# CARMA

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# RESEARCHING INTO FINANCE

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Interviewing Gaurav Aggarwal, BS-MS, Department of Mathematics, IISER Mohali (2015 Batch) who currently works as a Senior Solution Advisor in the Tax Consulting firm- Deloitte India, Hyderabad, following his passion for Applied Mathematics and using it to solve real life problems in domains like banking and financial services.

***What was going through your mind during your final year in terms of your future path? Were you following the academic trail at any point, considering that you got your job at Deloitte soon after you graduated?***

Yes, I did want to go for a PhD and I applied in various institutes across the country too. I even got through to one of the premiere research institutes in the country. Around the same time though, I applied for a job at Deloitte, where they were doing something on stochastic calculus. The job profile really interested me, as it gave me an opportunity to explore how mathematics in all its rigour could be applied in real life. I eventually landed the job which was a pleasant surprise for me.

***What got you motivated to get into financial modelling?***

A few professors visited IISER during various times, and threw a few terms at me, which got me interested to read more. Also, a project in the statistics department of Panjab University, where I met students who were preparing for a lot of finance related things, helped me know of this circle. My fifth year thesis was a

study on diffusion processes and Brownian motion, which involves a lot of stochastic calculus and probability theory; which has a lot of applications in the field of finance.

*In order to test my knowledge, I appeared for actuary exams, which dealt a lot with application of my knowledge in mathematics, especially subjects which I had done a lot of projects in and really solidified my interest and hence gravitated me towards finance.*

***What are some skills that you acquired as a student that are still helping you today?***

For my job, I would attribute most of my skills to things I did outside of academics. I have been in fest committees; and also have been the cultural secretary at my institute for two years. The skill of leading in a team under pressure helped me. From the academic perspective; math from the coursework, of course. I pursued my interest in probability theory and did internships and projects in allied subjects. Also, I developed my knowledge in statistics and more importantly, programming in due course and eventually ventured into financial math. However, I did have to study courses on finance after coming to Deloitte to match up with people who have majored in finance. The knowledge of Math, however, has been indispensable, as it helps deepen our understanding of the problem at hand.

***What are some of the avenues that Mathematics majors in IISERs can take other than academia?***

Some of the career options to choose from for Mathematics majors in IISERs include a career in finance – whose background is laid for by courses on probability and measure theory. Actuarial sciences is also a viable option, which attracts attention from insurance companies,

and finance companies in general. In addition; data science is a field that is gaining ground, which requires a good understanding of mathematics. Some health analytics firms, theoretical physics and computation research groups hire mathematics majors to provide certain solutions.

*Overall, mathematics majors are really well placed to be able to transition to the industry; they have their basics very well covered - only that they need to know when and which opportunity to grab onto.*

***How did you find the work culture is academia different from that in industry?***

One major difference I find in the work cultures lies in the way we approach a problem at hand. Academia entails for more of a process oriented approach to the problem at hand, which involves finding the most generalised solution for it; where time is not the biggest constraint, with the ultimate aim lying in the progress of the "subject" as a whole with time. Dealing with an industrial problem involves a more result oriented approach, which involves delivering the "end product" within a certain period of time; not necessarily in the most generalised manner.

*Another difference, of course, is that in industry based jobs, multitasking assumes much more importance than expertise in a particular field- the ability to do actual work and also being able to handle logistical and administrative aspects is imperative for smooth work flow.*

***How has the way you work changed due to the COVID-19 pandemic?***

Personally speaking, it hasn't changed much really, I must say. I am dealing with a client from overseas, by myself, so as of now not much coordination is required as such. I do enjoy my job, especially listening to the point of view of others and learning from their experiences in general. However, I do have to

manage household chores with this, which is a challenge but Maggi and Cup Noodles do come in handy every now and then (laughs).

***What advice would you give to the current crop of BS-MS students who want to get into the industry?***

I'd like to tell those who want to get into the industry to work on their programming skills, especially fifth year students who want to fast track themselves here. For mathematics majors, an important thing is to decide which industry they'd want to get into and get some background knowledge of the terminology associated with it; as the mathematical nuances involved remain the same irrespective of which route they choose

*I also want to emphasise on the fact that IISER students are trained on par with some of the best universities in the world; so it is important to sell themselves as what they are, and not become comparative to other graduates.*

For the first and second year students, I'd advice to keep their minds open for various future career possibilities, and fully appreciate what is being taught to them.

# ENTIRETY INVOLVES INTERDISCIPLINARITY

There are inputs from conversations with Nihar Sabnis, Sagar Sutar and Tejus Nagdev, each one from different educational backgrounds like engineering, design and research, currently pursuing their careers in highly interdisciplinary domains.

