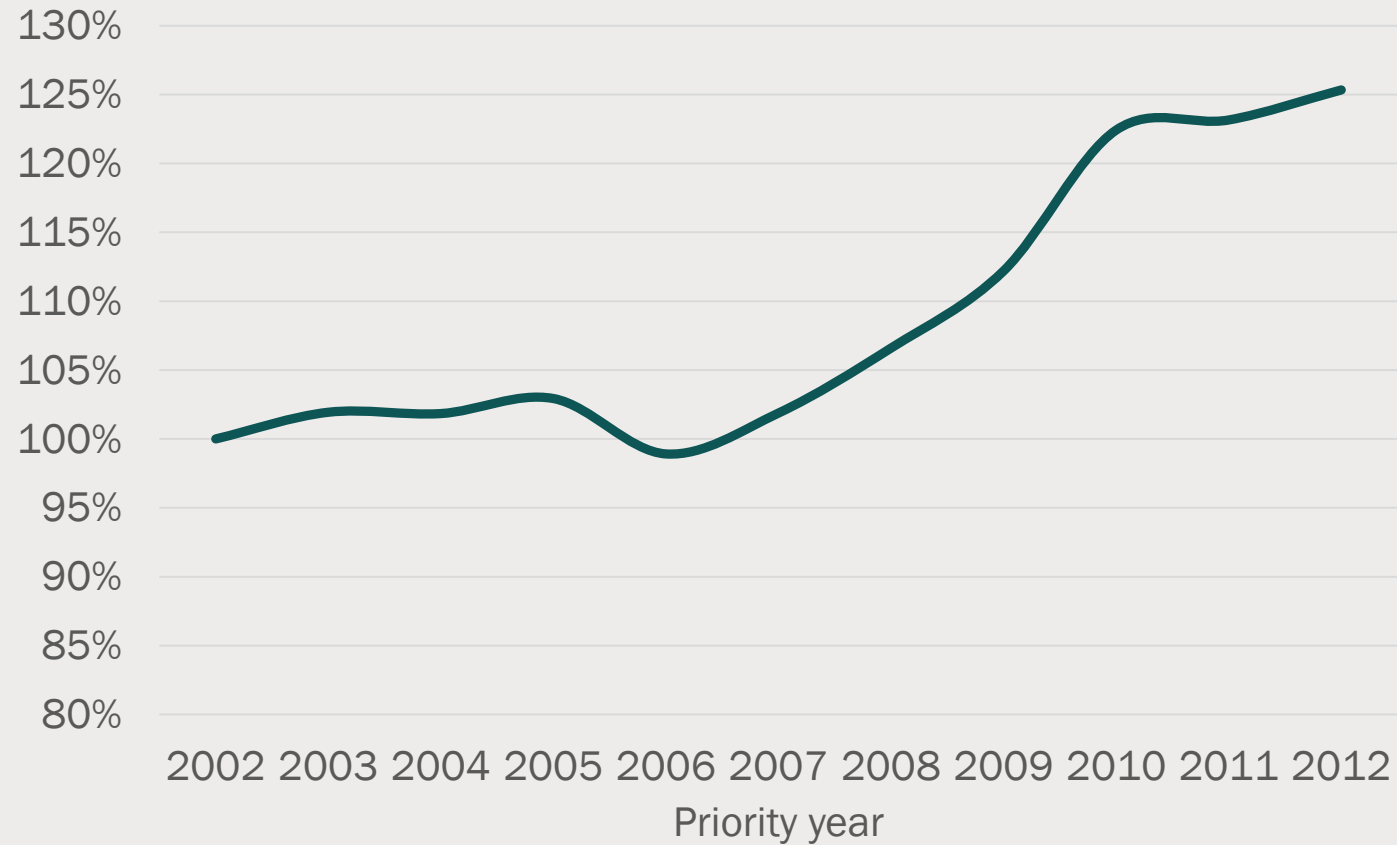
Total patents = 177,143, Families = 63,714

Selection criteria			Patent Families	Perc on tot. patent families
firm	IPC	keyword		
Y	Y	Y	2399	4%
Y	Y	N	3434	5%
Y	N	Y	658	1%
N	Y	Y	9010	14%
Y	N	N	27646	43%
N	Y	N	17182	27%
N	N	Y	3385	5%
Total			63714	100%





