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Analysis of Historical Patenting Behavior and Patent Characteristics of Computer Architecture Companies—Part VII: Relationship Between Prosecution Time and Claims

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In prior parts of this series, I analyzed the following for patents that were issued to 18 leading computer architecture companies that were filed between 1996 and 2020:

- The numbers of issued patents and computer architecture patents.
- The prosecution time and effective patent term.
- The number of claims, breakdown of independent and dependent claims, and effect that excess claim fees had on the numbers of total and independent claims.
- The type of claims (apparatus, method, or Beauregard) and the effect that the Supreme Court's decision in *Alice v. CLS Bank* had on the number of independent and dependent method claims.
- The number of "backward" citations to U.S. patents and publications, foreign patents, and Other References as well as the number of "forward" citations to a patent by another U.S. patent or U.S. patent publication.
- The correlation between prosecution time and number of claims.

The most recent article showed that correlation between the prosecution time and the number of claims was weak, both for all patents and for computer architecture patents, for all companies (with the exception of SiFive).

One factor that may affect the prosecution time is the technology center that a patent application is assigned to for the purpose of examination. A technology center that is relatively busier, has uneven distribution of work across examiners, or has relatively slower examiners may have relatively longer prosecution times. To determine what effect the technology center may have on the prosecution time, this article analyzes the effect that the patent class—which the U.S. Patent and Trademark Office uses to determine the technology center—has on the prosecution time.[a]

> *ONE FACTOR THAT MAY AFFECT THE PROSECUTION TIME IS THE TECHNOLOGY CENTER THAT A PATENT APPLICATION IS ASSIGNED TO FOR THE PURPOSE OF EXAMINATION.*

Table 1 lists the number of patents that were filed between 1 January 1996 and 31 December 2020 and that were issued by 31 March 2022 for each of the 18 companies. The right-most column lists the number of patents that are classified as computer architecture patents.[b] During this timeframe, some companies merged

[a]*CPC Classification: The New Approach to Assigning Art Units*. Accessed September 17, 2023. Available at https://www.lexisnexisip.com/resources/cpc-classification-the-new-approach-to-assigning-art-units/.

[b]I classified a patent as a "computer architecture" patent if it was classified in the 345, 708, 709, 710, 711, 712, 713, or 714 patent classes of the U.S. Patent Classification System or G06F, G06T, G09G, G11B, G11C, H03M, or H04L patent classes of the Cooperative Patent Classification System. These are the same patent classes that I used in Parts I–VI of this article series.

0272-1732 © 2023 IEEE
Digital Object Identifier 10.1109/MM.2023.3320318
Date of current version 2 November 2023.

TABLE 1. Number of all patents and computer architecture patents filed between 1 January 1996 and 31 December 2020 that were issued by 31 March 2022.

Company	All Patents	Computer Architecture Patents
Amazon	16,383	9268
AMD	11,189	4631
Apple	27,968	12,308
ARM	2782	2372
Broadcom	14,757	6292
Dell + EMC	21,427	18,264
IBM	133,932	82,821
Intel	45,680	24,467
Marvell	8626	5185
Microsoft	47,562	31,999
MIPS	273	271
NVIDIA	3957	3057
NXP	11,831	3729
Qualcomm	29,242	10,082
Renesas	14,384	4021
Samsung	136,054	33,301
SiFive	14	9
Via + Cyrix	1981	1320

TABLE 2. Percentage of all patents and percentage of computer architecture patents in one of the three largest patent classes for each company.

Company	All Patents (%)	Computer Architecture Patents (%)
Amazon	65.1	96.9
AMD	68.7	87.9
Apple	47.5	85.7
ARM	78.1	91.7
Broadcom	43.4	85.4
Dell + EMC	85.0	97.4
IBM	68.1	71.4
Intel	56.8	89.9
Marvell	81.4	99.2
Microsoft	65.3	95.2
MIPS	99.3	100.0
NVIDIA	70.4	89.2
NXP	45.2	86.0
Qualcomm	55.9	88.0
Renesas	58.9	86.9
Samsung	31.6	72.2
SiFive	92.9	100.0
Via + Cyrix	58.5	82.5

(e.g., Dell merged with EMC) or made significant acquisitions (e.g., Avago acquired Broadcom). To ensure that the results accurately reflect the present form of combined companies, I included the merged or acquired companies if 1) the companies were computer architecture companies and/or 2) they had a significant number of patents.

TO MAKE THE ANALYSIS MORE TRACTABLE, THIS ARTICLE FOCUSES ONLY ON THE TOP THREE PATENT CLASSES (EXCLUDING DESIGN PATENTS) WITH THE MOST ISSUED PATENTS.