The Masters programme in New Media Design offered by the National Institute of Design is essentially all about designing or inventing newer technologies. "The three primary domains are 'solving', 'staging' that involves experience design which in turn includes developing technologies for say, a better shopping experience for the consumers, and 'speculating', which trains designers specifically for foreseeing future possibilities, related problem solving and so on. We are a batch of 15- a diverse group of individuals from backgrounds like fine arts, economics, architecture and engineering! One of my seniors who had enrolled in the Masters programme in Toy and Game Design was from dentistry background!" explains Tejus who is an electronics engineer and is currently pursuing Masters in New Media Design from the National Institute of Design.

***"The real voyage of discovery consists not in seeking new landscapes, but in having new eyes."***

***- Marcel Proust***

*Unfamiliar perspective towards familiar surroundings is the key to fresh ideas!*

As a part of the New Media's ethnography course, students perform an exercise in which they write about their personal life experiences, as elaborate as an autobiography following which they "open-code" this write-up. This means to analyse and understand their own cultural experiences and thinking patterns and conclude their own "frame of reference"- literally, how they approach any task intuitively. For Sagar, a computer engineer and an alumnus of the National Institute of Design, the conclusion included words like 'craft', 'making things', 'hardwork' and so on. "This analysis played a key role in deciding what I would do for my final graduation project! Art and craft were the skills running through our family since my ancestors and even my father and grandfather were into carpentry." After sufficient thought, he decided to take up origami as his theme. "Meeting a lot of people involved in origami, referring to books followed and in a few months, it took me over. My perspective had completely changed and all I could see was folds and the resultant *being* of that object: folded plastic cups in the college canteen, the petals of flowers, the mimosa leaves.

*I had started to develop abstract connections like the 0,1 in binary being similar to 'fold', 'unfold' in origami- thanks to the computer engineering background!.., how unfolding is a form of folding, that folds had the power to give something a visible, 3D form and so on.*

Soon, I had an entire write-up ready on 'Meaning of Folds' and this was the first concrete step towards the entirety of my project.

"Air pollution is one common problem, the impact of which is dangerous but often not directly visible. But Hey Sagar! Folds contain

the power of giving anything a visible3D form... . That's literally how it clicked and I decided to design an origami heart model that would fold or unfold with changing air pollution levels and hence be indicative of the pollution. Later on, I prepared a computerised simulation of the same which completed the project."

What next? What of such ideas and prototypes? "Such projects might keep living heavily inside the portfolio for long before you scale it up to make them stand in the market or present them before well-established platforms. What is important is to take a call based on the availability of 4M's: Machine, Man, Money, Materials," says Tejus.

## *Classification is man-made!*

Nihar, once a National level badminton player, who completed mechanical engineering followed by a few design courses is currently pursuing Masters in Bio-Mechanical Design in the University of Technology, Delft, Netherlands. "The combination seemed interesting and I wanted to explore it more which led me to this course."

We do get overwhelmed or totally perplexed on hearing just the names of such work areas. However, it is important to understand that the very idea of amalgamation of disciplines is a mere discovery since it was our own learned ancestors who segregated the knowledge into 'disciplines' to facilitate learning.

*Accidental unmindful discoveries from a different discipline or even "...a 'chemist', 'physicist', 'philosopher' ..." and so on, all in one person's introduction indicates that entirety essentially involves interdisciplinarity.*

The recent times of rapidly advancing technology have led to the growth of such 'inter-disciplinary' fields, as we call them. "How is the same human hand, a gripper (as referred to in robotics) as effective at

holding a soft orange as it is at holding a hard metallic bottle? There's design and mechanics of the gripper along with neuroscience that is involved!" elaborates Nihar for an overwhelmed interviewer, for whom the three fields don't seem to connect even remotely.

"Keep practicing your liking or hobby, something that's very close to you, personal to you. It would sync in with your professional projects as your tinge in them! I have had a habit of doodling, as non-fancy as in notebook margins and that literally became the basis of one of my projects called Hoot Reader!" says Tejus when asked to elaborate on how ideas really click. Nihar adds, "Explore as much as you can, while the time permits.

*However, note that we don't want to be a rolling stone gathering no moss.*

Trying something new every day and touching a huge number of activities is not exploring. Give it time. Don't conclude you like biology on the first day of your reading- leave it for the...58th?? day!"

# BEYOND THE ORDINARY

Ever thought of career opportunities for science graduates/postgraduates apart from those in academia or the corporate industry? This article gives you a few insights on choosing a different career path altogether.

While non-governmental, non-profit organisations haven't been much talked about as a potential career option, they are the very places that bring the best of research minds together from all over the globe, to achieve a greater goal for the society.

**How do these research NGOs work? What makes them different from academia and the private sector?**

NGOs are mission-driven organisations that mainly focus their work on addressing the upcoming issues in the society, whether it be related to science or any other field for that matter. NGOs focus on having an immediate and urgent response to event.