## Trend of military patents



Increasing trend largely due to the «Firm» criterion

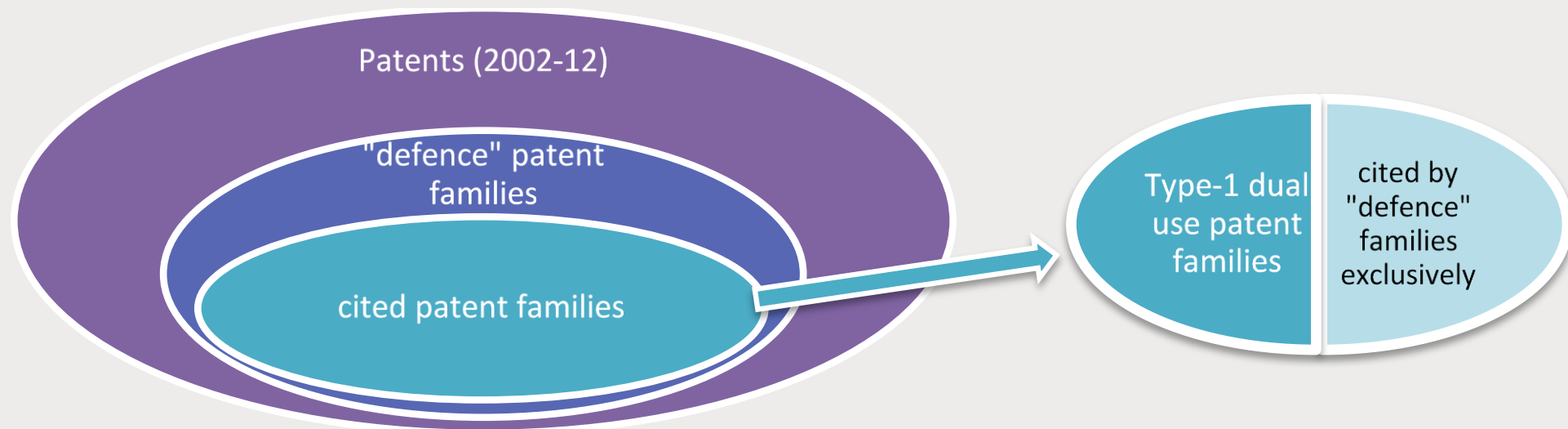
Military firms increasingly innovate in non-military specific fields

# Identification of dual-use patents

Previous works mostly relying on co-classification of IPC codes (Acosta et al., 2011; Acosta et al., 2017; Lee and Sohn, 2017).

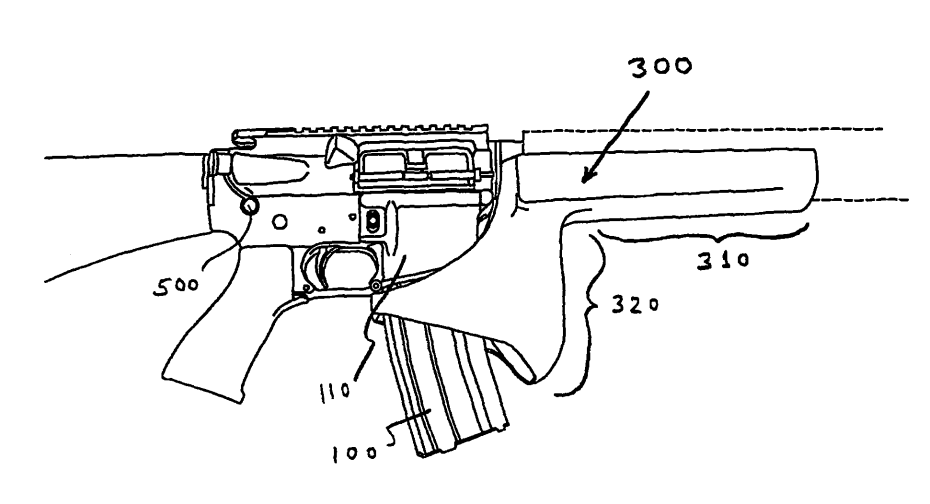
Dual-use as spillover effects when defence generate innovation is used to develop or improve products and processes throughout the economy (Cowan and Foray, 1995)

- At least one Citing Patent is NOT a defence innovation
- ....AND is NOT owned by any firm in SIPRI (*stricter rule, but small change: 2 % points*)

