

SSL Technology Development and Commercialization in the Global Context

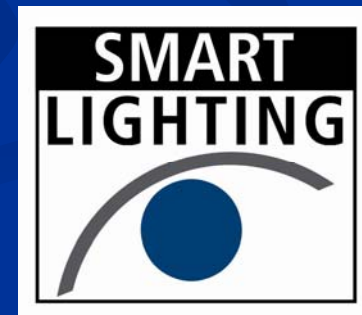
EERE Programmatic Lighting Support 570.01.05.007
SSL Global Technology Analysis

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Our LED Industry Research

- Unique comparison of inter-country, inter-firm trends
 - World patents, not just US
- Linked to broader ongoing study
 - Product creation in companies
 - National policy
 - Technology spread & economic impacts
- NSF Smart Lighting Engineering Research Center
- Our research team
 - 17 research assistants (students)
 - Fluent in Japanese, Chinese, Korean, & key European languages

Sample

- All patents whose title includes
 - “LED(s)”
 - “OLED(s)”
 - “light emitting diodes”
 - Foreign-language equivalents
- Well-focused on LEDs
 - But excludes many materials patents
- From worldwide patent data, collected by the European Patent Office
 - Includes filings in all major nations (about 70)
 - All years
- Totals 34,451 applications, of which:
 - 10,352 granted patents
 - 5,033 granted utility models
 - 543 other grants (design patents, provisional patents, inventor’s certificates)

SSL Patents

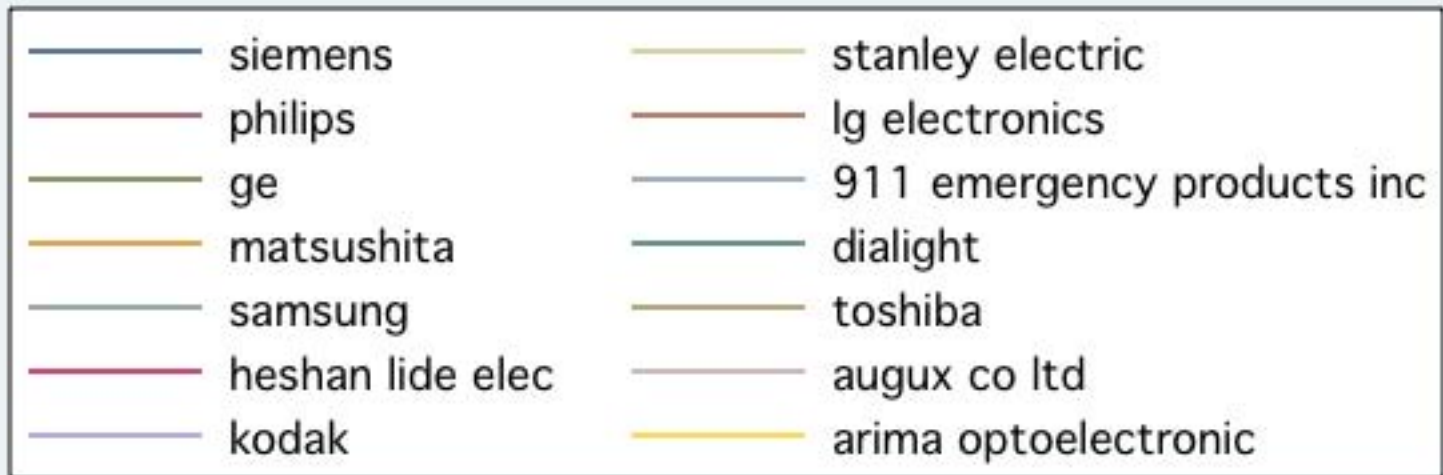
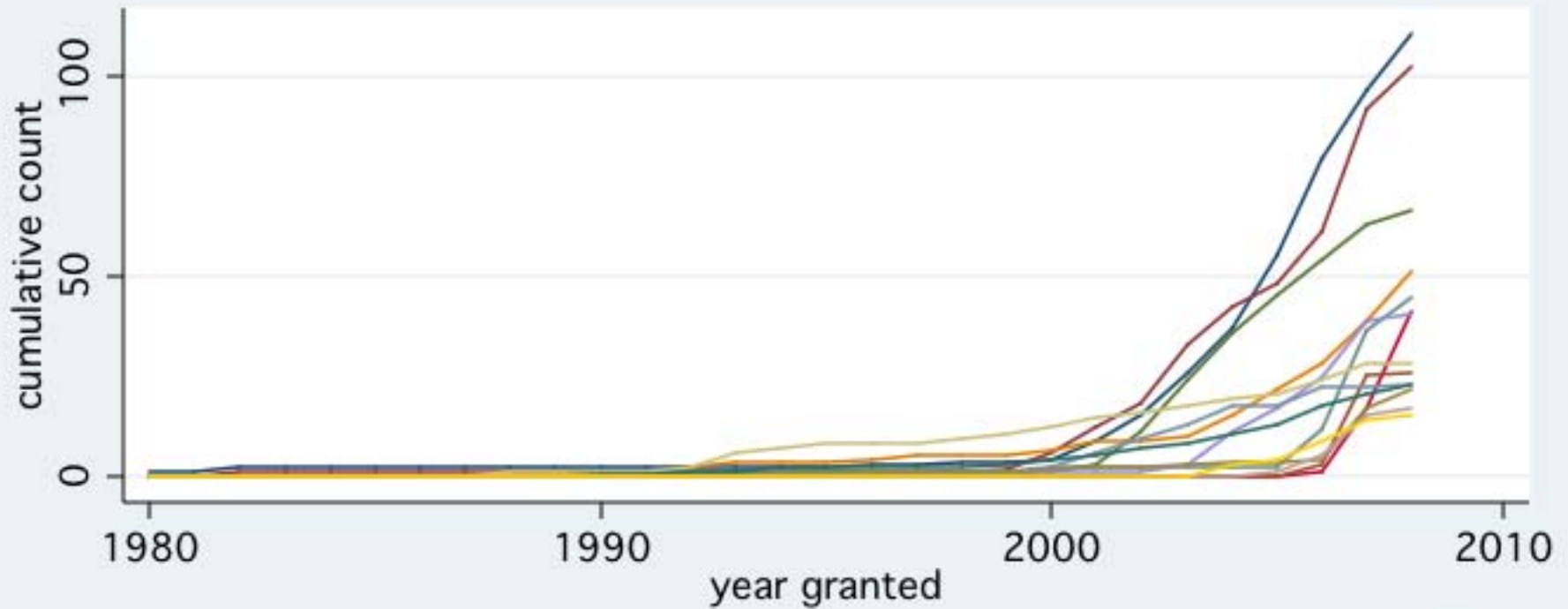
- DOE study focus: general illumination
 - Narrow SSL: Focus on lighting-specific uses
 - Broad SSL: Lighting + fundamental technologies & LED designs + applications
 - Excludes displays, printers, scanners
- Categories defined by
 - International patent classifications
 - Title keywords
 - E.g., lighting includes F21, H05B31-43, “lamp”, “luminaire”
 - E.g., displays includes G09G3/03-38, G09F9, “display”, “screen”