*Academia works on a different rhythm in terms of response and approach to the problem. This is because imparting education is also one of the primary goals in tandem with research in these institutions. On the other hand, corporate industry has been prioritising remunerative research much more than often. This, in turn, makes their products too exorbitant for everyone to afford and consequently narrows the potential impact of the developed research product.*

Given the recent pandemic situation, NGOs are playing a critical role in accelerating and giving precedence to the development of economical vaccines to provide for the entire community. PATH is one such non-profit global health organization that includes the development of

affordable and reliable medical technologies as one of its major goals.

While funding remains to be one of the biggest hurdles in NGOs, these organisations have gained massive recognition in the last decade, through their effective contribution to society. This has sky-rocketed the grants by the UN and governments along with the public and private donations.

**What's in for science graduates/postgraduates in the non-profit sector?**

» The jobs at these NGOs are highly competitive and are usually limited in number. One needs a strong academic and practical experience to be selected. Most NGOs hire people with a minimum academic qualification of post-graduation. Research internships may help one to gain the necessary practical experience. Here's some information about a few active recruiters. UN environment programme offers positions like 'Program Management Officer' to candidates with a strong background in Economic Sciences.

» Nature Conservation Foundation (NCF-India) invites applications for the post of 'Project Manager' for Bird LTEO (Long Term Ecological Observations) Project on biodiversity and climate change. Applications of candidates having a Ph.D. in topics related to ornithology or other ecological sciences and those having a Master's degree in avian ecology with a minimum experience of four years may be considered.

» PATH has opened applications for the post of 'Program Officer' (TB/HIV Programme, India) for those who have completed their MBBS or Masters in topics like Public Health and Epidemiology.

Andrew Thaler, a deep-sea ecologist and conservation geneticist is the CEO of Blackbeard Biologic: Science and Environmental Advisors. He says,

*" If you are a rogue scientist that is, if you pursue your research outside of academia, then non-governmental organizations are among the most valuable partner organizations you can have. Working with NGOs can be challenging, frustrating, and rewarding — all at the same time. NGOs may want a scientist to do the familiar work of primary research, offer critical reviews of the field, provide a policy context for the field, do community outreach and engagement, work with stakeholders or develop novel solutions to real-world problems."*

**Why work in such organisations?**

*The meaning of life is to find your gift. The purpose of life is to give it away.*

*-Pablo Picasso*

These organisations provide the researchers with a refined platform to engage in their study without much of profit constraints and capitalism being involved, unlike in the industrial sector. People working in NGOs have the unique privilege to work on current problems and provide real-time solutions that benefit the scientific as well the general community as a whole. Sheer passion to help make a difference to the society, as a sense of social responsibility is what drives one to work in this sector. One meets many such talented optimists at the workplace.

*"The satisfaction and happiness that one gains by helping people in need is an enormous psychic benefit that attracts talent and this is what gives the non-profit sector a competitive advantage over the for-profit sector," says Dan Pallotta, an entrepreneur and a humanitarian activist.*

Employee revenue depends on the size, funding and type of non-profit organisation. In India, program managers with a work experience of 5-6 years may earn anywhere between 50,000-1,50,000 Rupees, while CEOs earn about 1,00,000-5,00,000 Rupees per month. Guidestar and CNM reports peg the average median annual salary of CEOs of non-profits in the US as between $50,000 – $90,000. Some larger foundations pay up to $1,50,000.

NGOs are one of the best places where one can earn a decent salary as well as serve society through research.

**What all should one consider before joining the sector?**

⇒ As these organisations are mostly dependent on external funds, this path might be risky in terms of job security (especially in smaller NGOs).

⇒ The work done by these organisations generally takes longer to be acknowledged as compared to the corporate industry, since non-profits prefer investing in the implementation of work over advertising.

⇒ The stakes involved in such jobs are also high because donor money is being invested.

**Top NGOs for scientific research by Nature Publishing Index, 2019:**

- **Max Planck Society:**

In 2017, Max Planck Society's annual budget reached US$1.9 billion. In addition to basic research, it takes credit for more than 4,000 inventions

and 120 company spin-offs. (eg. : ProteoPlex, which develops protein analysis techniques.) It encompasses 84 institutes and more than 23,000 staff, with scientists accounting for 32% of employees

- **Leibniz Association:**

Encompassing 95 non-university research institutes with around 20,000 staff in total, including 9,000 researchers and roughly 3,900 PhD students, it is known for the breadth of research it undertakes, covering virtually all fields of academic research. Through its 'Junior Research Group Funding Programme', it offers talented young scientists attractive research conditions and an opportunity to establish themselves in their respective fields. Researchers with a post-doctorate are eligible to apply.

- **Scripps Research:**

One of the world's largest private, non-profit biomedical research organizations, encompassing more than 200 laboratories with roughly 2,400 staff, including scientists, technicians, graduate students and administrative personnel, Scripps Research is known for its work in areas such as immunology, molecular and cellular biology, infectious diseases and synthetic vaccine development.

