Part 1 (1)

The possible reason is slower information diffusion for patent with specific industry applications. Such applications can be interpreted and understood by a few groups of professionals like workers in peer companies. This is not the case for most investors since they are not professional in that field. As a result, they undervalue the technology breakthrough of the tech companies they invest. Meanwhile, peer technology companies integrate valuation of focal firm better, leading to high predictability to firm A's returns from its tech peers.

Part 1 (2)

Investors have limited attention so the amount of information that they can interpret is limited. Once they miss opportunity of trading shares of firm A, they will probably trade tech peers of firm A, hoping to capture similar price movement to earn capital gain.

In addition, professional stock analysts prioritize analyzing stocks of large firms since they have high trading volume. As a result, smaller firms have lower media coverage, thus less attention from investors and have lagged price movement with respect to corresponding news.

Part 2 (1)(a)

Marked in jupyter notebook.

Part 2 (1)(b)

lag(prc) greater than $5: Avoid high-risk stocks which usually have characteristics of low price.
hexcd (1,2,3): Choose stocks from New York exchanges. The stocks are usually liquid.
sharecode (10,11): Choose stocks that belong to common equity.
lag market cap not in the bottom 20% that month: Stocks with larger market cap are usually more liquid.

Part 2 (2)(a)

According to P&L curve from this replication (cross-momentum trading strategy), equal-weighted and value-weighted strategy have similar average return. Equal-weighted strategy is slightly higher.

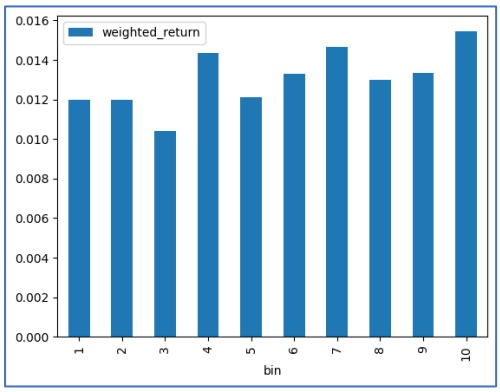
Part 2 (2)(b)

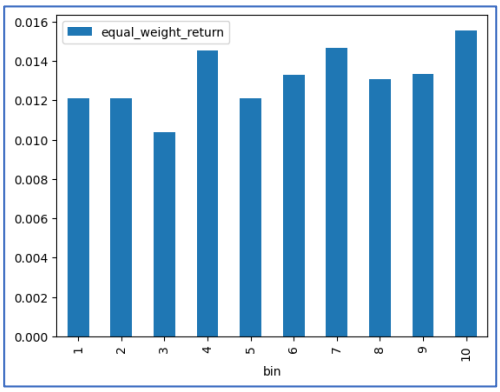
It is common for the equal-weighted strategies to have higher returns than value-weighted strategies.

Equal-weighted portfolio has higher systematic risk than value-weighted portfolio because equal-weighted portfolio weights small stocks more than value-weighted portfolio. Thus, equal-weighted portfolio is exposed to market, size, and value factors more. On average, higher risk implies higher return. So, the return of equal-weighted portfolio is usually higher.

Part 2 (2)(c)

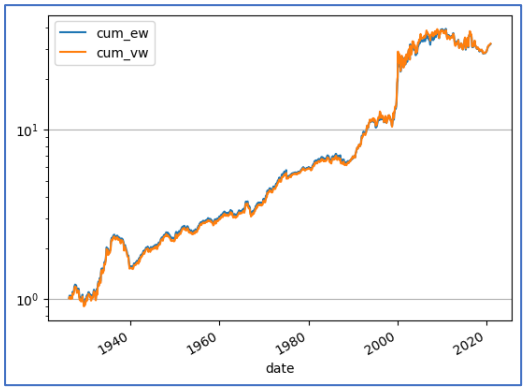
Return is slightly increasing from bin 1 to bin 10.





Part 2 (2)(d)

P&L Curve



Part 2 (2)(d)(i)

The strategy is not effective to guarantee stable growing return after 1990. Its return is stagnant from 1995 to 2000, but surges for 20% suddenly in 2000. Then remains stagnant until 2021. Dotcom Bubble and 1997 Asian Financial Crisis happened in 1990s.

Part 2 (2)(d)(ii)

Before outbreak of Dotcom Bubble, investors were very optimistic on growth of all tech firms. So, they were willing to invest in peer tech firms if investment opportunity of target tech firm was not available sometimes. Given the high demand for tech firm shares but supply of such shares might not be enough, their prices as well as shares prices return appreciated very much.

When there was financial crisis outbreak, investments of companies become riskier than before. They become more conservative on new technology adopted by peer companies. As a result, information diffusion thus stock price integration from peer companies' breakthrough is slower.

Meanwhile, the tech companies that go to bankruptcy probably due to excess loans and default of suppliers, but nothing to do with peer companies. So, such stock return is not correlated with peer companies. Predictability of such trading strategy decreases.

