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Development Seminar

No Free Lunch: Using Technology to Improve

the Efficacy of School Feeding Programmes

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Second Floor, No. 6, Dr Jose P Rizal Marg

Chanakyapuri, New Delhi 110021

India

Ph: 011 2415 7600

Speaker: Sisir Debnath (Professor, Indian School of Business)

Discussant: Shamika Ravi (Research Director, Brookings India)

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PROCEEDINGS

Shamika Ravi: Good afternoon everyone welcome to Brookings India. Welcome to the month's second Development Seminar. I'm Shamika Ravi, the Research Director at the institution. I'm very pleased to welcome Professor Sisir Debnath from the Indian School of Business.

Sisir is one of our leading micro economists in India, he has incredibly sound technical expertise in looking at household level data, looking at you know, disaggregated data across different sectors of interest. Today what he's going to present, while it is within the school system, so it's pertaining to education, but it's really about how do you use technology to improve governance, how do you use it to improve performance of public schools, how do you improve performance of bureaucrats, so it is broadly a governance question that he is going to address. It's a joint work with Sheetal Sikri from University of Virginia.

The rule of the game, Sisir, is you have an hour to present and then we can do half an hour of Q&A with the audience. I will have a few questions, so let's start.

Sisir Debnath: Thank you for that generous introduction. I don't know about leading but I do love to play with data. So this is a joint work with Sheetal Sikri. She was also my advisor and we started working on this around in 2015, and here is a working paper version, so comments and questions are always welcome. So, I will also be taking down notes in the middle but I guess we'll have the Q&A at the end.

One of our prime ministers once regretted that of every rupee that we spend on public programs - only 30% of it reaches the poor. But that was a long time back. But leakages and inefficiencies are our big concerns in government projects, and what it does [is], it essentially, apart from making the program ineffective, it erodes the trust of people in those government programs, and in general we start believing that the government doesn't work and cannot provide public goods. So we always, in developing countries particularly, have programs which are intended or targeted towards certain beneficiaries because we have limited funds and often times these better things do not really reach to the intended beneficiaries. It's a different argument altogether, who should be a beneficiary or who should not be a beneficiary, I am not getting into it. But once you identify a certain set of beneficiaries, the funds do not really reach them or it does reach them but there is a large chunk that doesn't reach them and often reaches someone who is not supposed to benefit.

So there are these two core problems and this is an observation by the World Bank in their 2003 report. And Lant Pritchett puts harsh words, even harsher than this, and says that institution capacity to implement this program is close, is high enough or thin enough to call it just failing. So these programs have failed and it erodes the public trust in the government program. At the same time it also affects the intended goal of the program. I mean if you really care, you carefully look into it and most of the public programs have some benefits or some intended welfare question that we want to answer. For example -- maybe you can think of it as if they are trying to entice kids to come to school and improve learning outcomes. But at the same time it's also trying to push

certain micronutrients that are not available in their daily food intake and also trying to make them healthier. So that our health expenditure later on when they become adult is much less. Similarly, for example -- when government is subsidising LPG for some beneficiaries, of course the intention is to make the process of cooking much more enjoyable, but at the same time, it is also trying to reduce indoor air pollution. So you know the moment a particular program fails, of course you do not deliver that public good, but at the same time you know you are also not achieving certain other educational goals, health goals, that the program was designed to achieve.

And once a particular program is rolled out, a certain set of infrastructure gets created, certain software gets created, certain bureaucratic positions get created. An institution gets created. Dismantling it and creating something new is very-very expensive. So the question that we are trying to answer is - are there scalable low-tech technologies which can help us to make existing public service delivery systems more efficient or not? And probably the question will be clearer in a few more slides, but this is a topic which has a larger context and that context is very recent, and it is called the personal economics of the states.

And this personal economics of the state is also a sub area of something in economics that we refer to as principle-agent problem. To put it very very loosely, principal-agent problem had traditionally been defined as a problem of a firm, or the owner of the firm or you can call them shareholders. And they have essentially hired a person, a manager, in order to look after the daily operations of the firm, and the principal owns the resources, but the principal doesn't get to see what the manager

is doing in their daily lives. Then they sign a contract, about what the salaries are going to be and what would be the performance on the basis of which the manager would be evaluated, but the problem is the principal can never see exactly what this manager is doing, and at the end of the day if the outcome of the efforts of the managers are bad, the manager can go ahead and say- "Oh, it was not my fault ...I put in all possible efforts that I could, but there simply wasn't enough rainfall, so my output was very-very small." So this is this particular problem of information asymmetry that we refer to in economics.

