

**ILLUminate Blog Transcript: Gauri Subramani on Gender and Resource Inequality in Innovation**

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- JACK CROFT: 00:14 Welcome. I'm Jack Croft, host of the Illuminate podcast for Lehigh University's College of Business. Today is February 18th, 2022. And we're talking with Gauri Subramani about her research looking at the underrepresentation of women in the United States patent application process and what that means for women in innovation. Dr. Subramani is an assistant professor of management at Lehigh's College of Business. She studies the implications of representation on entrepreneurship and innovation. Prior to entering academia, Gauri worked as a consultant and as a political appointee in the US.. Department of Treasury's Office of Economic Policy during the Obama administration. Thanks for joining us today, Gauri.
- GAURI SUBRAMANI: 01:02 Thanks so much for having me, Jack.
- CROFT: 01:04 Now, when talking about the gender gap in innovation, the underrepresentation of women is pretty clearly illustrated by what should be a shocking and staggering statistic. Roughly 86% of all patent applications are submitted by men or by all-male teams. And to put that another way, there is absolutely no female representation in 86% of patent applications. Now, research that you and your co-authors have conducted shows that the huge gender gap in the total number of patent applications actually gets worse as the patent approval process runs its course through granted patents. So what happens to the applications that are submitted by women? And what accounts for the much higher attrition rate for patent applications submitted by women compared to men?
- SUBRAMANI: 02:00 So what we find-- and one thing I just want to note is we look at the sample of applications from people in the United States and kind of regular patent applications. So that's the sample for which that 86% is true. So what we find is that applications from women and from teams that include more women are far less likely to convert to granted patents. And this isn't necessarily itself a new finding. But what we examine in our research is really why this is happening. So one key feature of the patent process, and this is also true of innovation and entrepreneurship more broadly, is that it's highly iterative. Rejection is really a feature of the process. More than 80% of applications receive a rejection in the patent process, but that rejection isn't final. You have the ability to follow up on it and respond to it and then continue on in the patent process. But what we find in this work is that female patent applicants are less likely to follow up after they receive a rejection and that that's a major driver of this differential rate of conversion of applications to granted patents.
- CROFT: 03:08 You had talked about the why as you began answering the question. So do you have information on why that's happening?
- SUBRAMANI: 03:18 So we dive into this by looking at kind of the other features of patent applications. So one of the things we take advantage of is looking at whether applications are affiliated with attorneys or use attorneys, rather, or are affiliated with firms. That's

kind of a way that you can measure access to resources and information in some sense. So we look at how that drives this differential. It's hard to exactly nail down what's going on because that's unobserved in this process, right? We see how applications go through the process, but we don't necessarily see why they don't. But what we really measure is basically this differential responsiveness to rejection.

CROFT: 04:01

And this is probably a good place to talk a little bit about what makes patents a good measure of innovation and how you went about getting the data that you needed for the study.

SUBRAMANI: 04:13

Patents are really one of the most measurable ways to evaluate innovation. And of course, there's a lot of innovation that can't necessarily be measured by patents. But receiving a patent gives an individual or an organization legal rights to an idea and the ability to commercialize something. So it's really a measurable way to think about innovation. And the data we use is publicly available from the U.S. Patent and Trademark Office. They spend a lot of resources making this data accessible and usable because they're really eager for researchers to look into these questions.

CROFT: 04:47

You had mentioned institutional support as one of the keys to successful patent applications. I don't know if you could expound on that a bit. The role that an attorney and/or a firm, I should say, being on the application, the amount of difference that makes, what does that represent in terms of kind of the broader equity question? You had mentioned resources that are available. And then how does that play into this underrepresentation of women in the patent process?

