

**TAKING A SLICE OF THE PIE:
AN EMPIRICAL AND THEORETICAL INQUIRY
ON ALLEGEDLY CHALLENGEABLE
INVENTORSHIPS**

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ABSTRACT

This article argues for a more widespread existence of inventorship misrepresentation by comparing the US, Taiwanese, and Chinese patents owned by US, Taiwanese, and Chinese healthcare companies respectively. The companies were selected from NASDAQ, the Taiwan Stock Exchange Corporation, and the Shanghai and Shenzhen Stock Exchange while the patents were all retrieved from their respective official databases. Our empirical analyses show that, in comparison to the US patents owned by the US healthcare companies, a significantly higher likelihood of “allegedly challengeable” inventorship exists in the Taiwanese and Chinese patents owned by the Taiwanese and Chinese healthcare companies. This conclusion is based on statistical results, including the findings of representative Taiwanese and Chinese companies having more than half of

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their 100-plus patents invented by solely management-level employees (instead of their R&D personnel), while such a phenomenon does not exist in their US counterparts.

We argue that the existences of these inventorship misrepresentations are not only unethical, but also damaging to society through the creation of severe external diseconomies. This article starts by studying the enormous social costs incurred from destructed job signaling systems—first introduced by Nobel laureate, Michael Spence—for which we further argue with patent asset-specific applications. With the empirically-proven inventorship misrepresentation, we also question the justification of introducing patent inventorship in criminal sentence commutation decisions in China. Finally, we argue that without prompt correction, these commonly seen inventorship misrepresentations, which should never exist, will undermine the very purpose of patent law by weakening inventors' incentives to innovate or to disclose their inventions.

We then offer comprehensive accounts on inventorship misrepresentation from both personal and institution-wide perspectives. First, we argue that private parties may become over-incentivized to “take a slice” of any benefits associated with being an inventor. We also find that the differences in legal landscapes and cultural dimensions are also important contributing factors to why some companies misrepresent their inventors. Finally, based on the insights of behavioral law and economics studies, we propose the imposition of legal costs and the mandatory disclosure of inventive contribution information as the two solutions to deter these undesirable conducts.

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I. INTRODUCTION

You are a researcher at a biotech company. After years of hard work, you finally had your eureka moment and found the answer to a long-unsolved problem in the field. You understand the value of this invention, so you would like to have it patented. You are also aware that you are obliged to assign the patent to your company because of an agreement you signed on the first day of work. Still, you are okay with that because listing your name as the inventor on this patent would give your credentials a tremendous boost. Plus, the company awards a generous bonus to the inventor if the patent is granted and further monetized. You can also expect a raise from such a great achievement. So, you report your brilliant idea to your supervisor.

Just when you think everything is going as planned, you noticed that you are not the sole inventor listed on the patent application. To your surprise, your supervisor is also

listed as an inventor despite the fact that you single-handedly came up with all the ideas in the patent. Your supervisor was never there to help conceive your invention. Being a nice person and all, you don't want to risk sabotaging your career, so you are hesitant about calling out your supervisor. Nevertheless, you are still irritated at your supervisor for taking credit that she should never have been entitled to.

Having friends in the bioindustry, we have heard similar anecdotes more than a few times.¹ The familiar storyline is supervisors being listed as joint inventors with their subordinates even though the supervisors did not contribute to the conception of any of the patent claims. An even worse variation is the subordinates that did contribute to the invention being left out. Either way, this conduct is a misrepresentation of inventorship.²

There are three types of inventorship misrepresentations: misjoinders (listing someone who is *not* a real inventor, as in our original story), nonjoinders (failing to list someone who *is* the real inventor), or combinations of both, which, in this article, we call *compound inventorship misrepresentations*. All three types of misrepresentation, if done purposefully, are unethical and can have serious legal consequences.

For example, in *Drone Technologies*,³ the defendants argued that the listed inventor of the patents-in-suit was not the real inventor because the listed inventor from the Taiwanese corporation only had the simple idea of “control[ling] [an] aircraft using the movements of a remote controller, and did not have a solution for accomplishing that idea or even understand any of the technology described in the patents-in-suit.”⁴ The defendants claimed that the real

¹ For obvious reasons, we will not disclose from whom or from where we acquired such information.

² 1 CHISUM ON PATENTS § 2.01 (2020).

³ *Drone Techs., Inc. v. Parrot S.A.*, 838 F.3d 1283 (Fed. Cir. 2016).

⁴ *Id.* at 1291.

inventor should instead be the husband of the listed inventor.⁵ On remand, the court allowed the defendants to have the opportunity to pursue an invalidity claim based on this accusation⁶ and even explicitly stated that “a successful challenge to inventorship may invalidate the patents-in-suit.”⁷

Because of the dire consequences inventorship misrepresentation can lead to, a number of articles have covered this issue before.⁸ However, we take a step further and argue for the possibility of this phenomenon existing on a larger scale.⁹ We also cover the costs and causes of inventorship misrepresentation from society’s perspective as opposed to only on the legal consequences thereof.¹⁰

Since much of our anecdotal evidence comes from Taiwanese healthcare companies, our empirical study starts there. In Part II., we analyze and compare the patents owned by the selected Taiwanese healthcare companies with those owned by the US and Chinese healthcare companies. Our results show that compared to US healthcare companies, Taiwanese and Chinese healthcare companies are more

⁵ *Id.*

⁶ *Id.* at 1288.

⁷ *Id.*

⁸ See, e.g., Patrick G. Gattari, *Determining Inventorship for US Patent Applications*, 17 INTELL. PROP. & TECH. L. J. 16, 18-19 (2005) (discussing possible reasons why inventorship misrepresentation exists); Antigone Kriss, *Misrepresentation of Inventorship and the Inequitable Conduct Defense: PerSeptive Biosystems, Inc. v. Pharmacia Biotech, Inc.*, 12 FED. CIR. B.J. 285 (2002); Chih-Jie Yang 楊智傑, *Determining Inventorship and the Consequences of Inventorship Misrepresentation in US Patents—Case Study and a Comparison with Taiwanese Law 美國發明人認定及錯列發明人之後果 (Meiguo Famingren Rending Chi Tsolei Famingren Chih Hogo)*, 38 TAIWAN PAT. ATT’YS J. 27, 48 (2019) (comparing the legal landscape of Taiwan with that of the US in terms of inventorship misrepresentation and the impacts thereof).

⁹ *Infra* Part II.

¹⁰ *Infra* Part III.; *infra* Part IV.

likely to misrepresent their inventors.¹¹ In Part III., we cover the costs of inventorship misrepresentation. We argue that inventorship misrepresentation is not merely about hard feelings or work ethic. It also results in external diseconomies, including the reduced value of patent credentials, both in job markets and in society, as well as reduced incentives for inventors, both to innovate and to disclose their inventions. In Part IV., we turn to the causes of inventorship misrepresentation. We argue that besides the benefits associated with being listed as an inventor, legal landscapes and cultural dimensions are also contributing factors to why some companies misrepresent their inventors. In Part V., we provide the imposition of legal costs by tying patent enforceability to the correctness of inventorship and the increasing of inventive information transparency by mandating inventive contribution disclosure as the two solutions. Part VI. concludes.

II. EMPIRICAL STUDY ON “ALLEGEDLY CHALLENGEABLE” INVENTORSHIP

In this part, we explore possibilities of inventorship misrepresentation existing on a larger scale through a three-market empirical study. In the study, we compare Taiwanese patents owned by Taiwanese healthcare companies, US patents owned by US healthcare companies, and Chinese patents owned by Chinese healthcare companies. The Taiwanese, US, and Chinese companies were selected from the listings on the Taiwan Stock Exchange Corporation, NASDAQ, and the Shanghai and

¹¹ Since our study is based on public information, we do not dive directly into individual patents. The empirical evidence we provide in this article is derived from a generalized perspective, as explained below. *See generally infra* Part II.A.

Shenzhen Stock Exchange respectively.¹² The patents of these companies were selected from the official databases of each country.¹³

We argue that the Taiwanese patents owned by the Taiwanese healthcare companies and the Chinese patents owned by the Chinese healthcare companies are more likely to have “allegedly challengeable” inventorships compared to the US patents owned by their US counterparts. How the indicators are derived are explained in more detail in Section C, but the general idea is that these “allegedly challengeable” inventorships are the results of listing non-inventive contributing supervisors or failing to list real inventors.

However, it should be noted that we do not ambitiously claim the absolute existence of inventorship misrepresentations as it is difficult to do so without inside information.¹⁴ As such, the word, “allegedly challengeable,” is used throughout this article to describe *possible* inventorship misrepresentations in these patents, as opposed to the word, “misrepresented.” Moreover, since direct evidence is hard to obtain,¹⁵ we derived several novel indicators to indirectly prove the existence of “allegedly challengeable” patent inventorships. We explain how the indicators were derived and how they are applied to reach our conclusions in detail in Section C.¹⁶

Also, we only conducted patent searches in the countries that the companies are based in. This is because we assume that, for the three markets we targeted, a company’s primary market should be in the country the

¹² See *infra* Part II.A. 1.

¹³ See *infra* Part II.A. 2.

¹⁴ Without inside-information, inventorship misrepresentations are hard to discover and are most likely found during due diligence where such information is accessible. See Donald A. Degnan & Libby A. Huskey, *INVENTORSHIP: WHAT HAPPENS WHEN YOU DON’T GET IT RIGHT?* 8 (Holland & Hart LLP 2006).

¹⁵ See *id.*

¹⁶ See *infra* Part II.C.

company is based and is thus one of the major jurisdictions—if not the most influential—where the company should have filed the most patent applications.¹⁷ We contend that this method would yield the most comprehensive results as opposed to, for example, only retrieving US patents owned by Taiwanese companies.

In Section A, we describe our research methodology, including how we selected the healthcare companies and how we retrieved the patents and inventor-related information. In Section B, we present the results. Finally, in Section C, we explain the derivation of our indicators, analyze the results, and argue for the higher likelihood of allegedly challengeable patent inventorships in the Taiwanese and Chinese healthcare companies.

A. Methodology

1. Retrieval of Taiwanese, US, and Chinese healthcare companies

a. Taiwanese healthcare companies

We retrieved the Taiwanese healthcare companies from equities listed under the category, “Biotechnology and Medical Care,” in the Taiwan Stock Exchange Corporation (TWSE) on Oct. 26, 2019.¹⁸ A total of thirty-five companies were retrieved.

¹⁷ It is possible that some companies in other countries do not follow this assumption, but by comparing across the Taiwanese, US, and Chinese patents owned by the different companies through preliminary patent searches, we found that almost all companies we looked at own the most patents in their home country. Thus, this assumption is arguably sustained in our empirical study.

¹⁸ List of ISIN Code for Listed Equities 本國上市證券國際證券辨識號碼一覽表 (Benguo Shangshi Chenchuan Guoji Chenchuan Bianshish Hauma Yeelan Biau), <https://isin.twse.com.tw/> [<https://perma.cc/H8LW-FJ2E>] (last visited Oct. 26, 2019).

b. US healthcare companies

We retrieved US healthcare companies listed under the category, “healthcare,” from NASDAQ’s list screener.¹⁹ For comparison purposes, we only selected US healthcare companies that have similar market capitalizations with those of the selected Taiwanese healthcare companies. Since most of the selected Taiwanese healthcare companies have market capitalizations smaller than 300 million USD, which is roughly equivalent to the market capitalization range of NASDAQ’s “micro-companies,”²⁰ we selected the US companies based on this filter as well. A total of thirty-five US Micro Healthcare Companies were selected.

c. Chinese healthcare companies

We selected the Chinese healthcare companies from Shanghai and Shenzhen Stock Exchange under the categories, “Biomedicine, Health and Social Work,” and “Public Health,” on Dec. 7, 2019.²¹ A total of twenty-eight companies were retrieved. Since the market capitalizations of the retrieved Chinese companies were not markedly different from those of the selected Taiwanese companies, none of the twenty-eight Chinese companies were filtered out.

¹⁹ Symbol Screener, NASDAQ, <https://www.nasdaq.com/market-activity/stocks/screener> [<https://perma.cc/W25X-QEN7>] (last visited Dec. 2, 2019).

²⁰ *Id.*

²¹ SHANGHAI STOCK EXCHANGE, <http://www.sse.com.cn> [<https://perma.cc/J5N4-QL63>] (last visited Mar. 2, 2020); SHENZHEN STOCK EXCHANGE, <http://www.szse.cn> [<https://perma.cc/T3VF-BM9D>] (last visited Mar. 2, 2020).

2. Retrieval of Taiwanese, US, and Chinese patents

Here we explain how the patents were retrieved. Notably, we filtered out companies that owned fewer than ten patents²² as we believe that these companies have too few patents to make them statistically representative for our discussions.

a. Taiwanese patents

We conducted Taiwanese patent searches in February, 2020 using the Global Patent Search System (GPSS) developed by the Taiwan Intellectual Property Office (TIPO).²³ The names of the selected Taiwanese companies were used as search queries in the “assignee/applicant” field.²⁴

It should be noted that the scope of the study on Taiwanese healthcare companies is limited to the analysis of granted Taiwanese patents and thus does not include Taiwanese patent applications or other patent-related documents outside of Taiwan.

b. US patents

We conducted the US patent searches in November and December, 2019 using the U.S. Official Patent Full Text

²² The cut-off value is set at ten because according to our data, companies having fewer than ten patents only have a significantly small number of inventors and would be unsuitable to undergo our analyses in Section C.

²³ Global Patent Search System, TIPO, <https://gpss.tipo.gov.tw> [<https://perma.cc/7H53-B8E2>] (last visited Feb. 18, 2020).

²⁴ Note that based on the search queries we used, we were only able to obtain patents that are assigned to the companies selected. Our results do not include possible misjoinders or nonjoinders that are not properly assigned to the selected companies. Nevertheless, the proper assignment of patents is not within the focus of our study. We thus do not to dive deeper into how to retrieve these types of patents in this article.

and Image Database.²⁵ The names of the selected US companies were used as search queries in the “assignee” field.