It is also common across various other fields. Not just firms, you can also think of the state as a principal, you can also think of the bureaucrats as an agent, and there could be multiple bureaucrats. Bureaucrats have their officers working under them, so there could be another layer of agent, and there could be district officer, sub-district officer and headmaster. So you can think of a tree diagram, where there is someone sitting on the top, there is another person under them, then there is another person under them, and they all try to achieve something. But the problem is that, no one gets to see what level of effort is being exerted by the lower level bureaucrats and the bureaucrats below that, ultimately the headmaster and ultimately what the beneficiaries are getting. This is called multiple agent or principal agent problem. We don't need to know much about it, I digressed a little bit. I just wanted to mention that this is how economic theorists would see this problem.

But this problem exists in public service provision as well, and traditionally the way theoritions have tried to attempt to solve the problem, is essentially to design the incentives properly. So you have to

design the salaries of the executers properly in order to make sure that they are putting their best foot forward, and the principle is realising in scope. But there are other possible solutions as well. You can monitor them better, you can put cameras in schools, the way the first paper did... Duflo, Hanna and Ryan published it in 2012 -it's one of the highly cited journals in macroeconomics. And what they did in Rajasthan, they put cameras in classrooms and saw what the teachers were doing, and took photographs of them with the students every single day with the date stamped on the photograph, so that's simple monitoring technology. It improved teacher attendance and later on improved students learning outcomes, and so on. So that was one way you could use these monitoring tools in education.

Then the second paper, which is by Hanna and Dhaliwal, published in Journal of Development Economics very recently in 2013. In it they look at Karnataka, and they look at what happens to hospitals, when the nurses and the doctors are supposed to get their thumbs scanned to mark their presence. And before the particular introduction of this tool, the rate of presence in hospitals, of doctors and nurses, were below 40 percent and 50 percent respectively. So, it improved their attendance rate and subsequently improved utilisation of public health care by people. Because earlier, villagers would not come to hospitals, they would say- "Why should I go there? I mean, the doctor is never present!"

Then there have been a bunch of other studies as well -- Kartik Murlidharan, Paul Niehaus and Sandip Sukhtankar recently published a paper. Here again, the idea was that we can make public programs much more efficient. We can use technologies which are very-very simple, to make sure that payments are going to a person who is an actual

beneficiary. And they show that the efficacy of the public goods delivery increases. So they did it in a very-very large-scale, randomised, control trial, in the state of Telengana. Similarly, Ben Olken also used monitoring versus audits, to see how the quality of roads is determined in Indonesia. But by and large, most of the people, what they do, is they show you that monitoring helps.

There is some literature in this area, and what we are attempting to do is something very similar. But we are using a very large-scale roll-out of a particular intervention in the state of Bihar, and in the context of the provision of mid-day meals. So, I won't spend much time but just to make sure that everybody is on board -- mid-day meal is one of the largest school feeding program in the world. Currently, it feeds, almost every day, freshly cooked meal to 120 million kids, which is a challenging exercise in itself. And the reason why this particular program was instituted, is to essentially combat malnutrition among school-going children. But it started with providing them with raw grains and later transitioned to cooked meals and so on.

Initially, kids in the primary schools were eligible, later it was increased and the beneficiary list included upper primary kids, kids going to grades 6, 7 & 8 were included in the list as well. But there are so many newspaper reports that we keep hearing, that this particular program is just fraught with corruption. People, you know, siphon off the resources that are meant for the kids, the food quality that is served is not good, and typically there are reports of huge over reporting on beneficiaries. Because the more you over report the beneficiaries, the government allots more funds and you are eligible to receive more grains as well, which increases the scope of siphoning.

And you know, I went ahead and talked to the director of mid-day meals in a couple of states, and what seemed to be a big problem is the flow of information. If I ask the mid-day meal director in any particular state -- do you know what fraction of schools provided mid-day meal today? They will not have a response, and they will bring out an A4 sheet with district level information on what percentage of schools, in each of the districts, were served mid-day meals at least three to four months back. Because that's the frequency at which data reaches them, and this data gathering process itself is very onerous. Like, how do you know how what fraction of schools in a district is providing mid-day meals quarterly, right.

