Where Do Canadians Patent?

Implications for Canada's Patents Regime

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Outline

- The case for patents
- Where Do Canadians Patent?
  - Imputing missing inventor countries
  - Canadian patenting globally
  - Inventions filed only domestically
- Implications for Canada's Optimal Patent Regime

"Ideas fuel the economy. Today's patent systems are a rotten way of rewarding them."

The Case for Patents

Benefits

Increased incentives to innovate

Facilitating knowledge diffusion

Creating a market for ideas and innovation

Costs

Deadweight losses for society

Stifling follow-on innovation (holdup)

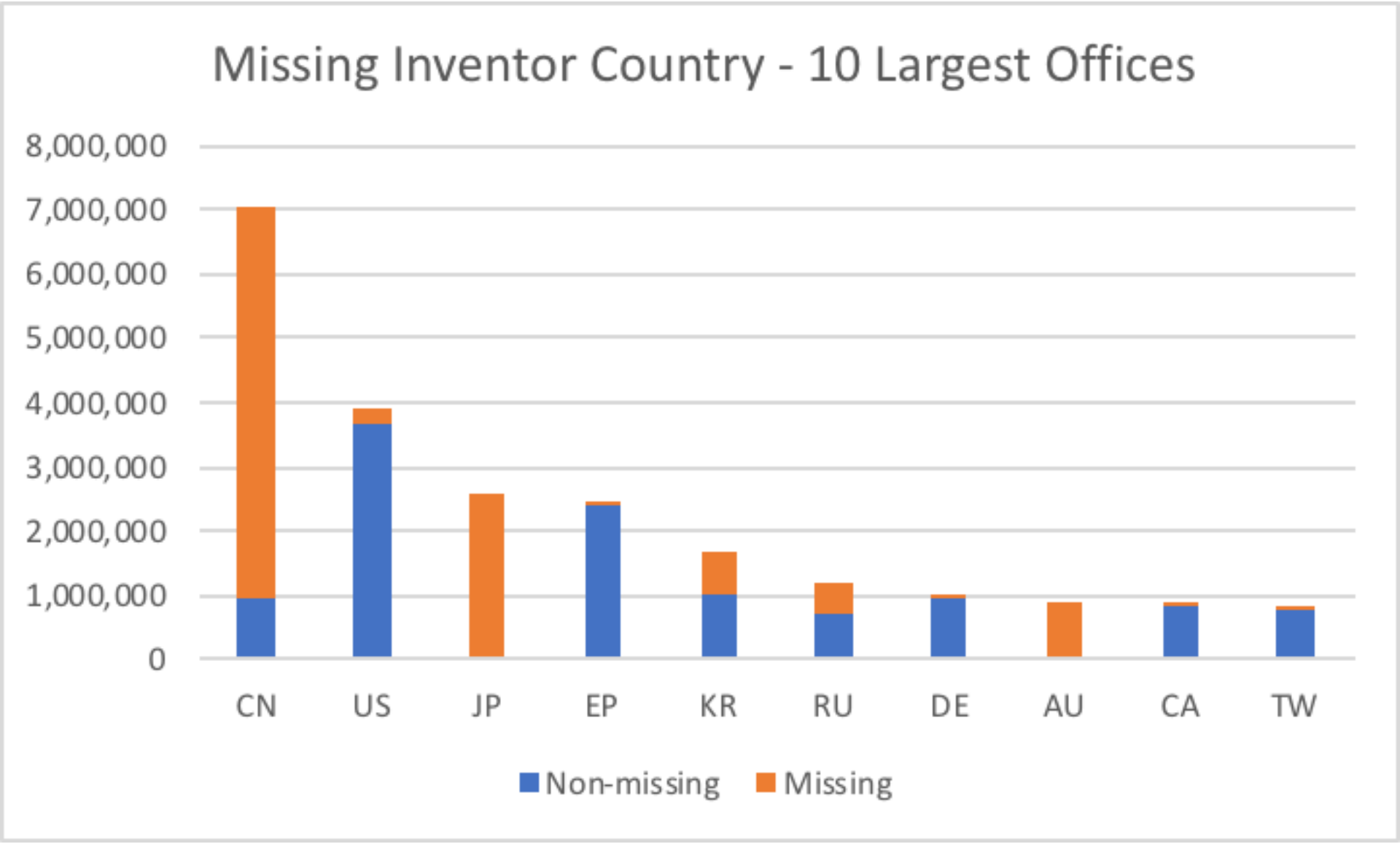
Administrative burden

Optimal Patent Strength

- When Canada creates a patents regime we do so knowing that society suffers static deadweight losses
  - But perhaps this is outweighed by a dynamic welfare gain if patents provide significant incentives for domestic innovation
- To what extent does the Canadian patents regime foster domestic innovation?

Where Do Canadians Patent?

- Patstat Database
  - 100M patent applications from >90 patent offices
- Can track patent families across offices
- Inventor country variable
  - Canadian inventions: ones where at least 50% of inventors reside in Canada
  - But inventor country variable is missing in 50% (67,524,123/133,914,816) of application-inventor instances


Missing Inventor Country - 10 Largest Offices
8,000,000
7,000,000
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
CN
US
JP
EP
KR
RU
DE
AU
CA
TW
Non-missing
Missing