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3) Harvard Law School: Nongovernmental Organizations (NGOs) | Harvard Law School

4) Oxfam Blogs: Why is it so hard for academics and NGOs to work together? – From Poverty to Power

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6) The Chronicle of Higher Education: Breaking into NGO Bubble | Chronicle Community

# STELLAR

Sneha Pandit, an alumnus of IISER Bhopal, a physics major who's currently pursuing a Ph.D. at the Institute of Theoretical Astrophysics of Oslo talks to us about her academic journey at IISER

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***Many people at IISER have a unique experience with regards to their academic journey. Can you walk us through yours? How did you know what major to pick and what courses to pick along with it?***

I wanted to pursue astrophysics since I was in 8$^{th}$ or 9$^{th}$ grade; but I didn't know how, because at that point, nobody knows how to get into it. In 11$^{th}$ grade, I got an opportunity to attend an INSPIRE science camp organized by DST. In such camps, they train 11$^{th}$ and 12$^{th}$ graders for a couple of weeks and tell more about how to pursue pure sciences. We attended lectures by many directors and professors from institutes like IISERs, IITs, IISc., and IIST along with some hands on experience as well. That was the trigger that drove me to go to IISER.

*I knew that I wanted to go into physics, but I didn't do as well as I would've liked in second year. I got good grades in all the other subjects, but I wasn't entirely satisfied with my grades in physics. Since I wasn't performing well in what I wanted to do, there was a dilemma for me in the form of good grades vs. astrophysics. But then I went with my gut feeling and took physics in third year.*

Along with all this, I grew a strong liking towards engineering sciences. I did my minor in engineering sciences, because I had realized that taking only physics could possibly reduce my CPI further, and I needed something to push it.

***What was the most difficult thing you faced after picking your major?***

In my 6th semester, I was going through a lot personally, and I ended up getting one F – and it hit me. Do I have in me what it takes to pursue this? But then I cleared the course, started studying extremely hard in 4th year and eventually I started getting good grades.

What I understood from this was that just having passion or love for the subject is not enough, you need to work hard along with that.

*It is only when you work hard that the subject will start showing its colours, otherwise you'll like it but it may not like you!*

Coming to terms with the fact that only passion and love for the field isn't all, and that in any case you have to work hard – that was the most difficult.

***When and how did you have clarity about your specialization?***

It wasn't sudden, it grew over time. I did internships every summer. After first year I did a review-based internship in solar physics, and in second year I worked in material science at IIT Indore. In the summer of my third year, I did an internship in galactic physics at Indian Institute of Astrophysics which had a lot of observational work. I loved this internship so much, because until then I was just reading and during this internship I could see the galaxies, the actual objects that I was going to study. This was when I realized that I liked observational astrophysics.

In my fifth year for my thesis I worked with Dr. Ritam Mallick at IISERB and it was wholly

computational. So after doing all this I realized that I liked a mixture of both observational and computational astrophysics. That's how it's been so far and I think it will evolve.

*Currently I'm working with sun and stars, maybe ten years later I'll be doing something else.*

***Tell us more about your final year. What competitive exams did you give?***

***What are some highlights from your grad school application process?***

It's very tiring! I gave a lot of exams such as NET, TOEFL, GRE, GRE-Physics, INAT (for Indian Institute of Astrophysics and IUCAA combined), TIFR, GATE and JEST.

But out of all these, only TOEFL counted towards my grad school application for University of Oslo (UiO). Mostly US, Canada and Australia require GRE, but you can put your GRE score on your CV if it's really good, which is a plus point. What happens because of all these exams is that you get a consolidated format of subject knowledge – you need to study say physics, or English as a whole. It's obviously an entrance exam, but while preparing for these exams you do get a whole picture of the field in which you're interested. After four years of learning you need to know where you stand, and these exams helps with that.

So now if anybody asks me about something about some quantum state I may not be able to give answer directly, but I can definitely solve it – I have that confidence now, because I have prepared for it.

I had applied to schools in USA, Canada and Australia via GRE and to some European schools via TOEFL. I could not clear NET, but I did well in GATE and JEST so I had applied so some Indian institutes as well.

*So I got a good experience in giving interviews in many different institutes throughout the world. This was also nice, because that way you get an idea*

*of what all these institutes look for in a PhD candidate, which varies from place to place.*

***So what are you doing now? In what kind of research are you involved?***

I am a part of RoCS – Rosseland Centre for Solar Physics, at Institute of Theoretical Astrophysics in UiO. I'm working with a "Sun as a Star" approach, where I think of Sun not as an object very near to us but as a random star placed anywhere in the universe and I try to reformulate the signals and spectrum I would get from a star at that point.
This is a procedure that we use to find an explanation for coronal heating, which is a very famous problem in solar and stellar physics. The outermost layer of the sun is called the corona. If the sun is considered as a black body, the temperature gradient from the center to outermost layer should taper away, but the temperature of the corona is way higher than the innermost layer, the chromosphere, which hasn't been explained yet.

I use ALMA (Atacama Large Millimeter Array), SDO (Solar Dynamic Observatory), and H-alpha calcium maps to get observational data.