So the data collection process is - I'll describe the process in a bit - but the data collection process involves that you start asking the headmaster, "Are you cooking meals?" That is done by a block level officer. For those who don't know, block is a subdivision of a district administrator. And then the block resource person collects all this information, and submits it at the district level. So this is all computerised, there is an MIS system through which this data is entered. And then someone at the district level collects this information creates an average out of it, submits to the state level. Then the state level folks, they collect and send it to the ministry. The ministry then allocates funds, and allocates grains, through FCI. And then through the same channel, both money and the grains flow back to the school.

So, you can see that this collection procedure, manual collection of the data, is very-very onerous. And Bihar side-tracked the system, and in order to get more detailed data, more real-time high frequency data, they

instead introduced an IVRS system. IVRS is interactive voice responsive system, it is the same annoying voice that greets us the moment we call Airtel. That, and you have to press this in order to know your balance, and so on. So, we use the same technology, apparently this is a very cheap technology, and the way they did it, is essentially they collected the database of all school teachers in Bihar, so roughly eighty thousand schools.

They created the database and then one automated phone call goes to at least one teacher, in every school, and every single day, right around noon, before they serve the meals or rather after the serve the meals. And they ask three-four questions, the first question is -- did you cook a mid-day meal today? And they don't necessarily need to have a smart phone to answer these questions, feature phones also do to answer this type of question. They have to press either the button zero or the bottom 1 in order to confirm, no or yes, and then the response gets registered in the system. The next question would be -- how many kids had the mid-day meal? If the response was yes, then again they punch numbers according to how many kids were getting meals in that particular day. But the third question varies, they might ask -- what is enrolment? If they did not serve the mid-day meal, what was the reason the meal was not served? And so on.

So this is a humongous data set that is getting created, with about 80,000 responses every single day of the year. So apart from collection of this data set, which was completely dependent on whatever the Headmasters felt they need to respond to, there was nothing else that was done. Just regular collection of information from headmasters who were responsible for serving these meals. Now why do we think that this act of

collection of data alone, can improve provision of meals? And there are multiple reasons to think we might. So now what you can do is, you can actually cross tally the information that the middle tier bureaucracy have been submitting to the state government. You can see if some district is saying that 100 percent of the schools in our district are providing mid-day meals. You can check, using the IVRS data. Whether the headmasters themselves are saying that or not, that's one point, another thing is, that once the headmaster responds through IVRS, it is essentially a sort of a government document that enters the system: that I have saved this much, and if there is an inspection team that arrives on that day, they have a reference point to see what the headmaster has reported to the government earlier. So the headmaster now, can be held responsible if they have responded differently to the IVRS and the inspection team found something different. And there are heavy penalties if there are any discrepancies.

How frequent are the inspections? Every school is supposed to be inspected once a year. And the frequency of the release of funds from the government to the schools? That depends, it is quarterly. And above all this, there is a community monitoring involved too. So, all these responses by the Headmasters, are open in the public at a website called dopahar.org. There are drop-down fields- through which you can find your school and see what your headmaster has responded on a particular day. Whether they supplied meals or not, right? So, these are the reasons why we believe, that this might affect the provision of mid-day meals. And as you can see, it's just a collection of regular data from those who are supposed to provide this. So what do we do? Well, ours is an empirical study of the impact of this particular program on provision of mid-day meals.

Our idea is very simple. So, Bihar started this program in 2012, and we collect data on mid-day meal provision both from government and from another NGO, Pratham. Now, we have data from Bihar from 2009 to 2014, so we just see how the average provision of meals is changing in Bihar over time, and not only in Bihar. In order to have a control set, and another set of states where this programme was not introduced, we also crosschecked what is happening in those states around that same time. So that's that. Essentially we only examine changes within Bihar before and after.

This is also referred to as event study analysis. This is very common in finance, when there is very high frequency data and you know that something happened in one point in time. But there could be confounding factors if you use only data from Bihar, because there could be something else happening in Bihar. Let's say, state-wide there's something that changed in the mid-day meal provision, all over India around 2012, and somehow we captured that if we look at just Bihar. So just to have another set of controls, we include a bunch of neighbouring states of Bihar as control states, and we see what is happening in those states around that time, and compare their averages with Bihar's average.

