Surviving the Fintech Disruption

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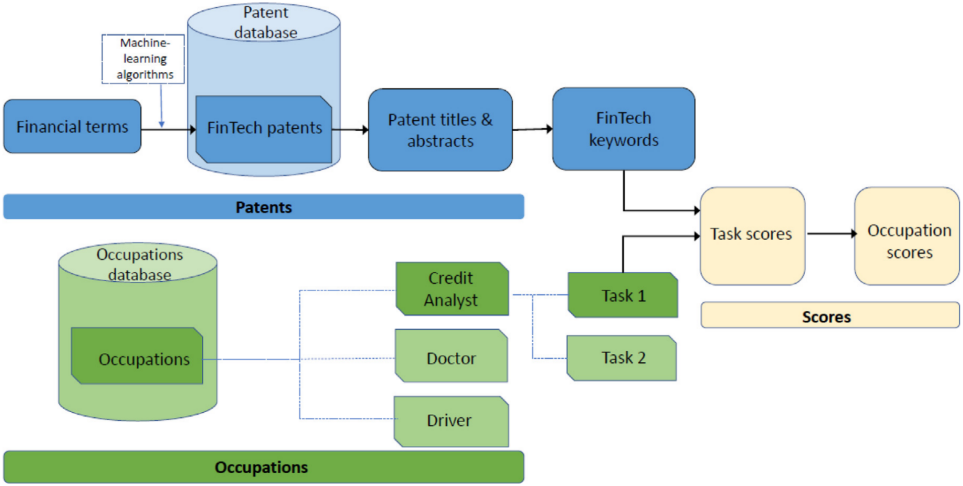
Overview


Patent database
Machine-learning algorithms
Financial terms
FinTech patents
Patent titles & abstracts
FinTech keywords
Patents
Task scores
Occupation scores
Scores
Occupations database
Occupations
Credit Analyst
Doctor
Driver
Task 1
Task 2
Occupations

Motivation

- Wave of fintech
  - Finance remain untouched by past waves of technological innovation (Philippon, 2015).
  - Recent fintech wave disrupt financial service (Decentralization & Disintermediation).
  - This setting allow to delve into creative destruction process of innovation.
- Creative destruction in finance
  - Debate on the **trade-off** between new opportunity technological advancement bring and labor force displacements it cause.
  - Inter-industry competition from IT provide more efficient service.
  - Effect of fintech on labor market complex (within and across firms and sectors).

Research Question

- What is impact of fintech innovation on labor market?
  - Occupation with high exposure to fintech decline in job postings and employment.
  - Fintech blur traditional industry boundary, creating demand for cross-disciplinary skill of finance and technology.
- How do firms adapt to fintech wave?
  - Firms upskill through hiring, reallocate talent internally, pivot innovation to new areas.
  - Firms better equipped to absorb shock than individual workers.
  - Innovative firms growth in employment, sales, and productivity upon disruption.

Contribution

- Contribute to literature on impact of technological changes on job market.
  - Prior: AI (Acemoglu, 2022; Babina et al., 2024); industrial robot (Acemoglu and Restrepo, 2018; Graetz et al., 2018); green technology (Vona et al., 2018; Cohen, 2020).
  - This paper: fintech change the way of finance instead of automating existing task.
- Contribute to literature on occupation-specific technological innovation.
  - Prior: occupation exposure to technology and industry-level employment (Webb, 2019); breakthrough innovation and worker-level earning growth rate (Kogan et al., 2023).
  - This paper: shift to firm-level, labor market response as channel of creative destruction.
- Contribute to literature at intersection between labor and finance.
  - Prior: capital structure and labor factor (Matsa, 2010); labor and corporate decision such as M&A (Tate, 2016), firm growth (Mueller, 2017), investment (Bai et al., 2020).
  - This paper: firm actively adjust hiring strategy and survive fintech disruption.