Part 2 (2)(e)(i)

According to four-factor-model, momentum is not the most important explanatory variable of such trading strategy. It is ranked 3rd importance in terms of statistical significance and magnitude of coefficient. Such trading strategy is not totally agreed with momentum strategy.

The most important statistically significant variable is alpha. This shows such trading strategy exploits risk factor that is not considered in four-factor-model.

The variable with largest magnitude of coefficient is value factor (hml). This shows that such trading strategy partially agrees with value investing by finding undervalued target tech firms by referring to returns of peer tech firms.

Regression result is shown below:

	cum_vw	cum_ew
Intercept	9.8439***	9.7951***
	(0.3727)	(0.3663)
smb	5.9770	5.8123
	(12.4430)	(12.2290)
hml	-22.6367**	-22.4210**
	(11.3832)	(11.1874)
mkt_rf	-2.8557	-2.5641
	(7.5172)	(7.3880)
mom	-15.4092*	-15.4251*
	(8.9187)	(8.7654)
R-squared	0.0052	0.0053
R-squared Adj.	0.0017	0.0018

Part2 (2)(e)(ii)

According to five-factor-model, value factor (hml) is the most important explanatory variable of such trading strategy, in terms of magnitude of coefficient.

Other important explanatory variables are alpha, profitability factor (rmw) and size factor (smb). They have lower magnitude of regression coefficients than hml. However, alpha is more statistically significant than hml.

This is sensible because size of technology firms affects economies of scale as well as production efficiency and profitability. So, rmw and smb can explain a portion of return from such trading strategy.

Regression result is shown below:

	cum_vw	cum_ew
Intercept	15.0719***	14.9521***
	(0.5110)	(0.5009)
mkt_rf	3.6187	4.5484
	(12.5937)	(12.3457)
smb	8.2171	7.9070
	(17.7652)	(17.4154)
hml	-40.5041*	-40.4895*
	(23.7989)	(23.3303)
rmw	24.6660	24.1073
	(24.5533)	(24.0698)
cma	18.9393	20.9432
	(36.4100)	(35.6931)
R-squared	0.0066	0.0067
R-squared Adj.	-0.0007	-0.0006

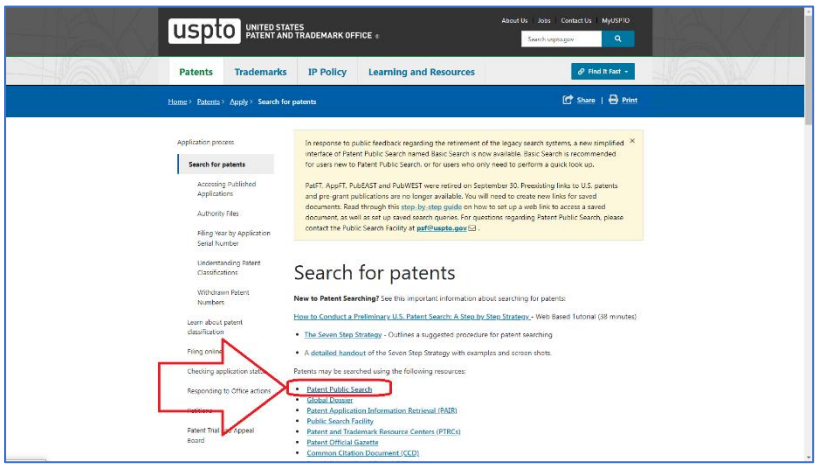
Part 3

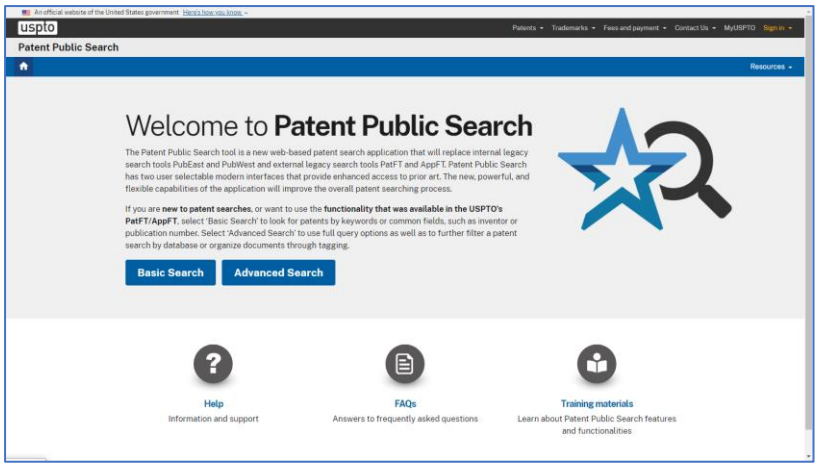
For further improvement, an additional coefficient τ^2 can be introduced to $TECH_{i,j,t}$, which is "uncentered correlation of the patent distributions between two firms i and j" (Lee, Charles M.C. et al., 2019). That is,

$$TECH_{i,j,t} = \boldsymbol{\tau^2} \times \frac{T_{i,t}T'_{j,t}}{\sqrt{T_{i,t}T'_{i,t}}\sqrt{T_{j,t}T'_{j,t}}}$$