Essentially, this is referred to as differencing in difference approach. So, where the first difference is within Bihar before and after the policy change, and the second difference is coming from the difference in other states before and after. And then we take the difference between the two, which is referred to as difference in difference (DiD), and then we do a lot of empirical checks of robustness, to make sure that whatever we are estimating are validated for difference or concerns. So we, or

you, estimate a generalised DiD model which I explained, and then we also control for district specific secular trends which might indicate that things were improving even earlier, but somehow we are capturing this in our data analysis. So the roadmap for the talk is, I will talk very briefly because almost everybody here, I'm guessing, knows what mean tables are, and I will talk about IVRS and data. The estimating strategy results and the robustness checks will be embedded on those results, and then we'll conclude.

So what are mid-day meals, essentially? They started with a national programme called Nutritional Support to Primary Education in India, in 1995. And initially the students were given raw uncooked food, just to incentivise them to come to class, because there was a concern that kids don't come to class because they have to work outside, because families cannot afford to put food on the table. So that was also to prevent child labour at that time, when they introduced the program. And then after about 10 years the program transitioned from raw food grains to cooked meal, and then there were some major changes in 2006. So, the government added a lot of micronutrients, then the minimum calorific requirements were increased. So the food portions were increased at some places, it included eggs the coverage was expanded, and not only the primary school going kids but other primary kids were also included. And the way it works is, essentially, central government provides free grains -- for rice eating districts it is going to be rice, for wheat eating districts (chapatis) they will provide wheat, and the state governments share the cooking costs, which is referred to as conversion cost.

Grants to the school could be of two types, it could be recurring or non-recurring. Recurring grants are essentially grants for conversion costs,

and non-recurring grants are essentially costs to set up the kitchen utensils and so on. And of course the grants vary by school, because the grant size is determined by the number of enrolled children. And the moment you have something like the grants being dependent on number of enrolled children, you can expect what is going to happen. Yeah, so if the fund that the school is getting depends on how many children are enrolled, it obviously incentivises enrolling more and more children to the school, and that's exactly what happened.

It's also important to know how the funds flow from the government to the schools. So, first the schools report their annual requirement to someone called block resource person, and these reports are essentially one-page, very simple reports, which include number of beneficiaries, number of meals that are served, the status of the funds and the food grain that has been supplied to that school. So the block officials then submit this report of the district official, when they go back to the Block headquarters, in a software. This goes directly to a district officer, then ultimately goes to the maintenance director. So these data are aggregated first at the block level, then at the district level, then at the state level. Based on these aggregated reports, an annual work plan budget is made by the state, and it is submitted to the project approval board of the Ministry of Human Resources. Then the Ministry of Human Resources, based on these AWP&B reports, releases the amount of grain, the amount of money, if they are approved, and more. In general, they are approved and all these AWP&B reports are available online.

And if you are wondering what the figures for Bihar are, it's all the districts, always providing for 100 percent of the schools that are providing mid-day meals. That's what it says, so. And once the funds are

sanctioned, they flow back to the school following the same chain of bureaucracy. So the way IVRS system works is, typically a primary school is supposed to have five teachers, some of them could be permanent and some of them could be temporary. The government has actually created a database of all these teachers, and IVRS system calls up 1 particular teacher from a school, at random, every single day. If it is a school day, you know, there's no national holiday or state holiday, and they ask some simple questions, such as -- did you cook a meal today? Press zero if you did not. And you may say that the valid question to ask here is -- how many of our headmasters do have a phone? And you'll be surprised, the penetration rates of mobile telephony, even in rural India, is almost more than hundred percent. So for our dataset, that we analysed in 2012 when the program was started, about 99% of the headmasters have their mobile phones registered.

Essentially, after completing all these calls, after the end of the day, the software summarises the entire data at the district level. So, if you are the state mid-day meal director, you can log in and you'll see that district level for each and every district -- What fraction of the schools were serving meals on that particular day? Now this level of disaggregated data is unheard of. And not only is it provided at the state level, these are clickable reports as well, so if you click on a particular district; let's say Katihar, and then all the sub districts under the district opens up real time in the computer. Then you can click on one particular sub district, then all the nyaya panchayats open up, you click the nyaya panchayats, the panchayats open up, you click panchayat, the schools open up, and you can then see what each school has responded, or each teacher has responded from each and every school,

every single day. And now, since you have this data, you can build a lot of applications on top of these databases.

