Trinh Pham | Research Statement

I am an economist working at the intersection of development, environmental and labor economics. I use a combination of economic theory and empirical causal inference techniques to understand the nexus between environmental and climate change, agriculture, household resource allocation, and labor markets in developing countries, employing randomized experiments and quasi-experimental research designs.

Unlike developed countries, developing countries are often characterized by a sizeable fraction of the poor acting as entrepreneurs and/or working for wages in small-scale, informal agricultural and non-agricultural businesses. Agriculture absorbs a large share of the labor force and contributes substantially to rural household income yet is vulnerable to environmental and climate change. A significant number of non-agricultural jobs are low-skilled and do not provide workers with access to social security benefits. These populations also often face incomplete or missing labor and credit markets and are increasingly and disproportionately affected by climate change and extreme weather events. These make it important to understand to what extent and how farming households in particular, and the economy in general respond to these changes, and how to improve the quality of the workforce to keep up with skill-intensive non-agricultural jobs for sustainable development.

Past and Ongoing Research

In my dissertation, I approach these issues by focusing on Vietnam, a lower-middle income country that has experienced relatively rapid growth. In the paper **The Intertemporal Evolution of Agriculture and Labor over a Rapid Structural Transformation: Lessons from Vietnam (*Food Policy*, 2020)**, written together with Yanyan Liu (IFPRI), Christopher B. Barrett (Cornell) and William Violette (Federal Trade Commission), we use multiple nationally representative household and labor force surveys to provide a detailed description of how the labor market evolves and how it relates to the structural transformation of rural Vietnam. We document increases in real agricultural wages and limited employment opportunities in agriculture, especially for young individuals. Importantly, as rural households increasingly diversify into the non-agricultural sector, human capital accumulation (rather than land endowments) has become the key correlate of improvements in rural standards of living.

Yet the accumulation of human capital, especially of rural households, could be impeded by negative shocks to household income, including those caused by climate change and extreme weather events. Such vulnerability, coupled with differential exposure to or capacity to manage weather risks across demographic groups, might result in lasting consequences for farming households and their children, thereby perpetuating inequality intergenerationally. My paper **The Child Education and Health Ethnic Inequality Consequences of Climate Shocks in Vietnam (*Economics of Education Review*, 2022)** provides an example. In Vietnam, ethnic minorities constituted only 14% of the population but 73% of the country's poor in 2016. Ethnic disparities in education not only persist but have increased, with a particularly worrisome declining rate of enrollment in upper secondary schools among ethnic minorities especially since 2004. Using a detailed individual and household-level panel dataset in rural Vietnam and exploiting plausibly random year-to-year variation in rainfall shocks during the typhoon season, I document that even small-scale, but frequent excess rainfall shocks negatively affect household economic conditions and their children along multiple

dimensions, and the effects may not be immediate. Poor households respond to the shocks by delaying children's entry to primary school with potentially big negative effects on their life-time earnings, and having their children engaged in different economic activities. Importantly, even within the sample of rural households, rainfall shocks can explain a substantial part of the observed school enrollment gaps between the majority Kinh children and their ethnic minority peers, especially in upper-secondary education. This is not driven by different exposures to excess rainfall, but by heterogeneous effects of rainfall shocks among ethnic groups. Examination of commonly studied economic channels such as parental investments cannot explain the differential effects by ethnicity.

Motivated by the result that rural households more likely reallocate labor from farming to non-farm activities in response to negative agricultural productivity growth, combined with limited evidence in the previous literature on the potentially disproportionate impacts of extreme temperatures on agricultural productivity, my job market paper, entitled **Climate Change and Intersectoral Labor Reallocation in a Developing Country,** examines how these household-level responses relate to the country's rapid structural transformation process. Over the last three decades, the share of labor in agriculture dropped from 75% to 30%, yet an estimated 80% of employment is considered unskilled, informal, and not protected by labor market institutions.