Which Firms Lead in Global SSL Patents?

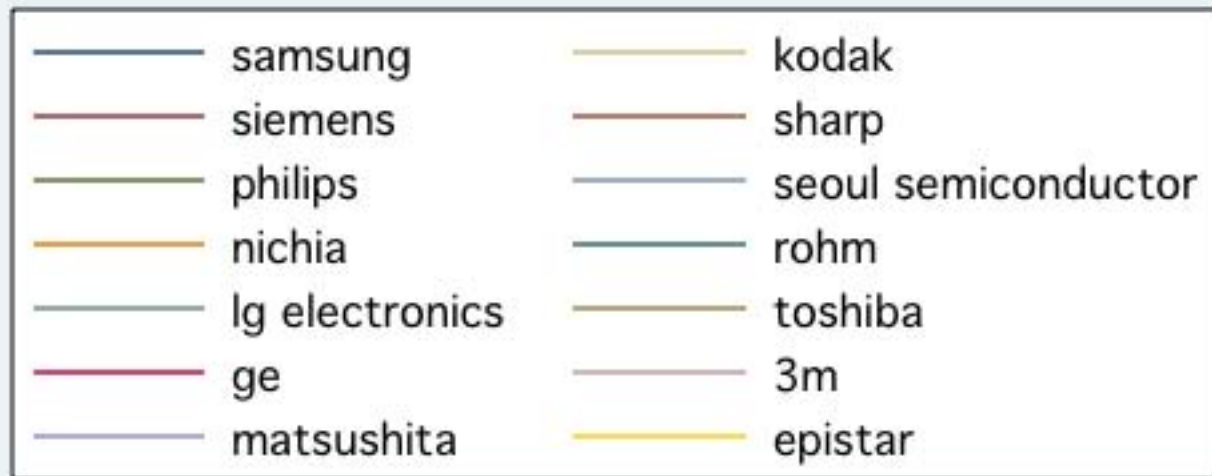
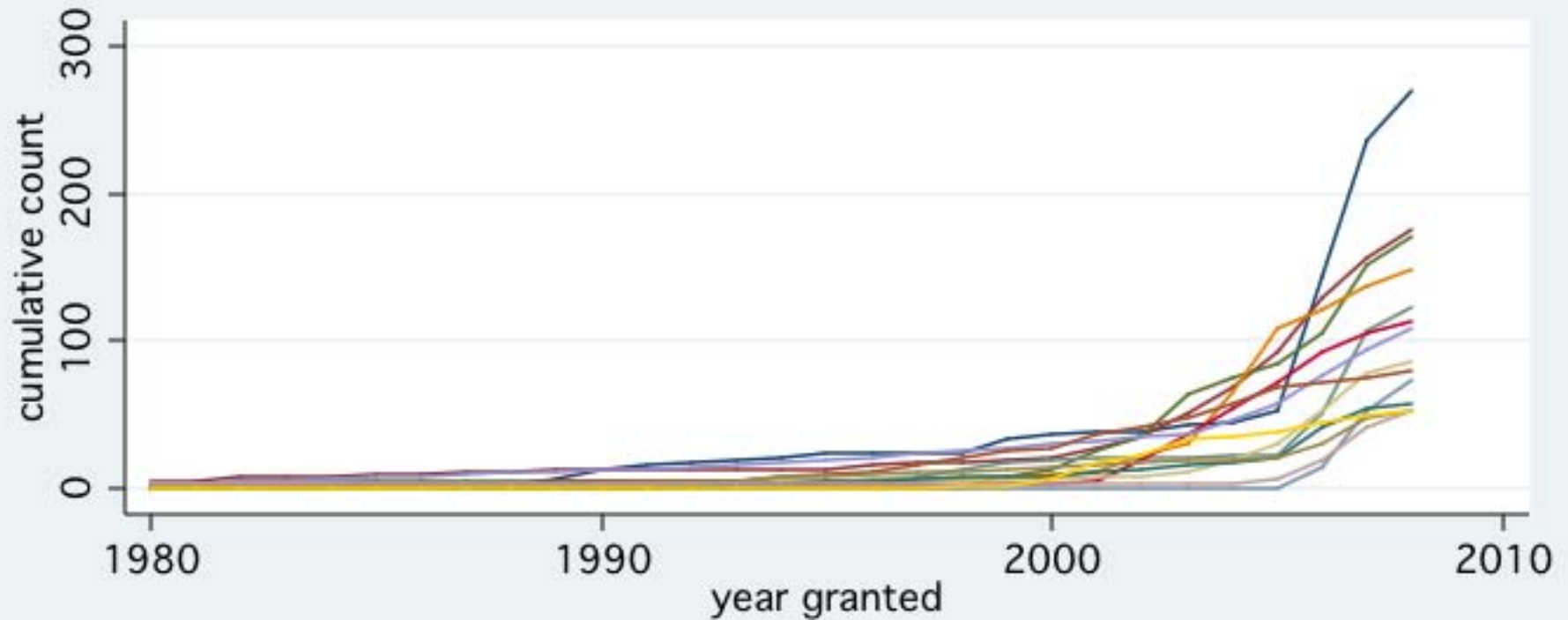
Applicants: Granted Patents & Utility Models