For example, if some headmaster has reported that they have not provided meals for last 7 days, so their response was zero on a row for seven days. You can write a simple program to flag those and put a flag against those codes, and then someone calls up those headmasters and ask -- why did you not supply mid-day meals? And then try to solve that problem. If there were any supply chain issues, and so on. But in order to do that, you have to know which school is not providing meals, and that's what this technology offers. And this is also uploaded on a publicly accessible website called dopahar.org, where you can essentially provide the school code, each school has a unique code called dicecode. Even if you don't know the code of a particular school, there is a drop-down menu to go to the district level then select the sub-district and so on, and see what that headmaster has reported for a given day.

So, to summarise this is how the system used to work. The flow of beneficiary information, first it would be the school headmaster who would be supplying this information manually, this information would include beneficiary take-up, the status of the funds and how much grain is there in the school. And then, the BRB, the block resource person, would essentially take this data every month, feed it to an MIS and then to the administration of the district system for education, every year. So this frequency was monthly through BRB, and then it went to the district officers. Then the BRB block resource person would upload this data on MIS manually, which is a software, and this will go to the district nodal officer for education in charge. Then they are also supposed to audit schools and verify, so this was the job of the block

resource personnel, and the district in charge would essentially report all these BRB, aggregate all this data from all the BRB in a district. They will manually add the data in MIS, it goes to the mid-day meal directorate, and then mid-day meal directorate releases the funds availability and food grain availability to the schools. Then it goes back to the schools following the same chain of commands, right?

What did IVRS do? So, it kind of eliminated the middle tier bureaucrats through which information flowed to mid-day meal directorate. But they are not obsolete, the data would still come through the traditional mechanism. But you have an additional source of data, which is much more frequent and much more disaggregated, and it would come directly to the directorate through a completely parallel system of data collection. So what do we do? What are the sources of our data we have? Primarily two sources of data that we extensively use for our analysis -- the first one is Annual Status of Education Report (ASER) dataset, and we have Bihar of course, because the program was introduced in Bihar, and we have four other states that we felt are compatible to be Bihar - Chhattisgarh, Jharkhand, Odisha and Madhya Pradesh. We did not include Uttar Pradesh in this list, because while UP had something similar to begin with, they were not very cooperative to share the other dataset that we wanted, from the state government.

So, this is essentially a repeated cross section at school and household level. So, for every year they will go to a certain number of schools in each district, and will give us certain variables that are of interest to us, and for each of the villages that were covered in ASER, one government school will be covered. And they would also collect information such as, whether mid-day meal was cooked on the day that the

enumerator from ASER went to the school, and whether there's evidence of food being served, and what about the school infrastructure. So, this sample includes about five thousand schools for Bihar, and around twenty thousand schools for all the five states taken together, and this is the second data set that we use extensively. This is annual work plan budget, these are the budgets that are produced by the mid-day meal directorate and sent for approval to the ministry. And this has a huge report, but the variables that are of interest to us, are essentially the total number of schools that are serving mid-day meals, number of beneficiaries availing meals, amount of rice which is consumed and amount of rice that is lifted from FCI godowns.

And this is district level data, so the number of observation is much less here. So we have thirty to thirty eight districts from Bihar, and we have about 190 districts' observations for only Bihar. And we have over 157 districts for all the five states taken together, we have around 785 district observations for all five states together. So this is a summary report of what we have. The first panel, is from the annual work plan budget data. So, this is the state government report data, and I want you to note the averages for the first two variables, right? Or rather first four variables. The percentage of primary schools serving mid-day meals, according to government report, is 99%. And that's in Bihar, and not only in Bihar, but in other states as well, 99% of the schools are serving mid-day meals. But if you look at ASER data, schools that are providing mid-day meals for the entire period, you will see that it's only 65%. So there's a huge discrepancy between what they independently collected, NGO finds, and what the annual work plan budget data tells you.

We are essentially investigating these two sources of information, on the same outcome variable, that is, whether a school is providing meals or not. Another question that could be asked is about completion rates, so if all calls are made - are they always picked up by the headmaster? And these are those rates. So you can see, in a given month, typically the number of calls would range between 20 or rather 19 to 25ish, depending on holidays and other stuff. And you can see there are some big drops in the month of June and all that, because these are summer months. So you can see that roughly, 80% of the calls are picked up by the headmasters. And they cannot go to voice messages, and this is the heat map of the call completion rate. So we know exact location of each of the 80,000 schools in Bihar and we know their response for all the schools, for a period right after the program was started.