***What other career alternatives had you been considering?***

Till maybe 2$^{nd}$ or 3$^{rd}$ year I was motivated to do public services, but then I got really very motivated to do astrophysics, so I dropped that thought. Sometimes I wonder that if I had not gotten into IISER, I would've pursued Bharatnatyam and done a masters or PhD there. But I don't think it hindered my journey anytime.

***Physics majors are often grilled for being a product of pop culture. Did popular media influence your perception of physics? How would you paint an expectations vs. reality picture?***

I think yes, sci-fi things like time travel and big bang theory seem very interesting and we want to know what it is, but I don't think my motivation stemmed from there. Maybe 10%, but I really liked physics ever since I was in school, so I had the interest from long before.

Obviously, when it comes to science, "what we know is a drop and what we don't know is an ocean!"

Physics is a science that spans everywhere, so if you have a degree in physics you can apply it to many fields – same is the case for other disciplines as well, but I can tell more about physics. Basically physics gives you tools: if you do theory in physics and applications in other fields like biology or chemistry, that kind of research is something that might be very exotic for people who are not acquainted to research and academia.

*I'm not sure whether pop-culture is the reason for this, but people often think that physicists are either astrophysicists, theoreticians with big thick glasses who're always reading and solving stuff, or just people who go to space! So the interdisciplinary thought process is not yet developed in the general public. So sadly that's not a clear picture that people have.*

***As an undergrad, how did you make yourself familiar with current research topics going on in the world?***

I did some GIAN courses, I did internships, and I had a really nice set of friends around me. So even if I (or anyone else) didn't know something, we had a nice culture around us wherein everyone would come and help, support and explain stuff to each other. Even when some interesting article popped up about something, we would just discuss amongst ourselves, be it in CCD in

fifth year, or in canteen or around hostel, or anywhere really.

That is one thing about IISER that I really love - right from freshman year you get mixed with a crowd that is very motivated to do science. There are very few people who come to IISER just because it's an elite institute. Most of them know what IISER is and really want to pursue pure science in their life. They have that passion inside them.

*Being around people from different academic fields but who are like-minded is something that I really miss now, because now in my institute everyone is an astrophysicist and I miss having this kind of diversity at the doorstep which was there in IISER.*

***What advice would you give to young undergrads who, despite being interested in physics, are still not sure whether it's their thing?***

Okay, there are two contradictory things I'd like to say here. First, don't be afraid that your grades will fall off; and second (which is contradictory) is that grades do matter. Even if people say that "grades don't matter, talent matters", or "grades are just a piece of paper" – it is not. Because when you apply anywhere, people are not going to judge you by your talent or whatever because they don't know you personally.

They just know the piece of paper. So grades may not matter as much as talent, but they still do matter. So we need to keep this in mind, and give importance to either as per circumstances. This is more of a philosophical point of view, but other than that I'd just say work hard. There's no substitute for hard work.

# ELUSIVE ECONOMICS

“Questions to economics and economic policy making are central to the present crisis. Is there something that can be done to boost growth? Should that even be a priority for the affluent west? What about exploding inequality everywhere? Is international trade the problem or the solution? What is its effect on inequality? What is the future for trade-can countries with cheaper labour costs lure global manufacturing away from China? And what about migration? Is there really too much low-skilled migration? What about new technologies? Should we, for example, worry about the rise of artificial intelligence (AI) or celebrate it? And, perhaps most urgently, how can society help all those people the markets have left behind?

The answers to these problems take more than a tweet. So there is an urge to just avoid them. And partly as a result, nations are doing very little to solve the most pressing challenges of our time; they continue to feed the anger and the distrust that polarize us, which makes us even more incapable of talking, thinking together, doing something about them. It often feels like a vicious cycle.

Economists have a lot to say about these big issues. They study immigration to see what it does to wages, taxes to determine if they discourage enterprise redistribution to figure out whether it encourages sloth. They think about what happens when nations trade, and have useful predictions about who the winners and losers are likely to be. They have worked hard to understand why some countries grow and others don’t and what, if anything, governments can do to help. They gather data on what makes people generous or wary, what makes a man leave his home for a strange place, how social media plays on our prejudices.”

-An excerpt from *Good economics, for hard times. By Nobel laureates Abhijit V. Banerjee & Esther Duflo*

***Following is an Interview of Dr. Sandip Kumar Agrawal, Assistant professor in the Economics Department at IISER-Bhopal.***

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***Were you interested in economics from the beginning of your student career? How did it pique your interests?***

Initially, I was not keen (quite unaware) on economics and instead wanted to be a chartered accountant. I aspired to get admitted to Shri Ram College of Commerce for B.com honours, but thankfully I could not. Then, I started thinking about alternative career options, and Economics' prospects began to look appealing. I appeared for different entrance tests in colleges of Calcutta University. Although I had offers from almost all colleges, I got myself admitted into Ramakrishna Mission Residential College, Narendrapur at

the University of Calcutta, where I began with economics (honours), statistics & maths.