Economic theory would tell us that a negative shock to agricultural productivity might cause two different effects. The first is a supply-side effect—a change in labor productivity induces workers to switch sectors. The second is the demand-side effect—a decrease in total income might shift households' demand towards subsistence agricultural goods and therefore generate greater demand for agricultural labor. In addition, workers' ability to change sectors of employment and the types of jobs they take also depend on how costly it is for them to switch sectors. Based on these insights, I developed a simple general equilibrium model of frictional labor allocation across sectors. The model predicts that the extent and direction of intersectoral costly reallocation caused by extreme temperatures depend crucially on the openness of the economy and distortions in the labor market. Furthermore, the model yields an important insight that the costs associated with such distortions can be inferred from the gains in earnings among workers who changed sectors of employment.

Using multiple micro-level Vietnamese data sources, linked with weather data and exploiting both short- and long-term variation in weather and climate distributions, I find that extremely hot temperatures induce workers to reallocate from agriculture to non-agriculture in both short and long terms. But these effects are only concentrated in areas that are close to the country's major seaports where rice prices are not significantly affected by extreme temperatures, consistent with being driven by relative labor productivity loss in the case of small open economies without the existence of trade barriers. In isolated areas, the reallocation effects run in the opposite direction. There is an increase in the share of agricultural labor and decreases in non-agricultural employment shares in response to hot temperatures, consistent with being predominantly driven by local demand effects wherein a reduction in local income generates a shift in demand toward subsistence agricultural goods. In addition, the rates of reallocation out of agriculture differ across age groups depending on destination jobs. While individuals of all groups are equally likely to move into informal non-agriculture, younger workers comprise most of those who shift to a formal non-agricultural job, even controlling for differences in educational attainment, consistent with the evidence of non-uniform labor market frictions where workers move to a sector into which entry entails lower switching cost.

Given that informal jobs do not provide workers with social security benefits, these findings imply an inequality consequence of climate change with respect to labor market outcomes across age

cohorts. They also illustrate the importance of removing trade barriers and labor market frictions in mitigating climate damages in low and middle-income countries, while supporting the hypothesis that climate change might magnify the pre-existing sectoral productivity gap, which might help structural transformation. This is among a few hypotheses that Christopher B. Barrett, Ariel Ortiz-Bobea (Cornell) and I proposed in our recent work **Structural Transformation, Agriculture, Climate, and the Environment (*Review of Environmental Economics and Policy*, 2023).**

Because a nontrivial share of the labor force is reallocated out of agriculture in response to climate change, and real agricultural wages have been increasing dramatically, an important question is how and to what extent farmers who chose to remain in agriculture adapt to the changing climate. In many low- and middle-income countries, farmers face multiple barriers to climate adaptation, for example, because of financial or knowledge constraints. In Vietnam, strict land use policies, especially with respect to agricultural production, further limit the ability of farmers to employ such adaptation strategies as adjusting land or changing crop mix that were previously documented in other settings. In a paper tentatively titled **Heat and Agricultural Transformation**, I study how extreme temperatures affect farmers' decisions in the context of Vietnam, with a focus on labor- and land-augmenting technology adoption. When labor becomes scarce and relatively more expensive due to climate change-induced intersectoral labor reallocation, economic theory suggests that farmers will adopt labor-saving technologies such as mechanization. Adoption of land-augmenting/labor-complementary technologies such as fertilizers, however, may be impeded. Furthermore, these predictions might differ across households due to heterogeneity in labor endowment and individual productivity in the non-agricultural sector under frictional labor market. Building on my job market paper's findings, I hypothesize that farming households with a higher share of younger household members experiencing a faster reallocation of household labor out of farming businesses in response to extreme heat will be more likely to adopt labor-saving technologies. On the other hand, older households have less incentives to transform their agricultural production because their farm labor demand is likely sufficiently met by household members.

