**Interview Scripts**

Thank you very much for having me. I’m Shunsuke, a Ph.D. candidate in economics at Brown University. (0:30)

**Research agenda (+ other papers and future after JMP)**

My primary research agenda is to uncover the economic geography and market structure in developing countries, especially focusing on rural areas, and to derive policy implications for improving market efficiency and human welfare as well as reducing environmental costs.

(The shortest summary: I have several papers and ongoing projects on this agenda, including the impact of refugee inflows on host economies and farmers in rural Africa, which is a published paper, the conservation of tropical forests, which is my job market paper, and the caste-based spatial segregation and its efficiency and welfare consequences in Indian villages, which is an ongoing project. *(1:00)*)

My job market paper is one example, and I also have several ongoing and future projects on this agenda at the intersection between development and environment while I sometimes import methods from spatial economics.

For example, in an ongoing project, I study caste-based spatial segregation and its efficiency, welfare, and environmental consequences in Indian villages, by developing a spatial rural model that explains the internal spatial structure of rural villages and collecting new data. We are going to collect detailed information on the caste identity, caste networks, commuting patterns of landless workers to agricultural fields, and the labor and water markets. Combining the model and the data, we aim to evaluate counterfactual scenarios, such as removing caste discrimination if any, improving commuting technology, and place-based irrigation investments, and we investigate their effects on welfare, market efficiency, and groundwater depletion at the village-level aggregate.

Related to my job market paper, I also plan to investigate the dynamic process and consequences of community formation, market evolution, and natural resource depletion in tropical forests with a dynamic spatial model and long-term data that we are constructing now. In addition, I believe that the insight from my job market paper can also be widely applicable not only to other rainforest areas but also to other environmental problems. With this motivation, I plan to start a new research project to study the relationship between population density and desertification in mobile pastoral communities in Mongolia.

My secondary research agenda is to uncover the roots of conflicts, violence, and criminal activities in fragile societies and to propose solutions. For example, I have one ongoing project in Somalia. We are collecting information from imprisoned ex-combatants of a violent extremist organization in Somalia. We measure ex-combatants’ expectations of their lives after their release from the prison and their willingness to make efforts, and we investigate how these outcomes are affected by a randomized intervention of providing role model information.

**What courses are you willing to teach?**

I’m happy to teach any courses you want me to teach, but if I could choose, I’m willing to teach any level of development economics, environmental economics, and urban and spatial economics, in which I can also include basic theories of international trade. In addition, I could also teach computational economics as I have been teaching it at Brown and you can find my teaching materials on my website, as well as applied econometrics with an emphasis on empirical applications.

**Job Market Paper: Short summary**

My job market paper studies the conservation of tropical forests, populated by indigenous people. Policymakers face the inherent trade-off between conserving the rainforest and improving local populations’ welfare. For example, restricting forest clearing may reduce deforestation, but it may also reduce agricultural income and thus undermine human welfare. In addition, human adaptation through sectoral reallocation or spatial reallocation of economic activity may undermine conservation policy goals.

So, in this paper, to design a policy that balances human and ecological well-being, we take the following steps.

First, we build a spatial general equilibrium model that formalizes such human-nature interactions.

Second, we estimate the model using geo-referenced data from river basins in the Peruvian Amazon.

Finally, by counterfactual simulations, we demonstrate that protection policies and transport infrastructure are complementary to improving both human welfare and ecological conservation.

This is the outline of the paper. I organize the rest of the talk as follows. First, I briefly describe the model and key parameters. Second, I summarize important counterfactual policy outcomes. Finally, I describe the mechanism behind the policy impacts in more detail. Please feel free to ask questions at any time. (*1:30 outline)*

The spatial model includes three sectors, consisting of two rural sectors and one urban sector. We primarily focus on the rural sectors, agriculture, which leads to deforestation, and extraction of natural resource products, such as fishing and hunting, which leads to resource depletion and biodiversity loss.

The model considers trade of the three sectors’ goods across multiple locations in a river basin where we consider general equilibrium.