So, for 2012 April onward, until 2017 and 18, we could figure out for each school, what is the call completion rate. And essentially we mapped it out by, where the colour is red, then the call completion rate is very-very low, when the colour is blue, then the call completion rate is very-very high. And you can see that it is scattered all over the place, but around Ganga it's in the middle. I don't know if you can see it, but right in the middle of the heart, the Ganga crosses, and those are the places where headmasters are reporting to this particular phone call, much more frequently, compared to the peripheries which are to the west, southwest and upper parts of Bihar. Can't this be because of connectivity issues? Could be. Connectivity to telephone numbers could be why they answered the IVRS call or not.

So, as I said earlier, the estimation framework involves 2 strategies. The first one is even study framework, where I look at the average mid-

day meals served in Bihar, before and after the program, and after controlling for a bunch of district level observations, and school-level observations. Then we also have a difference-in-difference framework, where we compare Bihar and the rest of the states, from when this policy was not instituted, and we do it annually, so typically difference-in-difference analysis is done as a comparison, between pre and post. But our result was so stark, that we could we could actually afford to break it up by year, to show you how things change. And this is how, so you can see the blue line there, this is coming from ASER data, right? So, the blue line is essentially showing, that ninety percent of the schools in ASER data says, that they served mid-day meals, and that fraction doesn't really change over time. So these are all states except Bihar. This is ASER for 4 states - the control states. And look at Bihar before IVRS, it was down below, around close to fifty five-ish percent, and there's a substantial jump in 2012, and then it declines a little bit, but the jump persists. That's essentially what we are estimating in our data set.

So in a difference in the difference, ultimately in an economics literature, if you cannot have a picture that says out loud, no matter how much estimate that you present, this picture should be convincing enough. And if I do this in econometrics, these are what the results are. What are the other 4 states again? Jharkhand, Madhya Pradesh, Odisha and Chhattisgarh. So, they aren't really break-out states, they're not Kerala, and yet you find this. That's why we excluded Kerala, Tamil Nadu and other states down south that I don't know. This just shared data. What could be the reasons behind the decline, we are not sure about. But here we will also see that decline in the numbers as well, if you look at it, this is just data from Bihar, and this is ASER dataset we are analysing, two variables that ASER reports – first, whether the school

that the ASER enumerator went to, provides meals, and second, was mid-day meal cooked on that day of inspection. These two variables, and we are looking after controlling, so the second and the fourth column, have the same outcome variable, but it additionally controls for some other school-specific variables. That's why the number of observation just drops in column two from column one and then again in column 4 to column 3.

And you can clearly see that for both variables which measure whether the school provides a meal or not, in percentage terms, there is a statistically significant improvement. And at the bottom what we present is, post IVRS - pre IVRS. So essentially, we are subtracting 3.47 from 15.10, 15.0, and this is the statistic that we are reporting here. So essentially, here it will be reporting, subtracting 5.94 from 10.5, what is the effect before and after the IVRS was implemented. That should be compared, relative to the top number, so the baseline average, that means before the IVRS kicked in, according to ASER data. About 56 percentage of schools claimed that they provide meals, and the enumerator found that about 50 percent were actually serving meals on the day of when they went to collect the data. And the improvement was on the baseline of 50 percent to 12 percent - that is a 24 percent increase in the provision of mid-day meals.

So here, there are a lot of schools, whether the school has a toilet or not, are girls toilets separate from boys toilets, whether there's a boundary wall or not, what is the number of teachers, etc. So these are the variables we are controlling, for I don't remember the entire list but quite a bit. There are also district specific fixed effects as well, in order to counter for the fact that distance could be different.

Schools in different districts could be different. Now this is just from Bihar. If we do a difference in difference estimate, so now we are comparing Bihar with the rest of the states, and again typically these estimates are done just by pre- post-analysis. Our results were so stark that we could break out by year to show exactly when this kicks in. Right at 2012 you see a huge increase in the provision of mid-day meals, and now surprisingly if you look at the AWPB data, the annual work plan budget that is essentially submitted by the state government to the ministry, the story completely changes, right? So other states are still claiming that 100 percent represented by the blue line, that there, essentially, hundred percent of the schools are serving mid-day meals, but suddenly for Bihar, which is the broken red line, there is a slight drop in the percentage of schools that are claiming that they are serving mid-day meals.

