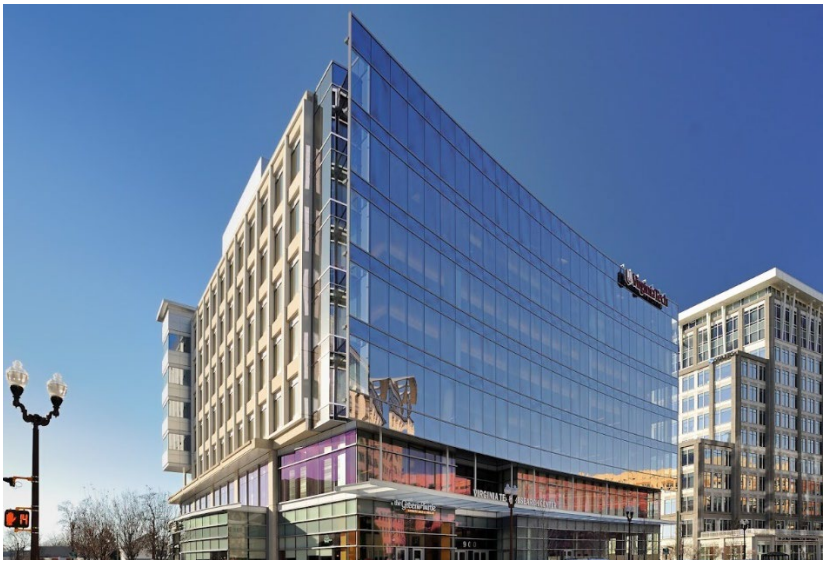
NC1034: Impact Analyses and Decision Strategies for Agricultural Research

2023 Annual Meeting and Research Conference

March 30-31, 2023

Virginia Tech Executive Briefing Center, Arlington VA



The NC1034 multistate research project, Impact Analysis and Decision Strategies for Agricultural Research, comprises an invigorating scholarly community of over 40 agricultural and resource economists and rural sociologists—from more than 20 major U.S. research universities as well as the USDA and international agricultural research organizations—that comes together at least once a year to communicate and coordinate cutting-edge economic and other social science research on science policy, R&D investment, innovation, adoption, and technological change in agriculture.

Program

Thursday March 30

Location: ***Ballston Local*** restaurant, 900 N Glebe Rd, Arlington, VA 22203

5:00 Reception begins

5:30-6:00 official NC1034 business meeting

6:00 Dinner

Friday March 31

Location: **Virginia Tech Executive Briefing Center**, 900 N Glebe Rd, Arlington, VA 22203

West Falls Church room

8:15 – 8:30 Breakfast

8:30 – 10:00 Session 1. Research Priorities, Incentives, and Impacts

Moderator: **Julian Alston**, University of California Davis

Presenter: Justus Wesseler, Wageningen University

Title: *High Rates of Returns to Research in Agriculture: An Explanation from a Real Option Perspective*

Abstract: High rates of returns (RORs) of hundred per sent and more have been reported for investment in research and development (R&D) in agriculture, both, at the public and private sector level. Several authors have concluded this to indicate an underinvestment in public and private sector agriculture R&D. The reported high RORs indeed present a puzzle. If RORs are that high, why do we not observe a substantial increase in public and private R&D that bring down RORs to levels that are close RORs observed in other sectors such as the stock market.

In this contribution we explain the ex-post observed high RORs by developing a real option model that identifies the ex-ante RORs needed for justifying immediate investment in R&D. The model is calibrated on important technical changes in agriculture such as new plant breeding technologies and what is called low risk pesticides. Our results indicate ex-ante RORs required for immediate investment that are substantially higher than those observed from ex-post RORs calculations. This indicates at face value rather an over- than underinvestment in agriculture R&D.

Ex-ante and ex-post RORs are not that easy to compare one-by-one. One of the driving forces for the ex-ante high RORs needed for inducing immediate investment are regulatory requirements. Those have

increased over time in many parts of the world including the US and the European Union. There are other factors that are important as well requiring additional research on the topic.