Then, the model highlights the rainforest population’s trade-off between spatial concentration and dispersion. Intuition is that natural resources and land endowments are more accessible in sparse areas. In contrast, dense areas have more agglomeration benefits as well as better access to market goods. The balance between these concentration and dispersion forces determines the spatial distribution of economic activity in equilibrium. (*1:00*)

The model’s key parameters are density externalities that explain how population density affects productivity in the rural sectors: If population density increases (decreases) productivity, it’s agglomeration (congestion).

We estimate these parameters by exploiting plausibly exogenous variation in the structure of river networks in the Peruvian Amazon where rivers almost solely constitute the transportation routes. (*30s*).

In the presence of the density externalities that we estimated and that I will explain in detail soon, counterfactuals show that combining well-targeted place-based protection policies and river transport infrastructure can simultaneously achieve higher welfare of local populations, lower deforestation, and less natural resource depletion, compared with those in the benchmark equilibrium.

Importantly, well-targeted means that spatial targeting matters for both types of policies.

For example, the location of transport infrastructure improvement within the river networks determines whether total deforestation increases or decreases. (*1:00*; *4:00 in total; The shortest summary, DONE*)

To understand the mechanism behind these policy impacts, the sector-specific density externalities are important.

So, in the rest of the talk, I will first describe the agricultural sector and deforestation. And then I will describe the natural resource extraction and depletion.

First, let’s look at the agricultural sector. We find a strong agglomeration externality in agricultural production and marketing. More importantly, this agglomeration outweighs dispersion forces in access to land, which implies that higher concentration at a particular location leads to higher productivity with less deforestation per farmer.

Then, improved river transport infrastructure that connects hinterlands to the central area of a river basin can reduce total deforestation by generating more medium-sized settlements and spreading the agglomeration benefits more evenly across the basin, rather than concentrating human settlements too much in the central area.

Total deforestation decreases given the structure of congestion forces in access to land, which is a negative and convex relationship between the settlement size and deforestation per capita around the settlement, which implies that a mean-preserving reduction in the variance of the settlement size in the river basin can decrease total deforestation.

Therefore, transport infrastructure that integrates hinterlands can reallocate farmers from the central area to remote areas and reduces the variance of the settlement size in the river basin, and thus total deforestation decreases. At the same time agricultural productivity in remote areas increases due to the agglomeration externality.

In plain words, even development is better for the environment than uneven development.

Next, let’s look at the natural resource extraction sector.

We find a strong congestion externality in natural resource extraction, with spatial spillovers from surrounding populations. This is reasonable because, in contrast to the agricultural sector, people tend to travel more for fishing or hunting wild animals, and thus surrounding populations affect its productivity given finite resource endowments.

Then, protecting the rural frontier primarily works to mitigate natural resource depletion, where the rural frontier is defined as the maximum distance from the urban center to locations where human settlements are allowed.

This is because, protecting the rural frontier increases the congestion force in extractive activities across the basin but within a more compact area for human settlements, as the surrounding population density increases in most areas for human settlements.

Finally (&most importantly), combining these two distinct types of policies, the transport infrastructure that integrates hinterlands and the rural frontier protection, simultaneously achieves higher human welfare, less deforestation, and less natural resource depletion. In contrast, any single policy cannot achieve this, so-called, win-win outcome.

That’s why I said at the beginning that protection policies and transport infrastructure, which are often studied in isolation, are complementary to improving human and ecological well-being. This is the main takeaway of the paper.

The intuition behind identification is that to estimate the effect of population size on productivity in a particular location, we exploit the variation in river shapes *in locations far away from the own location*, which would be plausibly uncorrelated with unobservable productivity fundamentals in this location (of course after controlling for a rich set of geographical conditions), but this variation as a market potential shifter could still affect the employment size through the trade mechanism. This is the logic behind the independence assumption and the exclusion restriction.

**Job Market Paper: Q&As**

**Q. What is the logic behind identification? (NYUAD; Glasgow; NUS Econ) (Short answer above)**

**A.** (Detail) To estimate the effect of population size on productivity, we construct a measure of “River Network Access”, which captures the distance-weighted sum of access to other locations via the river network, as an instrument for each location’s population. The structure of river networks is purely determined by nature.