Fintech Patents

- Fintech-related patent application
  - From US Patent and Trademark Office (USPTO) Jan.1, 2003 - Sept.7, 2017
  - Title and abstract of patent contain scope and content of underlying innovation.
  - Chen et al. (2019) procedure to filter fintech-related filing:
  - (1) Text search with financial terms
  - (2) Manually distinguish training sample
  - (3) Supervised ML to classify
  - Supplement with list of major finance innovation patents identified by Lerner (2024).
  - 6526 fintech patent fall into 7 categories: cybersecurity, mobile transaction, data analytics, blockchain, P2P, robo-advising, IoT

Fintech Innovators

- Fintech inventor & Acquisition innovator
  - Inventor and assignee of patent could be different from applicant.
  - Track each patent throughout life cycle: filing date ⇒ granting ⇒ assignment/transfer
  - 1384 filed and held by individuals, 5142 filed by firms or their employee transfer to firms.
  - Inventor: file at least 1 fintech patent during past 5 years.
  - Acquisition innovator: acquire fintech patent during past 5 years among non-inventor.
  - 485 fintech inventors (256 public), 307 acquisition innovators (161 public)

Top Inventors				Top Acquirers			
Firm	NAICS	Industry	Patents	Firm	NAICS	Industry	Patents
Mastercard	52	Finance	453	Paypal	51	Information	251
Visa	52	Finance	400	III Holdings 1			121
American Express	52	Finance	325	Microsoft	51	Information	53
Bank of America	52	Finance	317	Capital One	52	Finance	49
Ebay	51	Information	178	American Express	52	Finance	48
IBM	54	Information	151	Bank of America	52	Finance	47
Square	51	Information	131	Xatra Fund MX			44
First Data	51	Information	119	Visa	52	Finance	41
Paypal	51	Information	92	Chartoleaux KG LLC			30
Capital One	52	Finance	82	Square	51	Information	30

Industry Distribution of Fintech Patent Filers

NAICS Code	Industry Title	Number of Fintech Patents			% of Fintech Patents		
		Publication Date	Grant Date	1 Year After Grant Date	Publication Date	Grant Date	1 Year After Grant Date
11	Agriculture	0	0	0	0.00%	0.00%	0.00%
21	Mining	2	2	2	0.03%	0.06%	0.06%
22	Utilities	5	2	2	0.08%	0.06%	0.06%
23	Construction	1	1	1	0.02%	0.03%	0.03%
31-33	Manufacturing	369	178	156	5.65%	5.73%	5.02%
42	Wholesale Trade	11	7	6	0.17%	0.23%	0.19%
44-45	Retail Trade	46	30	23	0.70%	0.97%	0.74%
48-49	Transportation and Warehousing	26	6	6	0.40%	0.19%	0.19%
51	Information	1,103	490	413	16.90%	15.77%	13.29%
52	Finance and Insurance	1,965	765	644	30.11%	24.61%	20.72%
53	Real Estate Rental and Leasing	9	4	2	0.14%	0.13%	0.06%
54	Professional, Scientific, and Technical Services	129	53	48	1.98%	1.71%	1.54%
55	Management of Companies and Enterprises	0	0	0	0.00%	0.00%	0.00%
56	Administrative and Support and Waste... Services	50	19	19	0.77%	0.61%	0.61%
61	Educational Services	7	6	6	0.11%	0.19%	0.19%
62	Health Care and Social Assistance	33	15	15	0.51%	0.48%	0.48%
71	Arts, Entertainment, and Recreation	22	8	6	0.34%	0.26%	0.19%
72	Accommodation and Food Services	6	2	2	0.09%	0.06%	0.06%
81	Other Services (except Public Administration)	5	2	2	0.08%	0.06%	0.06%
92	Public Administration	12	3	3	0.18%	0.10%	0.10%
Other		2,725	1,515	1,752	41.76%	48.75%	56.37%
Total		6,526	3,108	3,108	100.00%	100.00%	100.00%

Fintech Occupation

- Description of occupation's job task
  - O*NET database from US Department of Labor
  - Outline specific tasks performed in occupations identified by 8-digit SOC
  - Each occupation typically include 5 to 40 tasks with score to indicate importance.

Accountants and Auditors
13-2011.00

Bright Outlook | Updated 2025

A subset of this occupation's profile is available. Data collection is currently underway to populate other parts of the profile.