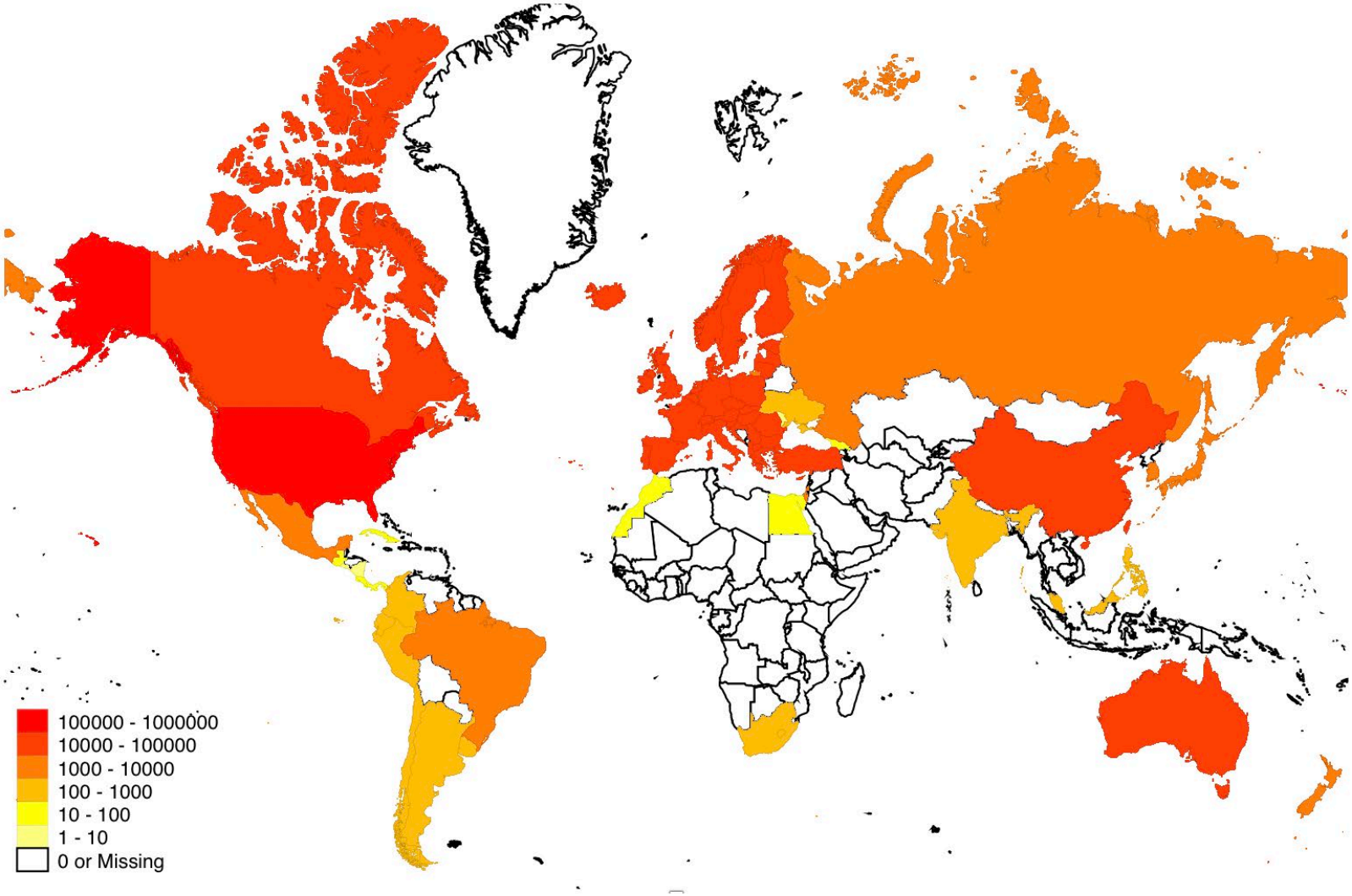
Inferring Missing Inventor Countries

- Step 1: Look for the inventor's country within other applications within the same family
  - Imputes 11,871,076/ 67,524,123
- Step 2: Look for the inventor's country within other applications with the same assignee and inventor
  - Imputes 8,709,381/ 55,653,047
- Step 3: Repeat step 1.
  - Imputes 104,967/ 46,943,666

Imputation Outcome

- Pre-imputation: 67.5M/133.9M (50.4%) missing
- Post-imputation: 46.8M/133.9M (35.0%) missing
- Take-away:
  - We will underestimate the extent of Canadian patenting in countries like CN, JP, and AU
  - But perhaps not by much since the large majority of inventions filed in those countries by Canadians will also have been filed in at least one of US, CA, EU

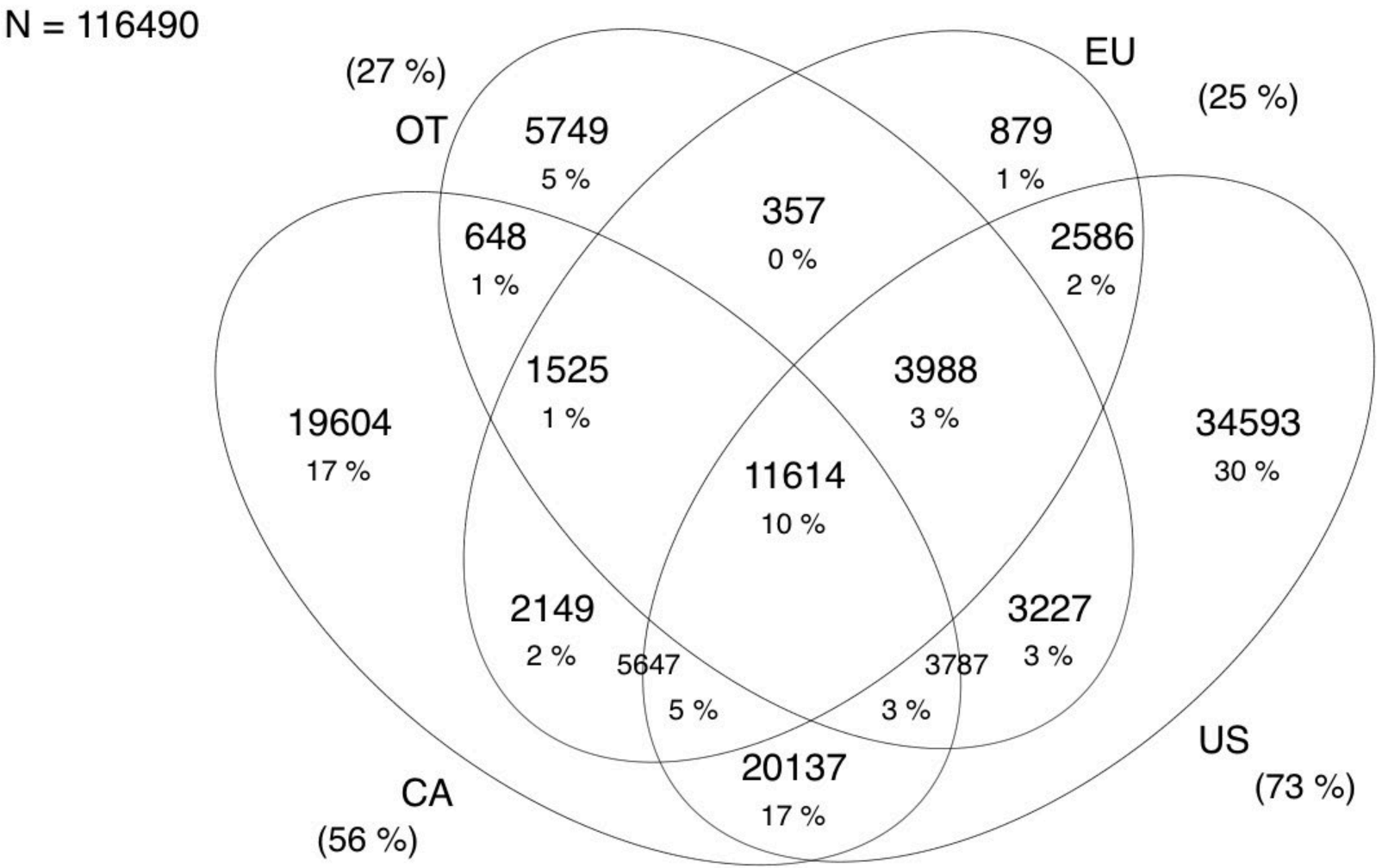
Canadian Global Patent Applications



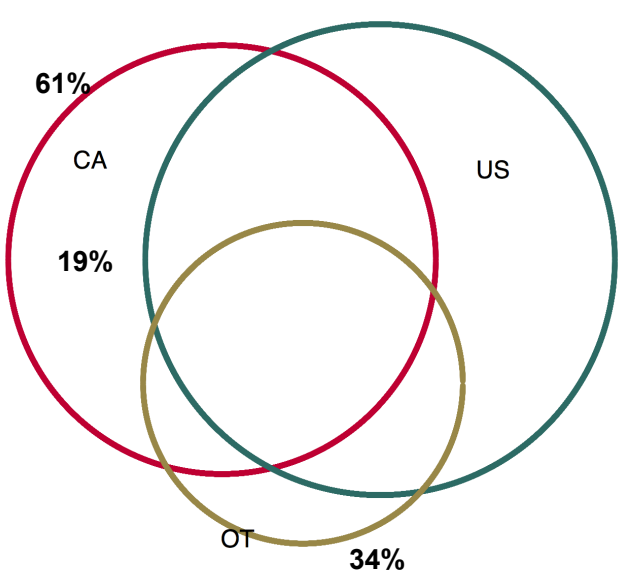
Canadian Patent Applications by Office

Patent Office	Number of Applications
1. United States	114,324
2. Canada	71,154
3. European Patent Office	31,960
4. China	19,781
5. Australia	11,495
6. Japan	7580
7. Korea	6949
8. Brazil	4180
9. Mexico	3870
10. Taiwan	2867
11. Russia	2228
12. Hong Kong	2025