Parent Company	Narrow SSL Patents	Broad SSL Patents	All LED Patents
Siemens	110.3	176.0	230.5
Philips	102.0	170.6	228.8
GE	66.6	112.9	139.6
Matsushita	51.1	109.1	141.9
Samsung	44.3	269.7	425.9
He Shan Li De / Neo-Neon	41.0	47.0	49.0
Kodak	40.4	85.4	243.5
Stanley Electric	28.1	49.5	78.5
LG Electronics	26.0	122.7	136.7
911 Emergency Prod.	22.7	30.1	41.5
Dialight	22.6	28.9	34.4
Toshiba	21.4	53.2	75.4
Augux	17.0	17.0	17.0
Arima Optoelectronic	15.0	37.8	41.8

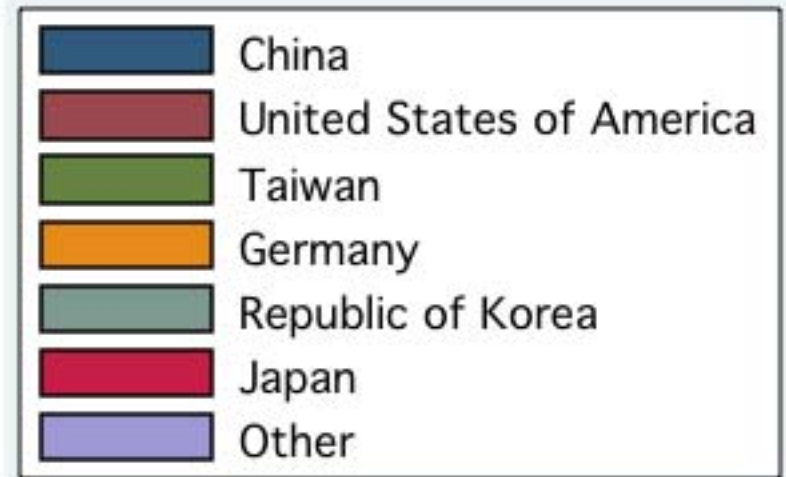
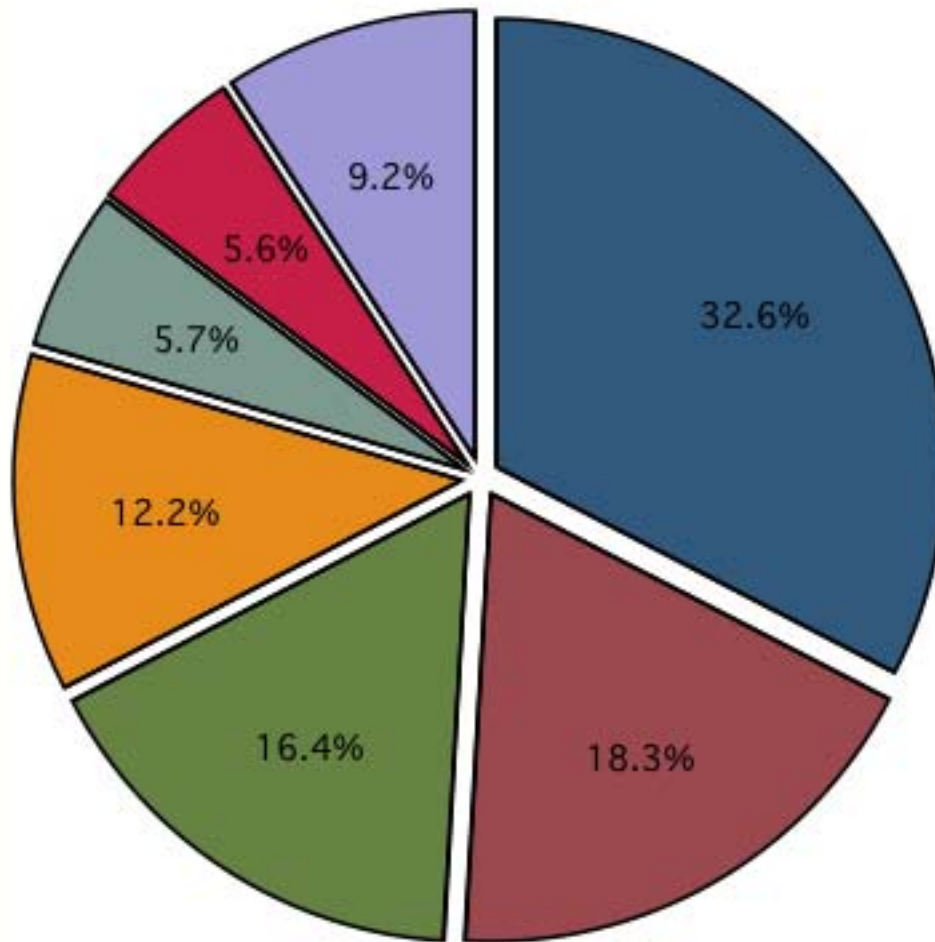
Applicants: Narrow SSL Patents & Utility Models