The exclusion restriction is that the river network access, as a market potential shifter, affects productivity only through its effect on employment and thus through externalities that arise (rather than through fundamentals).

The independence assumption is that, after controlling for a rich set of geographical conditions in the own location (e.g., proximity to the river, water areas, soil conditions, elevation), remaining unobservable productivity fundamentals are not correlated with the variation in River Network Access that can be generated by exogenous river shapes in locations far away from the own location.

**Q. Why is the setting (small-scale deforestation in the Peruvian Amazon) important? Aren’t large-scale external investments more important? What’s the government’s view? (Nottingham)**

**A.** The Peruvian Amazon is an ideal setting to study fundamental human-nature interactions for two reasons.

First, most of the populations engages in traditional ways of life in remote areas without modern technology and large-scale external investments. These features enable us to attribute resource extraction to small-scale farmers and hunter-gatherers and thus focus on density externalities that they cause.

(Second, river networks almost solely constitute the transportation routes in this region. This feature allows us to identify key structural parameters.)

This empirical setting is indeed (also) closely related to recent concerns and trends of deforestation in the Amazon.

According to a previous study, in recent years, small-scale deforestation has increased throughout the Amazon (in Brazil and other countries). Specifically, the number of small forest loss patches (< 1 ha) has been increasing, while the number of large ones (> 50 ha) has been declining. In addition, in the context of the Peruvian Amazon, government documents tend to blame smallholder farmers who practice shifting cultivation for most small-scale deforestation.

This trend raises concerns about the role of small-scale farmers in forest conversion, which this paper studies.

**Q. Mechanism behind agglomeration? (NYUAD; Aalto; Toronto; NUS Business; HKU; OSU)**

**A.** The agglomeration externality in agriculture may not be immediately obvious, in part because agglomeration has typically been discussed in urban settings. We find that the primary mechanism behind the agglomeration is economies of scale in transport technology.

That is, the cost of transporting products from a community decreases with the community population by aggregating exports and being able to use better quality transport modes (e.g., large-scale commercial river boats are more likely to stop by larger communities, or, populations in larger communities may cooperate to invest in a fast motor boat and they can share it). Indeed, the present model with the agglomeration externality in productivity is isomorphic to an alternative model with endogenous transport costs that depend on the origin population size.

In addition, we also find that economies of scale in agricultural intensification with modern technologies (such as fertilizer as input for farming and grain mills that facilitate marketing) are behind the agglomeration externality.

**Q. How does your paper contribute to the literature? (Berkeley ARE)**

**A.** I have three comments. First, this paper is the first to uncover the presence of agglomeration externality in tropical forests. We believe that the mechanism behind the agglomeration could be applicable to many other rural settings in developing countries. Second, we incorporate general equilibrium forces with distinct rural sectors in the conservation problem, while most prior studies have not considered them. Third, many previous studies of tropical forests focus on the contexts of extensive commercial investments (e.g., soybeans/cattle-ranching in Brazil; palm oil plantations in Indonesia), which cannot be generalized to less developed areas where deforestation and other resource extractions are primarily practiced by local populations for their livelihood. So, we also fill this knowledge gap.

**Q. What is the structure of the land market friction? What is the mechanism behind the congestion? (NUS)**

**A.** Farmers clear forests to obtain agricultural land only nearby their residential locations in the absence of the land market and property rights and with a high monitoring cost. The monitoring cost and the negotiation cost for allocating land areas to farmers increase as the agricultural population increases. Therefore, deforested areas cannot increase proportionally to the increase in the population size in a community and thus per-capita land footprint decreases with the population size.

**Q. Why do we have to think about the conservation problem in general equilibrium? (Toronto)**

**A.** To investigate the impact of conservation policies, it is important to understand human adaptation through sectoral reallocation or spatial reallocation of economic activity. For example, if the cost of forest clearing is increased, then local populations may shift from agriculture to other extractive activities such as fishing and hunting, which could lead to biodiversity loss; if a place-based protection policy prohibits resource extraction in one area, then local populations may move from that area to others to extract resources, and the impact on overall resource depletion through equilibrium effects is unclear. So, it is necessary to consider these general equilibrium forces to understand economy-wide outcomes of human welfare and ecological conservation.