Despite the growing body of literature examining the linkage between environmental/climate change and human capital and labor productivity outcomes that Christopher B. Barrett, Ariel Ortiz-Bobea and I review in the paper **Structural Transformation, Agriculture, Climate, and the Environment (*Review of Environmental Economics and Policy*, 2023)**, evidence of the impacts of heat, air pollution, and other climate-related risks on human capital in both the short- and long-run remains limited. Researchers working on human capital do not yet understand the effects across the lifecycle (early childhood, school age, youth transitioning to the labor market, prime-working age, and the aging population), especially in developing countries. In **Meta-analytic Review of Climate and Air Pollution Impacts on Human Capital,** joint with Teevrat Garg (UC San Diego), Patrick Behrer (World Bank), Alaka Holla (World Bank), Adriana Molina (University of New Mexico), and Dean Arnold (Cornell), we systematically review the recent evidence from low- and middle-income countries. We narrowed down studies with credible causal inference from a large database of all peer-reviewed articles in respected academic journals. We then standardize and aggregate estimates of impacts across studies to estimate an average effect size for each outcome-climate risk combination including temperature-mortality, temperature-morbidity, temperature-labor productivity, air pollution-mortality, and air pollution-morbidity. Our preliminary results confirm a non-linear relationship between temperature and health/productivity outcomes, with a significantly

larger impact (in magnitude) of heat on older population and weather-exposed industries. We are presently working on aggregating the impacts of air pollution.

Climate change's effect on human capital, sectoral productivity, and occupational safety risks could affect workers' occupational decisions. In developing countries, because of the typical lack of both quantity and quality of education and training, workers often find it challenging to change to a different, less weather-exposed job, which often requires higher skill or a different skill set. This makes it important to understand barriers to human capital accumulation and potential remedies.

My current work on information frictions in education in Bhutan explores these issues. Like many other developing countries, Bhutan has been encouraging students to study Technical and Vocational Education and Training (TVET) and Science, Technology, Engineering, and Math (STEM) after compulsory education. However, TVET has consistently received low recognition from students. In a project titled **Career Mentoring and Educational Choices: Evidence from Field Experiments in Bhutan**, joint with Hyuncheol Bryant Kim (Hong Kong University of Science and Technology), Ryotaro Hayashi (Asian Development Bank), and Norihiko Matsuda (Florida International University), we surveyed nearly the universe of Bhutanese students who were about to finish high school education. We documented that less than 5% of students reported having taken any TVET course at school, while less than 10% chose TVET as one of their top three options after graduating. The most cited reason was that students were not aware of TVET courses. In addition, students reported they know less about TVET relative to other education options with respect to admission criteria, application, typical student life, curriculum, and future employment prospects. Students held incorrect beliefs about population labor market outcomes, consistently underestimating the likelihood of TVET graduates being employed in regular wage jobs as well as their earnings.

Providing information about different aspects of TVET, thus, appears to offer a potential solution to address the information barrier and encourage students to enroll in the program. We therefore conducted a randomized control trial experiment among high school students to understand the role of information provision and career mentoring on their educational choice decision. Our intervention involved four one-on-one one-hour meetings between mentors who are TVET students or workers who graduated from TVET and high school students over the course of one month right before the students took the graduation exam and were expected to make educational choices. The intervention consisted of several components, including providing information on entry requirements and application process to TVET institutes, typical student life, labor market outcomes and job prospects of TVET graduates, as well as career advice. Although our intervention significantly improved students' knowledge about and preference for TVET, providing information and career mentoring alone did not significantly improve students' bias against blue-collar jobs or make students more likely to apply to or to be admitted to a TVET program.

In a separate but similar randomized controlled trial, we studied middle secondary school students who were about to make decisions on high school education. In Bhutan, graduating from the high school Science stream is a prerequisite for most STEM majors in college. As such, to promote STEM education, it is necessary to have interventions targeting middle secondary school students at the latest. We again find that the program updated students' preferences for Science stream, which is consistent with being driven by a combination of positive changes in a wide range of intermediate outcomes, including attitude towards science and technology, beliefs about the approval of parents, friends, and society, as well as increased beliefs that more peers will choose this field of study. However, our intervention failed to increase the likelihood of students being enrolled in the Science

stream. Because this stream is highly selective in terms of academic performance relative to other routes, our results could possibly be due to the short period that students had left to make an improvement in their test scores between our intervention and the national exam, although there was some suggestive evidence that our intervention helped increase students' test scores.