To improve readability, I generally refer to companies with multiple entities by the parent company's name. More specifically, I refer to AMD + ATI as "AMD," Dell + EMC + VMware as "Dell + EMC," Marvell + Cavium as "Marvell," NXP + Freescale as "NXP," Renesas + Dialog + IDT + Intersil as "Renesas," and Via + Cyrix as "Via." In addition, I refer to Avago + Broadcom as "Broadcom," as the latter may be the more well-known company and the company that is more relevant with respect to computer architecture.

To make the analysis more tractable, this article focuses only on the top three patent classes (excluding design patents) with the most issued patents. The reason that this article excludes design patents is because design patents only have one claim. As such, including design patents may distort the correlation between the prosecution time and the number of claims. Table 2 shows the percentage of all patents and the percentage of computer architecture patents that are in one of the top three patent classes for each company.

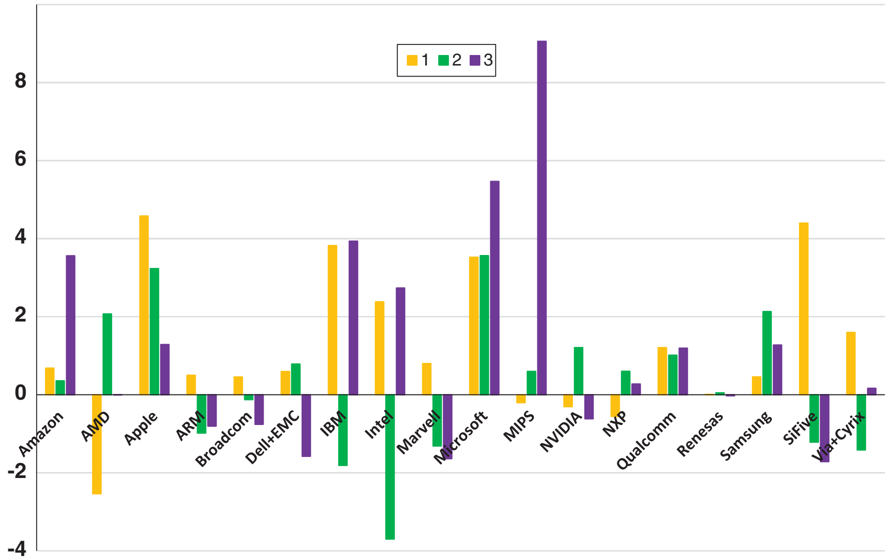
The results in Table 2 show that the three largest patent classes account for more than 50% of all patents for 14 companies (below 50% for Apple, Broadcom, NXP, and Samsung) and more than 70% of computer architecture patents for all 18 companies. Therefore,

FIGURE 1. Difference in the average prosecution time for patents in each of the three largest patent classes and (a) the average prosecution time for all patents or (b) the average prosecution time for the computer architecture patents. The "1," "2," and "3" in the legend correspond to the three largest patents classes (with "1" corresponding to the largest patent class).

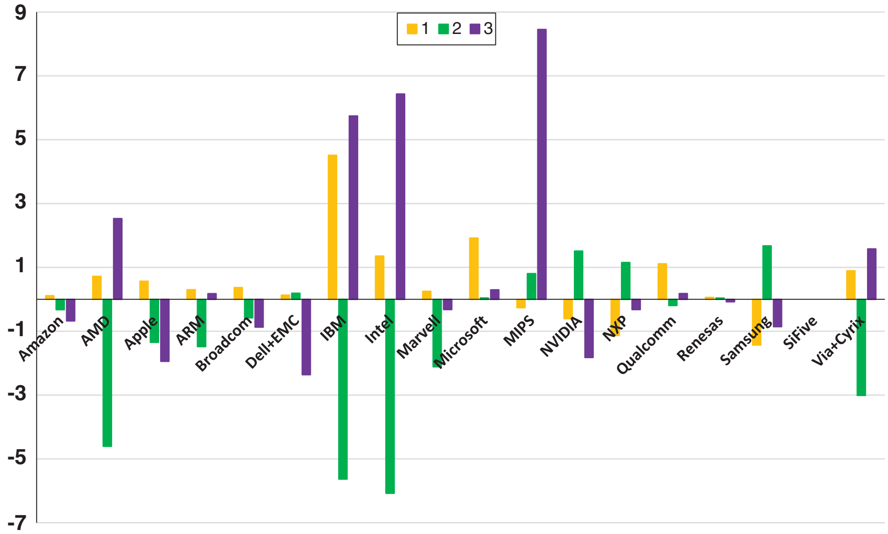
examining the three largest patent classes not only accounts for a significant percentage of all patents and computer architecture patents issued to each company, but it also provides a large enough sample size to determine whether there is a correlation between the prosecution time and the number of claims at the granularity of a patent class.