By the end of my 3-year program, I had identified my options for Masters in Economics -Delhi School of Economics (D-School), JNU, Madras School of Economics (MSE) & Indian Statistical Institute. Still, D-school, being the oldest and most reputed with a top-class faculty, fascinated me the most.

Eventually, I got myself admitted into DSE. I got to take electives in the 2nd year of PG & my interest in

Economics started building up. I took up many fascinating courses in Macroeconomics, Development Economics, Econometrics, and Law. However, a course on Economics of Discrimination by Prof. Ashwini Deshpande changed my whole perspective on Reservation in India. It was a life-changing course for me. Although taxing, I enjoyed D-school and learned how to better approach arguments and reasoning through them.

*Soon after starting to work for Absolut Data Analytics, I realized that I missed having conversations with my professors & friends, especially the applications of research. Then I deliberated on whether to go for further studies and took admission in MPhil course at JNU, where my supervisor suggested to think of going abroad.*

With a couple of offers from US universities, I decided to go to Iowa State University in the US to study Macroeconomic theory. I got interested in behavioural economics (with applications in Environmental and Resource Economics) and started working under the tutelage of Prof. Quinn Wenninger. I realized a significant distinction-In India, we are fascinated by theory, whereas, Abroad, I got acquainted with evidence-based research and policy-making aspects of Economics. Moreover, I developed an understanding and appreciation for interdisciplinary research during my Ph.D.

*For any kind of research to be worthwhile, it has to have convincing applications and achievable results.*

The circumstances of doing agricultural research in the US were a huge contrast to that in India. I was determined to pursue & try to develop Agricultural Economics as an

interdisciplinary research paradigm on returning to India.

There have been restrictions on farmers' operation procedures, and – land endowments have been one of the biggest impediments for-small & marginal farmers. Even when many reforms were introduced in 1991, this sector had been neglected. In the wake of COVID-19, there was news of significant Reforms like abolishing the Essential Commodities Act, which shall revolutionize the lives of farmers by enabling them to have better Income and sell their products in the open market, making the middlemen redundant.

***How's a degree in Economic Sciences different from a degree in Economics? How do other disciplines at IISER-Bhopal influence Economics?***

*It's just a matter of terminology: Economic Sciences is not very different from Economics. In terms of curriculum, ours is for quantitatively motivated students that include rigorous mathematical and statistical methods and data analysis.*

Before the commencement of the BS program in Economic Sciences, Economics courses (consisting of Industrial organization, behavioural economics, finance, and Game Theory) were already being offered as electives. It has been a good start in terms of response and interest from students. Through economics, entirely new applications of their chosen disciplines are perceptible, need not be directly related. I have been teaching behavioural economics to biology students who are involved in neurological studies, genetic studies via Gene editing data. Students from the EES department find Environmental and agricultural economics interesting.

Similarly, maths students find applications of mathematical tools. The engineering disciplines learn techniques for data analysis. Econometrics is one of the core courses in the Data Science and

Engineering (DSE) program. Our Ph.D. program admits students from all relevant fields that have a quantitative rigor in their PG. The department is also willing to train students keen to study economics even if they have had no exposure in the field.

*I think economics fits well into the IISER Bhopal System since we have complementarities to leverage for both teaching and research. So I think there is a vast potential with other disciplines being around.*

The different positions in financial markets, Investment Banking, banking sector, or even stock markets are fields especially attractive to the current generation. With the Data Analytics industry booming and

enhanced computational technology & its development on a day to day basis, we have massive data that can be used for research, policymaking & product development. Data is the place where economists can be useful – not just for number crunching but also bringing their nuanced insights on the table.

***How is the department trying to persuade the IISER-Bhopal Student Fraternity to appreciate Economics & the plethora of opportunities it brings?***

I think the department is doing its best. In March 2019, we arranged for a one-day workshop with four eminent Economists from DSE, ISI & JNU. We are aware that it's a relatively new field, and students come from Science backgrounds. So we try to have activities for them. During Singularity, there was an economic modelling competition. We had organized a one-day Workshop like last year, where speakers from IIM-Bangalore, IIT Kanpur agreed to interact with our students. Unfortunately, due to the pandemic, it had to be cancelled. On behalf of the department and the ICDPC *(Institute Career Development*

*& Placement Council)*, I have elaborated on opportunities in various areas to look for internships or even placements. We would like students also to participate proactively. One can always approach any faculty if need be.

***Where & more importantly, how to find the best career opportunities in Economics (Internships, Jobs, etc.)?***

It is a broad question and depends on one's interests. Opportunities in the corporate sector are in data analytics, banking, finance, and Media - print, visual, or online have equal opportunities. There is an indispensable role in policymaking, either through the RBI or the Indian Economic Service. The internet is the best source with keyword search - However, most specifically in policy organizations, one can look at Research Organization | Thinktank.