SUBRAMANI: 05:23

So this can be really key for a few reasons. And I want to explain what it means to use an attorney or be affiliated with a firm. If you're an employee at a company and you come up with a patentable innovation, usually, this happens in the course of work. It's generally in your employment contract that the organization will own the rights to the patent. So you work at Apple. You come up with a new idea - maybe it's for work itself - and then Apple's affiliated. The firm is affiliated with the patent application. So when firms are affiliated with these applications, they generally manage the whole process. Many firms, especially larger firms, have patent committees. And that committee, which is made up of a bunch of experts within the firm, determines which ideas to actually apply for patents on. And then they'll pay for the services of an attorney. Patent attorneys themselves are specialized experts. Sometimes, there are attorneys that work within firms. But generally speaking, firms will use attorneys from law firms who are patent attorneys. And patent attorneys are specialized experts. They have to pass a registration exam that's administered by the U.S. Patent Office before they can represent patent applications.

SUBRAMANI: 06:35

So they know a lot about the patent process and how to strategically craft an application, as well as to manage communications with patent examiners. So I mentioned these rejections before and that you have to respond to them. These people are really practiced at how to write a response to a rejection, for example. So what we find, perhaps unsurprisingly, is that both men and women who have institutional support, either in the form of an attorney or by having their application be affiliated with a firm, are more successful than these unaffiliated applicants. So this access to information and the financial resources of paying for an attorney can be very helpful. But what we see interestingly is that female applicants benefit more from the use of an attorney and firm affiliation than male applicants. So this is a bigger benefit for female patenters. And we can't discern exactly why that is, but we

have some ideas about this. The first is that it could be that access to information from people who are familiar with the patent process within firms, for example, is more helpful for women because they would be otherwise less plugged into these sources of information because of preexisting networks being different, for example. Or it could be that women are more financially constrained. There's a whole body of research about that. So the benefit of having the financial support from a firm paying for an attorney-- these attorneys are thousands of dollars generally to prosecute a patent application. So that benefit of financial support is greater for women than for men if they are within a firm.

- CROFT: 08:11 In general then, are firms-- and I'm not sure if this was part of the study or not, but I'll ask. Are firms generally more male than female?
- SUBRAMANI: 08:25 We do find that the proportion of inventors who are affiliated with firms is higher-- the proportion of male inventors who are affiliated is higher than the proportion of female inventors who are affiliated. But we don't really look at-- the composition of inventors at firms is not necessarily the same as the composition of people who work at those firms, so I can't necessarily say anything about that.
- CROFT: 08:50 Okay. Now, this is a question I know you've thought a lot about. And that's, what does the underrepresentation of women in innovation and entrepreneurship mean to society as a whole? The question, why does it matter? What are we missing out on by not having women represented as we would think they should be in innovation?
- SUBRAMANI: 09:18 I'm so glad you asked this because this is, I think, really at the heart of why this work matters. So first, if we have 50% of the population underrepresented in innovative activities, that means we're missing out on their contributions. Just from the perspective of the level of innovation, we're under-sampling from half of the population. So from a macroeconomic perspective, this is a huge loss in potential economic growth. You're not mining these people's talents and their ideas and their abilities. Then, if we think more specifically about what might be missing, there is evidence that women are more likely to develop innovations that serve the needs of other women. So teams that include women, for example, are more likely to receive biomedical patents on female-focused inventions. And broadly, I think this makes sense as well. Innovation comes from exposure and expertise. You have to be exposed to a problem or an issue to think about it. The first disposable diaper, for example, was created by a mother. So if female inventors are underrepresented, then women more broadly are underserved because the innovations that can serve women's specific needs are less likely to actually exist.
- SUBRAMANI: 10:32 And then I think there's a whole nother set of implications around individual-level benefits to participation in innovation that women are less likely to be able to capitalize on. So I knew you had asked earlier about using patents to measure innovation. And another reason why that's a useful measure is because people are able to kind of benefit from having a patent. So independent inventors can commercialize or sell their patent rights. And even within organizations, individuals who have patents see direct increases in their wages. They become more valuable as employees. And patents also at the firm level are valuable because they provide firms with intellectual property protection. But they also send a signal to investors—and startups, for example, that hold patents have higher sales and employment growth and better access to funding. So if we zoom out and you think that women are less likely to have patents, it means that they're also missing out on these really tangible

pecuniary benefits. And this can be one driver behind the underrepresentation of women in entrepreneurship at large. So there are a bunch of different dimensions on which this underrepresentation of women hurts the society overall. It hurts women more specifically. And then it also hurts individuals who are not able to benefit from the financial and employment gains that they could get from holding the patent.