**Q. How are you thinking about the renewability of natural resources in rainforests (reforestation; reproduction of fish/wild animal stock)? (Toronto; Osaka; HKU)**

**A.** As you point out, the natural resources that we are considering are renewable. However, since our model is static, studying the dynamics of resource depletion is a next step.

*Reforestation*: In the real world, farmers practice shifting cultivation with the swidden-fallow cycle.

First, farmers clear primary (old-growth) forests (and burn the vegetation) to obtain plots, and then they plant crops.

Second, when plots become no longer productive, plots are left in fallow and the secondary forest regrows.

After several years (8-12) of fallow, such secondary forests become old-growth forests and farmers clear these forests again and the cycle is repeated.

So, although the deforested locations around the community are moving over time due to this cycle, at any given moment the stock of forest fallow and the total deforested area around the community remain relatively constant.

Therefore, the cross-sectional relationship between the settlement size and deforestation has a more significant variation and is much more important for the model to focus on.

Secondary forests are forests re-growing after initial clearing and cropping for shifting cultivation.

*Coomes et al. (2021 ERL)*: Farmers practice shifting cultivation whereby a small plot of 0.5-1.0 ha is opened in the forest typically using machetes and axes; the vegetation is left to dry and then burned. Crops of varying maturation times are then planted including manioc, yams, pineapple, plantain, and perennial fruit trees. When the field is no longer productive, the plot is left in fallow and secondary forest quickly regrows. After 8-12 years of fallow, the plot is cut and burned and the cycle repeated. Farmers manage multiple fields and fallows scattered in the hinterland of the community. Land is held in usufruct and acquired by clearing of old-growth forest, and to a lesser degree through inheritance or gifting. There is no market for land but rights over fallows are usually retained by those who cleared the land.

**Despite the conversion of old-growth forest, forest cover around communities has been maintained through dynamic renewal associated with shifting cultivation whereby plots are cycled through phases of crops and secondary forest.**

The cycling of fields through phases of crop and fallow, across many households---each having multiple fields each at a different stage in the crop-fallow cycle---essentially gives rise to permanence of secondary forest cover in the working area around communities. As such, **although the life of any one secondary forest fallow is ephemeral, at any given moment the stock of forest fallow at the community level remains relatively constant. Therefore, the cross-sectional relationship between the settlement size and deforestation has a more significant variation and is much more important for the model to focus on.**

The cleared land from old-growth forest will be quickly cycled back into secondary forest once the cropping phase, which typically lasts only two to five years, is completed.

The mean distance to patches on the upland ranges from 247 m to 4.5 km.

The mean distance to patch was 1.5km and 80% of upland patches were found within 2km of the community center.

**Q. What is the role of logging? (Sciences Po; Delaware)**

**A.** We focus on deforestation caused by agriculture. Logging is also included in resource extractions, but its importance among local populations is limited and much smaller than other wild resource extractions (fishing and hunting). There are also external logging firms active in a very specific area. However, it would not affect local populations much because they do not hire local populations and their outputs are exported outside the Amazon.

**Q. How about the mining sector, such as oil? (Toronto)**

**A.** There are mining sectors, such as oil and gold, in the Peruvian Amazon. But their geographical coverages are limited and mostly outside our study area. So, we are not considering them.

**Q. Doesn’t roads cause more deforestation directly? (Fletcher; Tufts)**

**A.** We are not considering building roads. Specifically, we consider improving river transport infrastructure, such as better-quality boats or dredging rivers so that larger ships can travel more easily, which would decrease trade costs.

**Q. Why not agglomeration in the urban sector? Does that change results? (Sciences Po; NUS)**

**A.** Having said the model contains the urban sector, the urban center in the Peruvian Amazon is more like a market town and not like a big city where agglomeration is important. In addition, even if we incorporate agglomeration in the urban sector as well, the qualitative conclusion of this paper will not be affected at all.

**Q. Doesn’t deforestation for agriculture also affect other natural resource endowments? (Mark Rosenzweig)**

A. This is a great point. There may also be such an across-sector externality, but we focus on the first-order direct effects of the population engaging in the natural resource sector.