Presenters: Wenjun Wang and Brian Wright, University of California Berkeley

Title: *Estimating Patents Values using Stock Market Responses*

Abstract: As private agricultural research accounts for an increasingly large share of agricultural innovation, methods of measurement of private innovation results including patent evaluation become more relevant. In this paper, we estimate the value of patents for U.S. public firms by analyzing stock market responses and the probability of grant. We assess the effects of three significant patenting events: filing, publication, and issuance. We assume probability of grant at time of publication is the same for all patent applications. Using dynamic modeling and historical patent applications data, we reveal, quantitatively, a negative relationship between the probability of grant and the time lag between filing and issuance. We estimate patent values for patents filed by public firms between 2000 to 2022 and provide two individual value estimates for each patent, one at publication and the other at grant. The study shows that initial reliable information about patent values is gained when the patent is published, and this information is then adjusted and confirmed when the patent is issued. Finally, we find that if the relationship between the probability of grant and the time lag is ignored, patent values at grant will be significantly overestimated, particularly for patents that take longer to grant. However, if the relationship is appropriately incorporated, the estimated patent values at publication and issuance are similar on average, which suggests that market expectations about patent values are rational, and patent value does not increase, on average, as time lag between filing and issuance increases.

Presenter: Carl Pray, Rutgers University

Title: *Spillovers from Chinese R&D to the Americas*

Abstract: the impact of Chinese investments in research and innovation on firms like Syngenta, Makhteshim, Smithfield, Nidera and Dow's seed business on U.S., Brazil and Argentinian agriculture.

10:00 – 10:15 Coffee Break

10:15 – 11:45 Session 2. Economics of Seed, Pest Control, and Conservation Inputs for Major U.S. Cropping Systems

Moderator: Gal Hochman, Rutgers University

Presenter: Guanming Shi, University of Wisconsin, *Two Tigers in One Mountain: Are there Implicit Collusions in the U.S. Corn Seed Market?*

Title: *Two tigers in One Mountain: Are there Implicit Collusions in the U.S. Corn Seed Market?*

Authors: Artak Meloyan, Guanming Shi, and Kensuke Kubo

Abstract: In a market dominated by a few leading firms, firms can implicitly divide the market and offer different products from their rivals to avoid direct competition. Such implicit collusion can increase firms' market power to obtain additional profits. We show the difference in the Subgame Perfect Nash Equilibrium (SPNE) of implicit collusion between duopoly firms and those among oligopolistic firms. Using U.S. corn seed market as a case study, we examine whether there is evidence of implicit collusion in setting prices and/or product lines. Results indicate that there is significant collusion in not only price setting stage, but also product line choosing stage. However, the implicit collusion is not symmetric. Such implicit collusion, especially those on the product line choice, has important implication to firms'R&D and product innovation. We will further test the existence of such impacts.

Presenter: GianCarlo Moschini, Iowa State University

Title: *Genetically engineered varieties and applied pesticide toxicity in U.S. maize and soybeans*

Authors: Seungki Lee,[a] GianCarlo Moschini,[b] and Edward D. Perry [c]

[a] Department of Agricultural, Environmental, and Development Economics, The Ohio State University, Columbus, OH 43210.

[b] Department of Economics and Center for Agricultural and Rural Development, Iowa State University, Ames, IA 50011.

[c] Department of Agricultural Economics, Kansas State University, Manhattan, KS 66502

Abstract: The extensive adoption of genetically engineered (GE) varieties in U.S. agriculture has dramatically changed the patterns of pesticide use. Herbicide tolerance complements (and thereby increases) the use of glyphosate, which in turn substitutes for other herbicides. Insect resistance directly substitutes for the need to apply insecticides. How this process ultimately affects environmental risk remains an open question, because of two major problems in previous studies: measures to quantify pesticide use are often uninformative, and reliance on aggregate trends to infer the impact of GE adoption on pesticide use fails to address selection bias and unobserved heterogeneity. We overcome these limitations by using farm-level fixed effects models, estimated with rich plot-level data on more than 200,000 seed and pesticide choices by U.S. maize and soybean farmers during the 1998–2016 period. Pesticide use is measured by toxicity-based metrics, from LD50 values of individual pesticides, computed at the plot level. We find that applied toxicity was, on average, lowered by the adoption of GE

varieties across four target organism groups: mammals, birds, fish, and honey bees. However, most of the toxicity benefits conferred by GE adoption dissipated over time. For herbicide tolerant varieties, this was due to the increased use of old-line herbicides by GE adopters, a likely consequence of the growing problem of glyphosate weed resistance. Applied honey bee toxicity saw the sharpest increase during the GE era, but most of this increase was driven by the adoption of neonicotinoid seed treatments, rather than GE insect resistant traits.