Specifically, The opportunities available for,

1. **BS graduates are in:**

a. Corporate Sector-Data Analytics, Marketing & Strategy, Banking & Finance, Media
b. Civil Services, NGOs & Social Sector, Environment & Development Agencies

2. **MS & Ph.D. are in:**

c. Corporate, Banking & Finance, Investment Banking, Media, Consulting firms
d. RBI, Indian Economic Service, NITI Aayog, Policy Think Tanks
e. Multilateral organizations - IMF, World Bank, Asian Development Bank, IFPRI *(International Food Policy Research Institute)*
f. Academic Teaching and Research

*Students must augment their skills with techniques and tools (particularly data analysis and computation) to exploit the opportunity to the best.*

***What are the trends & research in behavioural Economics? How is it different from the classical approach to Economics?***

Behavioural economics is a tautology as economics is a subject that studies Behaviour. However, it mainly studies the behaviour of an artificially created benchmark case, i.e., homo economicus. As Vernon Smith (a 2002 Nobel Prize Recipient in economics) began working in this field, it was an offshoot of Economics, creating a framework to test decision theories through lab experiments. Similarly, Daniel Kahneman (2002 co-recipient of Nobel Prize in economics) trained as a psychologist, questioned assumptions in economics, and integrated economics with psychological foundations. While this has been an offshoot in Economics, now, it has become a part of mainstream Economics.

Behavioural Economics has wide-ranging trends. A whole framework has developed for studying economic discrimination, labour markets, agriculture, the environment and resources, macroeconomics & Finance, etc. Now behavioural economics has become so broad that it encompasses several subfields- answering questions about behaviour in financial markets- from how Individuals make decisions in the stock market or saving instruments to how they behave in terms of adopting conservation measures. Due to its multidisciplinary nature, it's difficult to talk of any particular single trend.

We cannot abandon the classical approach to economics as it enables us to estimate the accuracy of real-world predictions, how much they differ from the optimum and see how far we've come in any context, the deviations with the introduction of behavioural parameters?

Research in Economics has become very data-driven. Due to increased computing power, more and

different types of data are available. So now we don't restrict ourselves to surveys for data. Currently, there are plenty of sources, be it remote sensing satellite data or even biological data. Economists have increasingly embraced new data sets. Now, there *are* journals on climate change economics, economic botany, pharmaco-economics. Such sub-fields are currently setting up new research paradigms, showing us its rising interdisciplinary nature.

These two aspects are the biggest drivers of research in economics. And I see that continuing in the research domains in the future, as well.

***Interviewee's Recommendations for further reading:***

1. *What the Economy Needs Now* - edited by Abhijit Banerjee, Gita Gopinath, Raghuram Rajan & Mihir S. Sharma (for the Indian economy)

2. *Everybody Loves a Good Drought* - P. Sainath (a glimpse of agriculture in our country)

3. *Thinking Fast and Slow* - Daniel Kahneman

4. *Nudges - Improving Decisions about Health, Wealth, and Happiness* - Cass Sunstein & Richard Thaler.

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# COVID-19, SCIENCE AND SCIENTISTS

*'I think we are in the middle of a massive experiment worldwide, and the experiment is 'Will people listen to scientists?'*

*-Neil deGrasse Tyson*

Countless scientists around the world are working round the clock to understand and treat Covid-19. The world is rooting for them. Or at least attempting to, in ways they are familiar with. People are realizing more than ever that science, after all, is not a matter of opinion. They are interested in the take of scientists and doctors for adoptive measures, lifestyle changes to reduce vulnerability to the disease, etc. Newspapers, news channels, magazines, social media are all filled with interviews of scientists, relevant facts, and statistics related to the spread. The common folks are making increased efforts to educate themselves with concepts like immunity, antibodies, how the process of a vaccine development works, herd immunity, etc. By doing so they are not only increasing their awareness and knowledge but also harbouring a newfound approbation for scientists, something they previously didn't care for. A good example of this might be more and more people attempting to see the difference between a rigorously peer reviewed academic journal and some conspiracy theories they read in a magazine.

Despite the seemingly increased popularity, the struggle hasn't been easy. A big part of the challenge of getting people to adopt these

behaviours is misinformation. How do we counter the myths out there that masks, physical distancing doesn't work? These anti-science trends mix with an anti-authority trend, and scientists are often equated with authority. Young people may have been disappointed with the government, which unfortunately adds to the anti-science sentiment. Usually, the men and women of science take it upon themselves to fight a pandemic not only of the virus but of pseudoscience and deceptive claims as well.

*I t's not easy, but we've got to counter it by pounding away at the real truth. When you have misconceptions, let's get the right perceptions out there. We need to keep going out and talking about it more and more, very much like we're doing right now.'*

*-Dr. Anthony Stephen Fauci*

Dr. Fauci is a leading American physician and immunologist, has served as the director of the National Institute of Allergy and Infectious Diseases of the United States since 1984. He has been one of the prime voices globally to talk about the dangers of the Novel virus right from the early days, but the White House hasn't hesitated to counter his claims, even calling him 'an alarmist'. Anyone following the news can tell those allegations didn't age well, backing the word of Dr. Fauci even more.

