

A CENTURY-LONG PERSPECTIVE ON AGRICULTURAL DEVELOPMENT

CHRISTOPHER B. BARRETT, MICHAEL R. CARTER, AND C. PETER TIMMER

This article strategically surveys the past century's literature on agricultural development. We organize the discussion around three "grand themes" that reveal the richness of agricultural development as an intellectual endeavor. First, we explore the role of agriculture in the broader development process from a macroeconomic and political economy perspective. We then examine the role of technological and institutional change in successful agricultural development. Finally, the focus turns to a microeconomic perspective on agricultural household decision making and the problems of imperfect and missing markets, asymmetric information, and transactions costs that lead to widespread apparent inefficiency and disequilibrium.

Key words: Household Models, Institutional Change, Linkages, Structural Transformation, Technical Change.

JEL codes: O1, O3, O4, Q1.

Economists of all stripes have made fundamental contributions to the field of agricultural development. Many Nobel Laureates in Economics have thought about the field in ways that influenced scholarship and practice. But the core of what we know about agricultural development has been established by agricultural economists, with some contributions dating almost to the founding of our Association. Still, agricultural development is a younger field than any other in this centenary volume. Serious interest began in the 1950s as African and Asian independence movements gathered force, and an explosion of research in the 1960s established agricultural development as an influential field in both agricultural and development economics.

It is inevitable then that this chapter has a noticeable contemporary flavor. Several of the "giants" who helped establish the field remain active. There is a continuing sense of ferment in the field, with few established dogmas, many unanswered questions and resurgent interest in the wake of the global food price crisis of

2007–8. To be sure, we know a lot more than we did even fifty years ago. But it is sobering to read the classics from the early 1960s and realize how relevant many of their insights remain. Much of what was not known then remains unknown.

This article strategically surveys the literature in this vast field, highlighting key contributions by agricultural economists. We must move at a breathless pace; even important works are mentioned only in passing. To organize the discussion, we weave the story around three "grand themes" that reveal the richness of agricultural development as an intellectual endeavor. Following the style of this special issue, we flag each of these themes and the subsidiary main contributions in numbered headers, offering a road map of sorts through the vast literature on agricultural development.

We start with the big question: the role of agriculture in the broader development process. This macro perspective introduces key linkages between the agricultural sector and the rest of the economy, often via the rural nonfarm economy, and pursues the dynamic evolution of structural transformation. The economic and demographic pathways inherent in this transformation present strategic challenges and opportunities to development policymakers, which leads to a discussion of the political economy of agricultural policy design and implementation during the

Christopher Barrett is the Stephen B. and Janice G. Ashley Professor of Applied Economics and Management and International Professor of Agriculture, Cornell University; Michael Carter is a professor of Agricultural and Resource Economics, University of California at Davis; and Peter Timmer is the Thomas D. Cabot Professor of Development Studies, Emeritus, Harvard University. Seniority of authorship is shared equally; authors' names appear alphabetically.

Amer. J. Agr. Econ. 92(2): 447–468; doi: 10.1093/ajae/aaq005
Received December 2009; accepted January 2010

© The Author (2010). Published by Oxford University Press on behalf of the Agricultural and Applied Economics Association. All rights reserved. For permissions, please e-mail: journals.permissions@oxfordjournals.org

structural transformation. The discussion of agricultural development policy provides a useful transition to the second grand theme: the role of technological and institutional change in successful agricultural development.

The critical role of new technologies and effective institutions in stimulating agricultural productivity and inclusive economic growth is now well established. Although early thinkers saw this role, subsequent experience and analysis have clarified the ingredients, the overwhelming need for public investments—particularly in agricultural research—and the heterogeneity of impact across diverse farm communities and households. The role of integrated factor and product markets in conditioning this impact and determining the ultimate beneficiaries of technical and institutional change transitions us to our third grand theme: understanding how households and individuals participate (or not) in the process of agricultural development.

This micro perspective on household decision making reveals how much progress has been made since the days when “traditional” peasants were seen as the recipients of “modern” knowledge about farming techniques. Diversity remains crucial in this decision-making process, but imperfect and missing markets for risk and finance, thin input and output markets, and asymmetric information problems and transactions costs that lead to widespread apparent inefficiency and disequilibrium explain much of apparently perverse behavior from poor households that are vulnerable to devastating shocks to their livelihoods.