I have two comments on this.

First, this is because the spatial extent of these sectors’ activities is indeed very distinct.

Deforestation for agricultural land is mostly distributed along the rivers.

On the other hand, the spatial extent of some natural resource extraction activities (such as hunting wild animals and collecting forest products) is much broader, including deep inland areas away from the river.

And obviously, fishing is conducted on the river without forests.

Second, if you still think that this across-sector effect is not trivial, then you can interpret our counterfactual results in the following way. We investigate counterfactual policies that reduce deforestation. You can interpret these policies’ welfare effects as lower bounds because the reduction in deforestation may generate additional gains of natural resource endowments that our model is not accounting for.

**Q. Why free mobility? Migration cost? Is it justifiable to relocate “indigenous” populations? How about inflows and outflows of populations (Sciences Po; Toronto; Tufts)**

**A.** Exactly because of this reason, we do not consider population inflows to a river basin or outflows from a river basin where we consider general equilibrium. Most (indigenous) populations have been living within a particular region (in this case a river basin) for a long time since their ancestors.

At the same time, within the narrow geographical scale of a river basin, we actually observe migration and relocating community locations in response to economic opportunities as well, which would be consistent with the assumption of (free) labor mobility inside a river basin.

**Q. Merging several communities into one---Wouldn’t there be any ethical issue? There may be ethnicity differences. Can you compute optimal compensation amounts for resettlement policies? (Hitotsubashi)**

**A.** This is a very good question. It is not possible to implement a cost-benefit analysis of a single policy. Therefore, to compare and interpret different policy outcomes meaningfully, we implement multiple resettlement policies, each of which directly treats the same number of rural populations.

**Q. Transport infrastructure affects the protection status by improving the enforcement capacity? (Delaware)**

**A.** (After paraphrasing the Q…) this is a very good point, but our model is not capturing this effect.

**Q. Can transport infrastructure investments generate new associated employment, which affect the protection status by absorbing labor from natural resource extraction? (Nottingham)**

**A.** (After paraphrasing the Q…) this is a very good point, but our model is not capturing this effect.

**Q. Should we care about the spatial distribution of deforested areas, given the total area of deforestation? For example, concentrating deforested areas and sporadic deforested areas (fixing the total deforested area) may have different implications for environment? What is the justification for not caring about this? (Hitotsubashi)**

**A.** This is a very good question. Unfortunately, the static model cannot address this point. This matters in the next step of developing a dynamic model.

**Q. What is the relationship between the agglomeration externality and farm size? (BU, Martin)**

**A.** There is no direct relationship. Instead, the deforested area depends on the agricultural population size and the congestion externality.

**Q. How can you estimate two density externality parameters using one instrument? (BU, Dilip Mookherjee)**

**A.** It is indeed possible to exploit the same variation, the same IV, to estimate both agglomeration and congestion externalities in agriculture. We take the following steps to estimate them. First, by numerically solving the model, we invert productivity composites of agriculture, which contain productivity fundamentals and endogenous terms caused by the density externalities. Using these inverted productivity composites, the population information, and the IV, we estimate the overall agglomeration externality in agriculture, which contains both the congestion force in access to land and the agglomeration force in agricultural production. Second, by using additional information on the community-level land footprint, obtained from satellite images, and by exploiting the same variation, we estimate the congestion externality in access to land. Given that the residual term in this function of land access is also contained in the productivity composites used in the previous step, the identifying assumption from the previous step also holds in this step. That’s why we can use the same IV to estimate both congestion and agglomeration forces in agriculture. Third, using the net density externality and the congestion externality from the previous two steps, we can back out the agglomeration externality in agricultural production.

**Q. Can you prove that any targeting of transport infrastructure improvement cannot achieve the win-win outcome? (NYUAD)**

**Q. Doesn’t the RNA measure capture river shapes nearby? Why don’t you exclude nearby destination locations to construct RNA so that it captures river shapes in far locations? (NYUAD)**

**A.** This is a great idea. I will check the robustness with the modified RNA measure that contains only destinations further than 10km from the origin.