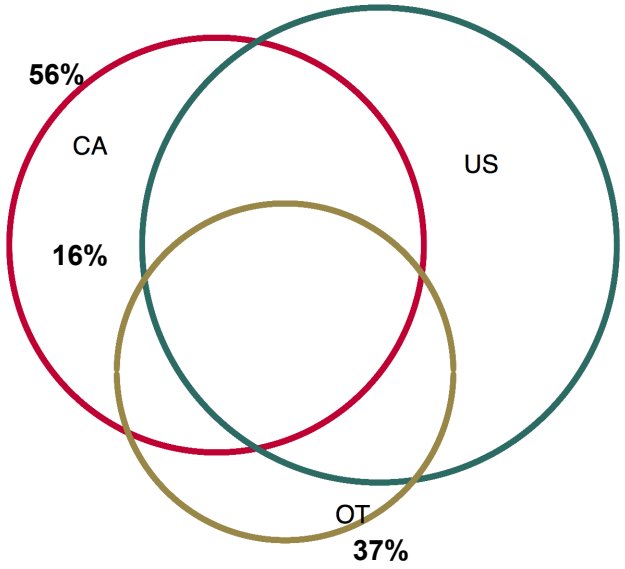
Canadian Invention Protection



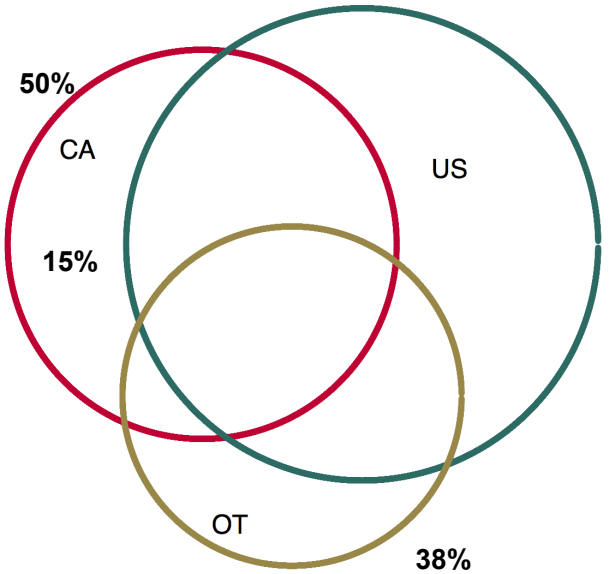
Canadian Invention Protection Over Time, Proportional Venn Diagram