Unsurprisingly, given that these are computer architecture companies, the largest computer architecture patent classes are frequently also one of the three large patent classes for all patent classes. For example, the G06F patent class, which covers "electric digital data processing," is one of the three largest computer architecture patent classes for all 18 companies, but it is also one of the three largest patent classes across all patent classes (i.e., computer architecture and noncomputer architecture) for all 18 companies. Similarly, the H04L patent class, which covers "transmission of digital information, e.g., telegraphic communication," is one of the three largest computer architecture patent classes for 14 companies, but it is also one of the three largest patent classes across all patent classes for 12 companies.

Figure 1 shows the difference in the average prosecution time for patents in each of the three largest patent classes and 1) the average prosecution time for all patents [Figure 1(a)] or 2) the average prosecution time for the computer architecture patents [Figure 1(b)]. In other words, Figure 1(a) shows the average prosecution time for largest patent classes minus the average prosecution time for all patents, while Figure 1(b) shows the average prosecution time for largest computer architecture patent classes minus the average prosecution time for computer architecture patents. The "1," "2," and "3" in the legend correspond to the three largest patents classes (with "1" corresponding to the largest patent class). Due to the very small number of issued patents, SiFive only has one computer architecture patent class, G06F. As such, there are no bars for the "2" and "3" largest patent classes for SiFive computer architecture patents. Furthermore, because there is only one patent class, the average prosecution time for all SiFive computer architecture patents is the average prosecution time for its only patent class. As such, the difference between those two average prosecution times is zero.



(A)



(B)

FIGURE 2. Difference in the average number of claims in each of the three largest patent classes and (a) the average number of claims for all patents or (b) the prosecution time for the computer architecture patents.

The results in Figure 1 show that there is generally a larger difference (positive or negative) in the average prosecution time (both longer and shorter) for the computer architecture patents as compared to all patents. For example, for IBM, the differences in the average prosecution times for all patents for the largest patent classes are 2.8, –10.0, and 4.9 months, while the differences in the average prosecution times for computer architecture patents for the largest patent classes are 0.3, –12.8, and 14.9 months.

Overall, the standard deviation in the differences is 4.8 for all patents but is 6.4 for the computer architecture patents. The higher variability for the computer architecture patents could potentially decrease the correlation between the prosecution time and the number of claims because the higher variability in the prosecution times may not be matched by similar variability in the number of claims.

Figure 2 shows the difference in the average number of claims in each of the three largest patent classes and 1) the average number of claims for all patents [Figure 2(a)] or 2) the average number of claims for the computer architecture patents [Figure 2(b)]. For the same reason that the difference in the average