Examine, analyze, and interpret accounting records to prepare financial statements, give advice, or audit and evaluate statements prepared by others. Install or advise on systems of recording costs or other financial and budgetary data.

Sample of reported job titles: Accountant, Accounting Officer, Audit Partner, Auditor, Certified Public Accountant (CPA), Cost Accountant, Financial Auditor, General Accountant, Internal Auditor, Revenue Tax Specialist

Summary | Details | Custom | Easy Read | Veterans | Español

Contents

Occupation-Specific Information

Tasks Save Table: XLSX CSV

All 29 displayed

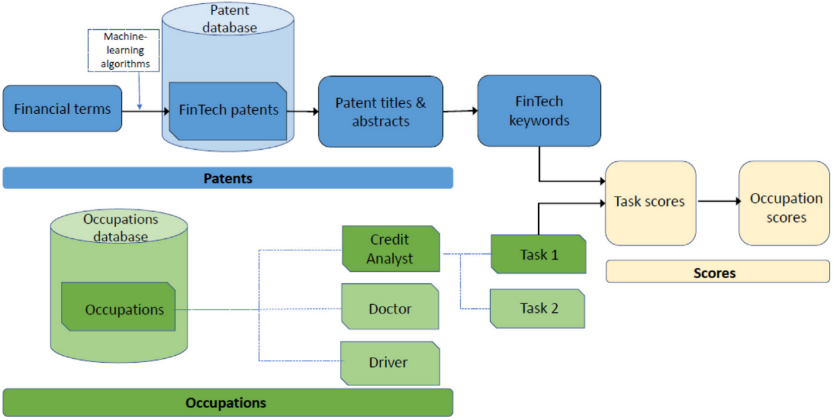
Importance	Category	Task
90	Core	Prepare detailed reports on audit findings.
89	Core	Report to management about asset utilization and audit results, and recommend changes in operations and financial activities.
88	Core	Collect and analyze data to detect deficient controls, duplicated effort, extravagance, fraud, or non-compliance with laws, regulations, and management policies.
8		, and use of accepted

Fintech Labor Demand and Supply

- Job posting
  - Burning Glass: capture near all online job postings (174 million) in US during 2010–2018 (60%–70% coverage).
  - Track well evolution of overall job vacancy based on official statistics (Templin, 2013)
  - Use as leading data source for labor demand and skill requirement (Dillender, 2022)
  - Available information: code, occupation title, location, employer identity, skill requirement, education requirement, experience requirement
- Job application
  - LinkedIn: professional networking platform with over one billion users worldwide
  - Trace employment history in financial sectors or tech sectors from 2010 to 2018
  - Worker-occupation-firm-year panel of 4 million individual in 1298 public firms
  - Available information: resume format, education, employment history, skills

Measuring Fintech Exposure

- Juxtaposing overlap between fintech patent filings and job descriptions.
- Informing extent to which fintech patents directed at tasks of each occupation.



Measuring Fintech Exposure

- Each fintech patent filing or occupation task description embedded to a vector (weighted average of word vectors for terms contained in the document)
- Task's exposure to a fintech patent: scalar projection of vector patent j filed during 5-year period end in year t, $b_{j,t}$ onto vector task i of occupation o, $a_{o,i}$

$$FT_{o,i,j,t} = \cos(\theta)\|b_{j,t}\| = \frac{a_{o,i} \cdot b_{j,t}}{\|a_{o,i}\|}$$

- Occupational exposure to cloud of fintech innovations: adds up shadow each patent cast on task and aggregate across all tasks weighted by importance w_i

$$FT_{o,t} = \sum_{i \in O} \omega_i \cdot FT_{o,i,t} = \sum_{i \in O} \omega_i \cdot \sum_{b_{j,t} \in A_t} FT_{o,i,j,t}$$