Likewise, the scope of the study on US healthcare companies is limited to granted US patents and does not include US patent applications or other patent-related documents outside of the US.

c. Chinese patents

Patent searches were conducted in February, 2020 using the patent retrieval system of the Chinese National Intellectual Property Administration (CNIPA).²⁶ The names of the selected Chinese companies were used as search queries in the “assignee/applicant” field.

Similarly, the study on Chinese healthcare companies does not include Chinese patent applications or other patent-related documents outside of China.

3. Retrieval of inventor information

Since, according to our anecdotal evidence, misrepresented inventors tend to be supervisors,²⁷ we also retrieved information about whether the inventors are the company’s “management-level employees.” We define “management-level” as management positions listed in the companies’ annual reports or public announcements. We assume that since companies list these positions on one of their most important corporate annual reports, the people in these positions should, generally speaking, be more likely to oversee many of the research projects conducted by

²⁵ Patent Full-Text Databases, USPTO, <http://patft.uspto.gov> [<https://perma.cc/6KHQ-K7VU>] (last visited Apr. 7, 2020) [hereinafter USPTO patent database].

²⁶ Patent Search and Analysis, CNIPA, <http://pss-system.cnipa.gov.cn/> [<https://perma.cc/VK3S-3JF3>] (last visited May 2, 2020).

²⁷ See *supra* Part I.

employees and be able to influence important decisions, such as patenting strategies, in the company. The importance of this information will manifest when we discuss how this information works with other data to serve as the indicators for the existence of allegedly challengeable inventorships.²⁸

4. Pseudonymization of companies and inventors

For the protection of the selected companies and inventors in our study, we assign code names to the selected companies and refrain from listing the companies' real names in this article.²⁹ We also do not disclose the names of the inventors for the same reason.³⁰ However, for the purposes of this study, we do have to mention the job titles of the inventors.

The assigned code names of the selected Taiwanese healthcare companies follow the pattern: TW1, TW2, TW3. . . . Similarly, the code names of the selected US and Chinese healthcare companies also follow similar patterns: US1, US2, US3. . . and CN1, CN2, CN3. . . .

²⁸ See *infra* Part II.C.

²⁹ We, however, are able to re-identify the companies' names and their information upon request. For protection purposes, we do not name them directly in this article. This method is commonly referred as "pseudonymization" and should not be confused with "anonymization," where re-identification is not possible. Jan-Eric Litton, *We Must Urgently Clarify Data-Sharing Rules*, 541 *NATURE* 437, 437 (2017) ("With pseudonymization, data can be attributed to individuals using 'additional information' (such as a key or encryption code), whereas with anonymized data such information is not available.").

³⁰ Note that we use female pronouns throughout the article even though some of the inventors are male.

B. Results

1. Taiwanese healthcare companies

First, we look at the Taiwanese healthcare companies:

Of the thirty-five retrieved Taiwanese healthcare companies selected from TWSE, nineteen companies were excluded from further analysis due to their low numbers (ten or fewer) of Taiwanese patents. As mentioned, the remaining sixteen companies were each assigned code names, from TW1 to TW16.

According to the information collected, fourteen out of the sixteen selected Taiwanese healthcare companies have fewer than 100 patents, and ten of them have fewer than fifty patents. All of the companies have at least some percentage of patents invented by their management-level employees, ranging from 14.93% to 100%. More than half, or eleven out of sixteen, of the companies, have percentages of *management-level-invented* patents higher than 50%.

The company having the highest percentage of patents resulting from inventions contributed by its management-level employees (100%) is TW2, where all of its fifty-eight patents are (at least jointly) invented by its management-level employees. Another company worth noting is TW8, which has 161 patents, or 72.56%, of its 222 patents (jointly) invented by its management-level employees.

On average, more than half (or 1.63 out of 3) of a Taiwanese company's top three inventors are in a management-level position. As for the sixteen top inventors of each Taiwanese company (the inventor that invented the most patents), fourteen have management-level positions. Moreover, a top inventor invents, on average, 55.14% of the patents owned by her company.

2. US healthcare companies

Now, we turn to the selected US healthcare companies:

Of the thirty-five retrieved US healthcare companies selected from NASDAQ, eighteen companies were excluded from further analysis due to their low numbers (ten or fewer) of US patents. Likewise, the remaining seventeen companies were assigned code names, from US1 to US17.

According to our data, fourteen of the seventeen selected US healthcare companies have fewer than 100 patents. The other three companies, US7, US13, and US17, have patent counts of more than 150. More than half, or nine out of the seventeen companies, do *not* have any patents invented by management-level employees. Those who do, have percentages over 75%. Notably, US10, US11, and US12 have all of their patents invented by management-level employees, but none of these companies have patent counts over fifteen.

Only seven of the seventeen companies have management-level employees in their top three inventors, and only four companies have management-level employees as their top inventors. However, on average, a top inventor invents 64.86% of the patents owned by her company because many companies have top inventors that invent almost all of the companies' inventions.

3. Chinese healthcare companies

Lastly, we cover the Chinese healthcare companies:

Of the twenty-eight retrieved companies, sixteen companies were excluded due to having fewer than ten Chinese patents.

Based on our results, eight out of the twelve selected Chinese healthcare companies have patent counts fewer than 100, in which six of them have fewer than fifty patents. Except for CN11, all of the selected Chinese companies have

at least some percentage of patents invented by management-level employees, ranging from 30.15% to 100%.

Additionally, more than ten out of the twelve companies have percentages of *management-level-invented* patents higher than 50%, and eight of them have percentages of such higher than 80%. The companies CN1, CN3, and CN12, have all of their patents invented by management-level employees, but none of them have more than fifty patents. However, three companies worth noting are: CN10, which owns 102 patents, 88.24% of which are invented by management-level employees; CN5 which owns 110 patents, 60% of which are invented by management-level employees; and CN2 which owns 138 patents, 55.07% of which are owned by management-level employees.

On average, more than half (or 1.75 out of 3) of a Chinese company's top three inventors are in a management-level position. As for the twelve top inventors of each company, nine out of them have management-level positions. On average, a top inventor invents 63.8% of the patents owned by her company.

C. Analysis

Here, we analyze the results and provide reasons why our self-derived indicators point out that the inventorships of patents owned by Taiwanese and Chinese healthcare companies are possibly more vulnerable to challenge compared to those owned by the US healthcare companies. However, as mentioned previously, our conclusions are based on circumstantial evidence. So, we concede that alternative explanations may exist, but we carefully address these doubts in this section as well.

We divide the self-derived indicators into two categories: those that allegedly point out misjoinders and those that allegedly point out nonjoinders. In Subsection 1,

we discuss the former, and in Subsection 2, we cover the latter.

1. Arguing for possibilities of misjoinders

a. Comparing “patent counts and percentages of management-level-invented patents”

The first indicator we propose to identify companies that are more likely to have patents with misjoinders is the “comparison of the total patent counts and the percentages of *management-level-invented patents* (patents invented by management-level employees).” To better visualize this comparison, we present a “Company Percentage of *Management-Level-Invented Patents* vs. Company Total Patent Count Scatter Plot” in Figure 1.³¹ On this scatter plot, the y-axis is the percentage of *management-level-invented patents*, while the x-axis is the total number of patents owned. We argue that the further up and to the right a company’s data point is, the more likely it is that the company’s patent inventorships are vulnerable to challenge.

The reasoning behind this inference is that we assume the number of patents owned by a company inversely correlates to the percentage of patents invented by management-level employees of that company. We base this assumption on the fact that patent counts strongly correlate to company size³² and that larger companies have

³¹ See *infra* Figure 1.

³² Alok K. Chakrabarti & Michael R. Halperin, *Technical Performance and Firm Size: Analysis of Patents and Publications of U.S. Firms*, 2 SMALL BUS. ECON. 183, 186 (1990). This assumption is also the reason why we choose to compare companies with similar market capitalizations as opposed to, for example, comparing top companies in each country. See *supra* Part II. A. 1. If we compared the top companies in each country, the large differences in company sizes will interfere with the differences in patent counts between the companies, thus skewing our results and analyses.

more capacity to implement employee specialization.³³ The management-level employees of companies with greater patent counts should, at least in theory, spend more of their efforts on managing the company and less on inventing. Therefore, if a company's patent count is large but its *management-level-invented* patent percentage is also high—hence further to the top-right of the plot—the company's patents should be more susceptible to the misjoinder-type of inventorship challenges.

Notice that we also drew a 5-, 25-, 50-, and 100-management-patent-curve. Any company located on the left of the 5-management-patent-curve has fewer than five *management-level-invented* patents; any company located on the right of the 5-management-patent-curve has more than five of such patents. Any company exactly on the 5-management-patent-curve has precisely five of such patents. The same goes for the 25-patent, 50-patent, and 100-management-patent-curves. Moreover, companies situated closer to the top-right corner of the graph are emphasized and labeled with their code names.

The only company located on the right of the 100-management-patent-curve is TW8. The companies located between the 50-management-patent-curve and the 100-management-patent-curve are TW1, TW2, CN2, CN5, CN7, and CN10.

If we also take the emphasized vertical and horizontal gridlines into consideration, the three Chinese companies, CN2, CN5, and CN10, and the Taiwanese company, TW8, are the only four companies situated on the right of the 50-management-patent-curve, the 100-patent-count vertical gridline, and the 50% horizontal gridline. These companies are the ones that not only have *more than 100 patents*, but also have more than half of these patents

³³ JEFFREY H. DYER ET AL., STRATEGIC MANAGEMENT: CONCEPTS AND CASES 64 (2017).

invented by management-level employees. It is also worth noting that no US healthcare companies are situated on the right of the 100-management-patent- or the 50-management-patent-curves. There are also *no* US healthcare companies located both on the right of the 100-patent-count gridline and above the 50% horizontal gridline.

The curves and gridlines point out that there exist Taiwanese and Chinese healthcare companies having both large number of patents and high percentages of *management-level-invented* patents. But this phenomenon is not seen from the US healthcare companies. All US companies have either a small number of patents with a high percentage of *management-level-invented* patents or a large number of patents with a low percentage of *management-level-invented* patents. This distribution is arguably more reasonable, as explained previously, because companies owning more patents tend to be larger³⁴ and should more likely exercise employee specialization.³⁵ Thus, it would be unexpected to see management-level employees spending so much time and effort on creating invention when they should, in theory, spend more time and effort on managing the company.

³⁴ Chakrabarti & Halperin, *supra* note 32, at 186.

³⁵ DYER ET AL., *supra* note 33, at 64.

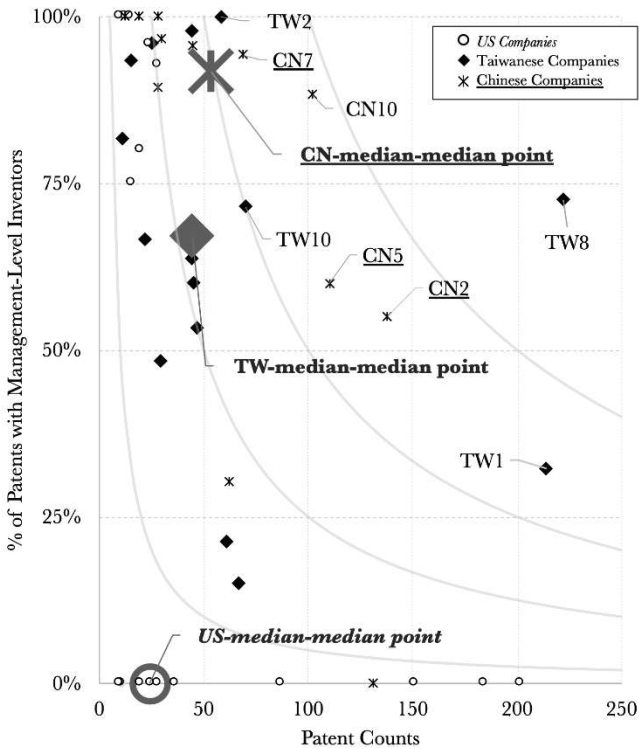


Figure 1: Company Percentage of *Management-Level-Invented Patents* vs. Company Total Patent Count Scatter Plot.³⁶

The phenomenon found in these Taiwanese and Chinese healthcare companies is against the assumption based on Chakrabarti & Halperin's³⁷ and Dyer's³⁸ research that an inverse correlation exists between total patent counts and percentages of *management-level-invented* patents. Because of this, there arguably exists Taiwanese and Chinese healthcare companies that have patents with the misjoinder-type of allegedly challengeable inventorships.

³⁶ Our own construction based on data retrieved in empirical study.

³⁷ Chakrabarti & Halperin, *supra* note 32, at 186.

³⁸ DYER ET AL., *supra* note 33, at 64.

Moreover, our argument is further fortified by the fact that we are comparing companies with similar market capitalizations. The anticipated rebuttal of company size being responsible for the differences seen in our results can be discarded. Another variable has been controlled by comparing companies falling into the same categorized industry, *i.e.* healthcare.