With the world slowly learning to come in terms of the pandemic, the race of vaccines is on. People around the globe are employing all their hopes on the one end product which will considerably end it all and bring their lives back to normal. Stakes are high, and to no one's surprise

finances are needed to back these up. But traditionally, when it comes to funding there's another sensitive tale we need to throw light on.

Science is a very expensive affair. A biologist seeking to understand the human immune system requires laboratories, test tubes, chemicals, and electron microscopes, not to mention lab assistants, electricians, plumbers, and cleaners. A data analyst seeking to model growth and trends must buy computers, set up giant databanks, and develop complicated data-processing programs.

Yuval Noah Harari in his book Sapiens explains the co-dependence of science, politics, and capitalism in great detail. He remarks, "In academic circles, many are naïve enough to believe that government and businesses altruistically give them money to pursue whatever research projects strike their fancy. But this hardly describes the realities of science funding. Looking at the bigger picture, scientific studies are funded because somebody believes they can help attain some political, economic, or religious goals. Our resources are limited, after all. To channel limited resources we must answer questions such as 'What is more important?' and 'What is good?' And these are not scientific questions."

*Science is unable to set its own priorities. It is also incapable of determining what to do with its discoveries. For example, from a purely scientific viewpoint, it is unclear what we should do with our increasing understanding of genetics. Should we use this knowledge to cure cancer, to create a race of genetically engineered supermen, or to engineer dairy cows with super-sized udders? A liberal government, a Communist government, a Nazi government, and a capitalist business corporation would use the very same scientific discovery for*

*completely different purposes, and there is no scientific reason to prefer one usage over others.*

Scientific research can flourish only in alliance with some belief or ideology. The said ideology justifies the costs of the research. In exchange, the ideology influences the scientific agenda and determines what to do with the discoveries. It is not enough to survey the achievements of physicists, biologists, and sociologists. We have to take into account the ideological, political, and economic forces that shaped physics, biology, and sociology, pushing them in certain directions while neglecting others.

The COVID situation might be changing this though, and positively. Although the scenario is far from ideal, it can be mapped down that funds have been flowing into a wide array of research fields like biochemistry, biophysics, pharmaceutical sciences, cyclone engineering, etc. all around the world for the development of an antidote. This is true for both Government based and Private sector endowment to facilitate a better understanding of the virus and to tackle the challenges that accompany it. Although this might be the result of the simple law of demand and supply, it is not unreasonable to conclude that the scientific community might benefit from the current state of affairs. Their judgement is being considered more seriously than ever, they are gaining leverage in negotiations with the government and corporations, fewer people are questioning the huge resources and efforts being put behind research with each passing day.

*The Economic Times* closely inspects India's game plan on the crisis and says, "India's R&D labs have turned into war rooms where scientists are the generals leading the charge, working round the clock to build its weapons. Covid-19 crisis can

potentially reinvigorate and transform India's scientific landscape. That hope is exciting for scientists. For a long time, India's scientific pursuits have been hobbled by multiple qualitative and quantitative issues. Urgency has also meant that merit is beginning to take precedence over hierarchy protocols. Instead of the institute's director bureaucratically rolling down decisions, relevant scientists are being enlisted directly on critical projects. The crisis is forcing a strategic rethink within the government on how it nurtures its scientific landscape. Fortunately, India, with its CSIR labs and outfits like BIRAC, has built a strong bio science foundation with a robust start-up and corporate base. Serum Institute of India is the world's largest vaccine manufacturer. India's pharmaceutical companies dominate the world's generic drug business."

As *Nature* promptly puts forward, "Government-funded medical research bodies in the UK, Europe, and Australia say they are committed to maintaining funding continuity for biomedical research. They are virtualizing peer-review panels and, in some cases, deferring deadlines for funding competitions. In the USA, where, despite calls from the Trump administration for deep cuts to the NIH and National Science Foundation budgets in February, Congress approved substantial increases, the COVID-19 crisis has generated additional funding for NIH biomedical research awardees."

***References***:


Fauci: 'The Virus Is a Formidable Foe'

Yuval Noah Harari on What Drives Science

COVID-19 seed grants awarded to Cyclone Engineering teams

Can the coronavirus crisis change Indian science for good?

How is biomedical research funding faring during the COVID-19


***Read more at:***

Who Sets the Funding Priorities?

4 ways science should transform after COVID-19

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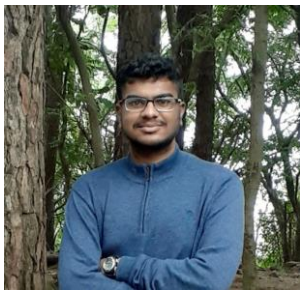

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