So these two data sets are completely in opposite direction in terms of the facts, and this is also present if we estimate this econometrically as well. So again, close to, from 1.6 percentage points, or rather if you look at pre versus post IVRS in the upper primary and primary schools, that decline was about 1.5 percentage points to 5.3 percentage points. So the government reports are saying that lesser and lesser schools are providing mid-day meals after IVRS, but if you look at the NGO data, it is telling us that more and more schools are providing mid-day meals. And it is there, in the difference and difference analysis as well. If I compare Bihar with the rest of the states, I see the exact same story. So this is, you know, these two results alone, potentially point out the fact that earlier, before IVRS, schools were probably, or states were submitting inflated data to the AWPB committee, in order to get more resources. Then we do a bunch of robustness tests on it, and given we

have only few minutes, 15 minutes or so - 13 minutes - I wouldn't get into the details, but I will just roughly tell you, what we did.

This is the benchmark result which I just showed you, I am not breaking them up by year, I'm just showing pre post what is the difference. Then we added district specific trends, so we have assumed that each and every district in the data set were following their own linear trend, even after controlling, for the effect size is exactly the same. Then we did something which is referred to as generalised DiD, so essentially we put, predict schools or districts, which are similar in terms of their composition, in Bihar and outside Bihar. And these are essentially predicted probabilities from being in Bihar and being outside other four districts - Chhattisgarh, Jharkhand, Madhya Pradesh and Odisha – and what we did, we chopped off the ends of the distributions, to make the districts look very-very similar. You can also see that in the averages, where for the states, control states and Bihar the differences are statistically insignificant. So this means that these districts are selectively similar in Bihar versus the control states, if you do the analysis for those selected sample, we still get the almost exact same estimate.

We do a propensity score matching. That's another way to do the same thing, and even with this where we are essentially weighting, re-weighting the observations, to make sure that the control and the treated, or Bihar districts, are very-very similar. Even there we see very similar results. So no matter what metric that we use, how rigorous model we use, our robustness data shows or tells us that indeed the effects were high. Then we also look at what happens to rice consumption, and the amount of rice that was actually lifted from FCI godowns, and

what we find here is that, there should have been stars. Some of the stars are missing, if you look at column number one, and column number 3, this is how much rice was being consumed in primary school, and that increased by 2162 metric tonnes before and after IVRS. And the amount of rice that was lifted in those schools, that remains exactly the same. So that means consumption has increased, but this is coming out of new food grains, or you know food grains that is coming to the system, which was not there earlier. And the data matches almost exactly, it's uncanny how well this data matches. Similarly, the same effects we see for upper primary schools as well. And if we do difference in difference, we'll also see very similar results.

So, we see that more and more rice is being consumed in Bihar primary and upper primary schools, and this consumption is coming not due to the existing stock being utilised properly, but almost same amount of additional rice is being lifted from FCI godowns. So this tells us that probably nobody was siphoning rice, because of course if you provide more mid-day meals, you need more rice and the amount of rice that you're additionally using, needs you to lift those much amount of rice as well. However there is another thing that we did, we looked at enrolment. So this data is coming from ASER as well, so enrolment and attendance, there were some pre trends in the data, we estimated trend break model and if you look at the very last row, which says Bihar interacted with, post 2012, that is gamma 3 in this paper you can see - so the different columns represents different grades, plus 1, plus 2 up to plus 5 for each and every class or grade. Suddenly the enrolment numbers have decreased in Bihar right up to 2012, but if you look at attendance then it's a complicated story altogether. So attendance has improved and it tells us that, you know, that enrolment figures are probably getting corrected,

which was inflated earlier. And since meals are provided more frequently, the number of students attending schools has improved. So this is the story that we can get out of this at the same time.

So, since we know that we have this quarterly progress reports from the government of Bihar, and we also have the enrolment data that the headmasters report to the IVRS system, and we could actually create a distribution to see whether these two distributions match or not. So exactly what we are trying to say here is, we have the same data from two different sources, one, the data is on enrolment -- how many kids are enrolled in each and every school in Bihar? The two sources: Our first source is coming from the government data, that is quarterly progress report, how many kids are enrolled, and the second one, is coming from IVRS. And if we plot the distribution, they correspond to each other. But if you plot the distribution of beneficiaries from the same data set, we see a completely different picture, right? So what we see here, the QPR report on the number of beneficiaries is, to the right of the number of beneficiaries reported in that IVRS system, so it immediately tells you, and we tested whether these two distributions are statistically significant or not, and they are very statistically significant, and it's telling you that, the QPR reports are much more inflated compared to what the headmaster is reporting to the IVRS system.