The higher possibility of Taiwanese and Chinese healthcare companies owning patents with the misjoinder-type of allegedly challengeable inventorship can also be demonstrated by comparing the median-median points.³⁹ The median-median points of the Taiwanese and Chinese healthcare companies are not only on the right of the 25-management-patent-curve but also closer to the top-right corner of the plot compared to that of the US healthcare companies. The median-median points on this plot also reflect that half of the selected Taiwanese companies have percentages of patents invented by management-level employees higher than 60%, half of the selected Chinese companies have percentages of such patents higher than 90%, but half of the selected US companies have *none* of these types of patents.

b. Comparing “top inventor patent counts”

Looking at the percentages and the numbers of the patents invented by management-level employees neglects a crucial point: it does not take the number of management-level employees into account. It may well be because some

³⁹ The mathematical term “median-median point” is an ordered pair (x_m, y_m) that represents the physical middle of a group of datapoints, in which x_m is the median of the x values, while y_m is the median of the y values. *MAT 312: Probability and Statistics for Middle School Teachers*, ILL. ST. U. MATH DEP’T (1999), <https://math.illinoisstate.edu/day/courses/old/312/session11.html> [<https://perma.cc/TNE2-MQ9P>].

companies have more “management-level employees” such that these companies end up with a higher number of patents invented by such employees. Suppose two companies, A and B, both have five employees. Company A has two management-level employees, while Company B has three management-level employees. If the employees at both companies each all invent one patent, Company A would have 40% of its patents invented by management-level employees, whereas Company B would have 60% of its patents invented by management-level employees. In this hypothetical scenario, both companies have not misrepresented the inventors of their patents, so their patents should, in theory, have equal strength against inventorship challenges. But if we implement the previous analytical method, Company B’s patents would be misjudged as being more vulnerable to inventorship challenge despite having the same count as Company A’s.

Hence, to circumvent this blind spot, the second indicator we propose is the comparison of *top inventor patent counts* (the number of patents invented by the inventor who invented the most patents owned by her company). If we assume that an inventor has a limited amount of time to spend on inventing, then there should be a limit for the number of inventions an inventor can invent in a particular time frame. Therefore, companies that have employees that “invent,” on average, significantly more patents than the employees of other companies should have more patents that are more susceptible to the misjoinder-type of inventorship challenges. If these “top-inventing” employees also happen to be management-level employees, who, in theory, should be spending more effort on company decisions than research and development, then the likelihood of their companies having the misjoinder-type of allegedly challengeable patent inventorships should be even higher.

This indicator may seem to penalize top inventors who are efficient in inventing. Nevertheless, as emphasized

before, we do not claim the misrepresentation of inventorship in any specific patent. The key to our argument lies in the likelihood of allegedly challengeable inventorship. This can occur when the number of patents exceeds a reasonable number, the more patents a top inventor invents, the more likely allegedly challengeable inventorships exist. We use Figure 2 below to apply this concept to advance our argument.

Figure 2 is a scatter plot detailing the *top inventor patent counts* of the selected companies. We divide the companies' data points into 5-year-segments. The first segment includes companies that have patent application dates of their top-inventor-invented patents spanning fewer than 5 years.⁴⁰ This categorization is to avoid penalizing companies that have top inventors that have been working in the company for more extended periods. We will thus only compare companies within, but not across each segment. We also classify the data points according to country and according to whether a management-level employee invents the patents. The markers in gray are companies whose top inventors are not in management-level positions.

Shifting to the assessment, notice that in almost all of the segments, the companies that have the larger *top inventor patent counts* are Taiwanese and Chinese companies. These companies are TW13, TW8, TW2, CN10, CN5, and CN2. Within segments, there is a significant difference between the *top inventor patent counts* of these companies and the US companies having the largest *top inventor patent counts*. For example, in five years, the top inventor of CN10 “invented” twenty-seven more patents compared to that of US16. Also note that these Taiwanese and Chinese

⁴⁰ This is determined by the inequality: (Year of Patent Application of Oldest Top-Inventor-Invented Patent) – (Year of Patent Application of Latest Top-Inventor-Invented Patent) \leq 5 years.

companies all have top inventors in management-level positions.

The only segment where a US company made it into the top two is the fourth segment, but that segment only has four companies. Here the company's top inventor is not even in a management-level position.

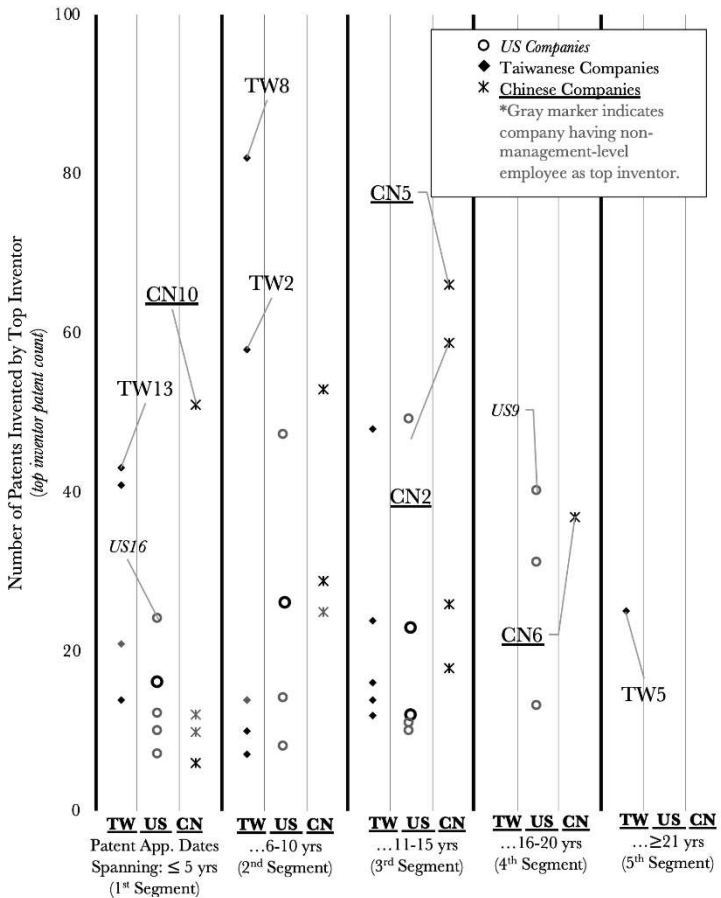


Figure 2: Number of Patents Invented by Company Top Inventor Presented in 5 Year Segments⁴¹

⁴¹ Our own construction based on data retrieved in empirical study.

The fact that there are marked *top inventor patent count* differences between some Taiwanese and Chinese companies and US healthcare companies suggests that the patents owned by some Taiwanese and Chinese healthcare companies are more susceptible to the misjoinder-type of inventorship challenges compared to their US counterparts. Moreover, the top inventors of these Taiwanese and Chinese healthcare companies being management-level employees further bolsters our argument. Since being in a management position would have more discretion in deciding the company’s patent-related affairs, the employee should thus be more likely to have the power, if the person wanted to, to list herself as an inventor in patents that she did not invent. Also note that TW8, TW2, CN5, and CN2 are also the companies situated to the right of the 50-management-patent-curve and closer to the top-right corner of Figure 1. The existence of this overlapping data serves as robust additional support for our argument that patents owned by Taiwanese and Chinese companies are more likely to be more vulnerable to inventorship challenges compared to those owned by their US counterparts.

c. Comparing “the top inventor’s different joint inventor counts”

This subsection provides a third indicator to analyze the misjoinder-type of allegedly challengeable inventorship: “the comparison of *the top inventor’s different joint inventor count* (the number of different joint inventors in the patents invented by the top inventors).” We argue that the higher this number is, the more likely the misjoinder-type of allegedly challengeable inventorship exists. Here we assume that an inventor, even a top inventor, has only a limited amount of time to spend on cooperating with other

inventors.⁴² Many inventors tend to specialize in a particular field⁴³ and should thus be more likely to work with a particular group of researchers than to work with researchers across different teams. Thus, in theory, it is rather unlikely for an inventor to work with a vast number of people in an inventive capacity. Hence, if the top inventor is part of a widely varying group of joint inventors across patents, then inventorship is more likely to be challengeable. If the top inventor also happens to be a management-level employee, the odds of the misjoinder-type of allegedly challengeable inventorship being present may increase even further.⁴⁴

We also must not forget the time element in this evaluation. We would not want to penalize top inventors who have worked longer at the company and thus have cooperated with many different people. Thus, to avoid complications, the data points are also categorized into 5-year segments. Likewise, we will not compare companies across different time segments.

Another worry is team size. Readers may argue that this assessment may also penalize top inventors who belong to larger research teams. This concern is valid, but we argue that it is only significant when comparing smaller sizes of research teams—or more specifically, when comparing research teams within a reasonable size.

Determining the reasonable limit for team size requires extensive study and is not the main point of this article. But to ease the concern of penalizing larger research teams, we will not compare companies if both companies' *top inventors' different joint inventor counts* are lower than seven. The number seven is chosen is because according to

⁴² After all, there are only 24 hours in a day.

⁴³ See Christopher Lettl et al., *Why Are Some Independent Inventors 'Heroes' and Others 'Hobbyists'? The Moderating Role of Technological Diversity and Specialization*, 38 RSCH. POL'Y 243, 243 (2009) (stating that inventors employ technological specialization).

⁴⁴ See *supra* Part II.C. 1.b.

Cook et al.’s study, the mean size for biologic research groups is seven.⁴⁵ Better yet, none of the segments only contain companies with *top inventors’ different joint inventor counts* lower than seven.

Figure 3 is a scatter plot organized similarly to Figure 2, except now the y-axis is the number of different joint inventors in patents listing the top inventor, or “*top inventor’s different joint inventor count.*”

The companies having larger *top inventors’ different joint inventor counts* in each segment are mostly Taiwanese and Chinese healthcare companies. The top companies in each segment are *all* companies that have management-level employees as their top inventors.

If the given inventorship information is correct, then for the past ten years, the top inventor of TW2, on average, works with at least five new inventors every year. This rate is high compared to its peers, where the top inventor of CN4 works with, on average, 3.6 new inventors every year. Also, the top inventor of TW2 not only co-invented with all of the company’s inventors but also has a management-level position. By comparing the companies’ *top inventors’ different joint inventor counts*, we infer, again,⁴⁶ that patents owned by Taiwanese and Chinese companies are more likely to be vulnerable to the misjoinder-type of inventorship challenges compared to those owned by their US counterparts. The overlap of certain highlighted companies, such as TW2 and CN5, across different analytic methods, reinforces our argument.

⁴⁵ See Isabella Cook et al., *Research groups: How big should they be?*, 3 PEERJ 989, 992 (2015).

⁴⁶ Part II.C. 1.

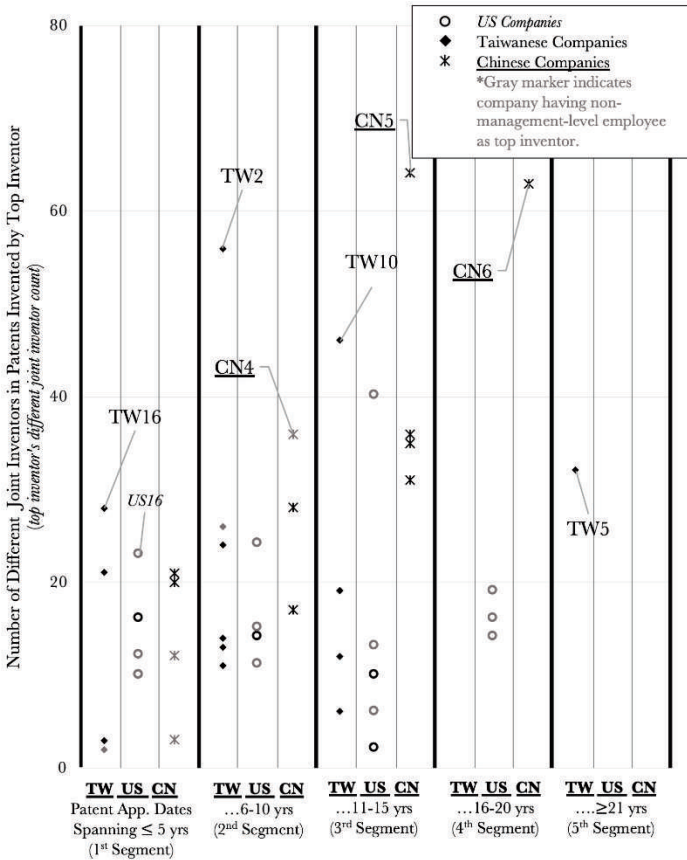


Figure 3: Number of Different Inventors in Patents Invented by Company Top Inventor Presented in 5 Year Segments.⁴⁷

However, we must emphasize that the companies having lower *top inventors' different joint inventor counts* may also have allegedly challengeable inventorship, but this possibility does not weaken our argument. Relevance is key. As emphasized earlier, we aim to demonstrate the relative possibilities of allegedly challengeable inventorship

⁴⁷ Our own construction based on data retrieved in empirical study.

between different companies, not to claim the absolute existence of inventorship misrepresentation in any company.

2. Arguing for possibilities of nonjoinders

The indicators in the previous section cannot point out nonjoinders or *compound inventorship misrepresentations* because the assumption was that allegedly challengeable inventorships only result from listing *more* inventors than a company should have listed. If nonjoinders or *compound inventorship misrepresentations* exist, the missing numbers of the real inventors would cancel out or subsume the added numbers of the misrepresented management-level inventors, leaving possible nonjoinder-type allegedly challengeable inventorships undetected.

It is relatively hard to identify nonjoinders as we cannot know whether a true inventor is missing without inside information. But by examining companies with *low total inventor counts* (total number of inventors in the patents owned by a company) we may gain some clues. Here, we point out one company that has a higher possibility of owning such patents.

a. Examining companies with “low total inventor counts”

Here, we argue that TW13 is the company most likely to be vulnerable to a nonjoinder-type inventorship challenge.

According to our empirical study, TW13 has a total of forty-four patents; the number of different inventors is only four. The top inventor, which is a C-level manager, is the single inventor of forty-two patents. All of the forty-two patents were applied for between 2011 and 2015. Although we do not want to doubt a person’s ability to innovate or apply for patents, TW13 is reported to have around 1,240

employees. The fact that there is only one inventor in over 1,000 employees and that the one inventor also happens to be in a rather high management position should at least raise some eyebrows.

Another company also comes into view if we look at low inventor counts: US10. This US company has twelve patents, and the number of different inventors is two. The top inventor of the company invented all twelve patents in which eleven of them were allegedly invented all by herself. However, unlike TW13, US10 has fewer employees: 114, to be exact.⁴⁸ Thus, coupled with the much lower count of patents/employees, US10 is arguably less suspicious to be the nonjoinder-type of inventorship misrepresentation.