2001-2006

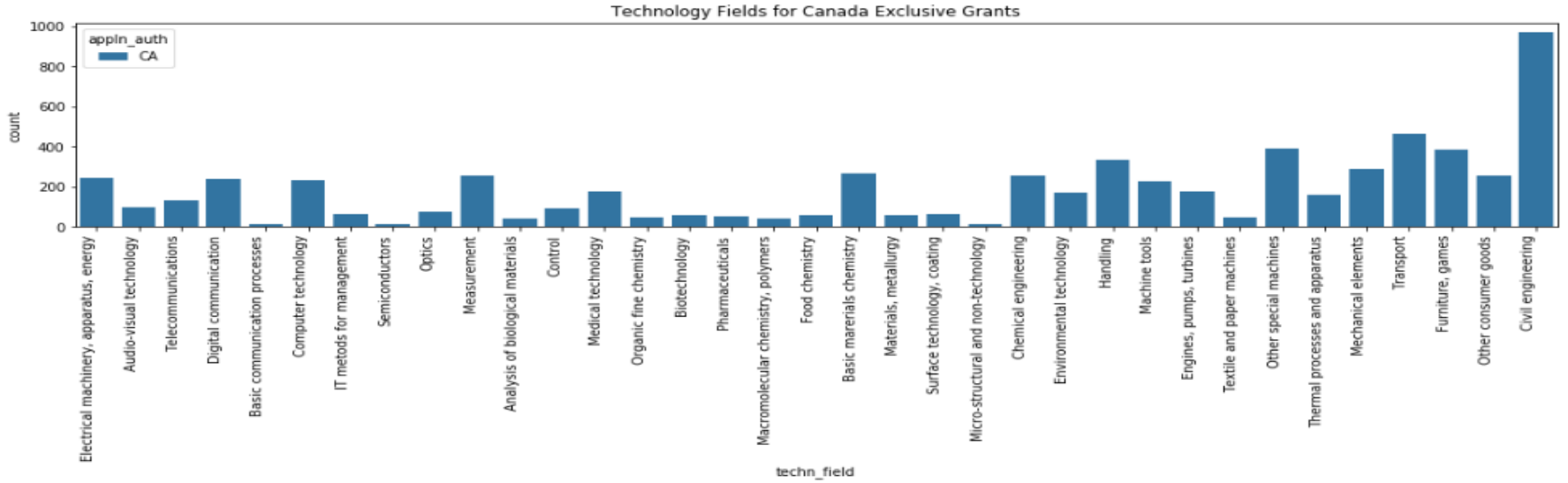


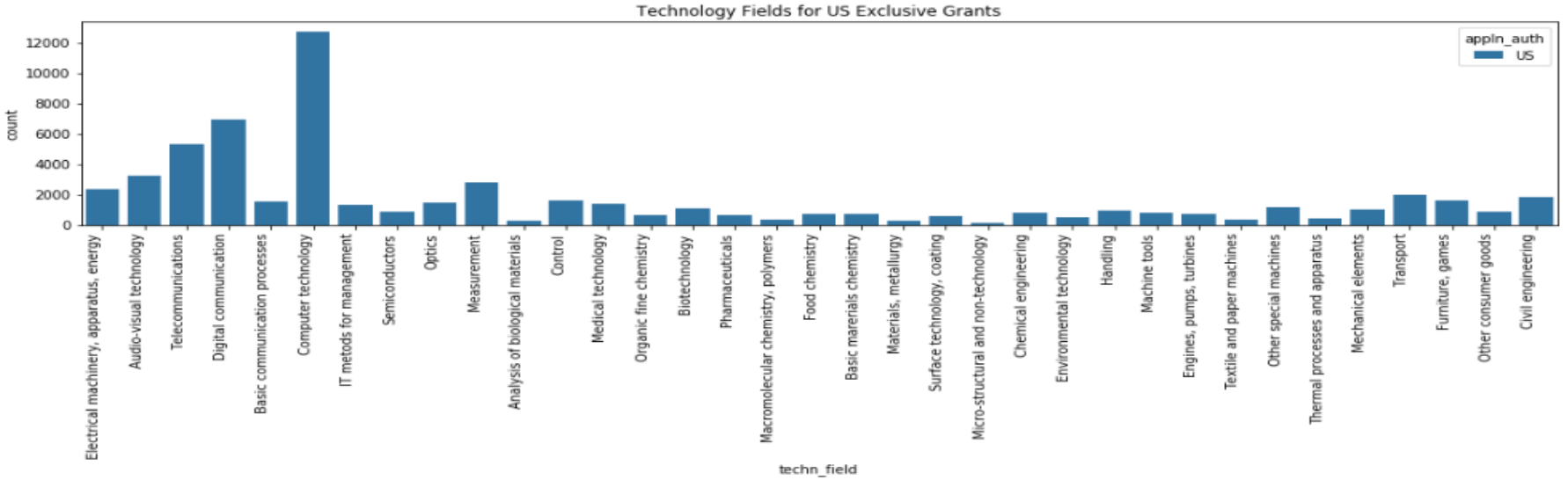
2006-2011



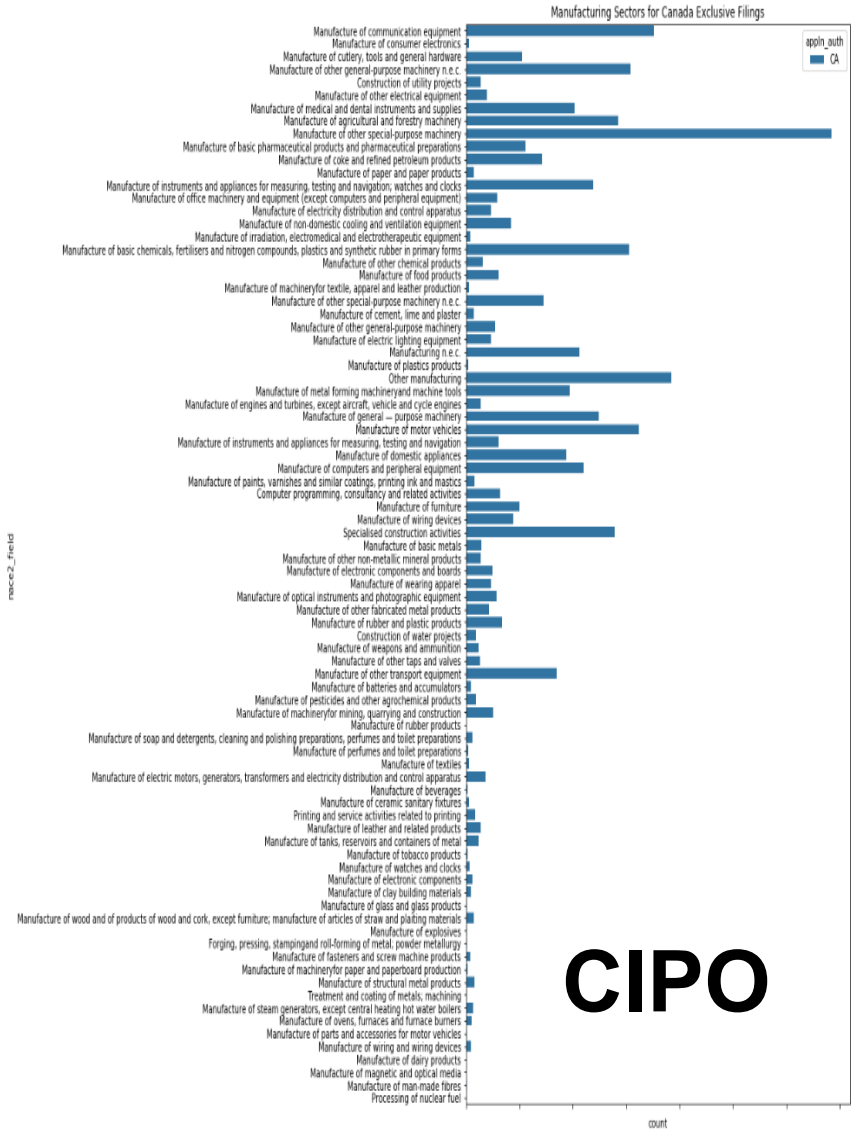
2011-2016

Canadian Inventions Filed Exclusively In Canada vs Exclusively In US

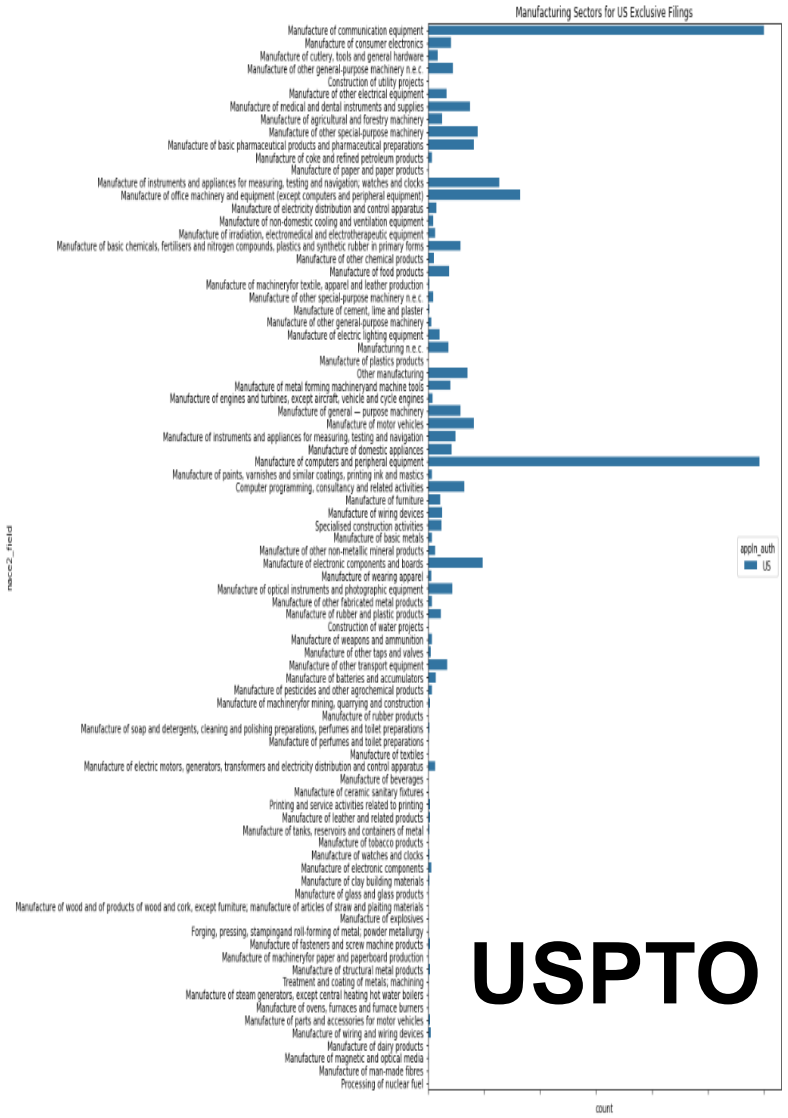




What do Canadians Patent at CIPO/USPTO?