In conclusion, we argue that the research on agricultural development over the past five decades has raised as many questions as it has answered. Such a conclusion leads naturally to a research agenda, which we briefly frame in regional terms as a small recognition of the great diversity in agricultural development settings.

Theme 1: Macro-growth dimensions of agricultural development

All societies have paid considerable attention to agricultural development and to the local food security it can provide. Ancient Greece, Rome, and Egypt all produced manuscripts on farm technology, best practices, and even grain storage rules and techniques. But agricultural development as an analytical topic,

with economics as an organizing framework, dates to the rapid emergence of Western Europe from the late eighteenth century. Economic historians have documented the critical role of agriculture in the development of virtually all the now-rich countries in the world, an experience drawn upon by W. Arthur Lewis when he wrote: “industrial and agrarian revolutions always go together, and ... economies in which agriculture is stagnant do not show industrial development” (Lewis 1954, p. 433).

Contribution #1: Demonstrating that the structural transformation is the only sustainable pathway out of poverty

These insights by Lewis stimulated three lines of thought about the role of agriculture in economic development. First, the direct outgrowth of Lewis’ analysis of dual economies was formal two-sector modeling (Ranis and Fei 1961; Jorgenson 1961), with its focus on structural changes. Hayami and Ruttan (1985) explain how the dual economy literature marked an important break introducing a “dynamic dualism” to replace prior, “static dualism” approaches that had mostly followed a descriptive, sociological, and structural approach. Hayami and Ruttan conclude that neither modeling approach significantly advanced the understanding of how agricultural modernization actually takes place, although they acknowledge that the models help understand why it is necessary if overall economic growth is to take place. “The very simplicity of the models, a major source of their insight into the fundamental process of development, however, has led to substantial underestimation of the difficulties that face poor countries in achieving such a transformation” (Hayami and Ruttan 1985, p. 30).

Second, the macro perspective and the importance of two-way linkages between rural and urban economies were stressed by Johnston and Mellor (1961). Johnston later became increasingly concerned about the size distribution of farms and the “uni-modal” lessons from East Asia for Africa and Latin America (Johnston and Kilby 1975; Johnston and Clark 1982). Mellor continued his focus on South Asia and the difficulties for the agricultural sector on its road to industrialization (Mellor 1966; 1976; 1986). Both saw higher productivity on small farms as the key ingredient to rapid poverty reduction and a healthy structural transformation.

Third, T.W. Schultz (1964) stressed the need for an “agrarian revolution,” or higher productivity through technical change in agriculture. He emphasized the importance of human capital, especially education of rural workers, in facilitating productivity growth, and governments’ failure to provide appropriate policy environments (Schultz 1975; 1978).

Masterfully synthesizing the main lessons from nearly five decades of such analysis, Staatz and Eicher (1998, p.31) explain:

By the end of the 1990s, development thinking had come nearly full circle. In the 1950s and 1960s, many development economists analyzed how the agricultural and nonagricultural sectors interacted during the process of economic growth, using simple two-sector models. This abstract theorizing was sharply criticized by dependency theorists, among others, who argued that such work abstracted from the institutional and structural barriers to broad-based growth in most low-income countries. During the 1970s and 1980s, the focus of research shifted to developing a more detailed theoretical and empirical understanding of the rural economy. But the emphasis on structural adjustment in the 1980s forced reexamination of agriculture’s relationship to the macroeconomy. By the late 1990s, economists were again focusing on how the rural economy was linked to the broader world market, but they demonstrated a renewed recognition of how important institutions are in determining a country’s pattern of growth and the distribution of the benefits of that growth.

In the ensuing decade, the profession has finally gotten agriculture back on the broader development agenda. The publication by the World Bank (2007) of the *World Development Report 2008: Agriculture for Development* was a key breakthrough. Coordinated and drafted by Derek Byerlee and Alain de Janvry, this WDR was the first in a quarter century to focus specifically on agriculture. Its publication late in 2007, just as the world food crisis was heating up, looked prescient. Still, none of the major donor agencies has figured out how to

gear up quickly to support more spending on agricultural development, partly because there remains deep uncertainty over what to do and how to do it.