Applicants: Broad SSL Patents & Utility Models

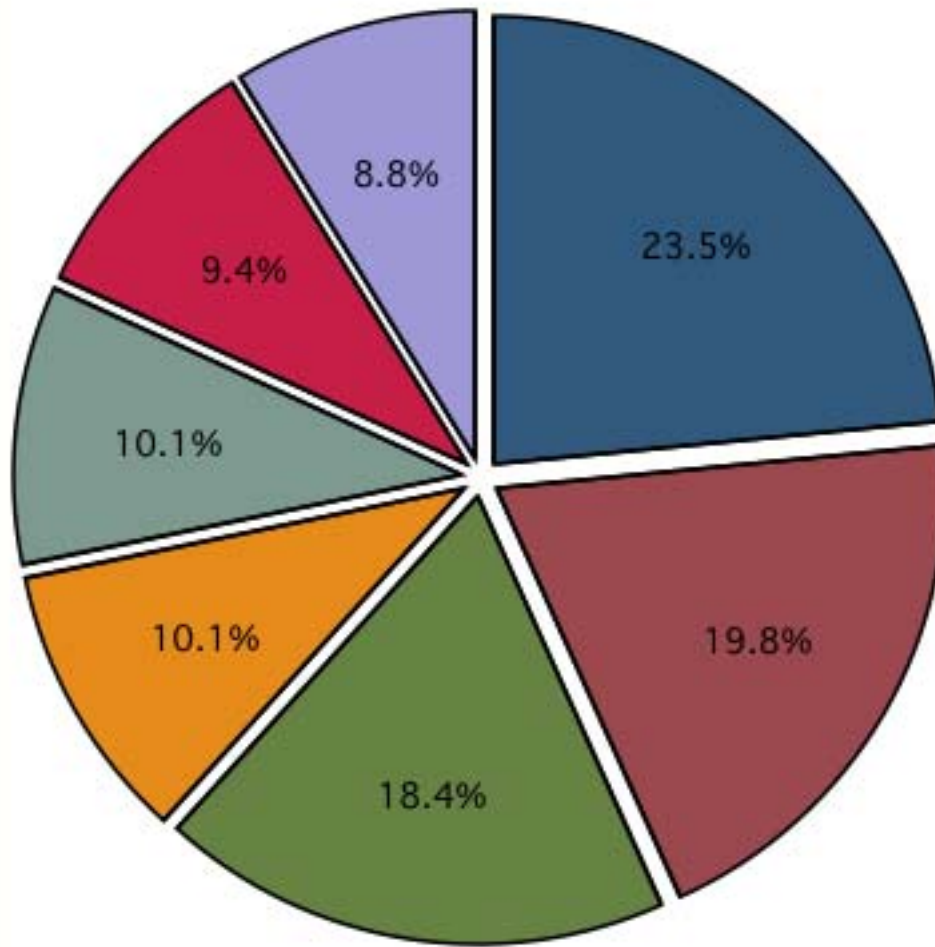


Applicant HQ Countries: Narrow SSL Patents & Utility Models



Includes individual persons filing, from their nation.

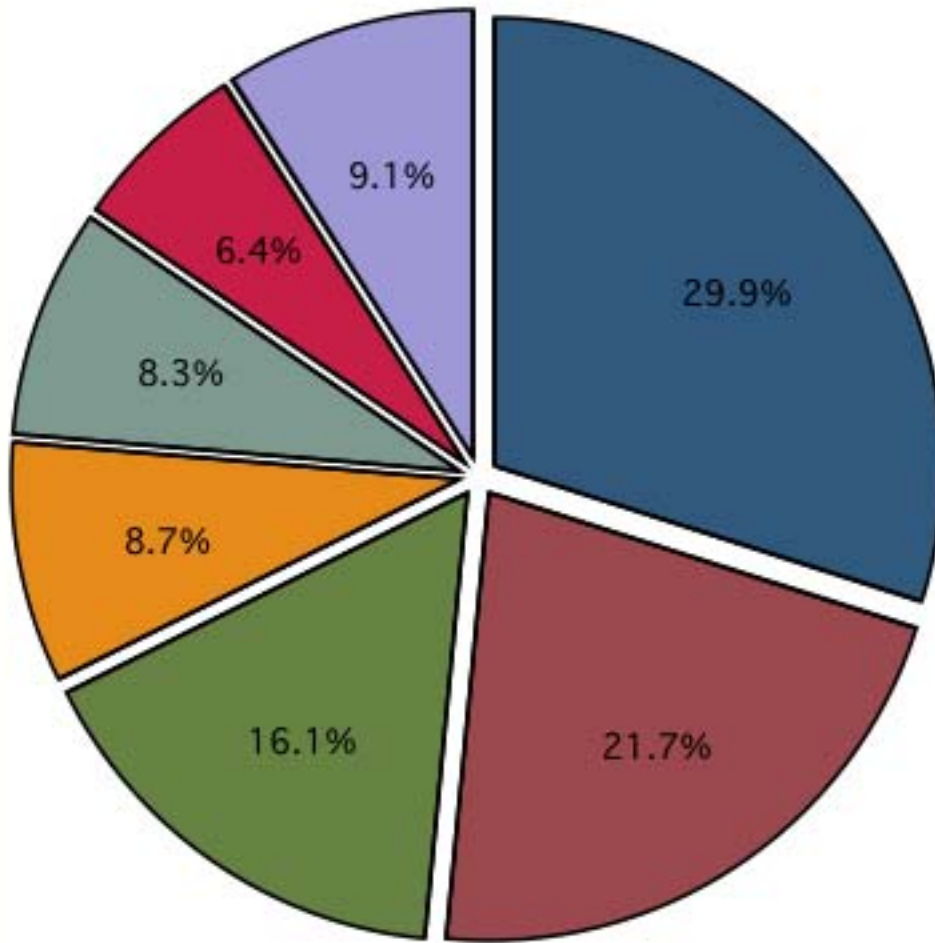
Applicant HQ Countries: Broad SSL Patents & Utility Models