III. COSTS OF INVENTORSHIP MISREPRESENTATION

Now having demonstrated that allegedly challengeable inventorship exists on a more common scale, the next logical question that pops to mind should be: so what? So what if inventorship misrepresentation does exist? The first thought that comes to mind may be the damage caused to the inventor's ego. However, inventorship misrepresentations are not only about hard feelings, they also create external diseconomies.

In this part, we discuss the costs of inventorship misrepresentation with a focus on society's perspective. Since the establishment of statutory laws of a particular topic is ultimately traced back to the topic's impact on society,⁴⁹ we wish to delve deeper into the impacts of inventorship misrepresentation in this part, instead of only doctrinally

⁴⁸ Note that the number of employees for the US10 corporation was retrieved from MARKET SCREENER, <https://www.marketscreener.com> [<https://perma.cc/9D3E-JQAB>] (last visited Apr. 19, 2020).

⁴⁹ Laurence H. Silberman, *Chevron—The Intersection of Law & Policy*, 58 GEO. WASH. L. REV. 821, 822 (1990) (stating that “[l]aw might be described as the accumulated crystallization of prior policy choices.”).

discussing the legal consequences of inventorship misrepresentation. We, however, touch on these legal issues in the next part, when we argue that the different legal consequences between the countries partially contribute to the differences in our results.⁵⁰

In Section A, we discuss the detrimental effects inventorship misrepresentation has on the value of patent credentials. In Section B, we turn to argue that inventorship misrepresentation may even act against the very goal patent law strives to attain.

A. *Reduced Patent Credential Values*

1. Credentials in job markets

a. *The job market patent credential system and its critical assumption*

Patents can serve as personal credentials.⁵¹ For instance, look at how people are suggested to add patents to their curriculum vitae⁵² or résumés.⁵³ Indeed, patents have powerful social recognition.⁵⁴ They indicate the existence of an invention that is certified by an entity possessing substantial legitimacy.⁵⁵ Being listed as an inventor on a

⁵⁰ See *infra* Part IV.A.

⁵¹ See generally Jason Rantanen & Sarah E. Jack, *Patents as Credentials*, 76 WASH. & LEE L. REV. 311, 317 (2019).

⁵² See, e.g., Elsevier Global Communications, *Writing an effective academic CV*, ELSEVIER (Jan. 4, 2013) <https://www.elsevier.com/connect/writing-an-effective-academic-cv> [<https://perma.cc/3GQN-FUJH>] (last updated Jun. 6, 2019).

⁵³ See, e.g., *Step-by-Step Resume Guide & Templates*, CARNEGIE MELLON UNIV., https://www.cmu.edu/career/documents/sample-resumes-cover-letters/resume-guide_college-of-engineering-graduate.pdf [<https://perma.cc/WND4-PHVJ>] (last visited Apr. 20, 2020).

⁵⁴ Rantanen & Jack, *supra* note 51 at 318.

⁵⁵ *Id.* at 318-319; William Hubbard, *Inventing Norms*, 44 CONN. L. REV. 369, 399 (2011) (stating that due to patents being examined, it serves as

patent serves as a credential that the person is a government-certified inventor.⁵⁶ This credential can, of course, attract attention from employers and signal that the person is associated with specific positive characteristics.⁵⁷ This function of patent inventorship is similar to how authorships of open-source codes⁵⁸ can help advance one's career.⁵⁹

However, this credential system only works if credential signals are valid. That is, the inventors claimed in the patents are the actual inventors—the ones that genuinely contributed to the conceptualization of the invention. Of course, the laws and rules, including those of the US,⁶⁰

an indication that the inventor is a creator of a new invention that meets the requirements of patentability).

⁵⁶ Note that the credentials are mainly directed to the inventor and not the patentee. Patentees may be assigned the associated patent rights, but are not certified for their ingenuity. *Contra* Rantanen & Jack, *supra* note 51 (failing to discuss the effects of patent credentials working for patentees).

⁵⁷ *Id.* at 319. See also Michael Spence, *Job Market Signaling*, 87 Q. J. ECON. 355, 355-58 (1973) (explaining that hiring is an investment with uncertainty and that employers would need to rely on readily available signals to determine whether the candidate's productive capabilities are desirable).

⁵⁸ Cf. PATRICIA WALLACE, *THE INTERNET IN THE WORKPLACE: HOW NEW TECHNOLOGY IS TRANSFORMING WORK* (2004) (explaining that one of the reasons people volunteer to become a part of the open source movement is because of “the desire to establish and maintain a good reputation among highly talented peers”); Josh Wulf, *How to Advance Your Career by Contributing to Open Source Projects*, OPENSOURCE.COM (May 22, 2019), <https://opensource.com/article/19/5/how-get-job-doing-open-source> [<https://perma.cc/2GGC-8W66>] (arguing that companies see the contribution of open-source codes as credentials and one can advance one's career by contributing to open sources projects).

⁵⁹ See generally ERIC S. RAYMOND, *THE CATHEDRAL AND THE BAZAAR: MUSINGS ON LINUX AND OPEN SOURCE BY AN ACCIDENTAL REVOLUTIONARY* (2001) (explaining the roots of open-source and why people are motivated to contribute to open-source projects).

⁶⁰ 35 U.S.C. § 101 (“Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new

Taiwan,⁶¹ and China,⁶² all require that the inventors listed in patents be the real inventors. This is also the reason why patents can serve as credentials in the first place. However, as shown in our empirical study, this may not always be the case.⁶³

When this presumption fails, the patent credential system becomes flawed or may even fall apart. Picture a scenario where the misjoinder-type of inventorship misrepresentations are present in some patents. In this

and useful improvement thereof, may obtain a patent therefor...”); *Burroughs Wellcome Co. v. Barr Labs., Inc.*, 40 F.3d 1223, 1227-28 (Fed. Cir. 1994) (stating that conception is most important in inventorship and is thus how inventorship is determined); 35 U.S.C. § 115(a) “[p]atent [a]pplication shall include (or be amended to include) the name of the inventor for any invention claimed in application.”); *see also* 35 U.S.C. § 102(f) before the enactment of Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (codified in scattered sections of 35 U.S.C.) (hereinafter, “AIA”) (“[a] person shall be entitled to a patent unless -... (f) he did not himself invent the subject matter sought to be patented...”).

⁶¹ Patent Act art. 7, para. 4 (2019) (Taiwan) (“[T]he inventor, utility model creator or designer concerned shall be entitled to a right to have his/her name shown as such.”); *Chen v. Taiwan Sunpan Biotech Dev. Co.*, 2013 SIFAYUAN FAXUE JIANSUO XITONG 9 (Intell. Prop. Ct. Jan. 25, 2013) (stating that the inventor must be a person who has made a substantial contribution to the technical features claimed in the patent application); PROCEDURE EXAMINATION AND PATENT RIGHT MANAGEMENT 1-3-3 (2013) (stating that the applicant should clearly indicate the inventor’s name in the application).

⁶² Patent Law of the People’s Republic of China (2008) art. 17 (“[t]he inventor or creator has the right to be named as such in the patent document.”); Rules for the Implementation of the Patent Law of the People’s Republic of China (2010) Rule 13 (““Inventor” or “creator” referred to in the Patent Law means any person who makes creative contributions to the substantive features of an invention-creation. Any person who, during the course of accomplishing the invention-creation, is responsible only for organisational work, or who offers facilities for making use of material and technical means, or who takes part in other auxiliary functions, shall not be considered as inventor or creator.”).

⁶³ Part II.C.

scenario, some named inventors are real inventors while other named inventors are not; all of these named inventors enjoy the credential boosts these patents provide.⁶⁴ At first, this is not fatal, as employers and society will still treat named inventors as signals for positive characteristics. But as more and more people realize that they can benefit from being named as inventors without really contributing as real ones, more people will follow. This trend will continue until employers gradually realize that not every named inventor is a real inventor. By then, the patent's function of credentials will be cast out.

b. The destruction of the job market patent credential system

The patent credential system's hypothetical destruction by misrepresented inventors can also be explained by applying Michael Spence's theory of job signaling (Figure 4).⁶⁵

When an employer is looking to hire an individual, she usually is not certain about the individual's productive capability. Therefore, in order to increase the odds of hiring a candidate with the desired productive capability, she can look for observable characteristics that indicate such capability. According to Spence, these observable characteristics are termed "indices" and "signals," in which "indices" are traits an individual generally cannot change

⁶⁴ People, including judges, do not presumptively question your identity as an inventor and thus treat you as one, at least until you are proven not to be one. *Acromed Corp. v. Sofamor Danek Grp., Inc.*, 253 F.3d 1371, 1379 (Fed. Cir. 2001) (stating that there is a "presumption that [a patent's] named inventors are the true and only inventors") (citing *Hess v. Advanced Cardiovascular Sys., Inc.*, 106 F.3d 976, 980 (Fed. Cir. 1997)).

⁶⁵ *Cf. Spence, supra* note 57, at 359-61 (wherein being listed as inventors in patents serve as the "job signal" in Michael Spence's theory of job signaling).

(such as race) while “signals” are those that can be altered by the individual by spending some time, money or other efforts (such as education).⁶⁶ Since being listed on a patent serves as a credential and is something that can be altered, we categorize it as a type of “signal.”

Under Spence’s theory, informational feedback exists in the job market. In this feedback loop, employers adjust their expectations of a certain signal, or here, the patent credential’s predictive strength after evaluating the productive capability of an employee giving out that signal.⁶⁷ The feedback loop reaches equilibrium when the signal’s indicating strength matches the employer’s expectations.⁶⁸

⁶⁶ Spence, *supra* note 57, at 357.

⁶⁷ *Id.* at 359-61.

⁶⁸ *Id.*

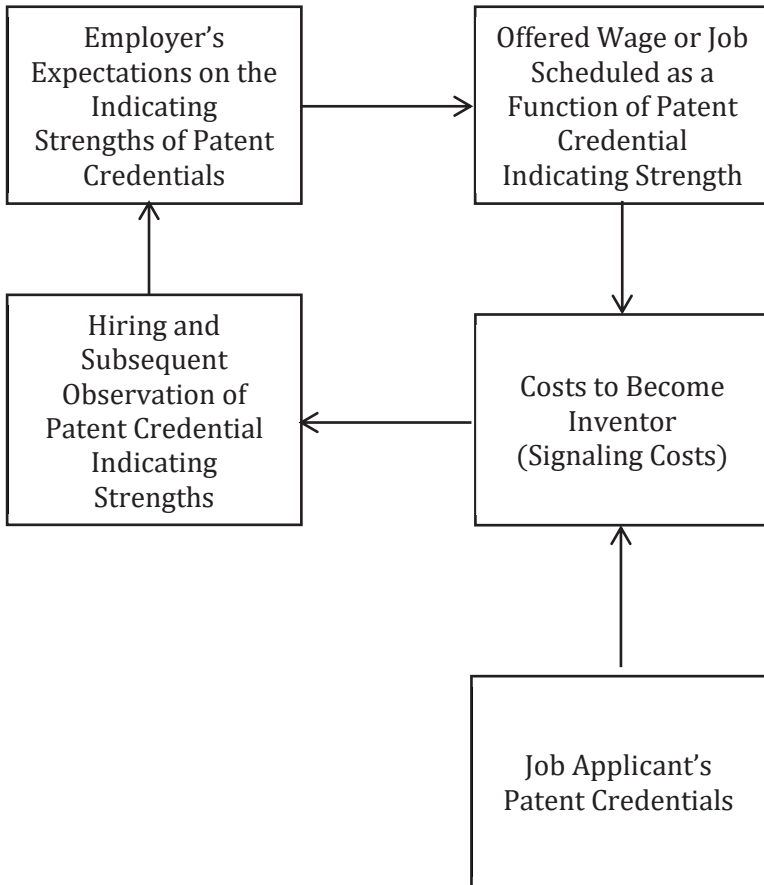


Figure 4: Patent Credential Value Feedback in the Job Market (An Application of Spence's Informational Feedback in the Job Market)⁶⁹

A critical assumption for job signaling to function properly is the existence of signaling costs, or the costs that need to be spent to obtain the signal.⁷⁰ These costs may include time, money, or effort, that needs to be spent to

⁶⁹ Our own version of Spence, *supra* note 57, at 359 fig.1.

⁷⁰ *See id.* at 358.

obtain the desired signal. Here, in the context of patent credentials, signaling costs may include the time and effort spent in conceptualizing the invention, and the money invested in reducing the idea into practice.

If no signaling costs exist, people will increasingly flock towards obtaining the same signal until the signal is so commonly seen that it cannot be used to distinguish one job applicant from another.⁷¹ By then, employers will discard the signal entirely, rendering the signal obsolete.⁷²

This is exactly what will happen if the costs or hurdles of becoming an inventor are too low. Currently, one of the main reasons why society thinks highly of inventors is the high costs that need to be spent in order to be listed as one.⁷³ Yet, if people can be listed as inventors without investing with the corresponding personal costs, the signaling strength of patents may no longer match what

⁷¹ *Id.*

⁷² An example of this is employers in Taiwan gradually discarding the undergraduate diploma signal as the costs of obtaining a university in Taiwan are relatively low and do not indicate productive capability in some industries. See 黃敦晴 [Huang Dwen-Ching], *當企業雇主不再要求大學學歷, 現在要教孩子什麼?* [When employers no longer require university diplomas, what are we teaching our children?], 親子天下 [EDUC. PARENTING FAM. LIFESTYLE] (May, 27, 2019), <https://flipedu.parenting.com.tw/article/5405> [<https://perma.cc/5SZ2-CL4A>] (stating the existence of diploma inflation and the fact that some employers are discarding the requirements of university diplomas); see also 戰寶華 [Chan, Bao-Hua], *學歷通膨成因與因應之道* [Causes and Solutions to Diploma Inflation], 3 臺灣教育評論月刊 [TAIWAN EDUC. REV. MONTHLY] 7, 9 (2014) (stating that having a university diploma in some fields does not indicate having the expected productive capability).