From a macro perspective, this uncertainty stems from two dimensions of the agricultural development process that remain poorly understood: (1) the dynamic role of the rural nonfarm economy and how it mediates the linkages between the farm sector and the macroeconomy during the structural transformation; and (2) the political economy of agricultural policy and how that too evolves. Both topics have received substantial research attention almost from the beginnings of the field, but the research began to show new empirical depth and policy impact by the end of the 2000s (Haggblade, Hazell, and Reardon 2007; Timmer 2009).

Contribution #2: Revealing the linkages that make an agricultural transformation essential to overall economic development

Formal two-sector models typically assumed the smooth functioning of the linkages that placed the fate of urban workers and farmers in each others’ hands. The actors who mediate these linkages in a real economy, and how their role and structure change over the course of economic development, only became a topic of serious analysis in the 1970s. Then a veritable cottage industry sprang up to conceptualize and measure the “multipliers” implied by market-mediated linkages between agriculture and industry. Haggblade, Hazell, and Reardon (2007) nicely synthesize this literature, stressing the crucial and changing role of the rural nonfarm economy.

The rural nonfarm sector provides the bridge between commodity-based agriculture and livelihoods earned in the modern industrial and service sectors in urban centers. Most rural households earn a large share of their incomes from nonfarm sources, and often this sector is the “ladder” from underemployment at farm tasks to regular wage employment in the local economy, and from there to jobs in the formal sector (Mellor 2000; Delgado, Hopkins, and Kelly 1998). The firms and activities in the rural nonfarm sector mediate many of the two-way linkages between agriculture and the macroeconomy that are at the core of the development process. These linkages can be summarized in three categories (Timmer 2002).

The “Lewis linkages” between agriculture and economic growth provide the nonagricultural sector with labor and capital freed up by higher productivity in the agricultural sector. These linkages work primarily through factor markets, but there is no suggestion that these markets work perfectly in the dualistic setting analyzed by Lewis (1954). Chenery and Syrquin (1975) argue that a major source of economic growth is the transfer of low-productivity labor from the rural to the urban sector. If labor markets worked perfectly, there would be few productivity gains from this structural transfer, a point emphasized first by Jorgenson (1961) and later by Syrquin (2006).

The indirect “Johnston-Mellor linkages” allow input-output interactions between the two sectors so that agriculture can contribute to economic development. These linkages are based on the agricultural sector supplying raw materials to industry, food for industrial workers, markets for industrial output, and the exports to earn foreign exchange needed to import capital goods (Johnston and Mellor 1961). As with the Lewis linkages, it is difficult to see any significant role for policy or economic growth unless some of the markets that serve these linkages operate imperfectly. Resource allocations must be out of equilibrium and face constraints not immediately reflected in market prices if increases in agricultural output are to stimulate the rest of the economy at a rate that causes the “contribution” from agriculture to exceed the market value of the output, i.e., the agricultural income multiplier is greater than one (Timmer 1995).

Writing in the mid 1960s, Mosher (1966) assumed that “getting agriculture moving” would have a high priority in national plans because of its “obvious” importance in feeding people and providing a spur to industrialization. That assumption has held only in parts of East and Southeast Asia, and has been badly off the mark in much of Africa and Latin America. In the latter regions, a historically prolonged and deep urban bias led to a distorted pattern of investment. Too much public and private capital was invested in urban areas and too little in rural areas. Too much capital was held as liquid and non-productive investments that rural households use to manage risk. Too little capital was invested in raising rural productivity.

Such distortions resulted in strikingly different marginal productivities of capital in urban

and rural areas (Lipton 1977; Timmer 1993). New growth strategies—such as those pursued in Indonesia after 1966, China after 1978, and Vietnam after 1989—altered investment priorities in favor of rural growth and benefited from this disequilibrium in rates of return, at least initially. For example, in Indonesia from the mid 1960s to the mid 1990s, real value added per farm worker increased by nearly half, whereas it had apparently declined from 1900 through the mid 1960s. In China, the increase from 1978 to 1994 was nearly 70%, whereas this measure had dropped by 20% between 1935 and 1978 (Prasada Rao, Maddison, and Lee 2002). A switch in investment strategy and improved rates of return on capital increase factor productivity (and farm income) by improving efficiency in resource allocation.