Our two different projects highlight the importance of non-monetary factors in educational decisions. The TVET finding is especially relevant to other developing countries. Unlike previous literature on information frictions and mentoring, our study takes place in a setting where there is a strong negative stigma attached to students' decisions. Society often views TVET as the last option, that is, it is only for students who do not qualify for admission to general higher education and produces poorly perceived "blue collar jobs." Likewise, our second intervention, albeit with limited evidence in the short run, illustrates that with the right information and mentoring, students could change perception and invest more in studies, thereby improving academic performance to meet their goals. This is relevant in settings where private tutoring is not a common practice or not permitted by the government.

Future Research

I plan to continue this research agenda at the nexus of environmental and climate change, agriculture, and human capital. In what follows, I discuss in detail some of the research questions I plan to explore and the approaches I anticipate taking to study them.

First, given the heterogeneity in climate and environmental change impacts across spaces, the increasing interdependence of production and consumption has at least two implications: (i) a local shock might affect not only local economies but might also propagate through these networks to affect production in other places, and (ii), a reduction in goods supply due to a local shock might create opportunities from suppliers from other places. The coffee leaf rust epidemic in Colombia and Central America in 2012 provides an example. The outbreak negatively affected coffee production in the region, likely threatening the livelihood and food security of workers who make their living in the industry, especially small farmers and seasonal workers. Because the disease could cause heavy defoliation and death of branches, which decreases the translocation process toward the branch tips and the branch growth, the 2012 epidemic ended up resulting in secondary yield losses up to several years after. Losses in coffee production in the region were expected to be compensated by increased production in other large coffee exporting countries including Ethiopia, Brazil, and Indonesia. How does this epidemic affect livelihood and well-being in regions that are directly and indirectly impacted? Are the effects on human capital, labor, and welfare asymmetric between places with negative versus positive agricultural shocks? Given that these questions cannot be answered by reduced-form analysis because of general equilibrium effects, I plan to study them using a spatial general equilibrium framework, exploiting spatial and temporal variation in the weather conditions suitable for the development and transmission of coffee leaf rust disease, and multiple data sources from major coffee producing countries.

Second, rising temperatures and rainfall make many parts of the world more suitable for dangerous but often neglected infectious diseases. This includes an uptick in mosquito-borne diseases like malaria and dengue. In many tropical countries, however, places that used to have optimal temperature for malaria transmission might now become too hot for this disease, but more suitable for transmission of dengue and other viruses by the yellow fever mosquitoes. In Vietnam,

malaria control has experienced remarkable progress, with low to no risk in areas including Ho Chi Minh City and Hanoi. However, frequent urban flooding during the annual typhoon season (July to November) and improper waste management, especially domestic waste along rivers and canals, likely make these places ideal breeding ground for mosquitoes, causing elevated risks of dengue fever outbreak. In 2022, Ho Chi Minh City observed a 7-fold surge in the number of dengue cases compared to the previous year. As these disease outbreaks represent not only a major threat to public health, but also negative shocks to economic outcomes, including labor productivity and labor supply, understanding the links between climatic conditions, urban flooding, waste, and dengue fever outbreak will help provide solutions to prevent outbreaks. For example, reducing debris and waste in the drainage system might help reduce blockages, thereby alleviating the risk of flooding. Similarly, empowering locals to clean up trash near their households likely helps remove breeding grounds for mosquitoes. I hope to develop this line of research using field experiments in collaboration with local authorities and health departments.

Third, following the current project **"Heat and Agricultural Transformation"**, I plan to formally study the role of institutions in climate adaptation of farmers. Agricultural institutions play an important role in agricultural productivity and input allocation. For example, the higher measured institutional distortions in the North of Vietnam, relative to the South, are associated with a reduction of agricultural productivity by 47%, with two-thirds of that is driven by farmers' choice of low-productivity crops and low productivity-enhancing investment (Ayerst et al. 2023). My focus will be on how these institutional distortions might affect farms' choice of crops and investment in response to climate change, and whether farmers will be better adapted if these distortions are corrected.

References

Ayerst, S., Brandt, L., & Restuccia, D. (2023). *Distortions, Producer Dynamics, and Aggregate Productivity: A General Equilibrium Analysis* (No. w30985). National Bureau of Economic Research.