Occupation with Highest and Lowest Fintech Exposure

O*NET Code	Occupation Title	*occ*1990*dd* Code	*occ*1990*dd* Title	Fintech Exposure	Fintech Percentile
		Top Occupations with the Highest FT Exposure			
15-1131	Computer Programmers	229	Computer software developers	2.30	100
15-1132	Software Developers, Applications	229	Computer software developers	2.30	100
15-1133	Software Developers, Systems Software	229	Computer software developers	2.30	100
13-1111	Management Analysts	26	Management analysts	2.20	99
17-2061	Computer Hardware Engineers	55	Electrical engineers	2.29	99
17-2071	Electrical Engineers	55	Electrical engineers	2.29	99
15-1121	Computer Systems Analysts	64	Computer systems analysts ...	2.25	97
15-1199	Computer Occupations, All Other	64	Computer systems analysts ...	2.25	97
43-4011	Brokerage Clerks	336	Records clerks	2.24	97
41-3031	Sales Agents, Securities and Commodities	255	Financial service sales occupations	2.23	97
		Bottom Occupations with the Lowest FT Exposure			
39-4011	Embalmers	469	Personal service occupations, n.e.c	1.08	1
39-4021	Funeral Attendants	469	Personal service occupations, n.e.c	1.08	1
37-2012	Maids and Housekeeping Cleaners	405	Housekeepers, maids, butlers, and cleaners	1.09	1
47-2142	Paperhangers	583	Paperhangers	1.19	1
51-6051	Sewers, Hand	666	Tailors, dressmakers, and sewers	1.20	1
51-6052	Tailors, Dressmakers, and Custom Sewers	666	Tailors, dressmakers, and sewers	1.20	1
51-3022	Meat, Poultry, and Fish Cutters and Trimmers	686	Butchers and meat cutters	1.20	1
51-3023	Slaughterers and Meat Packers	686	Butchers and meat cutters	1.20	1
47-2161	Plasterers and Stucco Masons	584	Plasterers	1.22	2
29-1021	Dentists, General	85	Dentists	1.28	3

Job Postings and Employment in Response to Fintech Exposure

- Occupation (o) $\times$ year (t) level: $\Delta Y_{o,t} = \beta_1 \cdot FT_{o,t-1} + \beta_2 \cdot X_o + \gamma_t + \varepsilon_{o,t}$
  - $\Delta Y_{o,t}$: log-growth rate in job postings from year $t-1$ to t in occupation o
  - $FT_{o,t-1}$: express in percentile at occupation level based on 5-year window of patents
  - X_o: exposure to general technologies: AI and software exposure (Webb, 2019); routine and abstract task (Autor and Dorn, 2013); offshorability from (Firpo et al., 2011)

Dep Var	Panel regressions		Long differences		
	ΔLog(Postings)$_{o,t}$ $\times$ 100		ΔLog(Postings)$_{o}$ $\times$ 100		
	2010–2018		2010–2014	2015–2018	2010–2018
	(1)	(2)	(3)	(4)	(5)
Fintech Exposure$_{o,t-1}$	−0.100***	−0.071***	−0.125**	−0.153**	−0.330***
	(−3.22)	(−3.46)	(−2.08)	(−2.26)	(−2.90)
Other Occupational Exposure	No	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	No	No	No
Observations	2,288	2,288	286	286	286
R^2	0.416	0.433	0.382	0.567	0.670

Complementary vs. Substitutive Effect

- Distinguish between substitutive or complementary effect
  - ChatGPT with proper prompting to obtain binary classification of whether fintech patent more likely to replace (substitute) or enhance (complement) task of occupation.
  - 500 most relevant fintech patents generate highest exposure for each occupation.
  - **Complementarity**: difference between exposure to all complementary and substitutive patents in 5 years

Dep Var	ΔLog(Postings)$_{o,t} \times 100$			
Sample	2010–2018		2015–2018	
	(1)	(2)	(3)	(4)
Fintech Exposure$_{o,t-1}$	−0.101***	−0.176***	−0.151**	−0.289**
	(−3.89)	(−3.27)	(−2.27)	(−2.10)
× I(Complementarity - Above Median)$_{o,t-1}$	0.059**		0.118*	
	(2.41)		(1.73)	
× I(Complementarity - Q2)$_{o,t-1}$		0.100*		0.189
		(1.76)		(1.44)
× I(Complementarity - Q3)$_{o,t-1}$		0.137**		0.254*
		(2.70)		(1.84)
× I(Most Complementarity/Least Substitute - Q4)$_{o,t-1}$		0.136**		0.276*
		(2.76)		(1.94)
Other Occupational Exposure	Yes	Yes	Yes	Yes
Year Dummy	Yes	Yes	Yes	Yes
Observations	2,288	2,288	858	858
R^2	0.542	0.542	0.540	0.543