Presenter 3: Zhen Lei, Pennsylvania State University

Title: *Practice and Impacts of Conservation Tillage and Cover Cropping In U.S. Corn Fields*

Authors: Zhongyang He[1], Jinhua Zhao[2], Bruno Basso[3], Zhen Lei[1]

[1] Department of Energy and Mineral Engineering, The Pennsylvania State University

[2] Dyson School of Applied Economics and Management, Cornell University

[3] Department of Earth and Environmental Sciences, Michigan State University

Abstract: Conservation tillage (CT) and cover cropping (CC) are two important conversation practices for improving soil health and environment and increasing crop yields. In this study, we use data from the 2010 and 2016 Agricultural Resource Management Survey (ARMS) in corn fields, to examine the adoption and impacts of conservation tillage and cover cropping on input use and yields in corn fields. The adoption rate of CT increased from around 30% in 2010 to 60% in 2016, while the adoption of CC increased from less than 5% in 2010 to 15% in 2016. The combined adoption of CT and CC also increased; in 2010 less than 8% of the fields adopting CT or CC adopted both practices, but in 2016 this proportion increased to nearly 20%. Cover cropping alone is associated with reduced use of inputs fertilizers and pesticides, but conservation tillage does not have much effects in input reduction and may offset the impacts of cover cropping when adopted together with cover cropping. Controlling for input uses, fields adopting cover cropping alone have lower corn yields, while those adopting conservation tillage alone do not show a significant difference. Only fields adopting both practices see significant increase in yields. These preliminary results imply potential trade-offs associated with cover cropping and conservation tillage, in terms of economic costs and benefits and environmental impacts such as risk of nitrogen leaching in watersheds.

11:45 – 12:30 Lunch

Lunch discussion: Stephanie Mercier, Principal at Agricultural Perspectives, Senior Policy Adviser, Farm Journal Foundation, and former Chief Economist, Senate Agriculture Committee

Title: *Prioritizing Agricultural Research in the 2023 Farm Bill*

Abstract: The United States should increase support for agricultural R&D in the next Farm Bill to ensure farmers can keep feeding the world in spite of challenges from climate change and other shocks. In collaboration with the Farm Journal Foundation, the Council provides recommendations for US government action.

Link to report: https://globalaffairs.org/research/report/prioritizing-agricultural-research-2023-farm-bill

12:30 – 2:00 Session 3. Innovation and Climate Change

Moderator: Greg Graff, Colorado State University

Presenter 1: Ruiqing Miao, Auburn University

Title: *Geography of Climate Change Adaptation in U.S. Agriculture*

Authors: Jingfang Zhang, Emir Malikov, Ruiqing Miao, and Prasenjit Ghosh

Abstract: Natural variation in resource endowments, climate, and geotopographic characteristics across locations suggests non-trivial spatial heterogeneity in agricultural adaptation to a warming climate. We examine spatial heterogeneity in heat sensitivity of U.S. agriculture and its spatially inhomogeneous adaptation thereto over time. Using semiparametric methods, we model the long-run relationship between crop yields and climate while explicitly allowing its parameters to vary across geography and over time, which enables us to control for local heterogeneity that no longer needs to be restricted to be additively separable (i.e., climate-neutral), as typically done by means of county fixed effects, and to accommodate a naturally occurring spatial clustering therein. Our treatment of cross-county heterogeneity is more flexible as it can be multiplicative/nonneutral and mediate local effects of climate on agriculture. We find that the overall yield sensitivity of U.S. corn, soybeans, and cotton to overheat decreased respectively by 73%, 49%, and 51% over 1958–2019, but with significant spatial heterogeneity. For corn (soybeans, cotton), 54% (74.9%, 23%) of producing counties experienced a decrease in sensitivity to overheat, 12% (2.2%, 77%) experienced an increase, and 34% (22.9%, 0%) no change. For corn and soybeans, the adaptation mainly occurred in the Northern Great Plains and Upper Midwest, and we do not find evidence that crop insurance or the genetically-engineered crop adoption is significantly associated with this adaptation. Further, our preferred model predicts 7.3–12.6% corn yield losses, 11.8–47.9% soybean yield losses, and 4.7–23.9% cotton yield gains by 2048–2052, which are notably smaller than projections from models neglecting spatial heterogeneity.