CROFT: 12:00

Now, you've taken a pretty interesting path to the work that you're doing now at Lehigh. You graduated with undergraduate degrees in English and economics from Wellesley College. As an English major myself, I always find that a good thing. And you worked for two years as a political appointee in the Office of Economic Policy at the U.S. Department of Treasury during the Obama administration. And I wonder how your experiences working on policy at the federal level before you made that transition to academia informs the work that you're doing now and that you've been doing, and how the research that you're doing, you see that influencing policy moving forward.

SUBRAMANI: 12:52

It's really been an asset to me in graduate school and thinking about research. So I learned so much at Treasury, both about the value of policy-relevant economic research and actually how that research is used by economists at places like the Office of Economic Policy, and also about the other opportunities outside of academia available for researchers. So one thing that that experience motivated me to do is to think about my work and research outside of a purely academic context and think about the policy relevance of whatever I'm doing. And that's one of the things that really motivates me about the research we've been talking about. I have and continue to be in touch and work with individuals at the U.S. Patent Office to try to understand the drivers of participation and success in the patent process. And they're very invested in studying these questions and diversifying the population of innovators. So for example, we talked about the potential effect of having access to legal resources, right, and the advice of an attorney on success in the patent process. And this is something that the patent office takes quite seriously. And actually, in the past two years, they've instituted a program in which unaffiliated inventors can be matched with free legal representation through the patent process and are trying to evaluate how that affects outcomes. So there are really kind of direct policy levers that you can move, specifically in the context of thinking about innovation and patenting, to try to improve outcomes and improve the diversity of participation in this context.

CROFT: 14:27

And there also seems to be a thread running through even the academic work as a doctoral candidate at the University of California, Berkeley, where you had worked with the team at Yelp that had undertaken a pretty ambitious project a few years earlier to increase workforce diversity at the company. I'm wondering what were some of the takeaways from that effort that have helped you as you studied diversity, equity, and inclusion, especially as it's related to the underrepresentation of women?

SUBRAMANI: 15:02

So I was able to work with Yelp's head of diversity and inclusion on trying to understand what had moved the needle in their efforts to improve diversity. And like you said, they had made a really big investment in this. They tried a number of different approaches at various stages in the hiring and retention process. So for example, they had expanded the set of schools at which they recruited employees to include HBCUs [Historically Black Colleges and Universities], Hispanic-serving institutions, and women's colleges. And they had tried different approaches towards recruitment. They also did things like implement interventions during the interview

process, so they blinded resumes. They removed names from resumes, and they used a voice disguiser during first-round phone interviews to make gender less easy to discern. But interestingly, these efforts specifically, kind of these blinding identity efforts, didn't increase the proportion of female applicants who made it through those stages. And upon reviewing why this was, it seemed like this was potentially because of things that they hadn't anticipated, like the fact that female applicants were more likely to describe their prior accomplishments by saying, "We did," as opposed to the more kind of agentic, "I did," which then potentially diluted the credit that they received or the kind of skill that was attributed to them during that interview.

SUBRAMANI: 16:18

And another thing that Yelp did was to focus on retention and creating a more supportive work environment by investing in developing employee resource groups and training programs unbiased for employees and managers. One of the real takeaways from this experience, I think, is the importance for organizations of evaluating the effects of their efforts to increase diversity in a really rigorous manner, as opposed to just implementing changes with the purported goal of increasing diversity and then not evaluating their efficacy. And another thing, to the question of the relationship between all of this work in the underrepresentation of women, I think, is how sometimes when we conduct research, this doesn't necessarily port into every setting. So for example, there is a pretty large body of research that looks at how creating the blinding evaluative processes leads to more gender-equitable outcomes. But in the specific context of interviews for technical workers, it didn't end up actually doing that. So I think the importance of evaluating these different initiatives once they go into place and then thinking about how to improve them is really important in a real-world organizational setting.