⁷³ For a discussion of the monetary costs of obtaining a patent, including legal fees, see *How Much Does a Patent Cost: Everything You Need to Know*, UPCOUNSEL, <https://www.upcounsel.com/how-much-does-a-patent-cost> [<https://perma.cc/QA2K-YHC7>] (last updated: Jun 18, 2020) (stating the costs to obtain a patent). Note that this does not consider the time spent coming up with the invention and the education and knowledge required to make the invention.

employers expect. The credential value of patents will then gradually reduce until, eventually, the patent's function of serving as credentials becomes useless.

c. Society paying the costs at every stage

Society starts paying the costs long before patent credentials become entirely obsolete. As long as inventorship misrepresentation is present, society pays. When only a few misrepresented inventors exist, employers misjudge their job candidates. As a result of this, companies may not perform as expected, and customers may not be able to receive the higher quality of services or products that they could have otherwise received.

When the number of misrepresented inventors increases to the extent where employers notice, the employers will start doing additional background checks on their candidates. At this stage, the credentials provided by patents are meaningless. Employers will worry that if they completely trust patent credentials, they might overestimate the abilities of their candidates. But at this stage, employers still will recognize that patent credentials are not wholly without merits and if they discard patent credentials entirely, they will penalize the real inventors. So, the only way to make sure is to research into whether the candidate is the real inventor of the invention. Although many companies provide background check services,⁷⁴ validating whether the candidate is the real inventor may require more effort than merely asking the candidates' supervisors.⁷⁵

⁷⁴ See Carrie Marshall & Brian Turner, *Best background check services in 2020: Personal and Business*, TECHRADAR (Feb. 13, 2020), <http://www.techradar.com/best/background-check-services-sites-online> [<https://perma.cc/ZF36-6EYC>].

⁷⁵ Imagine calling a candidate's former supervisor and asking, "Can you describe XYZ's ah-ha moment when she conceptualized the invention

Finally, when the numbers of misrepresented inventors become so ubiquitous that employers no longer trust the value of named patent inventors, the patent credential system may collapse or at least lose some of its core value.⁷⁶ When this happens, society will have lost an indicator that could have served as an accurate signal. By then, employers may need to use alternate signals to test for the characteristics initially associated with a named patent inventor.

2. Credentials in criminal sentence commutations (China)

The damage caused by inventorship misrepresentation is not only limited to job markets. It can also affect the justification of criminal sentence commutations.

Under China's criminal law, the making of "inventions or major technological renovations" can serve as a "meritorious service" that reduces criminal sentences.⁷⁷

claimed in her patent?" The former supervisor is likely to awkwardly reply that she was not there at her moment of conception.

⁷⁶ Compare this to the phenomenon in Taiwan: employers are having difficulty distinguishing between job candidates with the undergraduate diploma signal. See 李建興 [Lee Chieh Hsing], *驚！企業用人選才：先看證照再看學歷—證照在手的4大好處* [Shocking! Employers Value Certificates First and Diplomas Second: the Four Advantages of Having Certificates], *今週刊* [BUS. TODAY] (Aug 10, 2012), <https://www.businesstoday.com.tw/article/category/80409/post/201208100022> [<https://perma.cc/SEA5-WLNV>] (stating that with the decreasing costs of obtaining an undergraduate degree, the usefulness of a diploma in terms of job hunting is gradually being replaced by non-degree certificates.).

⁷⁷ Criminal Law of the People's Republic of China art. 78 ("The [criminal] sentence shall be reduced if any of the following meritorious services are performed...(3) making inventions or major technological renovations. . .").

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Other issues aside,⁷⁸ the justification of commutation decisions based on this clause is questionable if inventorship misrepresentation exists.

Indeed, people have been found to fake themselves as inventors in order to reduce their criminal sentences.⁷⁹ This problem has been so widespread that an article even claims the existence of an “industrial chain” that provides paid services for such conduct.⁸⁰

Thus, the presence of inventorship misrepresentation not only causes such chaos,⁸¹ it also works against the criminal law’s purpose.⁸² When people fake themselves as inventors to reduce their criminal sentences, not only are there no additional inventions created, criminals also serve

⁷⁸ See 赵蓉 & 吴思思 [Rong Zhao & Sisi Wu], *我国立功减刑制度中发明创造与技术革新的认定研究* [A Study on the Identification of Inventions or Major Technological Renovations in the Criminal Sentence Reduction System], 12 知识产权 [INTELL. PROP.] 55, 55-59 (2014) (China).

⁷⁹ See generally 姜瀛 [Ying Jiang], *服刑人员发明创造减刑之“实践乱象”及其法律对策* [Invention “Chaos” of the Persons Serving Sentences Driven by Commutation and Its Legal Countermeasures], 4 行政与法 [ADMIN. & L.] 110, 110-116 (2016) (stating that “an incentive system is clearly stipulated [under Criminal Law of the People’s Republic of China art. 78 (1997) art. 78] that through invention or major technological innovation, persons serving sentences can apply for commutation.” But “in judicial practice, interest driven by the commutation through invention and innovation has led to an industry chain of commutation through purchasing patents.”).

⁸⁰ *Id.* at 112.

⁸¹ *Id.*

⁸² Criminal Law of the People’s Republic of China art. 1 (1997) (“This law is formulated in accordance with the Constitution and in light of the concrete experience of China launching a struggle against crime and the realities in the country, with a view to punishing crime and protecting the people.”).

fewer years than they should have—all costs society has to bear.

As discussed in this Section, the damages inventorship misrepresentations create are not limited to the misrepresented supervisor and the resentful subordinate. The impacts of inventorship misrepresentation can reach the scale of entire societies, causing severe external diseconomies. This is a reason why we argue that patent inventorships must be scrutinized to ensure its correctness.

B. Reduced Inventor Incentives

1. Incentive to innovate

Although patents offer the right to exclude others,⁸³ this incentive may not motivate all inventors. Many of them are employees and the patents rights are either not vested with them,⁸⁴ or are assigned to their employers under obligation.⁸⁵

⁸³ 35 U.S.C. § 154(a)(1) (2013); Patent Act art. 58 (2019) (Taiwan); Patent Law of the People’s Republic of China art. 11 (2008).

⁸⁴ Patent Act art. 7 (2019) (Taiwan); Patent Law of the People’s Republic of China art. 6 (2008) (stating under Taiwanese and Chinese Patent Acts, the statutes stipulate that where an invention is made during the course of employment, the patent rights shall be vested in the employer unless there is an agreement stating otherwise.).

⁸⁵ 8 CHISUM ON PATENTS § 22.03 (2020) (explaining that under the United States Patent Act, ownership of an invention naturally belongs to the inventor and can only be transferred to another, including an employer, through a written assignment.); Uttam G. Dubal et al., *Employment Agreements for Employee-Inventors Should Be Drafted to Assign Patent Rights at the Time the Agreement is Signed Rather than Requiring Later Acts*, FINNEGAN (May 14, 2012) <https://www.finnegan.com/> [<https://perma.cc/W2S8-HEC4>] (stating that it is common practice for employers to require employees to sign an agreement that usually “contain[s] clauses that assign all of the inventor’s patent rights to the employer and require the employee to assist the employer in securing patent rights.”).

Fortunately, other incentives for inventors exist.⁸⁶ They may include potential promotions⁸⁷ or financial bonuses⁸⁸ provided by the inventor's employers and, of course, as discussed previously, the credentials being listed as an inventor provides.⁸⁹

But when a person's contribution is not reasonably valued or credited, the person's motivation to continue contributing will be weakened. This not only includes the scenario where a contributing employee is unnamed ('non-joinders') but also where she is listed as a co-inventor with other non-contributing persons ('misjoinder'). Thus, when invention misrepresentation happens, the incentives for employees to invest time in creating inventions will be reduced.

2. Incentive to disclose invention

Even if employees do invest in the time to create inventions, they would have a weaker motivation to report their discoveries to their supervisors despite many of them are obligated to do so.⁹⁰ Consequently, inventorship

⁸⁶ See generally Rantanen & Jack, *supra* note 51 (discussing patents as credentials).

⁸⁷ See DEP'T COM., ADVISORY COMM'N ON INDUS. INNOVATION: FINAL REPORT 186 (1979) (stating that employers claim that employees have an incentive in potential promotion); *but see id.* (arguing that promotion is not always automatic for the creative individual).

⁸⁸ See *Chou v. Univ. of Chi.*, 254 F.3d 1347, 1353 (Fed. Cir. 2001) ("Under University policy, inventors receive 25% of the gross royalties and up-front payments from licensing of the patents, as well as 25% of the stock of new companies that are based on their inventions."); see generally Charles E. McTiernan, *Employee-Inventor Compensation Plans*, 46 J. Pat. Off. Soc'y 475 (1964).

⁸⁹ See Rantanen & Jack, *supra* note 51; see also *supra* Part III.A.

⁹⁰ See, e.g., *LG Display Co., Ltd. v. Tanaka Sakae*, 2015 SIFAYUAN FAXUE JIANSUO XITONG (Taipei Dist. Ct. Mar. 11, 2015) (arising from the defendant refusing to disclose his invention to his company for patent

misrepresentation can indirectly increase the employer's costs on catching these "should-have-assigned" patents invented by employees. However, companies are not the only ones paying the costs when inventors do not disclose their inventions.

Patents are a means to an end. The ultimate purpose is to promote scientific progress and industrial development through a quid pro quo between society and the inventor.⁹¹ In exchange for the full disclosure of the invention, the inventor is granted a limited period of time in which she can exclude others from making, using, selling, offering to sell, or importing the patented invention.⁹² From the perspective

application purposes, even though he had the obligation to do so and instead applying for the patent by himself).

⁹¹ *Graham v. John Deere Co.*, 383 U.S. 1, 9-10 (1966) ("The patent monopoly was not designed to secure to the inventor his natural right in his discoveries. Rather, it was a reward, an inducement, to bring forth new knowledge. . . . Apparently Congress agreed with Jefferson and the board that the courts should develop additional conditions for patentability."); THOMAS JEFFERSON, VI WRITINGS OF THOMAS JEFFERSON 180-181 (Washington ed.); *see also* U.S. CONST. art. I, § 8, cl. 8 ("The Congress shall have Power To...promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries..."); Patent Act art. 1 (2019) (Taiwan) ("This Patent Act is formulated to encourage, protect and utilize the creations of invention, utility model and design in order to promote industrial development."); Patent Law of the People's Republic of China art. 1 (2008) ("This Law is enacted ...to promote the development of science and technology...").

⁹² Disclosure of the invention is required for patent applications, and such requirement is codified not only in 35 U.S.C. § 112, but also in both Taiwanese and Chinese Patent Law. 35 U.S.C. § 112 (2011); Patent Act art. 26, para. 1(2019) (Taiwan) ("The description shall fully disclose the invention in a manner clear and sufficient for it to be understood and carried out by a person ordinarily skilled in the art."); Patent Law of the People's Republic of China art. 26 (2008) ("The description shall set forth the invention or utility model in a manner sufficiently clear and complete so as to enable a person skilled in the relevant field of technology to carry it out"). In return, the laws grant the patentee a

of society, disclosure is what matters most. When an inventor voluntarily discloses her invention to the public domain without applying for a patent, the purpose of patents is satisfied. Under this scenario, there would be no need to induce such disclosure by rewarding the inventor a patent monopoly. This consideration is also why novelty is one of the requirements to obtain a patent.⁹³

When researchers have weaker or very little incentives to disclose their inventions through the application of patents, social and economic resources that could be spent on advancing technology will instead be wasted on reinventing technology that is already made but undisclosed to the public.⁹⁴ Moreover, potential inventors may not be able to build off of supposedly disclosed inventions.⁹⁵ The eventual consequence is the slowed progression of science and technology—a contradiction to the very purpose of patent law.

specific period of time in which the patentee can exclude others from exploiting the patented invention. 35 U.S.C. § 154(a)(1)-(2); Patent Act art. 58, para. 1 (2019) (Taiwan) (“...the patentee of an invention patent has an exclusive right to prevent others from exploiting the invention without the patentee’s consent.”); Patent Act art. 52 (2019) (Taiwan) (“The term of an invention patent shall expire after a period of twenty (20) years from the filing date of the application.”); Patent Law of the People’s Republic of China art. 11 (“After the grant of the patent right... no entity or individual may, without the authorization of the patentee, make, use or sell the patented product, or use the patented process and use or sell the product directly obtained by the patented process, for production or business purposes.”); Patent Law of the People’s Republic of China art. 45 (“The duration of patent right for inventions shall be 20 years...”).

⁹³ 35 U.S.C. § 102(a).

⁹⁴ See Donald McNab, *Avoiding Reinventing the Wheel*, LEXOLOGY (Oct. 21, 2014), <https://www.lexology.com/library/detail.aspx?g=f778b5b1-a9a9-4127-9c71-3e7940ed539c> [<https://perma.cc/H5MR-VZU5>] (stating that the publication of patents “allows others to learn about the invention, potentially stimulating further technological development” and “avoid[s] reinventing technology in the public domain.”).

⁹⁵ *Id.*

We have repeatedly shown that the misrepresentation of inventors creates external costs. But we seriously doubt that people regularly think about these external diseconomies as people tend to only care about themselves.⁹⁶ It is this exact reason why we hope to raise the awareness of listing inventors properly.

IV. CAUSES OF INVENTORSHIP MISREPRESENTATION

Identifying the causes of inventorship misrepresentation itself is rather straightforward: it is beneficial to be listed as an inventor. As mentioned previously, it can accumulate credentials⁹⁷ and provide royalty payments,⁹⁸ bonuses,⁹⁹ or opportunities to advance careers,¹⁰⁰ including academic ones.¹⁰¹ These benefits explain why people who have non-inventive contributions

⁹⁶ See Jeremy A. Frimer et al., *Moral Actor, Selfish Agent*, 106 J. PERSONALITY & SOC. PSYCHOL. 790, 790 (2014) (stating that “[p]eople are motivated to behave selfishly while appearing moral.”).