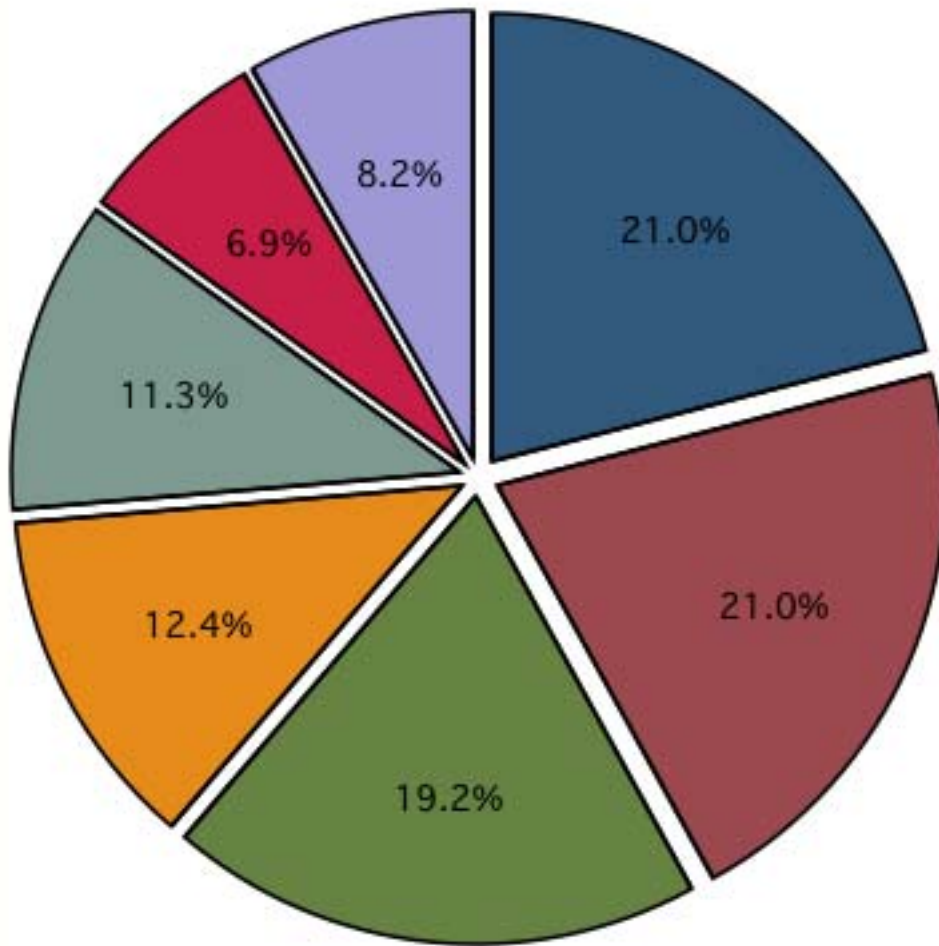
Includes individual persons filing, from their nation.

Where are Inventors of Global SSL Patents?

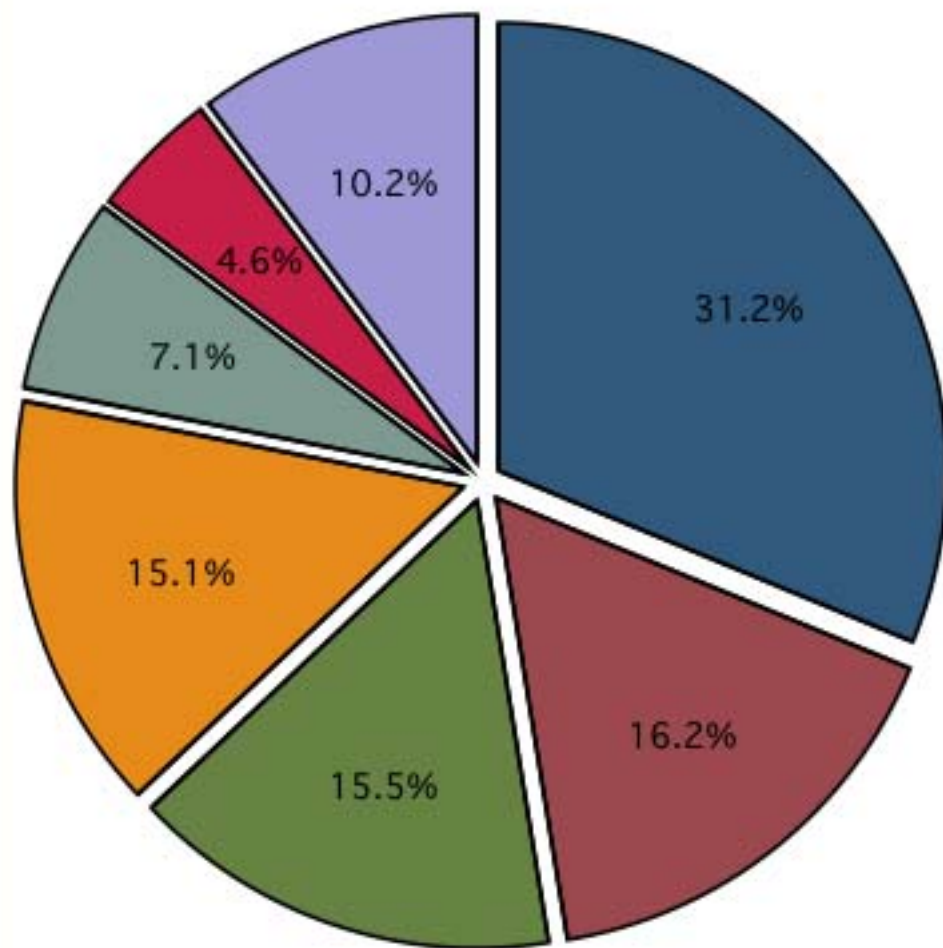
Inventor Countries: Narrow SSL Patents & Utility Models



Inventor Countries: Broad SSL Patents & Utility Models



Inventor Countries: Broad SSL Full Patents (No Utility Models)