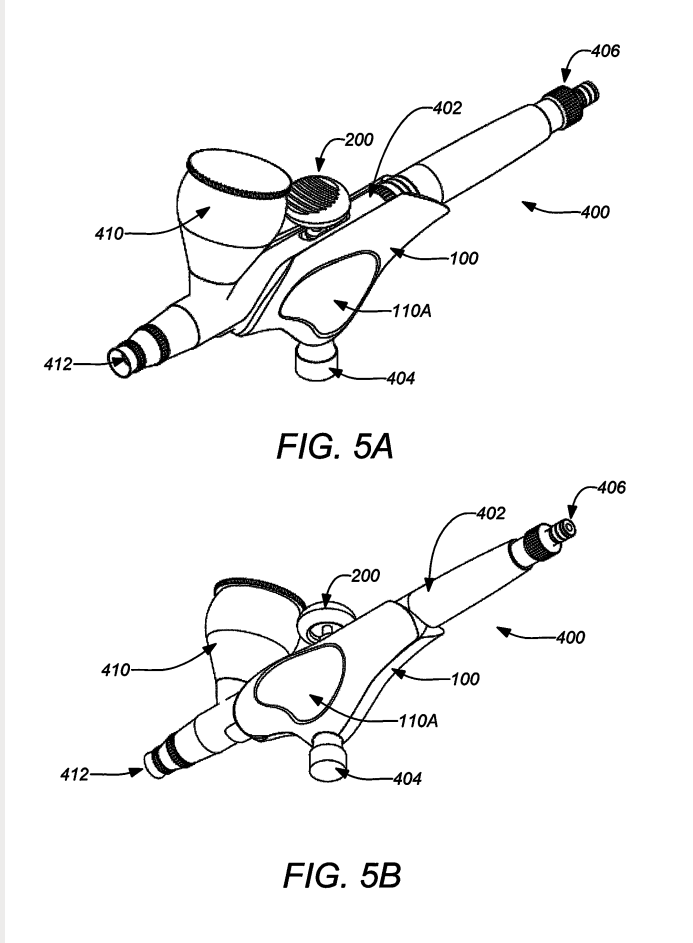


# Some examples of dual-use

US8590201B2  
Firearm grip



US9073200B2  
Pliant removeable airbrush grip



US9206941B2  
Apparatus and method  
for clamping



US9696610B2  
Chain link fence  
attachment clip