**Q. What is the role of trade in natural resource depletion and protection policies? (Academia Sinica)**

**A.** This is a very broad question.

**Q. What are the roles of you and your coauthors? (Several places)**

**A.** Yoshito Takasaki collected the primary data from the field. Mari Tanaka conducted the reduced-form analyses related to the Market Access approach, which is now in the appendix.

**Q. How are you modelling the features of indigenous populations? How will the model be modified if we consider modernized agriculture instead of traditional shifting cultivation? (Berkeley ARE)**

**A.**

Q. What aspect of the paper worries you the most? What is the biggest limitation to your approach? What was the biggest obstacle you encountered when writing it?

A.

Q. What are the unanswered questions raised by your results?

A.

Q. What is the advantage of taking a structural approach to your problem?

A.

**Q. On the negative relationship between population per capita and land footprint: Can the relationship between population and deforestation reflect sectoral differences depending on population size? (Hitotsubashi)**

**A.** Except for a few market center, most communities have only rural sectors. In the structural estimation, we look at the relationship between the agricultural population size and deforestation.

**Q. On the negative relationship between population per capita and land footprint: If some areas are already deforested, it is easier to live there. So, this relationship may depend on initial deforestation? (Hitotsubashi)**

**A.** We observe the same negative relationship if we replace the deforestation measure with the non-forest area.

**Q. Urban center is exogenously given. What is the justification for it? (Hitotsubashi)**

**A.** The location of urban center is historically determined long time ago at the time of colonial settlement. But its population size is endogenously determined in the model.

Q. So in your model, can we think of urban center as a place somehow endowed with different set of endowments (like capital or infrastructure) for some reasons? How is the urban center different from other locations in your model?

A.

**Q. How much of the relationship between population and per-capita deforestation can be explained by congestions and how much by agricultural productivity agglomeration?**

**A.** The structural relationship between population and per-capita deforestation is solely explained by the congestion.

**Q. Where do you plan to send your job market paper for publication? What is your back-up?**

**A.** I aim to submit the paper to a top-5 economics journal. I will also consider other general economic journals (e.g., REStat/EJ/AEJ Applied) depending on the outcome from the top-5 journals.

**Other Q&As**

Q. What do you see as the most relevant/interesting issues in your field?

**Q. Please tell me about one of your weaknesses?**

**A.** I occasionally focus too much on one task. I’m trying to have a better balance between multiple tasks.

I would also like to get better at time management. I tend to leave things to the last minute.

**Q. Do you have any questions to us?**

**A.** What kind of agglomeration benefits are you enjoying?

**Q. How would you help promote equity, diversity, and inclusion?**

**A.** I will contribute primarily in two ways, both of which are motivated by my personal experiences. First, I will create an inclusive classroom and promote a professional environment with equal opportunity and fair treatment. Second, I will actively engage in outreach and mentoring services, especially for those underrepresented.

Regarding the first point, I make my classroom a safe space to speak up and ask questions. One way is to achieve this is to show appreciation whenever students ask questions. Another way is to motivate discussion by making my class interactive with regular Q&A sessions and in-class exercises. Meanwhile, I also understand that some students may still be nervous about speaking up in the classroom. To alleviate this concern, I prepare multiple communication tools, including regular office hours, a common discussion board that all students can follow, individual private emails, and even anonymous surveys.

Indeed, I have been doing these things in my course “Computing for Economists” at Brown. The students’ backgrounds were very diverse. This is a Ph.D.-level course, but some undergrad students also took it. In addition, Student’s prior experiences of programming were also very diverse. In this environment, I tried to make my course valuable to all students and I believe that I successfully made it, and my teaching evaluations reflect this outcome.

Regarding the second point, I believe that I have a deep understanding on difficulties that minorities face. When I was an undergrad student, I studied abroad at the University of Delhi as an exchange student. I was the only international student in the classrooms there and had a hard time making friends and participating in classroom discussions. At that time, one teacher talked to me and helped me overcome my hurdles. His support reduced my mental stress and gave me more confidence in myself. I learnt from this experience that a good educator can have a significant impact on a student’s later life. Motivated by this experience, as a faculty member, I would like to be an active participant in outreach and mentoring services for underrepresented students to enhance their confidence in pursuing their academic goals.