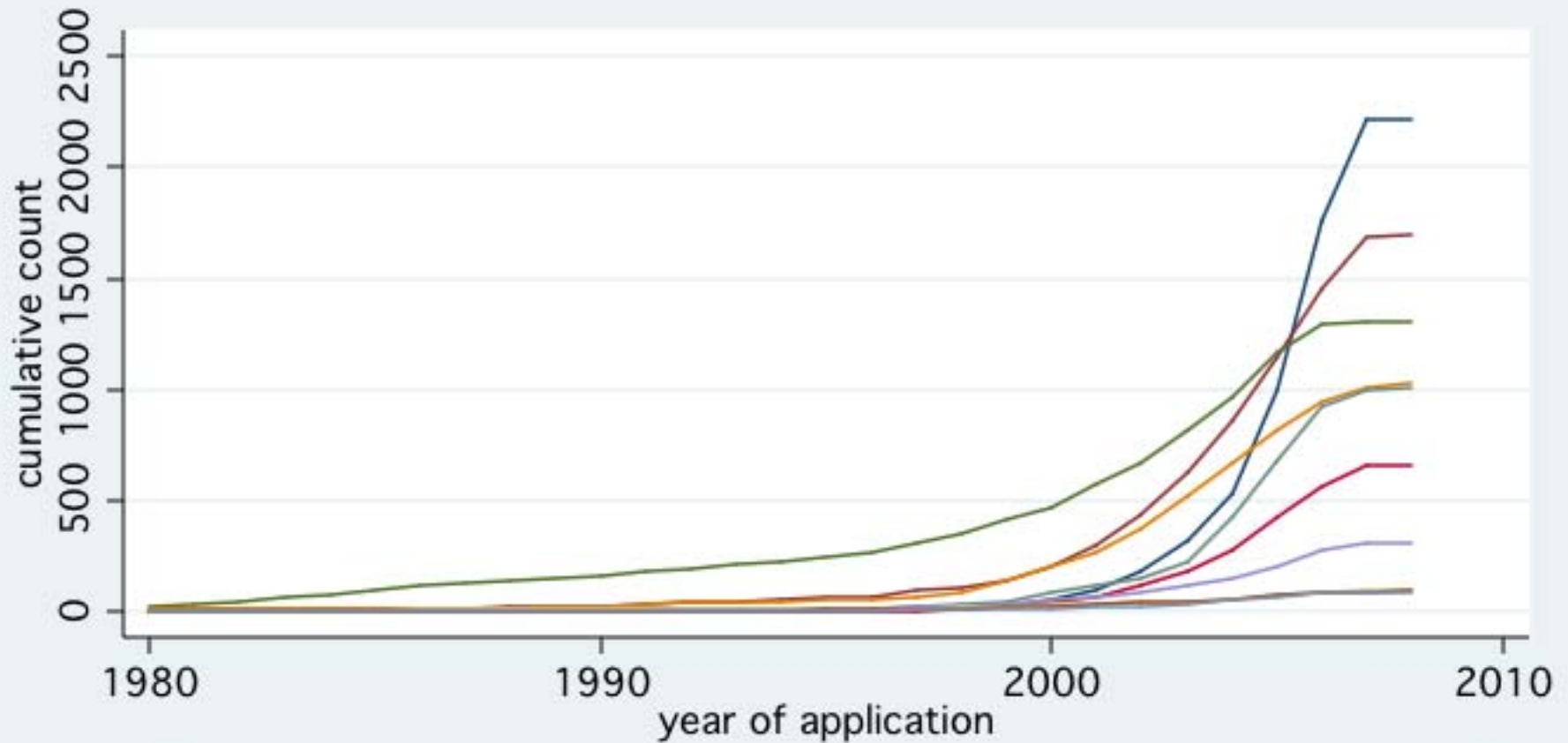


Inventor Countries: Percent Organic among All LED Grants

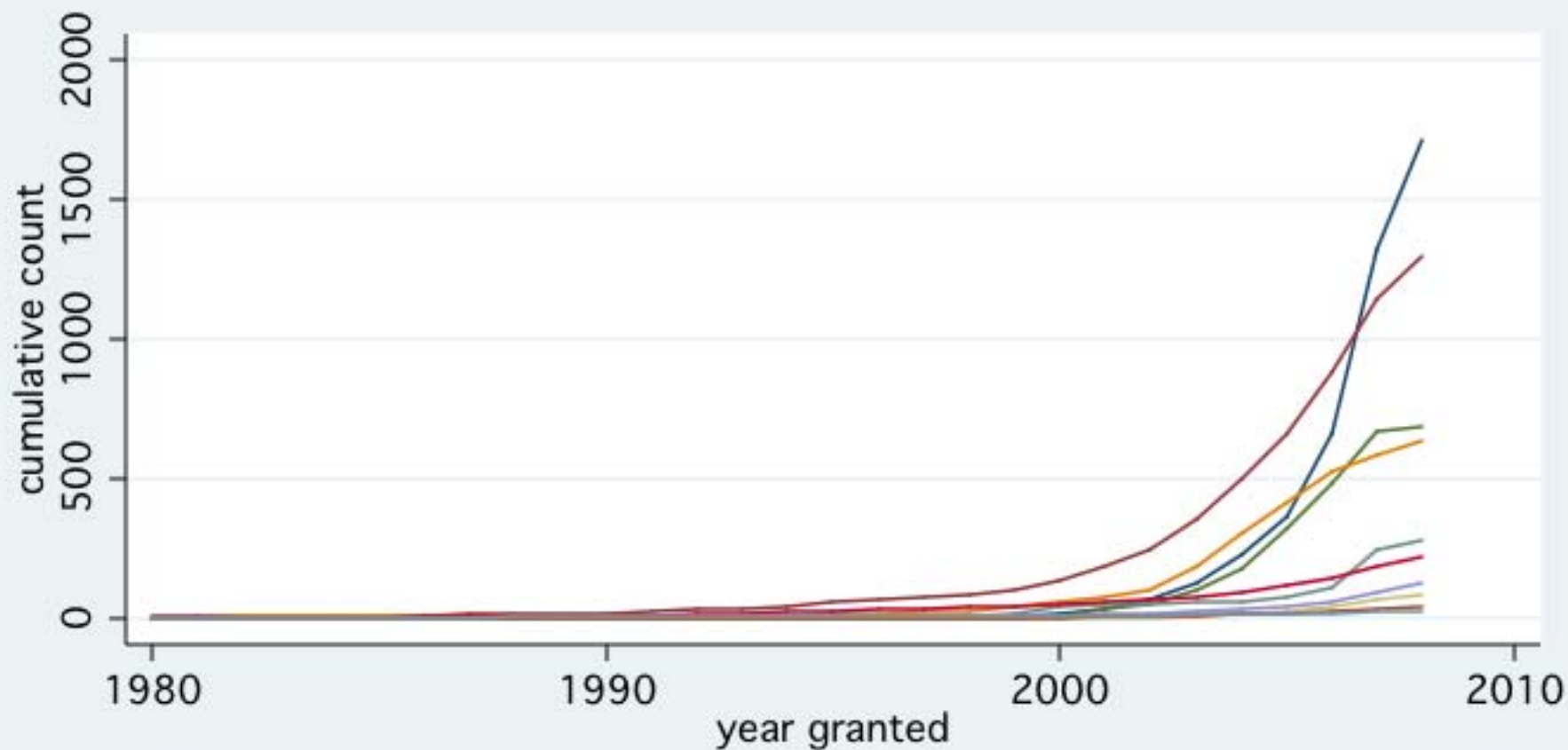
Inventor Country	% Organic	Count of All LED Grants
United States of America	18.6	4225.7
China	1.7	3602.1
Taiwan	11.7	3308.7
Japan	2.4	2664.1
Korea	15.0	2090.7
Germany	15.3	1231.7
Netherlands	16.2	299.0
United Kingdom	17.2	160.5
Canada	23.7	151.0
France	8.8	148.0