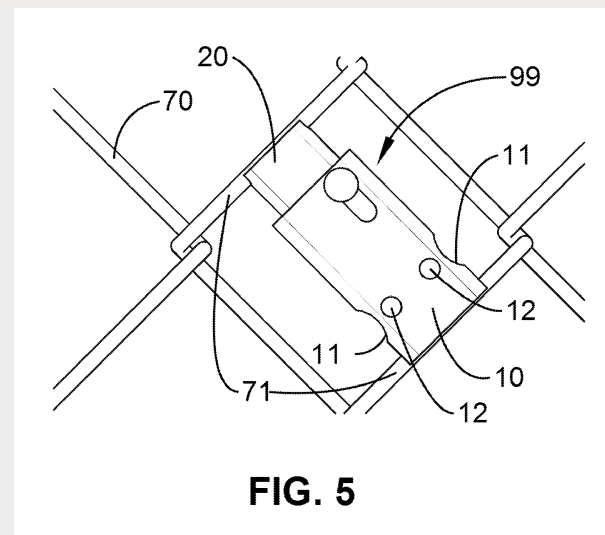


FIG. 5

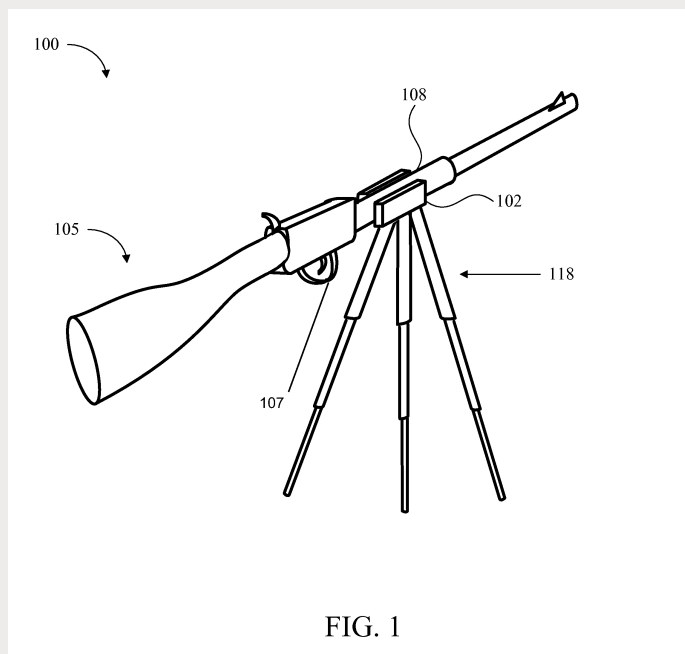


FIG. 1



US9767776B2  
Support stand for a  
musical instrument

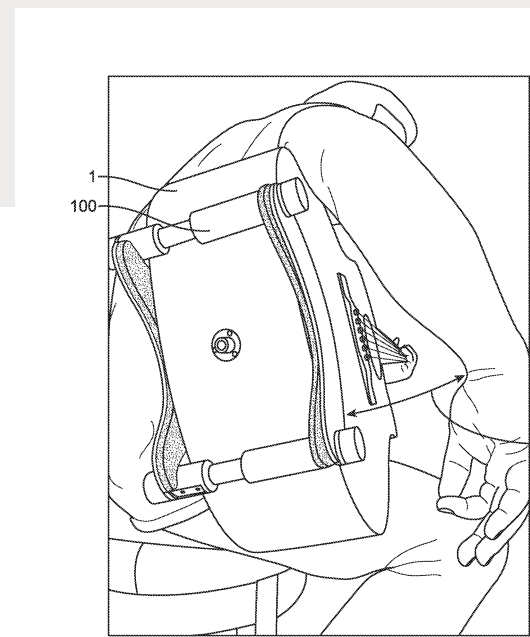
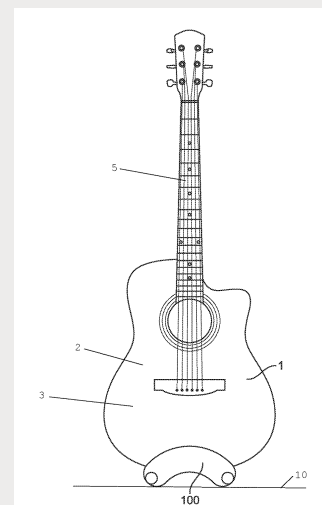
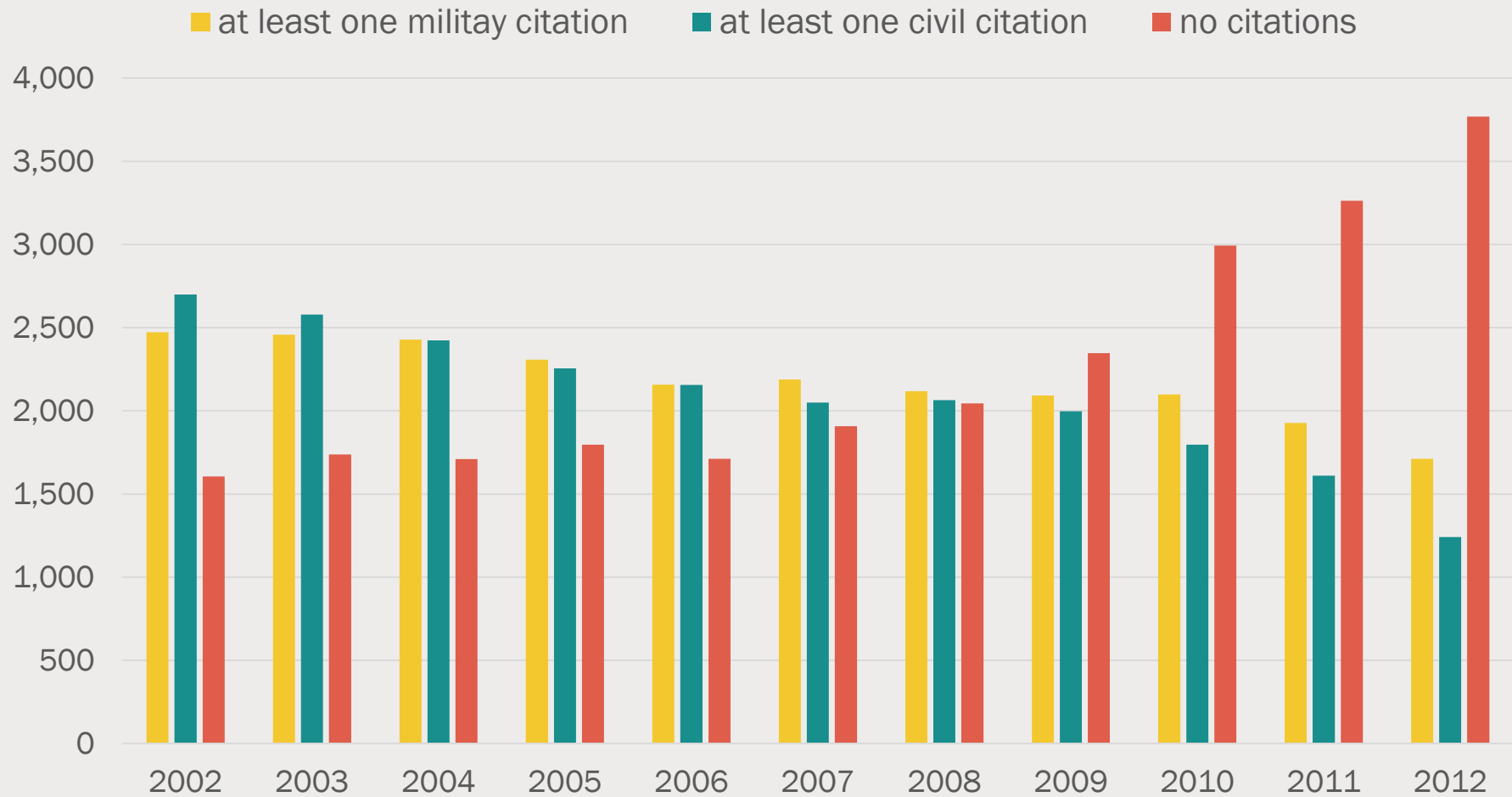