⁹⁷ See generally Rantanen & Jack, *supra* note 51.

⁹⁸ See *Chou*, 254 F.3d at 1353 (“Under University policy, inventors receive 25% of the gross royalties and up-front payments from licensing of the patents, as well as 25% of the stock of new companies that are based on their inventions.”); see also Saul Lach & Mark Schankerman, *Incentives and Invention in Universities*, 39 RAND J. ECON. 403, 404 (2008) (stating that universities provide royalty sharing arrangements as incentives for inventions).

⁹⁹ See generally McTiernan, *supra* note 88.

¹⁰⁰ Knut Blind et al., *Motives to Patent: Empirical Evidence from Germany*, 35 RES. POL’Y 655, 670 (2006) (stating that employers may use patents as a method to evaluate employee performance).

¹⁰¹ Charlotta Dahlborg et al., *To Invent and Let Others Innovate: A Framework of Academic Patent Transfer Modes*, 42 J. TECH. TRANSFER 538, 541 (2017) (“studies show that university scientists may be motivated to patent and pursue commercialisation if they perceive that it can enhance their reputation and progress their research.”).

still hope to be listed as,¹⁰² or—due to their contributions to the company— still “honored” as,¹⁰³ inventors. This desire to be recognized results in inventorship misrepresentations. Worse yet, people who know that they do not have inventive contributions may even forge their contributions due to these benefits, thus exacerbating the spread of inventorship misrepresentation.¹⁰⁴

Furthermore, employees may not necessarily disagree with their employers in terms of listing non-inventive contributors as inventors.¹⁰⁵ Employers can use the listing of inventors as a corporate tool to promote teamwork.¹⁰⁶ It is precisely due to this exchange in interests between employers and employees that even further increases the incidences of inventorship misrepresentations—since the only people who know

¹⁰² Gattari, *supra* note 8, at 18 (“Employees also are often eager to be named as inventors to build their credentials or to qualify for bonus or royalty payments.”).

¹⁰³ This may include cases where employers list employees that have significant yet non-inventive contributions as inventors. *See, e.g., Fuma Int’l LLC v. R.J. Reynolds Vapor Co.*, No. 1: 19-CV-260, 2019 WL 3066404, at *4 (M.D.N.C. July 12, 2019) (in which the founder of Fuma allegedly “knew of his duty of candor to the Patent Office but chose to misrepresent [his employees] as inventors on ‘604 patent family application documents to [‘]incentivize, recognize, and reward members and employees . . . of his company Fuma for their non-inventive contributions.[‘]” The founder also “specifically instructed his attorney not to remove the other named inventors from the ‘813 application before a February 2013 filing because [‘]misnaming these other inventors suited [his] and Fuma’s interests.[‘]” Another scenario can also happen when employees name their supervisors “just to score some brownie points.” HENRI J. A. CHARMASSON & JOHN BUCHACA, PATENTS, COPYRIGHTS AND TRADEMARKS FOR DUMMIES 335 (2009).

¹⁰⁴ *E.g., Jiang, supra* note 79, at 113.

¹⁰⁵ Gattari, *supra* note 8, at 18.

¹⁰⁶ *Id.* at 17-18.

whether one is an inventor may have little interest in calling each other out.¹⁰⁷

Ignorance may also be part of the reason for inventorship misrepresentations. People often misunderstand what it means to be an “inventor.”¹⁰⁸ Listing co-inventors is not totally the same as listing co-authors.¹⁰⁹ Not everyone associated with the creation of the invention is entitled as an inventor—only those that have contributed to the inventive step may qualify.¹¹⁰

¹⁰⁷ Even though the listing of inventors can work as a tool to promote teamwork, it can also backfire if people think or find out that the team members listed as inventors do not deserve such titles. This possibility can be explained with Adam’s equity theory in which it is assumed that a person compares the ratio of input and output of another person with that of oneself. J. Stacy Adams, *Inequity in Social Exchange*, 2 *ADVANCES IN EXPERIMENTAL SOC. PSYCH.* 267, 273 (1965). If the ratios are different, there is inequity, and the person feels discomfort and will be motivated to restore equity. *Id.* Thus, under this theory, a person will feel discomfort if she sees that both she and her co-worker receive the same output—both being listed as inventors—despite putting in different inputs—she put in the effort to conceptualized the invention while her co-worker did not. Ultimately, employees would be unsatisfied with their jobs and result in damages to the company. See Christina G. Chi & Dogan Gursoy, *Employee Satisfaction, Customer Satisfaction, and Financial Performance: An Empirical Examination*, 28 *INT’L J. HOSP. MGMT.* 245, 252 (2009) (concluding that their study shows an indirect relationship between employee satisfaction and the company’s financial performance mediated by customer satisfaction).

¹⁰⁸ Gattari, *supra* note 8, at 18 (“Many people fail to realize, however, that the determination of inventorship is substantially different [from] the determination of authorship for a publication. Inventorship is a legal, not a collegial or team-building, matter.”).

¹⁰⁹ *Id.*

¹¹⁰ *Burroughs Wellcome Co.*, 40 F.3d at 1227-28 (stating that conception is most important in inventorship and is thus how inventorship is determined); *Chen v. Taiwan Sunpan Biotech Dev. Co.*, 2013 SIFAYUAN FAXUE JIANSUO XITONG (Intell. Prop. Ct. Jan. 25, 2013); Rules for the Implementation of the Patent Law of the People’s Republic of China Rule 13 (2010) (“Any person who, during the course of accomplishing the invention-creation, is responsible only for organisational work, or

Our concerns do not end here. The aforementioned reasons do not fully explain why the patents owned by the US, Taiwanese, and Chinese companies have different vulnerabilities to inventorship challenges.¹¹¹ Other factors must be in play and we propose that they are the differences in legal landscapes, which we elaborate in Section A, and the differences in cultural dimensions, which we discuss in Section B.

A. Differences in Legal Landscapes

In this Section, we focus on the essential differences between the laws and rules governing inventorship in the US, Taiwan, and China. We argue that these differences explain the conclusions of our empirical study.

who offers facilities for making use of material and technical means, or who takes part in other auxiliary functions, *shall not* be considered as inventor or creator.” (emphasis added)); *see also* Gattari, *supra* note 8, at 16-17 (stating who is qualified as an inventor and who is not).

¹¹¹ *See supra* Part II.C.

1. Person naturally vested with patent rights

The US,¹¹² Taiwanese,¹¹³ and Chinese law¹¹⁴ all emphasize having conceptualization as one of the requirements of inventorship. Additionally, they all stipulate that every inventor must be listed in the patent.¹¹⁵ However, an essential difference among the laws and rules is with whom the patent rights are naturally vested.

Under Taiwanese law, for example, unless an agreement exists stating otherwise, both the patent rights and the right to apply for a patent are vested with the employer if the invention is made by an employee during her performance of duties.¹¹⁶ As such, employers may lack incentives to figure out who the real inventors are if they only want to apply for patents in Taiwan or China. They

¹¹² *Hybritech, Inc. v. Monoclonal Antibodies, Inc.*, 802 F.2d 1367, 1376 (Fed. Cir. 1986); *see* 35 U.S.C. § 201(g) (stating the definition of “made” when used in relation to any invention means that “the conception or first actual reduction to practice of such invention.”).

¹¹³ *Tsai v. Nat’l Taiwan University*, 2018 SIFAYUAN FAXUE JIANSUO XITONG (Intell. Prop. Ct. Mar. 20, 2018) (Taiwan) (stating that an inventor is the person who has actually researched the invention and has made a substantial contribution to the technical features of the claimed invention. The so-called ‘substantial contribution’ refers to the spiritual creation carried out in order to complete an invention. A person making ‘substantial contribution’ has to conceptualize the problem to be solved or the effect achieved by the invention, and then propose specific and technical means that can achieve the conception...in principle, research and development personnel are usually such people. This, of course, does not include people who only propose ideas or verify experiments.); *see also* *Chen v. Taiwan Sunpan Biotech Dev. Co.*, 2013 SIFAYUAN FAXUE JIANSUO XITONG (Intell. Prop. Ct. Jan. 25, 2013) (Taiwan).

¹¹⁴ Rules for the Implementation of the Patent Law of the People’s Republic of China Rule 13 (2010).

¹¹⁵ 35 U.S.C. § 115(a); Patent Act art. 7, para. 4 (2019) (Taiwan); Patent Law of the People’s Republic of China art. 17 (2008).

¹¹⁶ Patent Act art. 7, para. 1 (2019) (Taiwan).

may think that, regardless of which employee is the true inventor, the rights are already theirs.

However, under US law the patent rights, including the right to apply for a patent, are naturally vested with the inventor.¹¹⁷ These rights can only be transferred to another, including an employer, through a written assignment.¹¹⁸

Although this difference may seem trivial, it can lead to very different results. Studies have found that countries implementing opting-out organ donation policies have a higher organ donation rate compared to countries implementing opt-in policies¹¹⁹ even when variables such as

¹¹⁷ 35 U.S.C. § 101; 35 U.S.C. § 111(a)(1) (“An application for patent shall be made, or authorized to be made, by the inventor...”); Joseph D. Matal, *A Guide to the Legislative History of the America Invents Act: Part I of II*, 21 FED. CIR. B.J. 435, 451-52 (2012) (“Some may think that, because § 102(f) has been repealed, there is no longer any legal requirement that a patent for an invention be obtained by the inventor. Not so. Both the Constitution and § 101 still specify that a patent may only be obtained by the person who engages in the act of inventing. Indeed, even commentary on the 1952 Patent Act noted, with respect to § 102(f), that “[t]his paragraph is perhaps unnecessary since under § 101 it is “Whoever invents ...” who may obtain a patent and later sections provide that the inventor must apply for the patent and execute an oath of inventorship.”); 8 CHISUM ON PATENTS § 22.03 (2020); *see also* Yang Chih-Jie (楊智傑), Meiguo Famingren Rending Chi Tsolei Famingren Chih Hoguo (美國發明人認定及錯列發明人之後果) [Determining Inventorship and the Consequences of Inventorship Misrepresentation in US Patents—Case Study and a Comparison with Taiwanese Law], 38 TAIWAN PAT. ATT’YS J. 27, 48 (2019) (stating that Taiwanese patent law is different from US patent law: US patent law stipulates that only the inventor can apply for a patent, but the patent right can be assigned at the time of application. In contrast, the right to apply for a patent under Taiwanese patent law can be transferred before filing the patent application, and therefore does not require the inventor to be the applicant).

¹¹⁸ 35 U.S.C. § 261.

¹¹⁹ *E.g.*, Michael Gnant et al., *The Impact of the Presumed Consent Law and a Decentralized Organ Procurement System on Organ Donation: Quadruplication in the Number of Organ Donors*, 23 TRANSPLANTATION PROC. 2685, 2685-86 (1991); Leo Roels & Johan De

transplant infrastructure, economic and educational status, and religion are controlled.¹²⁰ Researchers argue that part of the reason why such a marked difference exists is because of the costs involved in these additional “trivial” steps.¹²¹ Analogously, we believe the trivial or almost-ignorable administrative costs¹²² under the US patent system (i.e., that employers have to ensure the rights are rightfully transferred from the *real* inventor) also remind most participants to verify the true inventorship and avoid unintentional misrepresentation.

Moreover, the stakes are high if the process goes wrong in the US. If employers do not make sure that the listed inventors are the real inventors (so they do have the patent rights to transfer) and that these listed inventors have properly transferred their rights, all the efforts could be in vain.¹²³

Meester, *The Relative Impact of Presumed-Consent Legislation on Thoracic Organ Donation in the Eurotransplant Area*, 6 J. TRANSPLANT COORDINATION 174, 174-77 (1996) ; Lee Shepherd et al., *An International Comparison of Deceased and Living organ Donation/Transplant Rates in Opt-In and Opt-Out Systems: A Panel Study*, 12 BMC MED. art. no. 131 (2014).

¹²⁰ Ronald W. Gimbel et. al, *Presumed Consent and other Predictors of Cadaveric Organ Donation in Europe*, 13 PROGRESS IN TRANSPLANTATION 17, 17-23 (2003).

¹²¹ Eric J. Johnson & Daniel Goldstein, *Do Defaults Save Lives?*, 302 SCIENCE 1338, 1339 (2003).

¹²² It may take some time to draft the patent assignment agreement at first, but once the agreement is standardized, asking an employee to sign an agreement upon employment should be rather simple and quick.

¹²³ *See* *Advanced Video Techs. LLC, v. HTC Corp.*, 879 F.3d 1314, 1317-18 (Fed. Cir. 2018) (dismissing the case because one of the co-inventor’s patent rights was not properly transferred because she only signed an agreement upon her employment stating that she *will sign* an agreement that will transfer her patent rights to her employer if she created an invention). *Cf.* *Bd. of Trs. of the Leland Stanford Junior Univ. v. Roche Molecular Sys. Inc.*, 563 U.S. 776, 780-87 (2011) (arising out of a dispute largely due to Stanford not securing a tight patent assignment agreement with its researchers).

Consequently, with the high stakes involved, employers will exercise more caution in determining who the real inventors are when applying for US patents, thus resulting in a lower possibility of inventorship misrepresentation.

2. Duty to disclose material information

Another crucial difference between the laws of these countries is the duty to disclose material information. Under the US Code of Federal Regulations, each individual associated with the patent has “the duty to disclose to the [US Patent and Trademark] Office all information known to that individual to be material to patentability,”¹²⁴ including inventorship.¹²⁵ However, neither the Taiwanese,¹²⁶ nor the

¹²⁴ 37 C.F.R. § 1.56.