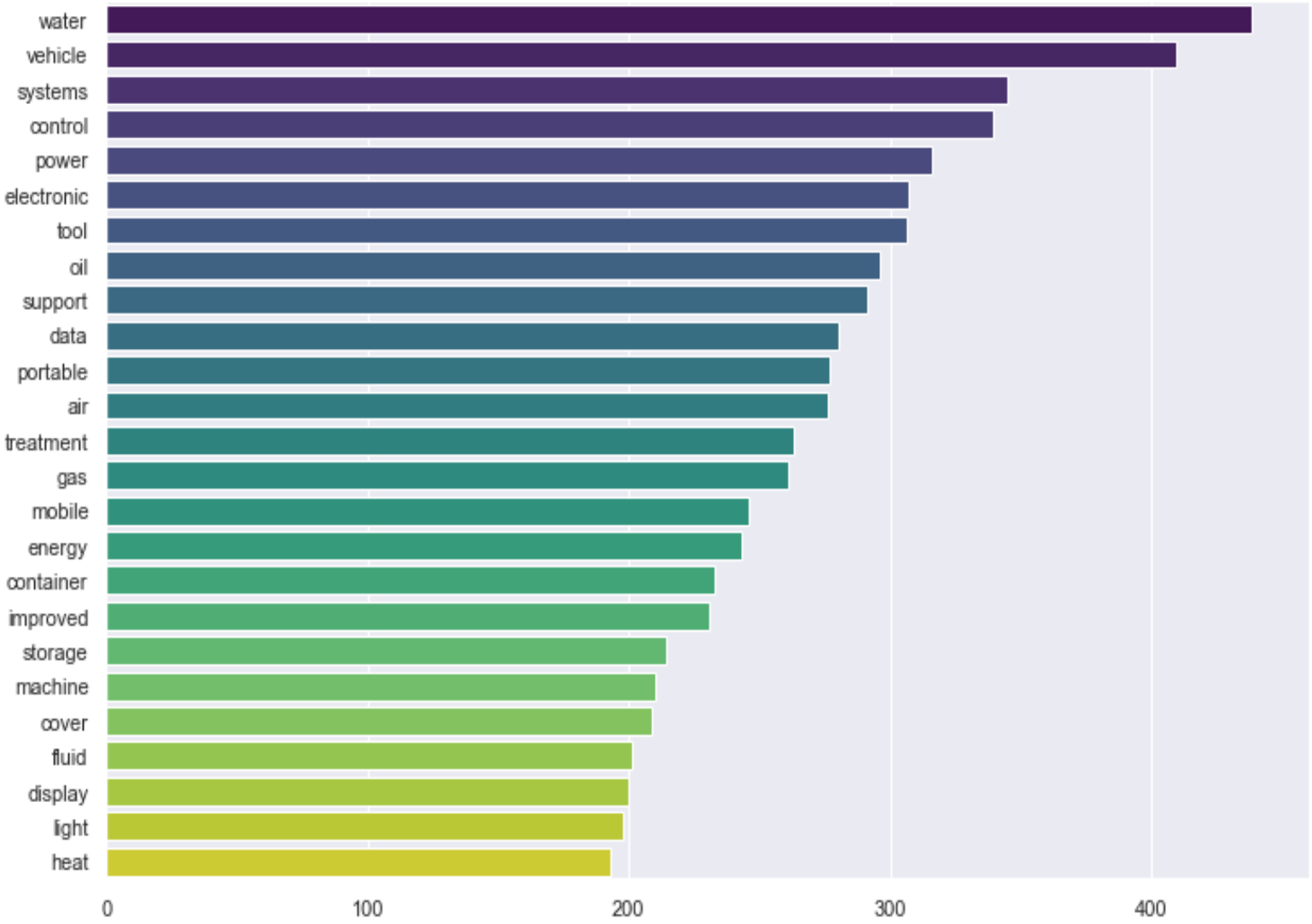


CIPO

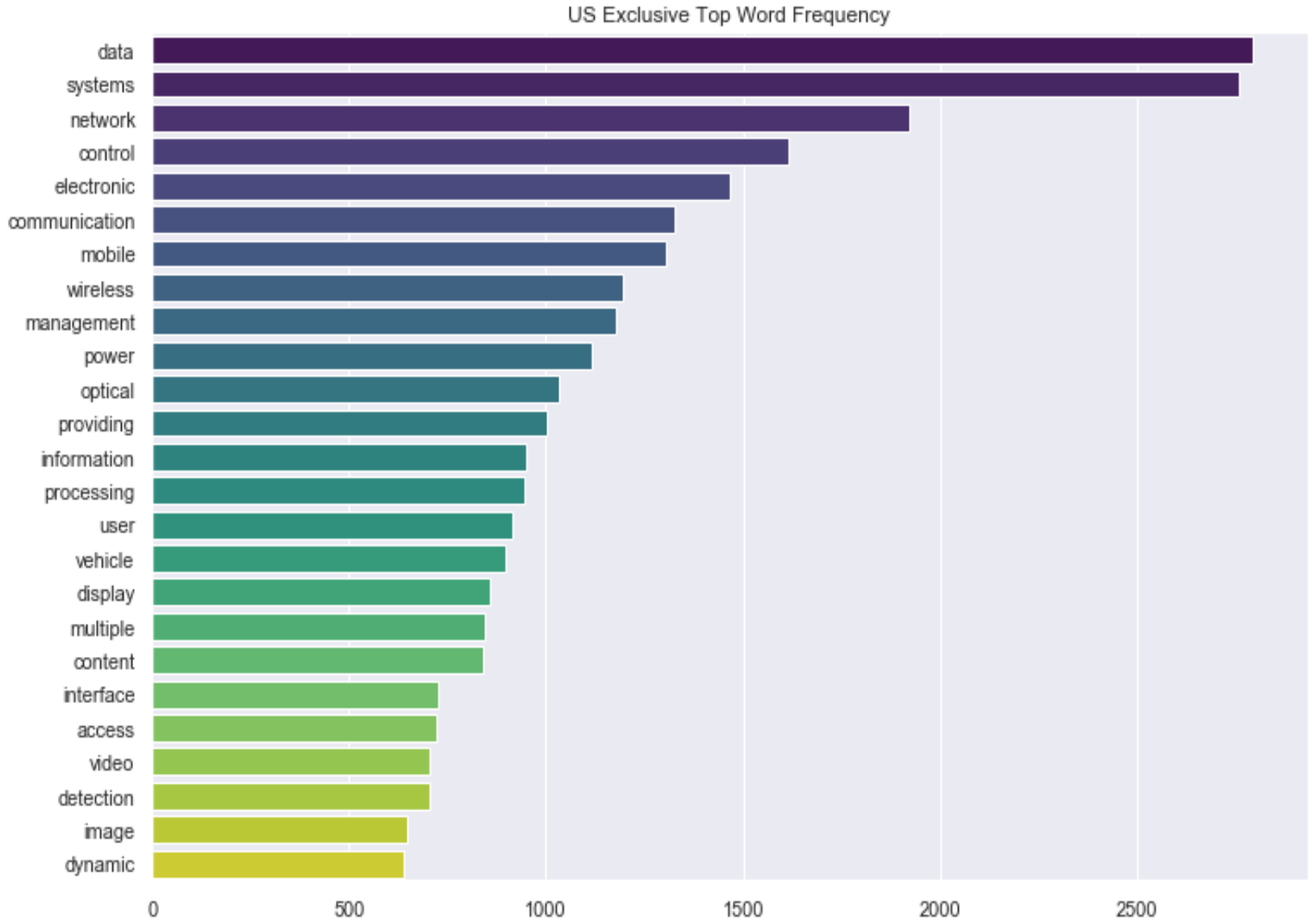


USPTO

Top Words In CIPO Exclusive Canadian Patents



Top Words In USPTO Exclusive Canadian Patents



CIPO vs USPTO Exclusive Canadian Applications

Dependent Variable: Indicator for CIPO exclusive filing		(1) OLS
Industry R&D Intensity		-0.0169***
		(0.0003)
Firm Assignee		-0.0192***
		(0.005)
Number of Inventors		-0.035***
		(0.002)
Citations Received		-0.0131***
		(0.0007)
Application Year		
	2002	-0.01 (0.01)
	2003	-0.05*** (0.01)
	2004	-0.07*** (0.01)
	2005	-0.08*** (0.01)
	2006	-0.11*** (0.01)
	2007	-0.15*** (0.01)
	2008	-0.13*** (0.01)
	2009	-0.14*** (0.01)
	2010	-0.17*** (0.01)
	2011	-0.18*** (0.01)
	2012	-0.20*** (0.01)
	2013	-0.22*** (0.01)
	2014	-0.24*** (0.01)
	2015	-0.21*** (0.01)
	2016	-0.19*** (0.01)
R-squared		0.2070
Observations		43,960

Conclusions

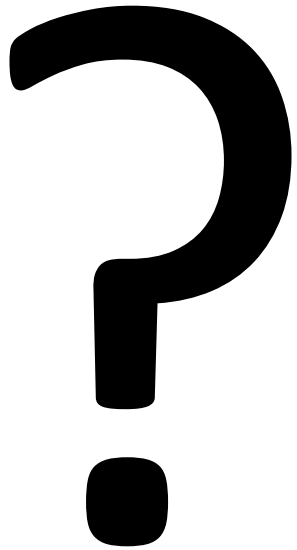
- Canadians derive patent-related incentives to innovate mostly from abroad
  - Mostly patent abroad
  - Few inventions are only patented in Canada (and falling) and these seem to be the least valuable
- Canada's patent regime unlikely to be significantly promoting domestic innovation

Canada's Optimal Patent Regime*

- From the point of view of welfare, patents are probably too strong
  - Make patents more narrow
  - Limit patentable subject matter
  - Apply higher examination standards (utility, novelty, non-obviousness)
  - Etc.

*Subject to international obligations

Questions?