CROFT: 17:30

Yeah. And that is an interesting point and for all the talk about team approach and the importance of team in business. And I don't know that this is necessarily true, but if women are more likely to say "we" instead of men in job interviews using "I," where the blinding can be heard as, "Well, how much of a contributor then was this person to the we?" even if it's blinded. So that's a really interesting finding that I confess I hadn't thought about before, is the way people react to what they hear in an atmosphere generally, I think, where being a good team player is certainly a plus.

SUBRAMANI: 18:25

Right. And to your point, this matters also based on how the evaluation is conducted. So you can imagine, in these types of qualitative interviews, it's hard to standardize evaluation in a sense. Whereas, one of the most famous studies that looked at blinding in an evaluation process was in orchestra auditions. And when there was a screen so it wasn't possible to discern the gender of the person playing the instrument, then gender equity increased significantly. But that's obviously a different setting than when you're using a voice disguiser in an interview. And then you have this dynamic of people using different phrases that are maybe evaluated differently. So there's really a lot of complexity in the real world.

CROFT: 19:09

There is, indeed. One of the things, when we talked a few weeks ago initially where you said something I found very interesting, which is that your research on innovation and patents focuses on "the end of a leaky pipeline". And I know this is somewhat outside the purview of the research we're talking about here, but I think it helps put it into a broader context. So I'm wondering if you could talk a little bit about what happens to women scientists and inventors as they move through that leaky pipeline

that runs from a STEM education, high school, college, grad school, into the workforce, and eventually into innovation and entrepreneurship at the end.

SUBRAMANI: 19:55

Sure. So I'll start actually by situating my research kind of at the end of that pipeline and explaining how that dynamic, I think, matters, which is that, by the time you get to this stage of applying for a patent and being really an innovator who's developed something new, you can imagine this is a select group of people, right? Not everyone does this. So actually, my prior is going into trying to understand the underrepresentation of women in the patent process, where that you would almost imagine that, if this is a really self-selected group of women and a group of women that's more self-selected in a sense than the group of men, that they might actually be less likely to fall out at this kind of end of the leaky pipeline, right? These might be the people who are totally resistant to getting negative feedback because they've already persisted after getting so much negative feedback.

SUBRAMANI: 20:47

So it almost makes the findings of the research that we talked about, I think, even more striking because you see how this dynamic continues to exist. But looking backwards a little, it's a little outside of my research area per se, but I'm happy to highlight some of the work that has influenced me. There's a robust body of research that illustrates that demographics, as well as exposure to innovation, are really important in terms of career choices and trajectories. Children born into the richest 1% of society are 10 times more likely to be inventors than those born into the bottom 50%. Who you are really determines a lot of your trajectory. And when we think about this in the context of gender, conditional on studying STEM subjects, female college graduates are less likely to transition to STEM jobs. And even when it comes to choosing majors, there's research that shows that female college students are less likely to pursue a major in a topic in which they've received a bad grade or a lower grade.

SUBRAMANI: 21:48

So there's even some fallout that happens in the process of choosing college majors. But even conditional on studying a STEM subject, female college graduates are less likely to enter those fields. And then, even once they're in these roles, female academic scientists, academics have to go through so many different hurdles, are less likely to patent than male academic scientists. And part of this is due to having more limited professional networks. Then the small proportion of women who do end up participating in innovation are often disadvantaged by biased evaluations of their accomplishments and capabilities as compared to similarly qualified men. So there's kind of this series of hurdles that lead to fallout of women throughout the process of becoming a scientist or participating in these innovative or entrepreneurial fields.

CROFT: 22:38

And I do think that that is an important point because this isn't an issue that we need to better understand and deal with just at the very end among innovation and entrepreneurs, the group that has made it to that point. The issues kind of pop up at each step along the way, and it would seem like it would be hard to separate one from the other, so ...

SUBRAMANI: 23:04

Right. And that's actually one of the things that I-- this can kind of be a tough question or issue to put your finger on because there are so many things happening at so many different stages. And you think, "What's an intervention that could actually solve these problems?" So that's one of the things that I find really compelling about sort of the constrained setting of the patent process itself, which is that, OK, this is maybe at the end of the pipeline to some extent. But we can actually identify ways to improve



outcomes, like providing better access to information or providing free legal representation. So there are, like I said, levers that you can directly move, which makes it kind of a satisfying context to study.