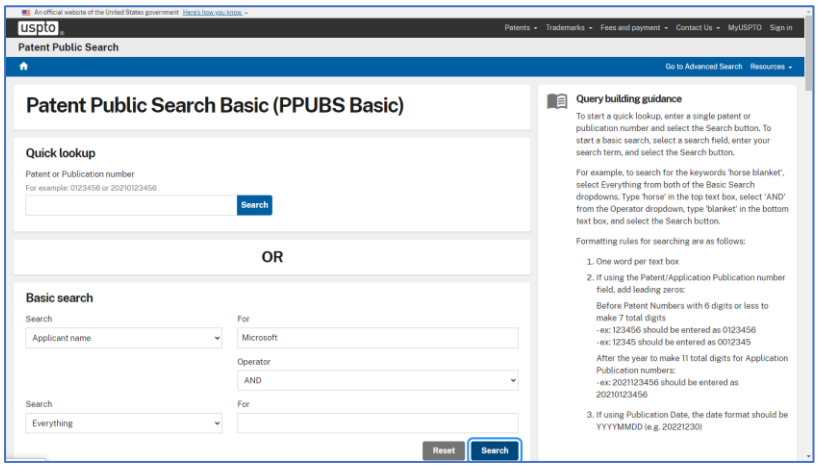
Where τ is remaining time for the patent to be valid. Here it is squared above because we want to overweight patents that lasts for longer time. The intuition is patents that will due soon do not bring much profit to tech companies. If a tech firm has many patents that last for long time, then it is probably profitable in long term. If other tech firms have the share of long-lasting patent as well, then they can also share the long-run profit. This guarantees the firms shares return in the perspective of fundamental analysis.

Information of τ can be found from United States Patent and Trademark Office: https://www.uspto.gov/patents/search

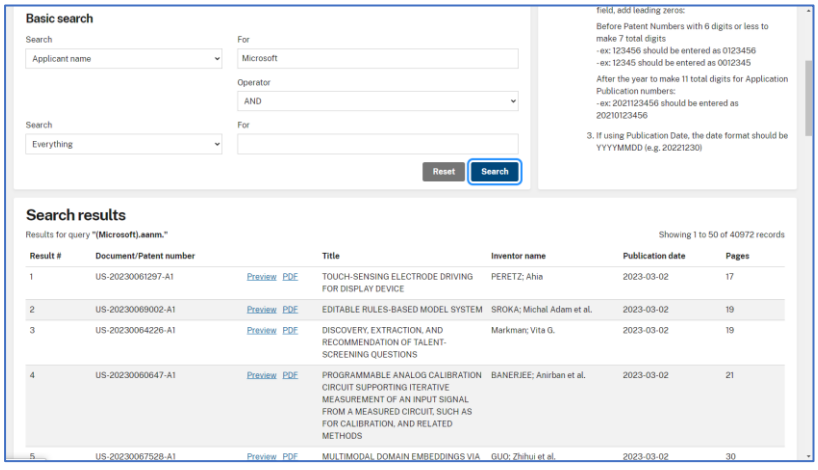




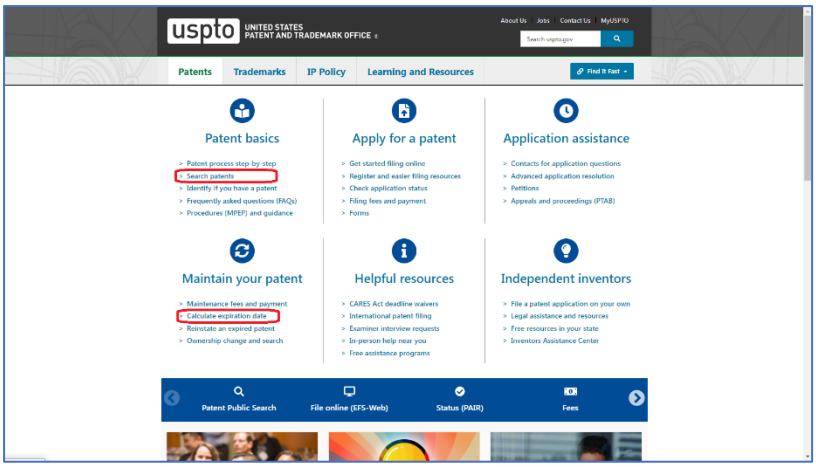
If “Basic Search” is clicked, then the following interface is shown:



As a demonstration, I selected searching “applicant name” with keyword “Microsoft”. Then, details of patents applied by Microsoft are shown as below:



Expiration date of patents can be accessed via this website, circled in red rectangles.: https://www.uspto.gov/patents



Reference

Lee, Charles M.C. et al. “Technological Links and Predictable Returns.” Journal of financial economics 132.3 (2019): 76–96. Web.