UNITED STATES
PATENT AND TRADEMARK OFFICE

Identifying AI invention: A novel AI patent dataset

Nicholas A. Pairolero
Coauthors: Alexander V. Giczy and Andrew A. Toole

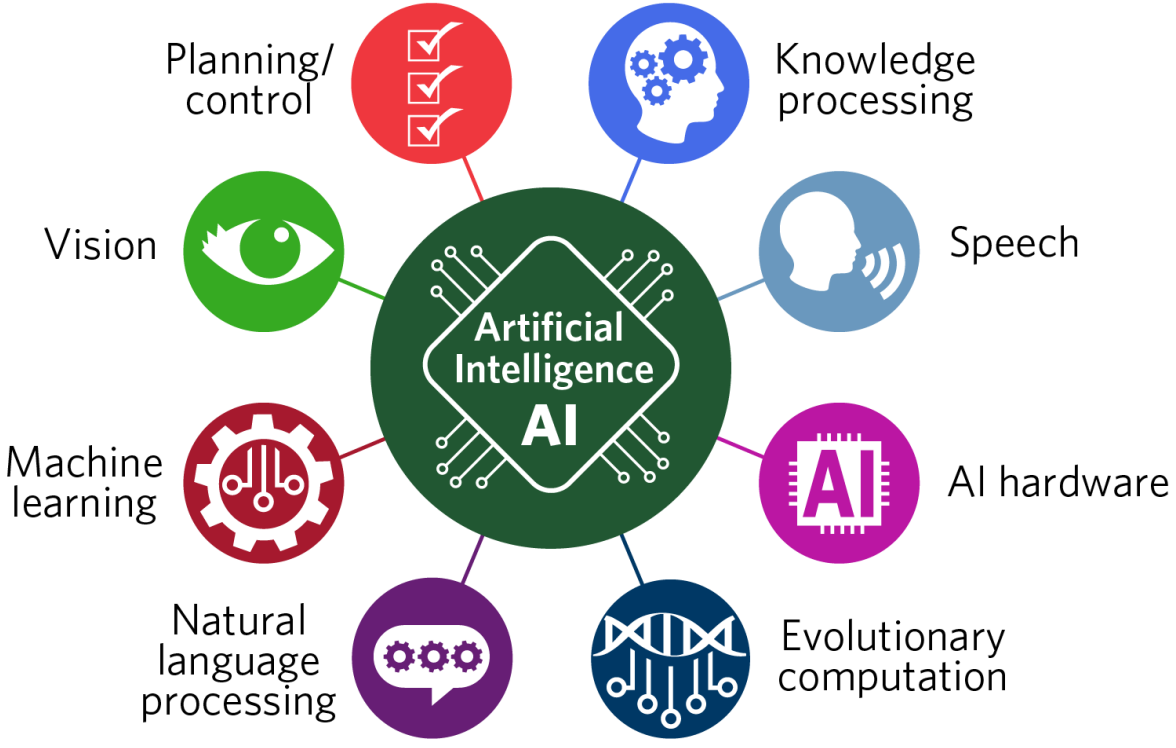
March 24, 2022

UNITED STATES
PATENT AND TRADEMARK OFFICE
uspto

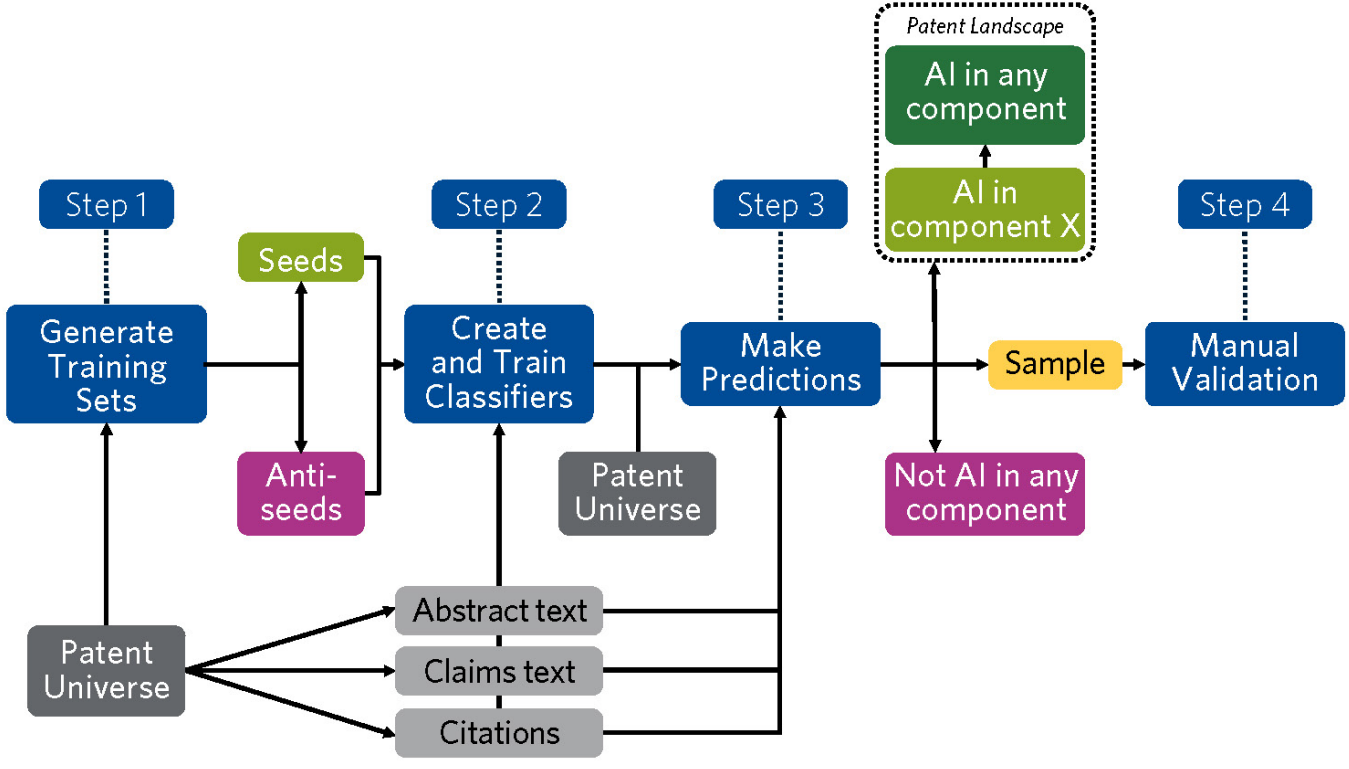
Overview

- Artificial intelligence (AI) has progressed rapidly in recent years, generating considerable interest among academic researchers and policymakers.
- Surprisingly, empirical evidence on the determinants and impacts of AI inventions is still limited (Raj and Seamans 2018; Felten et al. 2021).
- One reason is a paucity of publicly available data.
- To help researchers, policymakers, and the public, we released a novel dataset identifying AI (or not AI) in over 13.2 million USPTO patents and pre-grant publications (PGPubs).

Component technology-based definition of AI

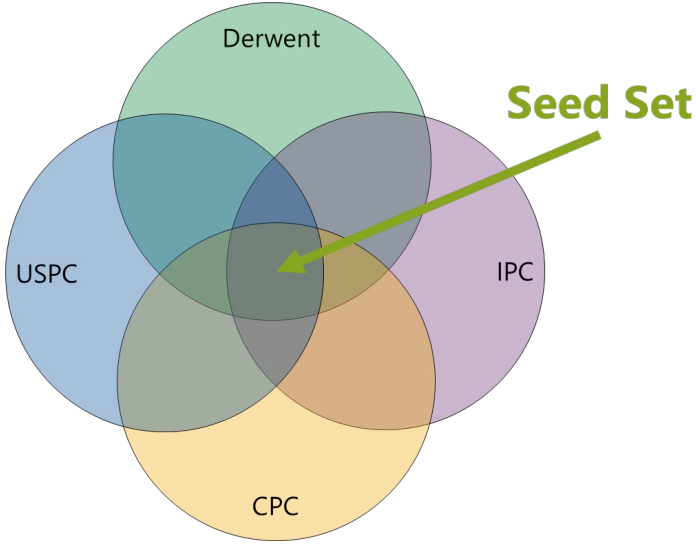


Methodological approach



Seed and anti-seed generation

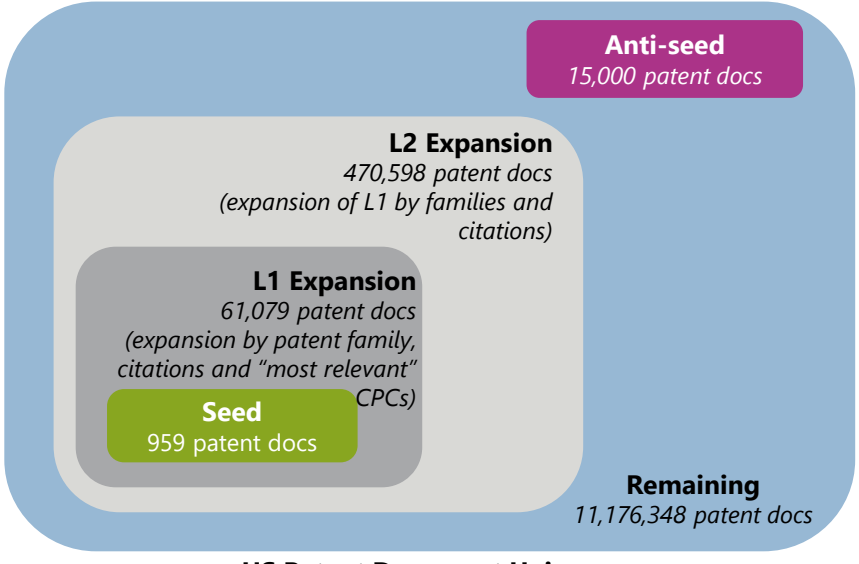
Seed set generation



Source: USPTO analysis

Expansion to generate anti-seed

Example: Machine Learning category



Source: Abood and Feltenberger (2018);
machine learning results per USPTO analysis

Evaluation sample

- Randomly sample 800 patent documents from the consolidated seed set (216), anti-seed set (216), and everything else (368).
  - Seed and anti-seed evaluation examines accuracy of training data.
  - Everything else provides information on prediction on the broader patent universe outside of the seed and anti-seed.