FIG. 2B

## “Quantifying” dual-use

Reference sample	Patent Families	Share of cited	Share of dual-use
Full sample (2002-12)	63,714	61%	<b>41%</b>
<b>Subsamples:</b>			
“firm” criterion	34,137 (54%)	64%	<b>50%</b>
“IPC” criterion	32,025 (50%)	58%	<b>28%</b>
“keyword” criterion	15,452 (24%)	56%	<b>28%</b>

- ❖ Even patents with defence IPC show a non negligible share of dual use (28%)
- ❖ Remember: focus limited to disclosed defence innovations
- ❖ Acosta et al. (2013), citations: 34% ↔ Lee and Sohn (2017), co-occurrence: 12%

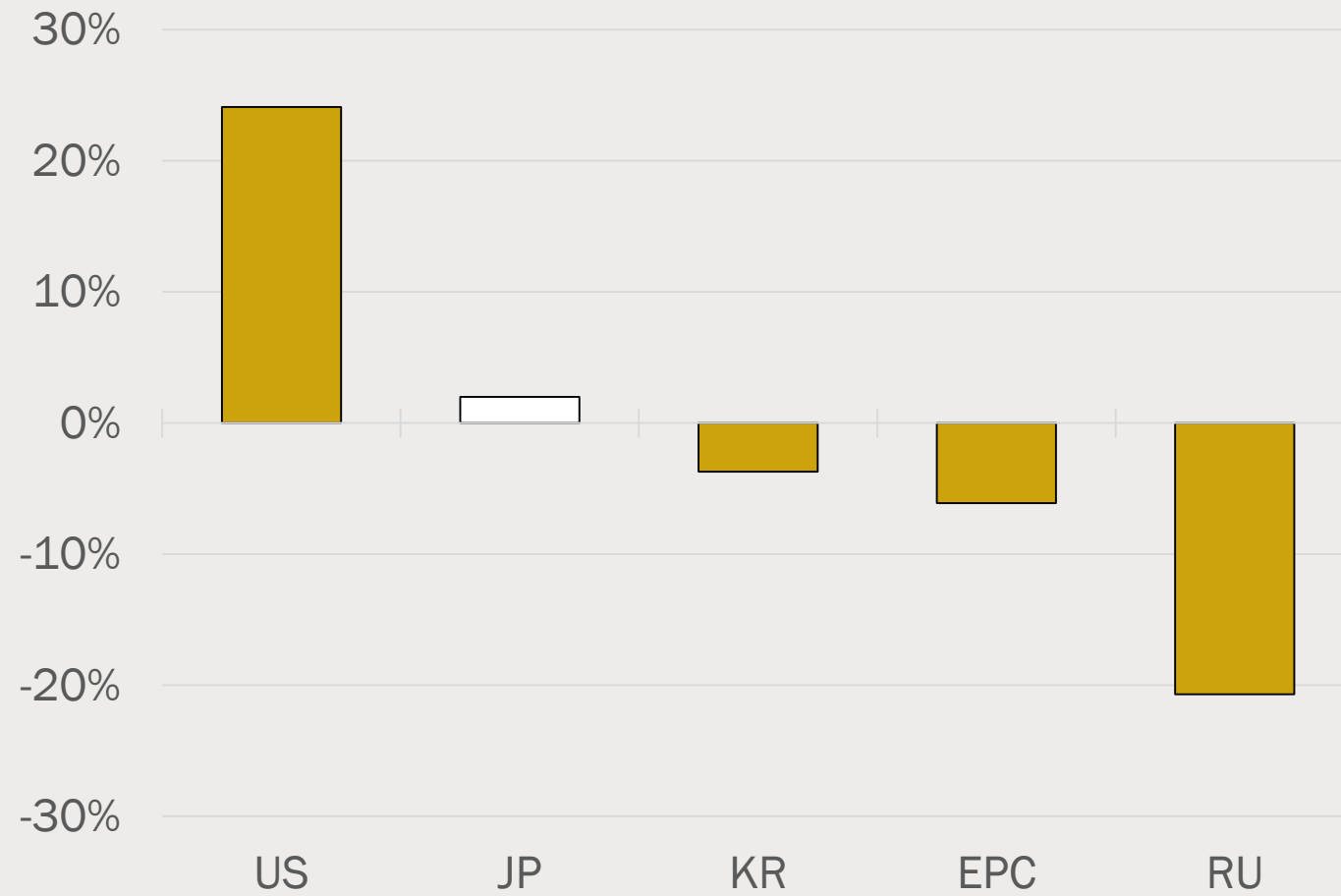


Average time to first military citation, 1281 days  
 Average time to first civilian citation, 1291 days

## Probit: likelihood of becoming a dual-use patent family

	Model 1	Model 2	Model 3
Tech scope		0.128***	0.104***
Backward citations		0.009***	0.008***
Geographical scope			0.052***
Priority office	Yes	Yes	Yes
Tech sector dummies	Yes	Yes	Yes
Priority year dummies	Yes	Yes	Yes
Constant	Yes	Yes	Yes

# Average Marginal Effects for priority offices





# Survival models on the time to the first civil citation

Sub-sample	All patent families	All patent families	All patent families	All patent families	Only weap. and ammun.
Tech scope		-0.151***	-0.121***	-0.164***	-0.268***
Backward citations		-0.008***	-0.006***	-0.007***	-0.007***
Geographical scope			-0.060***	-0.057***	-0.069***
USPTO priority	-1.051***	-0.881***	-1.006***	-1.015***	-1.024***