Filing Locations of Global SSL Patents?

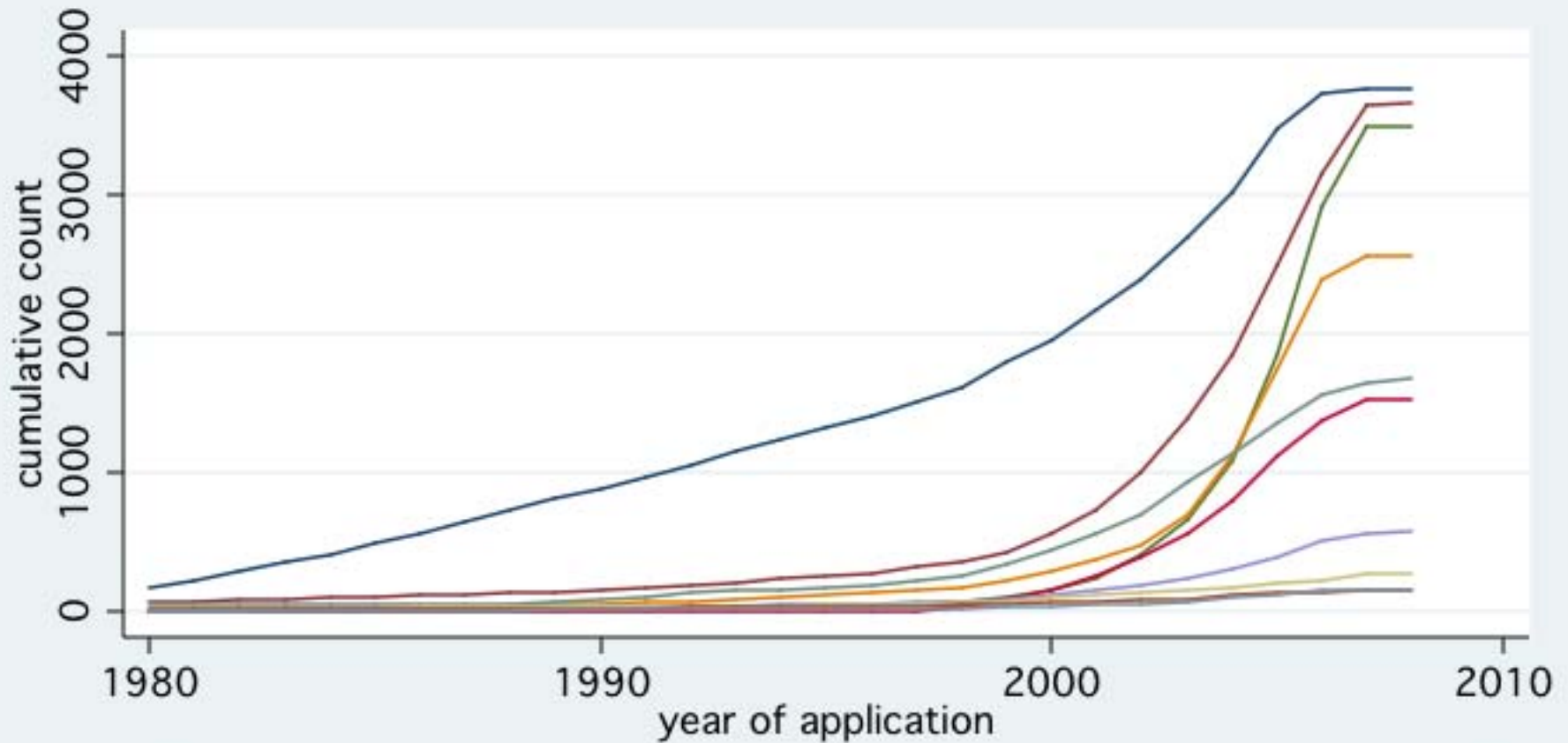
Filings by National Patent Office: Narrow SSL