- Each document was evaluated by two AI examiners for each AI component technology.
- A third examiner adjudicated disagreements at the level of “any ai,” that is, whether the patent document contained any AI component technology.

Exploring the annotation

Confusion Matrixes	Seed		Anti-seed		L1, L2, and remaining	
	Adj: any AI	Adj: not AI	Adj: any AI	Adj: not AI	Adj: any AI	Adj: not AI
A or B: any AI	199	7	16	35	40	75
A or B: not AI	14	17	2	200	9	328
Metrics						
# documents	237		253		452	
Precision	0.9660		0.9901		0.3478	
Recall	0.9343		0.8511		0.8163	
Accuracy	0.9114		0.8538		0.8142	
F1 score	0.9499		0.9153		0.4878	

Comparison to other studies

Confusion Matrixes	Cockburn (recreated)		WIPO (recreated)		Our approach	
	Examiners: any AI	Examines: not AI	Examiners: any AI	Examines: not AI	Examiners: any AI	Examines: not AI
Study: any AI	0	0	4	2	15	22
Study: not AI	40	328	36	326	25	306
Metrics						
# documents	368		368		368	
Precision	0.0000		0.6667		0.4054	
Recall	0.0000		0.1000		0.3750	
Accuracy	0.8913		0.8967		0.8723	
F1 score	0.0000		0.1739		0.3896	

Conclusion

- Our ML approach achieves state-of-the-art overall performance relative to a variety of benchmarks from the academic and policy literatures.
- Both machines and humans struggled with classification at the boundaries of the various AI component technologies.
- The performance of our ML classifier varies by component technology
  - Evolutionary computation, knowledge processing, and planning and control have lower performance statistics than others

Thank you!