CROFT: 23:40

Yes. Definitely. Now, another thing in our earlier conversation that kind of struck me was you were talking about your 1,000-foot perspective on the research questions that you're looking at and that it kind of boils down to how representation affects what exists. And I like the phrasing of that because what exists-- there's always a reason for things being the way they are. So looking at what those reasons are and the role that, and particularly this case, representation plays in the way that things are are important questions to ask. So I was wondering if you could elaborate a little on what you mean by how representation affects what exists and perhaps share what you're thinking is on that question at this point in your life and work, with the understanding that it may well change.

SUBRAMANI: 24:36

Yeah. Certainly. So I think that, right now, the motivating force behind my research is this question of who gets represented, regardless of the context you're looking at. Who shows up and who does the data that we examine include and who does it omit? And also, how does this affect our determinations of who's successful and who isn't? So I'll give you one example in the context of patent data, which is that the research I described to you uses patent applications. But the availability of that data is actually relatively new. And before that, most of the research-- and actually, still, a lot of the research that looks at patenting focuses on granted patents. But as we talked about, there's fallout between the process of applying for a patent and receiving a patent. So even if you're examining the sample of people who are patenters by looking at just people who've received patents versus applied, you're seeing a different kind of the data. You're seeing far fewer women. If you look at the network of people who patent together by looking at people who've received patents together versus people who've applied for patents together, a given individual's network will be far more diverse with respect to gender if you look at their co-applicants versus the people with whom they're actually on granted patents. And you can think of this in a variety of contexts.

SUBRAMANI: 25:51

I've been talking about this with patenting and innovation. But one example that I find really compelling comes from a book called *Invisible Women* by Caroline Criado Perez, who's a very innovative woman who writes a lot about the harms that come from kind of excluding women in our analysis of data. So she talks about how the average female handspan is between 7 and 8 inches, and the standard keyboard on a piano is 48 inches. Octaves on a standard keyboard are 7.4 inches wide. And this keyboard disadvantage is 87% of adult female pianists, just because their hands are too small. And at the same time, a study that compared the hand span of 473 adult pianists to their level of acclaim found that all of the pianists considered to be of international renown had spans of over 8.8 inches or above. So what this really highlights is that you see women are far less likely to be successful pianists. But this is partly because pianos are actually constructed in a way that makes it impossible for many women to be very, very good at piano, so this idea of bias appearing in the outcomes in a lot of scenarios because of who gets represented in kind of the construction of norms or even physical things like pianos.

CROFT: 27:13

Finally, we've talked about a lot of different things. But I always like to ask if there's anything we haven't discussed that you think our listeners should know about your work.

SUBRAMANI: 27:24

It's been great to talk to you about this, and I think I've touched most of the topics that I'm interested in. But one thing that I found and continue to explore, and it always surprises me, is how important diversity really is in a variety of contexts. And this is really diversity of experiences, of backgrounds, of demographics. It really helps us create innovations that serve a diverse world of people. And this pops up in situations and contexts like this piano example, for example, that you wouldn't necessarily even think of as having anything to do with gender or demographics. But that's really something that struck me.

CROFT: 28:01

Thank you so much for being with us today.

SUBRAMANI: 28:04

Thanks so much.

CROFT: 28:05

Gauri's research has received several awards and grants, including recognition as a finalist in the Organization Science/INFORMS Dissertation Proposal Competition, the Strategic Management Society's Audience Choice Best Conference Paper, and support from Economists for Equity at Berkeley, the Center for Equity, Gender, and Leadership, and Facebook. This podcast is brought to you by iLUminate, the Lehigh Business blog. To hear more podcasts featuring Lehigh Business thought leaders, please visit us at [business.lehigh.edu/news](http://business.lehigh.edu/news). And Gauri also has some videos where she talks about some of her other work on her personal website, and we will include a link to that in the blog post accompanying the podcast on the Lehigh Business site. And don't forget to follow us on Twitter @lehighbusiness. This is Jack Croft, host of the iLUminate podcast. Thanks for listening.