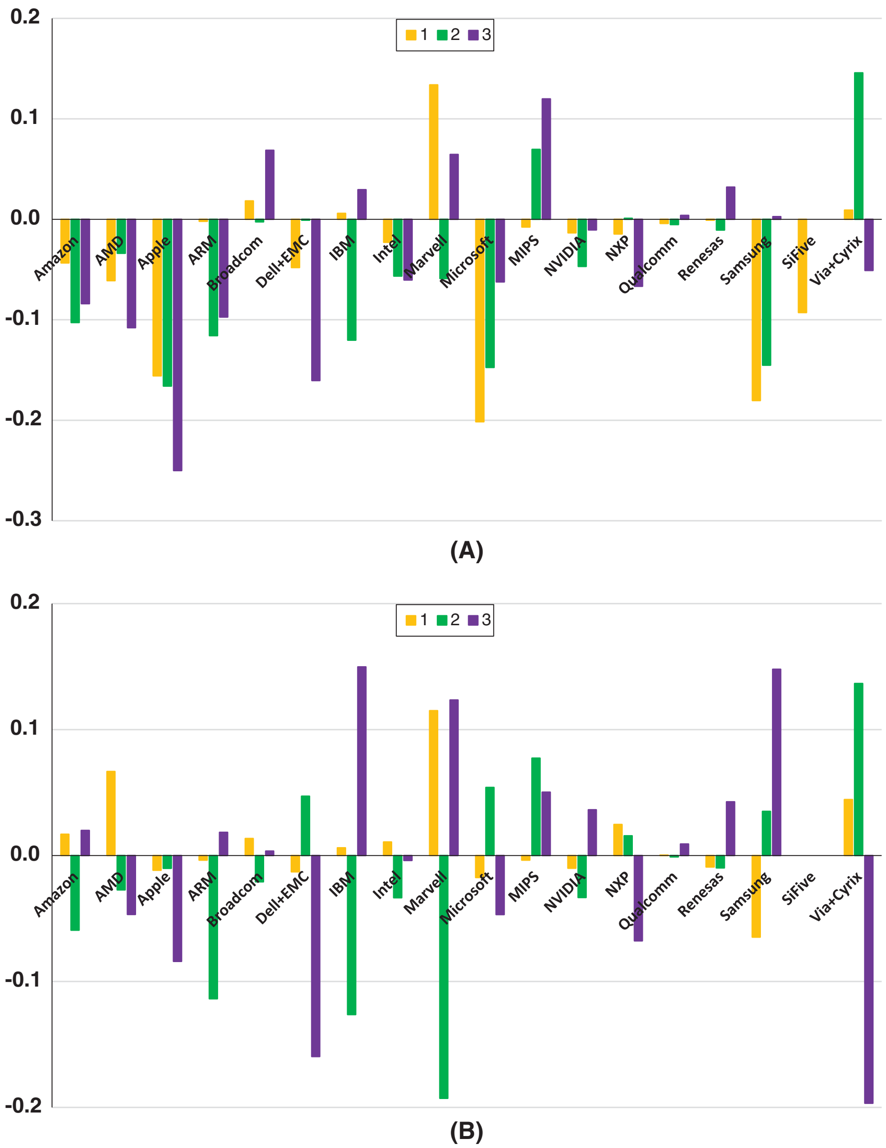


FIGURE 3. Difference in the correlation coefficient for patents in each of the three largest patent classes and (a) the correlation coefficient for all patents or (b) the correlation coefficient for the computer architecture patents.

prosecution times for SiFive computer architecture patents is zero, the difference in the average number of *claims* for SiFive computer architecture patents is also zero (i.e., only one patent class).

The results in Figure 2 are similar to those in Figure 1; namely, there may be a significant difference in the average number of claims across all patent classes and the average number of claims for one of the largest patent classes. For example, for the third largest patent class for MIPS (714: "error detection/correction and fault detection/recovery"), the difference is 9.1 claims. Furthermore, the results show that the standard deviation in the differences is higher for computer architecture patents (2.6) than for all patents (2.2).

Figure 3 shows the differences in the correlation coefficient for all patent classes and the correlation coefficients for the each of the three largest patent classes 1) for all patents [Figure 3(a)] and 2) for the computer architecture patents [Figure 3(b)]. The correlation coefficients are for the prosecution time and the number of claims. Negative bars indicate that there is less correlation for the largest patent classes as compared to all patents or all computer architecture patents. For the same reason that the difference in the average prosecution time or claims for SiFive computer architecture patents is zero, the difference in the correlation coefficients for SiFive computer architecture patents is also zero.

The results in Figure 3(a) show that most of the bars (38) are negative, with only a few (14) that are positive, which indicates that there is less correlation between the prosecution time and claims *within* patent classes *than across* all patent classes. This result is counterintuitive because one would expect that patent applications in the same technology center would have a *higher* correlation given that there is likely to be a similar workload across examiners, similar technological difficulty, less variability in the prosecution times for each examiner, etc.

The correlation coefficient for one of the largest patent classes may be lower than the overall correlation coefficient when, for example, the average prosecution time for the largest patent class is higher than the average prosecution time for all patent classes, while the average number of claims for the largest patent classes is lower than the average number of claims for all patent classes; i.e., the average prosecution time and the average number of claims trend in opposite directions. The correlation coefficient for a patent class may also be lower than the overall correlation coefficient—even if the average prosecution time and the average number of claims trend in the same direction—when one of the two increases or decreases at a faster rate than the other.

Analyzing the companies and patent classes where the correlation coefficients for the largest patent classes were lower than the overall correlation coefficient shows that there does not appear to be any commonality in terms of whether the average prosecution time or average number of claims is higher or lower than the overall average prosecution time and overall average number of claims, respectively. Rather, whether the correlation coefficient for the largest patent classes was lower than the overall correlation coefficient appears to be independent of—or, at most, very weakly related to—the overall average prosecution time and overall average number of claims.

By contrast, the results in Figure 3(b) show that approximately half of the bars are positive (26), while the other half are negative (25). This result is more intuitive, as one would expect that half of the correlation coefficients for individual patent classes would be higher than the overall correlation coefficient (i.e., across all patent classes), while the other half are lower; these then, in effect, average out to have a correlation coefficient in the middle.

The reason that the correlation coefficient for a single patent class may be lower than the overall correlation coefficient for all patent classes is because the larger number of patents in the latter may "average" out outliers, thus potentially increasing the correlation in the latter. On the other hand, the correlation coefficient for a single patent class may be lower because, when there are fewer patents, outliers may have more of an effect on the correlation coefficient. Furthermore, given that the correlation coefficients are generally lower for individual patent classes, this might also indicate that the effect of the technology class on the prosecution time may not be significant.

The next part in this series will continue to analyze potential factors that contribute to the prosecution time.

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