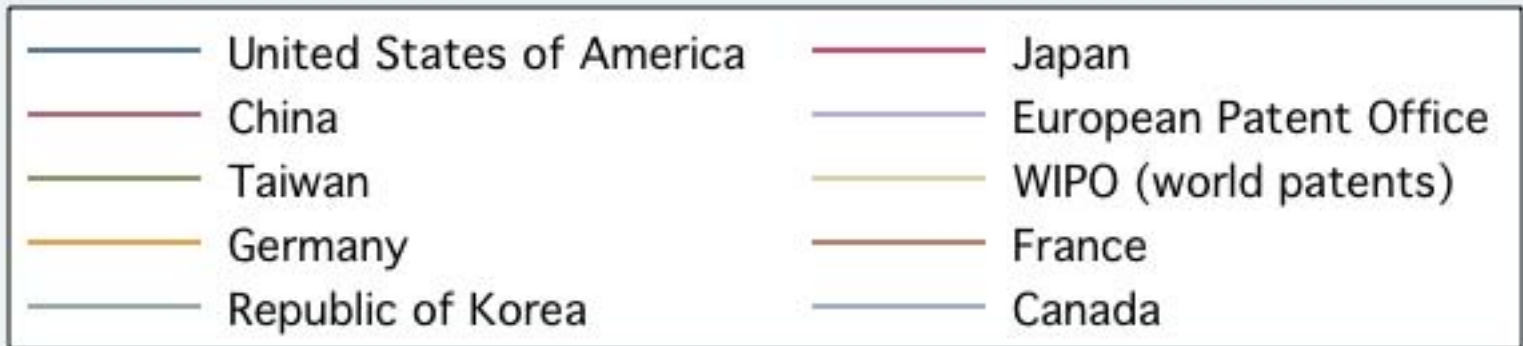
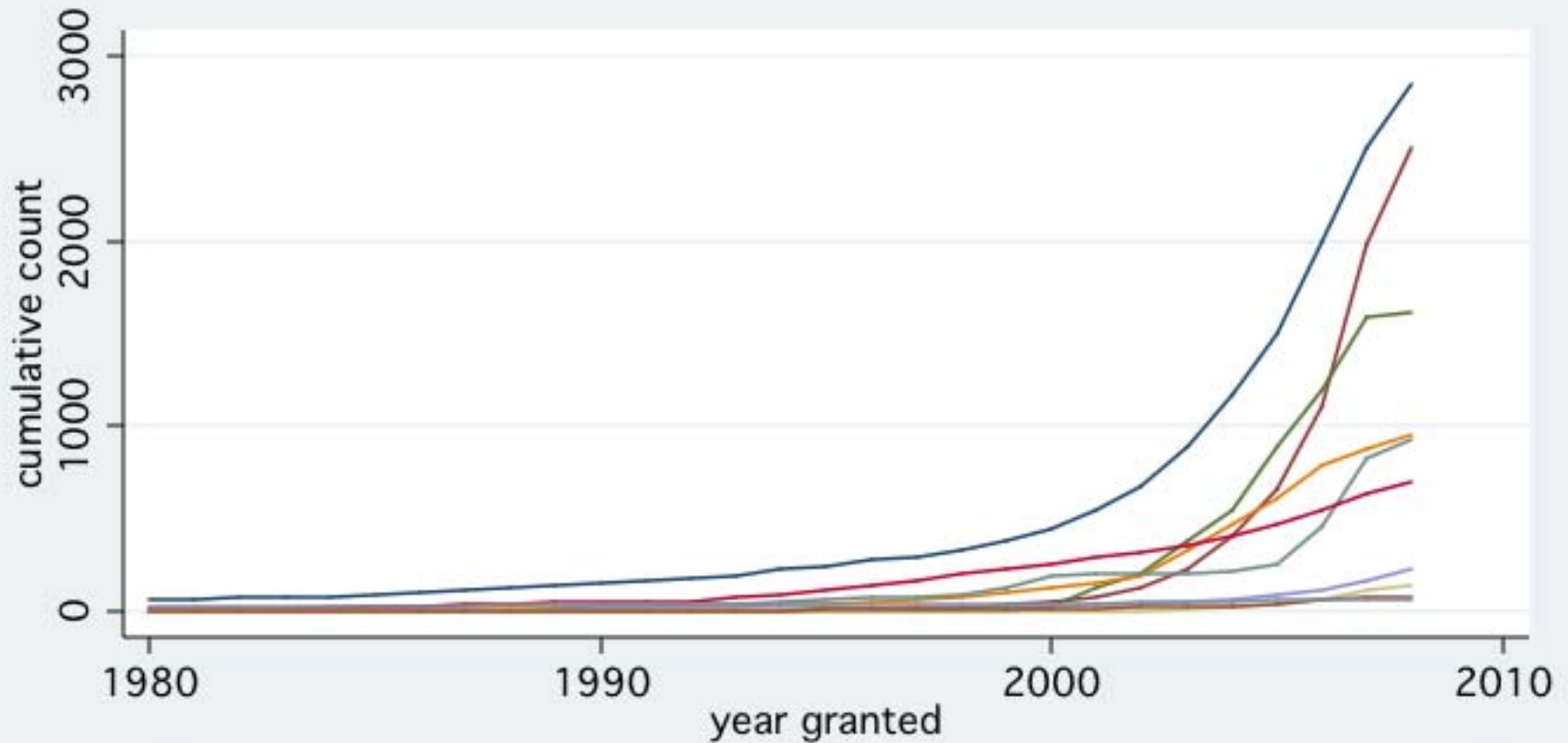
Grants by National Patent Office: Narrow SSL



Filings by National Patent Office: Broad SSL



Grants by National Patent Office: Broad SSL



Conclusions

- SSL R&D spreading further in Asia
 - Growing Chinese role
 - Especially in narrowly-defined SSL
 - Mainly individual applicants
 - Short-term utility models, few full patents
 - Manufacturing and R&D
- International interdependence
- Traditional lighting firms transitioned into SSL through joint ventures & acquisitions
 - Dominant firms, but small firms not (yet) locked out
- For small firms, major opportunities in materials, devices, & fixtures?