Occupation Creation Amid Disruption

- Fintech disruption could also lead to job creation
  - Firm need people to adopt, operate, and maintain new technology.
  - Four major waves of new occupation categorization in 2006, 2009, 2011 and 2020.
  - **New occupation creation**: one if suboccupation is newly categorized in given wave

Dep Var	$I(\text{New SOC-8 Occupation})_{o,wave}$							
Fintech Subcategory	All	Cyber-security	Mobile Transaction	Data Analytics	Block-chain	P2P	Robo-advising	IoT
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\text{Fintech Exposure}_{o,t-1}$	0.011***	0.010***	0.010***	0.011***	0.014***	0.011***	0.011***	0.007***
	(6.69)	(4.72)	(4.58)	(5.79)	(3.27)	(3.39)	(5.86)	(3.00)
Marginal Prob	0.119%	0.107%	0.103%	0.115%	0.206%	0.115%	0.120%	0.080%
Other Occupational Exposure	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,968	3,968	3,968	3,968	757	3,968	3,968	3,968
R^2	0.249	0.247	0.246	0.246	0.070	0.244	0.246	0.244

Upskilling

- Shift in skill requirements in response to fintech wave
  - **Requirement increase**: one if given occupation increase in BG job postings that require specific type of skill, education, experience

Dep Var	I(Increases in Postings Requiring)$_{o,t}$				
	Finance + Tech	Finance only	Tech only	4+ Year Experience	BA+ Education
	(1)	(2)	(3)	(4)	(5)
Fintech Exposure$_{o,t-1}$	0.008***	0.001	0.006***	0.003**	0.007***
	(5.88)	(0.99)	(4.61)	(2.24)	(3.17)
Marginal Prob	0.226%	0.041%	0.150%	0.082%	0.210%
Other Occupational Exposure	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	2,288	2,288	2,288	2,288	2,288
Pseudo R^2	0.131	0.095	0.147	0.096	0.126

Firm Performance

- Whether adjustment translate to real outcome?
  - 3 type of firm based on ownership of fintech patent: inventor, acquirer, non-innovator
  - 3 firm outcome: employment, sales, total factor productivity (TFP)

Sample	Public Firms								
Dep Var	$\Delta Log(Y)_{i,t} \times 100$								
	Employment			Sales			TFP		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fintech Exposure$_{i,t-1}$	−0.009	−0.010	−0.013	−0.076*	−0.083**	−0.080**	−0.042	−0.048	−0.040
	(−0.32)	(−0.37)	(−0.45)	(−1.89)	(−2.03)	(−1.97)	(−1.23)	(−1.39)	(−1.18)
× I(Inventor)$_{i,t-1}$		0.168*			0.193**			0.103**	
		(1.91)			(2.29)			(2.07)	
× I(Acquirer)$_{i,t-1}$		−0.061			0.041			0.127	
		(−0.40)			(0.34)			(0.87)	
× I(% of Complementary Occ. - Q4)$_{i,t-1}$			0.108*			0.231**			0.199**
			(1.66)			(2.09)			(2.28)
I(Non-Fintech Inventor)$_{i,t-1}$	−1.084**	−1.097**	−1.079**	1.309*	1.171	1.293*	2.658***	2.529***	2.633***
	(−2.17)	(−2.17)	(−2.16)	(1.82)	(1.61)	(1.79)	(4.34)	(4.09)	(4.29)
Firm Attributes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	24,787	24,787	24,787	24,644	24,644	24,644	22,500	22,500	22,500
R^2	0.034	0.034	0.034	0.050	0.050	0.050	0.038	0.038	0.038

Discussion

- Technological patent corpus with other text
  - Exposure in business operation: anual report, earning call transcript, news
  - Exposure in firm strategy: M&A announcement, investment announcement
- Fintech risk identification based on LLMs
- Analyze fintech trends and finance development by inputting patent filings year by year and fine-tuning LLMs