So there is some inflation or there was some inflation in the reporting of the number of beneficiaries. We investigated whether there was quality quantity trade-off or not. So if a lot of schools are suddenly like around 24%, the later schools are more likely serving mid-day meals, more does the quality of meals deteriorate. And there's a lot of collection that went on to creating this table, we have to cull this out of

inspection reports, and we do not find anything actually. So these reports tell you how many schools they found had good quality meals, bad quality meals, sufficient quality meals and insufficient quality meals. So these are inspection reports that are sent to the ministry, by you know, eminent scholars or retired professors in different colleges. They are sent at random to school to inspect, and they submit these reports in PDF copies to the ministry. All these reports are available online, so we downloaded all the PDFs, cleaned up the data, and ran the analysis for Bihar and for the rest of the states. But it says that the quality has improved, and sufficiency of the meals have improved as well. So there was no quality-quantity trade-off. And then what we did is, we also looked at if a headmaster is completing the calls, does it really mean that students are more likely to attend those schools? Now this is something that we cannot draw inferences on, causality. Because it the headmaster's choice to pick up the phone and receive the calls from the IVRS system, but nonetheless we do find very positive correlations between the number of completed calls, and average daily attendance, average daily meals, average attendance over enrolment, and so on.

So essentially the way to read this information is, if you look at column number one, if the headmaster completes one call, the marginal effect of that translates into .6 additional kids attending that particular school. So the more likely they are to pick up these calls, attendance rates of that school increases. These are very statistically significant results. And then, this is just a pure attendance number, so there's no level here, and if you look at attendance over enrolment, then percentage of enrolled students who were attending, that increases by about .21, if they just accept one phone call coming from the IVRS system. So that's a marginal effect of one phone call, going from the IVRS to a particular

school headmaster. And you can look at the number of observations here, we have about 2 million observations, this is school daily data which we are regressing. And we have about 80,000 fixed effects, because these are the number of schools, and we also have eighty thousand time trends. So we have assumed different time trends for different schools, still these results are very-very strong. So that is the summary of what we just saw earlier, I will skip this in the interest of time.

Another thing that we wanted to talk about, though this is preliminary result, so that's why I kept it at the end, we haven't fleshed them out in detail. But another thing that we have noticed is, AESR also administers this arithmetic and reading test to the kids. But we found surprisingly, that in Bihar, in public schools, right after 2005 the scores for these tests that were administered, suddenly decreases both for arithmetic and for reading test. And that is given by the second column. All these coefficients are negative here, and all these coefficients here are also negative. Some of them are significant, others are not, but if you look at private schools, they are very tiny and they're hardly negative or statistically significant. This tells us that somehow, what has happened in Bihar after 2012 is that, number of enrolment has gone down, number of attendance has improved, yet their test scores have worsened in public school. But somehow they did not worsen in private schools. So we are yet to pin down -- what were the actual mechanisms, why did this happen? One hypothesis could be, that since headmasters are getting more involved in provision of meals, maybe they are paying less attention towards educating. Could be that since meals are served more regularly, the marginal kid who is coming to school induced by this food, is coming from a, you know, weaker socio-economic background, so that is lowering the average test score for the entire

class. But these are competing hypotheses, we have no way to substantiate this at this moment.

So we have ton of more data, but we are essentially analysing this right now, and this data set is so large that our computer is collapsing every time we want to do any analysis on it. But nonetheless, a lot to be done. But what we could show so far, NGO collected data shows that the performance of mid-day meals have improved substantially, at the same time the government data set shows that lesser and lesser schools are providing them. So these two cannot go hand in hand, unless there was some over-reporting in the system. So we also used a central government audit data and it reveals that the quality of the meals did not deteriorate either. Neither did sufficiency. We also find enrolment decreases but attendance increases, and taken together what we could say is that it could reduce leakages. We are yet to do a cost-benefit analysis, so from the state government data we can figure out how many less kids are attending or beneficiaries are being affected now. Because their numbers are decreasing, we can multiply that by the per kid allotment of funds, we can figure out, that is money, that is savings to the state exchequer. And the cost to the system of IVRS, we know it up front -- in 60 lakh rupees per annum, for the entire state. So we are doing that cost benefit analysis rigorously, to figure out what is the bang per buck for this technology.

In a nutshell, monitoring, simple monitoring without any consequences, potentially can improve public service delivery. And this is one case where we saw, that just increasing the frequency of data collection at a much disaggregated level, making it public, just doing that can improve delivery of public services.