¹²⁵ MANUAL OF PATENT EXAMINING PROCEDURE § 2001.04 (9th ed. 10th rev., 2014) [hereinafter “MPEP”]. *See also* under the Pre-AIA law, Kriss, *supra* note 8, at n.18 (“a person cannot receive a patent on something he did not invent under § 102(f) in Title 35 of the United States Code, so information relating to inventorship may result in a § 102 bar. 35 U.S.C. § 102(f) (2000). Because inventorship implicates § 102, it is certainly material to patentability.”). Similar reasoning applies after the enactment of the AIA; under the AIA, an examiner will bar patent application under 35 U.S.C. § 101. Since the correct inventorship is indispensable to a proper patent, inventorship information is material. 2 ETHAN HORWITZ ET AL., HORWITZ ON PATENT LITIGATION § 10.13[3][f] (2020).

¹²⁶ *See* Yang Chih-Jie (楊智傑), Meiguo Shenching Chuanlee Shufu Chenshih Yeewu Taiwan Chuanlee Wutze Shuchou Daochih Chuanlee Shencha Pingchih Deelo (美國申請專利須負誠實義務台灣專利法無此需求導致專利審查品質低落) [U.S. Requires Patent Applicants to Disclose Material Information While Taiwan Does Not, Resulting in Poor Examination Quality of Taiwanese Patents] N. AM. INTEL. PROP. CORP. (Jan. 21, 2014), http://www.naipo.com/Portals/1/web_tw/Knowledge_Center/Infringement_Case/publish-78.htm [https://perma.cc/JM25-7MH2] (stating that Taiwanese Patent Law does not require patent applicants to disclose material information). *See*

Chinese Patent Act,¹²⁷ including their related rules, stipulate a duty to disclose material information to their respective patent office. The lack of these disclosure rules can lead to employers only applying for Taiwanese or Chinese patents not taking the proper listing of inventors seriously as they may not know this constitutes “material information.” This inattentive approach results in a higher possibility of inventorship misrepresentation in their patents, as reflected in our empirical study.

3. Civil Procedures

Another contributing factor to the higher rates of inventorship misrepresentation is the difference in evidentiary procedure and, in particular, the discovery procedure. The discovery procedure under US law makes companies more wary of who they list as their patents’ inventors, because during discovery, internal information, including emails, communications, private documents, and company databases can all come under scrutiny.¹²⁸ When companies are aware that the defendants can have access to this information during future litigation, they will do the best they can to make their patents unchallengeable, leaving them an incentive to not misrepresent their patents’ inventorships.¹²⁹

generally Patent Act (2019) (Taiwan); Enforcement Rules of the Patent Act (2020) (Taiwan).

¹²⁷ *See generally* Rules for the Implementation of the Patent Law of the People’s Republic of China (2010).

¹²⁸ FED. R. CIV. P. 26(a)(1)(A)(ii) (stating that the disclosing party shall provide to the other parties “a copy—or a description by category and location—of all documents, electronically stored information, and tangible things that the disclosing party has in its possession, custody, or control and may use to support its claims or defenses...”).

¹²⁹ Under US law, misrepresenting inventorship with deceptive intent is an inequitable conduct and can render a patent unenforceable. 2 HORWITZ, *supra* note 125, § 10.13 (2020). This defense is often used in patent litigation. *See id.*

But under Taiwanese law, for example, the evidential procedure is markedly different and arguably less scrutinizing than that of the US.¹³⁰ In particular, there is no discovery procedure under Taiwanese law.¹³¹ The only way to obtain evidence from an adverse party is through the motion for pre-action perpetuation of evidence, a motion courts do not grant easily.¹³² This difference can also result in companies that only apply for Taiwanese patents to not be cautious about their acts, consequently leading to incidences of inventorship misrepresentations.

4. Legal consequences

Perhaps the most critical difference between the laws and rules of these countries is the legal consequence of purposefully misrepresenting inventorship.

Under US law, misrepresenting inventorship information with deceptive intent is treated as inequitable

¹³⁰ See, Jiang Mengzhen (江孟貞) & Lin Weiliang (林威良), Chianlun Buei Chude Chuanlee Chinchuan Chanping Zhe Chinhai Chuchen Wentee (淺論不易取得專利侵權產品之侵害舉證問題) [A Discussion on the Difficulty of Obtaining Patent Infringing Products], Chuanguo Lushih (全國律師) [TAIWAN BAR ASS'N], no. 10, 2017, at 23-26 (proposing that because of the difficulties in Taiwanese civil procedure, one should, if possible, utilize the discovery procedure in the US to obtain evidence).

¹³¹ 陳宜誠 [Chen Yi-Chen], *我國智慧財產訴訟法制亟需改革* [The Nation's Intellectual Property Litigation System Is in Urgent Need of Revolution], N. AM. INTELL. PROP. CORP. (Jan. 7, 2014), http://www.naipo.com/Portals/1/web_tw/Knowledge_Center/Industry_Economy/publish-179.htm [<https://perma.cc/K94U-LST2>].

¹³² *Id.* (deciding whether to grant a motion for pre-action perpetuation of evidence, involves the “Intellectual Property Court consider[ing] the plaintiff’s (patentee’s) possibility of winning the case and the impact on the defendant’s business. The court often believes that the patent holder is using this motion to harass the alleged infringer, resulting in extremely low approval rates of the motion.”).

conduct,¹³³ which can render the patent unenforceable.¹³⁴ One of the primary purposes of a patent is its right to exclude others.¹³⁵ Having a patent deemed unenforceable is the last thing an employer wants. Therefore, employers planning to apply for US patents have an incentive to not purposefully misrepresent inventorship.

However, under Taiwanese¹³⁶ and Chinese patent law,¹³⁷ inventorship misrepresentation is not grounds for patent invalidation, nor is the patent's enforceability dependent on correct inventorship. The absence of these statutes not only reflects Taiwanese and Chinese patent laws' lack of emphasis on the correctness of inventorship, but also impacts the degree of attention employers spend on the correctness of inventorship.¹³⁸ If no legal consequences

¹³³ See *PerSeptive Biosystems, Inc. v. Pharmacia Biotech, Inc.*, 225 F.3d 1315, 1318 (Fed. Cir. 2000) (“Inequitable conduct includes affirmative misrepresentations of a material fact, failure to disclose material information, or submission of false material information, coupled with an intent to deceive.”).

¹³⁴ *Frank's Casing Crew & Rental Tools, Inc., v. PMR Techs., Ltd.*, 292 F.3d 1363, 1376-77 (Fed. Cir. 2002) (stating that when there is deceptive intent in naming the inventors, even if the correct inventorship can be established, the patent would still be unenforceable and that “a patent may not be enforced even by ‘innocent’ co-inventors.” (citing *Stark v. Advanced Magnetics, Inc.*, 119 F.3d 1551, 1556 (Fed. Cir. 1997))); *Kingsdown Med. Consultants, Ltd. v. Hollister, Inc.*, 863 F.2d 867, 877 (Fed. Cir. 1988); 2 HORWITZ, *supra* note 125, § 10.13[8] (“A finding of the inequitable conduct renders the entire patent unenforceable.”) (citing *Therasense, Inc. v. Boston, Dickerson & Co.*, 649 F.3d 1276, 1288 (Fed. Cir. 2011)).

¹³⁵ 35 U.S.C. § 154(a)(1)-(2); Patent Act art. 58, para. 1 (2019) (Taiwan); Patent Law of the People's Republic of China art. 11 (2008).

¹³⁶ Patent Act art. 71 (2019) (Taiwan).

¹³⁷ See Rules for the Implementation of the Patent Law of the People's Republic of China Rule 65, para. 2 (2010).

¹³⁸ Yang, *supra* note 126, at 57 (stating that, in contrast, in Taiwan the Patent Act does not emphasize the importance of proper inventorship listing and arguing that because inventorship misrepresentation has no

arise from misrepresenting inventors, employers would tend to list inventors according to their best interests—whether it is listing investors or stock-holders of the company,¹³⁹ or listing non-inventive contributors for corporate political purposes¹⁴⁰—instead of according to who the real inventors are.

Notably, misrepresenting inventorship information to the Taiwan Intellectual Property Office (TIPO) with deceptive intent can be deemed a crime subject to the provisions of the Criminal Code of Taiwan, Article 214.¹⁴¹ But, the deterring effects of this crime still do not match the deterring effect that patent invalidation offers. Indeed, there has only been one criminal case¹⁴² involving inventorship misrepresentation,¹⁴³ and the possibility of inventorship misrepresentation existing is still arguably high in

serious consequences, in practice, some small or medium-sized corporations tend only to list the employer as the inventor).

¹³⁹ Mark Malek, *The Effect of Listing an Improper Inventor on a Patent Application*, WIDERMAN MALEK (June 10, 2013), <https://www.legalteamusa.net/improper-inventor-on-a-patent-application/> [<https://perma.cc/3WME-L8C5>].

¹⁴⁰ Gattari, *supra* note 8, at 17-18.

¹⁴¹ Criminal Code of Republic of China ch. 15, art. 214 (2019) (Taiwan) (“A person who causes a public official to make in a public document an entry which such a person knows to be false and causes injury to the public or another shall be sentenced to imprisonment for not more than three years, short-term imprisonment, or a fine of not more than . . . [15,000 yuan].”).

¹⁴² *Taichung v. Hu*, 2019 SIFAYUAN FAXUE JIANSUO XITONG (Taichung Dist. Ct. Aug. 13, 2019).

¹⁴³ Interestingly, it has been investigated in previous literature in Taiwan, that Chapter 15 of Criminal Code aims to punish *not* mainly direct private interests, *e.g.* creditor’s right, but rather, the “public trust” or “(lowered) transaction cost” offered by authentic documents. In other words, it is the “signaling function” that is in concern for the law here. See Wu Yao-Zhong (吳耀宗), *Weizao Wenshuhzue Baohu Fayee Chi Yanchiu (偽造文書罪保護法益之研究)* [Research on the Legal Protected Interests of Forgery], 128 TAIWAN JURIST 120, 120-41 (2006).

Taiwanese patents owned by Taiwanese companies.¹⁴⁴ The problem lies with companies not having proper incentives to verify and disclose this information.

Employees are the ones most likely to know that inventorship misrepresentation exists.¹⁴⁵ But gifts blind the eyes. Employees will have financial reasons to keep their mouths shut.¹⁴⁶ Even if they do not have these gains, employees usually have no desire to risk their jobs by speaking out about a problem to their employers,¹⁴⁷ let alone doing so through filing a criminal complaint.

Nevertheless, even if employers do get convicted, the legal costs are arguably not significant. Under Taiwan's Criminal Code, misrepresenting inventors with deceptive intent can only lead to "imprisonment for not more than three years, short-term imprisonment, or a fine of not more than [15,000 NTD, or 500 USD.]"¹⁴⁸ The patent supposedly would still be intact if the inventorship errors are corrected.¹⁴⁹ But if a patent is deemed unenforceable due to

¹⁴⁴ See *supra* Part II.C.

¹⁴⁵ Employees have inside information, and inventors usually know who contributed to the creation of the invention.

¹⁴⁶ For example, royalty payments or bonuses.

¹⁴⁷ See Frances J. Milliken et al., *An Exploratory Study of Employee Silence: Issues Employees Don't Communicate Upward and Why*, 40 J. MGMT. STUD. 1453, 1453 (2003) (quoting the words of a male respondent, "I raised a concern about some policies and I was told to shut up and that I was becoming a troublemaker. I would have pursued [the issue] further but presently I can't afford to risk my job. This has made me go into a detached mode, making me a 'yes man'").

¹⁴⁸ Criminal Code of Republic of China art. 214 (2019) (Taiwan).

¹⁴⁹ The consequences of inventorship error after patent issuance are not specifically stated in the provisions of the Patent Act (Taiwan) nor in its interpretation. See Patent Act art. 71 (2019) (Taiwan); Chuanleefa Chutiao Shihyee (專利法逐條釋義) [Interpretation of the Patent Act] 227 (2014) (Taiwan) (The correction of inventorship errors is not implied in its definition of "errors." An inventorship error or misrepresentation is arguably not a type of error that "can be obviously noticed as incorrect by a person having ordinary skill in the field of the

inventorship misrepresentation in the US, it is irreversible, and no remedies exist to revive the patent.¹⁵⁰

More importantly, alleged patent infringers would also have little interest in disclosing inventorship misrepresentation information, even if they managed to obtain proof of such conduct. For unlike under the provisions of US law, proving the presence of inventorship misrepresentation under Taiwanese law provides no benefit to the alleged infringers, as it does not affect the enforceability or the validity of the allegedly infringed patent.¹⁵¹

B. Differences in Cultural Dimensions

The listing of inventors can be seen as a corporate decision¹⁵² and can thus be subject to an organization's culture.¹⁵³ According to Hofstede's influential study, there are four cultural dimensions that influence organizational

invention without relying on external references," nor is it an ambiguous statement "whose inherent meaning can be clearly understood by a person having ordinary skill in the field of the invention by referring to the specifications, claims, or drawings." Although such clarification "would help others better understand the content of the disclosed invention," changing the inventorship would, of course, "affect the interpretation of the patent's substantive content.").

¹⁵⁰ See *Hoffman-La Roche Inc. v. Lemmon Co.*, 906 F.2d 684, 688-89 (Fed. Cir. 1990); 2 HORWITZ, *supra* note 125, § 10.13[9] (stating that that once a patent is deemed unenforceable under inequitable conduct, there is no remedy and it is irreversible).

¹⁵¹ Compare 2 HORWITZ, *supra* note 125, § 10.13[9], with Patent Act art. 71 (2019) (Taiwan).

¹⁵² Whom to list and to not list as an inventor is, by nature, a decision, and as discussed previously, this decision can be subject to corporate politics. Gattari, *supra* note 8, at 17-18; see also *supra* Part IV.