Keywords: Adaptation, Agriculture, Climate Change, Crop Yields, Heterogeneity, Spatially Varying Coefficients

JEL Classification: Q16, Q54

Presenter 2: Gal Hochman, Rutgers University

Title: *Taxes versus intensity upper-bound and the introduction of abatement technologies*

Authors: Gal Hochman and David Zilberman

Abstract: The paper introduces a political-economic framework to compare upper bounds with taxes to control externalities. The paper models policy design in democratic regimes, assuming heterogeneous firms use polluting capital-intensive technologies but can reduce pollution by adopting cleaner technologies. Policymakers take a multiperiod perspective, weighing the probability of reelection, the value of an improved environment, and economic viability in making policy choices. If policymakers realize that policies are irreversible, they may prefer intensity upper-bound over taxation to regulate and mitigate the pollution. However, this ranking preference changes over time since taxes effects are concentrated more at the intensity margins while upper-bound at the extensive margins.

Presenter 3: Maria Gerullis, Cornell University

Title: *Technology adaptation to diseases under climate change – a job for the government? Evidence from German seed growers*

Authors: Maria Gerullis, Ariel Ortiz-Bobea, and Thomas Heckelei

Most research assessing the impacts of climate change on agriculture focuses on how agricultural producers respond to weather shocks or recent climate trends. We know much less about how agriculture could respond rising pest and disease pressures arising from climate change. A key strategy to fight disease (beyond using pesticides) is to improve resistance through the dissemination of improved crop varieties. Seed multipliers, which are intermediaries between crop breeders and farmers, play a critical role in this process because they decide on the allocation of competing varieties to be multiplied. In some contexts, like in Germany, the government plays a key role in influencing the direction of innovation diffusion by providing explicit recommendations to farmers and seed multipliers. Previous work has qualitatively stressed the importance of governance structures, but its role has not been quantified. In this study, we explore how seed growers alter their land allocation among seeds with varying degrees of disease resistance following a disease shock. We also quantify the role of institutional advice in these technology diffusion activities. Our preliminary results show no evidence of an immediate behavioral adjustment from crop breeders to a pathogen shocks. However, we observe a sizeable and statistically response of seed growers to government variety recommendations. We are currently seeking to expand a comparative analysis to the US Midwest.

Participants

First Name	Last Name	email	organization
Julian	Alston	jmalston@ucdavis.edu	University of California Davis
Sam	Bailey	sbailey@ers.usda.gov	USDA ERS
Anne	Dorrance	dorrance.1@osu.edu	Ohio State University
Keith	Fuglie	kfuglie@ers.usda.gov	USDA ERS
Lilyan	Fulginiti	lfulginiti@unl.edu	University of Nebraska
Maria	Gerullis	mkg66@cornell.edu	Cornell University
Gregory	Graff	gregory.graff@colostate.edu	Colorado State University
Zhongyang	He	zuh116@psu.edu	Pennsylvania State University
Gal	Hochman	gal.hochman@rutgers.edu	Rutgers University
Brent	Hueth	Brent.Hueth@usda.gov	USDA ERS
Zhen	Lei	zxl26@psu.edu	Pennsylvania State University
James	MacDonald	james.macdonald@usda.gov	USDA ERS / University of Maryland
Jonathan	McFadden	jmcfadden@ers.usda.gov	USDA ERS
Stephanie	Mercier	smercier27@gmail.com	Farm Journal Foundation
GianCarlo	Moschini	moschini@iastate.edu	Iowa State University
Richard	Nehring	rnehring@ers.usda.gov	USDA ERS
Kelly	Nelson	knelson@ers.usda.gov	USDA ERS
George	Norton	gnorton@vt.edu	Virginia Tech
Ariel	Ortiz Bobea	ao332@cornell.edu	Cornell University
Richard	Perrin	rperrin@unl.edu	University of Nebraska
Carl	Pray	cpray@sebs.rutgers.edu	Rutgers University
Andrew	Schmitz	aschmitz@ufl.edu	University of Florida
Guanming	Shi	gshi@wisc.edu	University of Wisconsin
Vincent	Smith	vsmith@montana.edu	Montana State University
Sun Ling	Wang	slwang@ers.usda.gov	USDA ERS
Wenjun	Wang	wenjun.wang@berkeley.edu	University of California Berkeley
Justus	Wesseler	justus.wesseler@wur.nl	Wageningen University
Brian	Wright	bwright@berkeley.edu	University of California Berkeley