EPC POs priority	0.234***	0.295***	0.285***	0.261***	0.443***
JPO priority	0.018	0.099*	-0.06	-0.059	-0.006
KIPO priority	0.350***	0.429***	0.272***	0.262***	0.181**
Rospatent priority	1.479***	1.530***	1.369***	1.418***	1.759***
Weapons and ammunit.				0.967***	
Tech sector dummies	Yes	Yes	Yes	No	No
Priority year dummies	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes

## Competing risk model: likelihood of receiving a first civil domestic citation vs. a non-domestic one

	Model 1	Model 2
Tech scope		0.095***
Backward citations		0.004***
Geographical scope		0.004
<b>USPTO priority</b>	<b>3.283***</b>	<b>3.164***</b>
<b>EPC POs priority</b>	<b>0.961***</b>	<b>0.910***</b>
JPO priority	2.274***	2.201***
KIPO priority	2.276***	2.209***
Rospatent priority	0.910***	0.855***
Tech sector dummies	Yes	Yes
Priority year dummies	Yes	Yes

# Conclusions

The USA reports the highest share of dual-use cases and knowledge spillovers tend to happen in a shorter period of time.

Military innovations from Europe EU have a higher probability of nurturing civilian applications in other economic areas (*particularly in the USA*).

Military innovation with a broader technology and geographical scope have a higher probability to nourish future civilian applications, suggesting that targeting multi-purposes technologies may generate more externalities than very targeting very specific ones.

Implications for the European Defence Fund?