¹⁵³ See generally Kit-Fai Pun et al., *A Review of the Chinese Cultural Influences on Chinese Enterprise Management*, 2 INT'L J. MGMT. REV. 325, 326 (2000) (reviewing how Chinese cultural influences on Chinese enterprise decisions and management).

culture.¹⁵⁴ We argue that two of these cultural dimensions—power distance, and individualism/collectivism—influence a company’s tendency to misrepresent its inventors.

When comparing the two cultural dimensions in this Section, we split the companies according to their geographical regions: the East and the West. We understand that by doing so, there is a certain degree of generalization. We are also clearly aware that companies have their differences in terms of organizational culture. However, this dichotomization is a compromise for the sake of our discussion and argument.

1. Power distance

Power distance “refers to cultural conceptions regarding the degree of power which authorities should have over subordinates,”¹⁵⁵ and can vary across culture.¹⁵⁶ In the East, companies tend to have higher power distances.¹⁵⁷ In these companies, employees are more likely to have their place in a hierarchy without the need for further justification,¹⁵⁸ and those that are in higher positions are to

¹⁵⁴ The four dimensions are power distance, uncertainty avoidance, individualism/collectivism, and masculinity/femininity. GEERT HOFSTEDE, *CULTURE’S CONSEQUENCES: INTERNATIONAL DIFFERENCES IN WORK RELATED VALUES* (1980).

¹⁵⁵ Cynthia Lee et al., *Power-Distance, Gender, and Organizational Justice*, 26 J. MGMT 685, 687 (2000); see also HOFSTEDE, *supra* note 154.

¹⁵⁶ See Pun et al., *supra* note 153, at 329 tbl.1; see also Dickon Stone, *East vs. West: 10 Corporate Cultural Differences All Interns Abroad Should Know*, GOABROAD.COM (Jan. 8, 2019), <https://www.goabroad.com/articles/intern-abroad/east-vs-west-corporate-cultural-differences-for-interns-abroad> [https://perma.cc/UL96-84UJ].

¹⁵⁷ See Pun et al., *supra* note 153, at 332.

¹⁵⁸ See Stephen Bochner & Beryl Hesketh, *Power Distance, Individual/Collectivism, and Job-Related Attitudes in a Culturally*

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be highly respected.¹⁵⁹ In these companies, orders and authorities are not easily questioned,¹⁶⁰ and when subordinates have achievements, they are expected to acknowledge their supervisors' guidance, even if the existence of such guidance is sometimes doubtful.¹⁶¹

Thus, in Eastern companies, when non-inventive, contributing supervisors ask to be listed as inventors, subordinates usually do not disobey their orders. Even if subordinates are aware of their mistakes, to save the "face" of their supervisors,¹⁶² they tend not to call their supervisors out on them.¹⁶³ Furthermore, subordinates in Eastern companies do not necessarily disagree on listing non-inventive contributing supervisors as co-inventors because they may see the listing as a means to acknowledge their supervisors.¹⁶⁴

Diverse Work Group, 25 J. CROSS-CULTURAL PSYCH. 233, 235-36 (1994) (stating that in workplaces with higher power distances, subordinates are more willing to accept hierarchical inequality).

¹⁵⁹ See Stone, *supra* note 156.

¹⁶⁰ See Bochner & Hesketh, *supra* note 158, at 236 (stating that individuals from countries high on power distance tend to be more submissive in the presence of a manager and are afraid of, or unwilling to, disagree with a superior).

¹⁶¹ Cf. Huang Chen-Chieh (黃政傑), Yo Guochih Chouwen Kan Wuoguo Gaochiao Shueshu Chentzuh (由國際論文醜聞看我國高教學術政策) [A Discussion of Taiwan's Higher Education Teaching Policy from the International Paper Scandal], 3 TAIWAN EDUC. REV. MONTHLY 42, 42-45 (discussing that students in Taiwan are expected to list their advisors despite their little contribution to the academic research paper).

¹⁶² Stone, *supra* note 156. Cf. Hsien Chin Hu, *The Chinese Concepts of "Face"*, 46 AM. ANTHROPOLOGIST (N.S.) 45, 45 (1944) (explaining the concept of "face" in Chinese-influenced cultures).

¹⁶³ Stone, *supra* note 156.

¹⁶⁴ See Bochner & Hesketh, *supra* note 158, at 236. Cf. Drone Techs. Inc. v. Parrot S.A., 838 F.3d 1283 (Fed. Cir. 2016) (arising out of a dispute where the Taiwanese husband allegedly acknowledged his wife's support by naming her as the inventor of the patent in dispute).

In Western companies, power distances tend to be relatively lower.¹⁶⁵ Pointing out the mistakes of supervisors in workplaces is a norm,¹⁶⁶ and supervisors usually do not take criticism too personally compared to their Eastern counterparts.¹⁶⁷

Thus, if a supervisor in a Western company asks to be listed as an inventor despite having no inventive contributions, subordinates may immediately question the appropriateness of this request. Consequently, these differences resulting from different power distances between the companies affect their tendencies to misrepresent management-level employees as patent inventors.

2. Individualism/Collectivism

Individualism/collectivism refers to “the form of the relationship between the individual and the collectivity in a given society.”¹⁶⁸ In Eastern companies, collective interests often consume the interests of individuals.¹⁶⁹ Harmony among co-workers is rather emphasized, and company achievements are preferably viewed as a collective effort rather than an individual accomplishment.¹⁷⁰ Hence, employers in Eastern companies are more likely to promote teamwork and evade conflict by listing everyone on the team as inventors, even though not everyone has contributed to the conceptualization of the invention.

In Western companies, individualism is emphasized more, and employees tend to proactively claim their credits.¹⁷¹ Calling out on another’s mistakes or wrongdoing, such as free-riding on an achievement of oneself, often leads

¹⁶⁵ See Pun et al., *supra* note 153, at 332 tbl.2.

¹⁶⁶ Stone, *supra* note 156.

¹⁶⁷ See *id.*

¹⁶⁸ Bochner & Hesketh, *supra* note 158, at 236

¹⁶⁹ *Id.* at 236-37; Stone, *supra* note 156.

¹⁷⁰ Bochner & Hesketh, *supra* note 158, at 236-37.

¹⁷¹ See *Id.*

to conflict. But since people in Western companies are relatively less afraid of conflicts and have a stronger emphasis on individuality,¹⁷² employees in the Western companies may be less tolerant of inventorship misrepresentation.

V. SOLUTIONS TO INVENTORSHIP MISREPRESENTATION

To cut down on the undesirable social costs caused by inventorship misrepresentation, we propose two solutions: imposing legal costs, as discussed in Section A, and increasing inventive contribution transparency, as covered in Section B. Note that since there are already legal costs imposed on inventorship misrepresentation under US law,¹⁷³ the solution proposed in Section A is thus directed more towards Taiwanese and Chinese law. As for the proposal raised in Section B, it can be directed towards all three countries, since no countries have implemented similar requirements so far.

A. *Imposing Legal Costs*

The most direct way to reduce the incidence of inventorship misrepresentation in Taiwanese and Chinese patents is to impose legal costs, namely by making patents invalid or unenforceable. This solution corresponds to the causes mentioned in Part IV.A.3. If misrepresenting inventors results in serious legal consequences to the patent, employers will spend more effort on finding out whom the real inventors are.¹⁷⁴ Moreover, alleged infringers will then have an incentive to scrutinize the correctness of inventorship, as proof of inventorship misrepresentation can

¹⁷² Stone, *supra* note 156.

¹⁷³ 2 HORWITZ, *supra* note 125, § 10.13[3][f].

¹⁷⁴ See *supra* Part IV.A. 3.

work as a defense in patent litigation.¹⁷⁵ With these legal costs, the proper listing of inventors will be emphasized more by employers and an employers’ tendency to list inventors only in accord with their interests will be reduced

B. Increasing Inventive Contribution Transparency

The second solution is the increase of inventive information transparency. We propose that this can be achieved by requiring patent applicants to list not only all co-inventors, but also the co-inventor’s respective *inventive* contributions. Preferably, we propose the mandatory disclosure of which claims are conceptualized by which co-inventor. This requirement is similar to the listing of contributions of each co-author in some academic publications.¹⁷⁶

Admittedly, the listing of contribution is still, by nature, a self-disclosure. Thus, the duty to disclose this

¹⁷⁵ Cf. 35 U.S.C. § 282. (“The following shall be defenses in any action involving the validity or infringement of a patent and shall be pleaded: (1) Noninfringement, absence of liability for infringement or unenforceability. . .”).

¹⁷⁶ E.g., Megan K. O’Brien & Alaa A. Ahmed, *Asymmetric Valuation of Gains and Losses in Effort-Based Decision Making*, 14 PLOS ONE 10 e0223268 (2019) (available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6793877>) (where the respective contributions of the authors are detailed as “Megan K. O’Brien, Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Visualization, Writing – original draft, Writing – review & editing* and Alaa A. Ahmed, Conceptualization, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – review & editing”); *but see* Gattari, *supra* note 8, at 18 (stating that “the determination of inventorship is substantially different than the determination of authorship for a publication.”). Nevertheless, what we argue here is the analogy of disclosing specific contribution. Whether such contribution qualifies as inventive is another issue.

information needs to be established in order to achieve optimal results. However, there are still quite a few benefits associated with this requirement.

First, patent applicants need to ensure that each listed inventor has at least contributed to a part of the invention. This requirement reminds patent applicants to not misrepresent their inventors and eliminates the possibility of inventorship misrepresentation due to ignorance.¹⁷⁷

Second, if patent applicants do list non-inventive contributions, either out of ignorance or out of other interests, patent examiners or patent agents and attorneys will still have the chance to point this out.¹⁷⁸ Alternatively, statutes requiring the examination of whether the listed contributions are inventive could be established.¹⁷⁹ Moreover, the statutes can further stipulate that the listing of non-inventive contributions is grounds for patent rejection. Of course, the patent examiner would still need to rely on the

¹⁷⁷ Cf. TERI MOSER WOO & MARYLOU V ROBINSON, PHARMACOTHERAPEUTICS FOR ADVANCED PRACTICE NURSE PRESCRIBERS 1333 (4th ed. 2015) (stating that reminding patients can increase patient compliance, which can be analogized to reminding patent applicants the importance of listing the proper inventors may increase the patent applicant's compliance to the law and rules).

¹⁷⁸ Note that this does not prevent inventors from being left off of the patent.

¹⁷⁹ In the U.S., inventorship is presumed to be correct. MPEP § 2157 (9th ed. 10th rev., 2014). In Taiwan, inventorship only undergoes formal examination. CHUANLEefa CHUTIAO SHIHYEE (專利法逐條釋義) [INTERPRETATION OF THE PATENT ACT] ch. 1, at 15 (2014) (stating that the Taiwan Intellectual Property Office (TIPO) will only conduct formal examinations, as opposed to substantial examinations, on whether the applicant has the right to apply, that is, merely relying on the inventor[ship] information provided by the applicant. The TIPO cannot determine—as this issue is a matter of law—the correctness of inventorship/applicant. If interested parties have doubts or believe that their rights and interests are infringed, they should resolve their issues through judicial relief procedures). In China, the patent office does not examine whether the named inventor has substantially contributed to the invention. Guidelines for Patent Examination § 4.1.2 (2010) (China).

information provided by the patent applicant. Nevertheless, as mentioned before, patent applicants that list people who have non-inventive contributions can then be identified. The downside of this proposal, however, is that it would make patent examiners bear a heavier burden than they already do.¹⁸⁰

Third, as a side-benefit, the listing of contributions also increases the indicating strength of patents as job credentials. The increase in strength, we argue, is not only due to the lower incidences of misrepresented inventors,¹⁸¹ but also due to the more detailed information provided by the increased transparency of inventive contributions. By matching an inventor to the specific claims she contributed, employers can learn more about the inventor's abilities.

VI. CONCLUSION

In this article, we demonstrated a more widespread existence of inventorship misrepresentation through indirect empirical evidence. In particular, we argue that the Taiwanese and Chinese patents owned by the Taiwanese and Chinese healthcare companies are more vulnerable to inventorship challenges compared to the US patents owned by their US counterparts. This conclusion is based on statistical results including, but not limited to, the findings that representative Taiwanese and Chinese companies have more than half of their 100-plus patents invented solely by management-level employees (instead of their R&D personnel), while none of the selected companies in the US have this phenomenon.¹⁸²

¹⁸⁰ See Saurabh Vishnubhakat & Arti K. Rai, *When Biopharma Meets Software: Bioinformatics at the Patent Office*, 29 HARV. J. L. & TECH 205, 211 (2015) (stating that “examiners have a very limited amount of time to examine patents.”).

¹⁸¹ See *supra* Part III.A. 1.

¹⁸² See *supra* Part III.C. 1.a.

Contrary to what most people would think, inventorship misrepresentation is not only a matter between irritated subordinates and supervisors who want to take a slice of the pie. Inventorship misrepresentation results in severe external diseconomies such as the reduction of patent credential values and the reduction of incentives to innovate or to disclose inventions.

Due to the benefits of being listed as an inventor, it is not hard to understand why all those associated with a patent wish to be listed as its inventors. Nevertheless, we argue that additional factors, including the differences in legal landscapes and cultural dimensions, are present as well. These additional factors partially account for why Taiwanese and Chinese companies are more likely to misrepresent their inventors compared to US companies.

To alleviate the negative impacts of inventorship misrepresentation, we propose the imposition of legal costs and the increase of inventive contribution transparency across all three countries. The former can be achieved by tying the enforceability or the validity of the patent to accurate inventorship, while the latter can be attained by mandating the disclosure of each listed inventor's inventive contributions.

Although inventorship misrepresentation has been discussed in previous literature, our article offers additional empirical evidence that this phenomenon is arguably more widespread in some countries and further insight into the external diseconomies it creates – including the dilution of signaling modeled by Nobel laureate Michael Spence. By providing these new observations, we aim to emphasize the importance of listing inventors properly and hope that our article provides a reference for future legal amendments and policy developments in the US, Taiwan, and China.