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Missions, Mandates and Metrics: What are the Right Metrics for Academic Technology Transfer?

3/23/2022

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University of Waterloo Office of Research

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What is the Problem?

- Technology Transfer Offices (TTOs) are operational units created by universities and other research organizations primarily to manage intellectual property arising from research.
- In the early 80s TTOs spread widely in North America as a result of the US Bayh-Dole Act of 1980
- AUTM began collecting statistics on royalty generation from IP licensing shortly after
- It has become commonplace to use the AUTM Licensing Survey as a means of benchmarking TTO performance. But is it aligned with how Canadian TTOs see their own mission?

A Proposed Model for Understanding Missions and Mandates

- Based on many years of observation, it is suggested that most TTOs focus on some combination of the following deliverables:

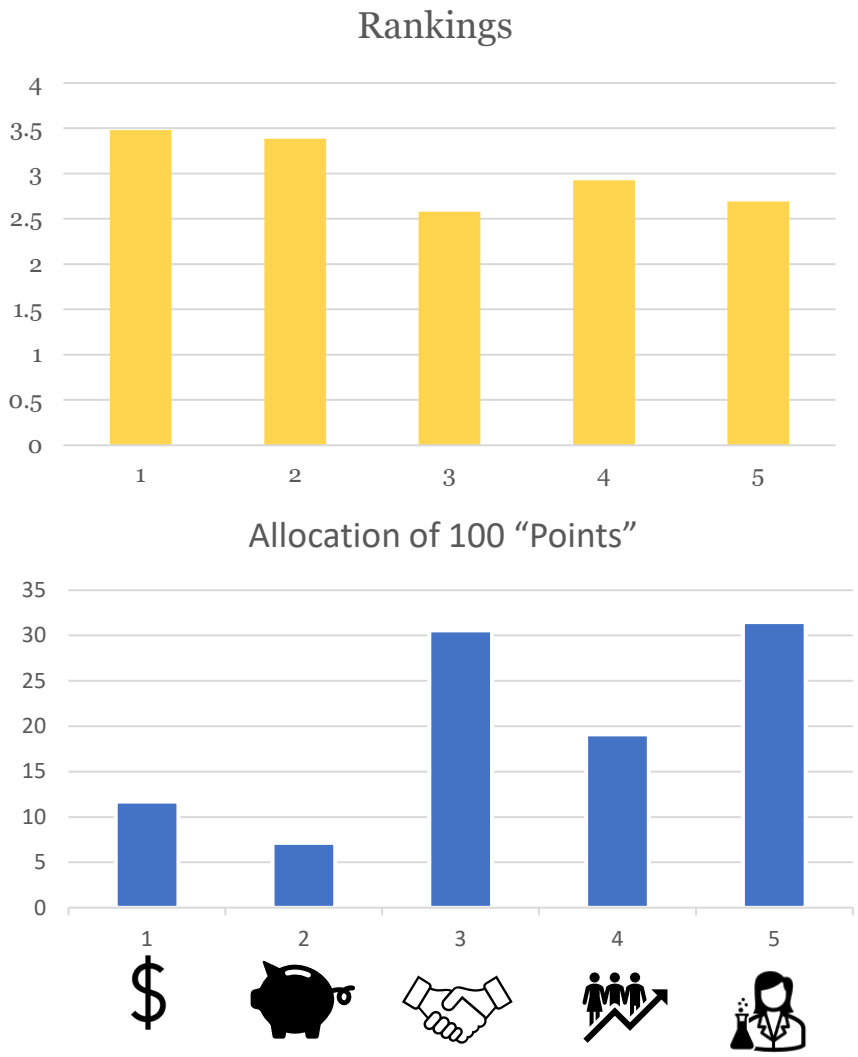
1. Maximize gross revenue (focus on 'gross license income' as reported to AUTM)
2. Maximize profits (more selective; focus on big wins; fewer techs per staff)
3. Maximize knowledge mobilization (KM) and research impact (get as much IP in use by third parties as possible; take on more projects and deals, even at expense of revenue)
4. Maximize local economic growth (prioritize local companies and start-ups)
5. Maximize client satisfaction (prioritize the needs of faculty and students; focus on the culture)





- Survey respondents (TTO Directors) were asked to (a) rank these approaches 1-5; (b) assign “points” out of 100 total to each approach

Survey Results



- Respondents were asked to rank these approaches out of order of priority (lower number is higher ranking)
- Respondents were asked to allocate 100 total "points" among the approaches
- Very clear priority for knowledge mobilization (3) and service to researchers (5). Revenue generation categories ranked lower.
- Economic Development (4) noted as priority for Quebec Valorisation entities and a few others, e.g., U of Manitoba - #1 ranked priority

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Interpretation

- Few TTO directors profess a focus on revenue generation as their primary mission
- Knowledge mobilization, economic development, and service to academic community rank much higher in the minds of TTO directors
- **TTO metrics focused on royalties do not reflect the priorities and missions of most TTOs (as interpreted by their directors).** Metrics on transfer of technologies (deal flow) for societal and economic impact better fit the focus of most TTOs. This focus also suggests relevance of metrics on industry-sponsored research, which is the most direct form of technology transfer (and which may or may not include patents or royalties)
- Closing thought – the mission orientation away from revenues may also reflect the difficulty of making sustainable positive revenues from technology transfer activities, except at elite institutions. But if the goal of technology transfer is primarily about the betterment of society, should the burden of paying for it fall to institutions?

Future Metrics for Academic Technology Transfer for the Betterment of Society

Natalie Raffoul, P. Eng. (Electrical), J.D.

Lawyer, Patent Agent

Managing Partner of Brion Raffoul LLP

Co-Found of Fortress.Legal™

Future metrics

"For the betterment of Canadian society" we need to address:

low BERD (business expenditure in research and development is well below OECD average (https://www.ic.gc.ca/eic/site/062.nsf/eng/00088.html)

low labour productivity compared to other advanced economies see OECD report (https://www.oecd.org/economy/growth/scenarios-for-the-world-economy-to-2060.htm)

Academic tech transfer to Canadian **headquartered** versus foreign firms:

1. Number of licenses/options/transfers to Canadian v. foreign firms
2. Revenue generated from licenses/options/transfers to Canadian v. foreign firms
3. Patents licensed/optioned/transferred to Canadian v. foreign firms
4. Number of research collaborations with Canadian v. foreign firms

Future metrics

For company-sponsored academic research, we need to measure

1. co-ownership of patents **versus**
2. co-authorship of papers/publications

From Cecilia Rikap: https://www.tandfonline.com/doi/abs/10.1080/2157930X.2020.1855825?journalCode=riad20

Table 4. Co-authorship versus co-patenting as evidence of knowledge predation.

Company	Publications (until 2019 included)	Co-authored papers	% Co-authorship	Applied & granted patents (until 2017 included)	% of co-owned patents	Co-authorship versus co-ownership
Amazon	824	719	87.3%	10,063	0.1%	87,257
Microsoft	17,405	13622	78.3%	76,109	0.2%	39,132
Google	6447	5305	82.3%	25,538	0.3%	27,429

Source: Authors' calculation based on Web of Science and Derwent Innovation.

Questions?

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