The contribution of agricultural growth to productivity growth in the nonagricultural economy stems from several other sources as well: greater efficiency in decision making as rural enterprises claim a larger share of output; higher productivity of industrial capital as urban bias is reduced; higher productivity of labor as nutritional standards are improved; and a link between agricultural profitability (as distinct from agricultural *productivity*) and household investments in rural human capital, which raises labor productivity and also facilitates rural-urban migration. These mechanisms capitalize on the efficiency of rural household decision making, the low opportunity cost of their labor, the opportunity for on-farm investment without financial intermediaries, and the potential to earn high rates of return on public investments that correct for urban bias. In combination, these mechanisms translate faster agricultural growth into measurably faster economic growth in aggregate, after controlling for the direct contribution of the agricultural sector to growth in GDP itself (Timmer 2002).

Contribution #3: Developing the empirical and theoretical understanding for why all successful structural transformations are painful for farm households and thus generate a reasonably standard political response to reduce that pain

The agricultural transformation

The structural transformation is the defining characteristic of the development process, both cause and effect of economic growth (Syrquin 2006). Four relentless and

interrelated processes define the structural transformation: a declining share of agriculture in GDP and employment; rural-to-urban migration that stimulates urbanization; the rise of a modern industrial and service economy; and a demographic transition from high birth and death rates common in backward rural areas to lower ones associated with better health standards in urban areas. The final outcome of the structural transformation is an economy in which capital and labor productivity in agriculture is equalized with other sectors through well-functioning labor and capital markets.

As Chairman Mao crudely but correctly put it, “the only way out for agriculture is industry.” Unless the nonagricultural economy grows, there is little long-run hope for agriculture. At the same time, the historical record is very clear on the key role that agriculture plays in stimulating the nonagricultural economy (Timmer 2002). This feedback has sparked a long-contested literature on the role of agriculture in economic development (Johnston and Mellor 1961; Hayami and Ruttan 1985; Mundlak 2000; Timmer 2002; 2009).

Part of the controversy stems from the structural transformation, a general equilibrium process not easily understood from within the agricultural sector. Over long historical periods, agriculture’s role seems to evolve through four basic stages (Timmer 1988): the early “Mosher” stage when “getting agriculture moving” is the main policy objective (Mosher 1966); the “Johnston-Mellor” stage when agriculture contributes to economic growth through a variety of linkages (Johnston and Mellor 1961); the “Schultz” stage when rising agricultural incomes fall behind those in a rapidly growing nonfarm economy, inducing political tensions (Schultz 1978); and the “Johnson” stage where labor and financial markets fully integrate the agricultural economy into the rest of the economy (Johnson 1997; Gardner 2002). Efforts to “skip” the early stages and jump directly to a modern industrial economy have generally courted disaster.

In the early stages there is typically a substantial gap between the share of the labor force employed in agriculture and the share of GDP generated by that work force. This gap narrows over time as incomes rise; the convergence reflects better integrated labor and financial markets. But this structural gap often widens during periods of rapid growth, as is evident in the history of OECD economies (Timmer 2009). When overall GDP grows

rapidly, the share of agriculture in GDP falls much faster than the share of agricultural labor in the overall labor force. The turning point in the gap generated by these differential processes, after which labor productivity in the two sectors begins to converge, has also been moving “to the right” over time, requiring progressively higher per capita incomes before the convergence process begins.

This lag inevitably presents political problems as farm incomes visibly fall behind incomes earned in the rest of the economy. The long-run answer is faster integration of farm labor into the nonfarm economy, including the rural, nonfarm economy. But such integration takes a long time. It was not fully achieved in the United States until the 1980s (Gardner 2002), and the productivity gap appears increasingly difficult to bridge through economic growth alone (Timmer 2009). Lagging real agricultural earnings growth fosters deep political tensions over the course of the structural transformation, and those tensions grow with the lag. The standard government response to these tensions has been to protect the agricultural sector from international competition and ultimately to provide direct income subsidies to farmers (Lindert 1991).

The political economy of agricultural policy

Modern political economy has its roots deep in agriculture. Explaining the evolution of agricultural policy has long been difficult for models that use democratic institutions, median voters, or other forms of representative governance. Two aspects of agricultural policy are especially puzzling: the “development paradox,” whereby the sector is discriminated against when a large share of the population works in agriculture but is protected when the number of farmers becomes much smaller; and the “trade paradox,” whereby both agricultural imports and exports are taxed. Neither of these patterns makes sense in a democratic society where rational voters elect officials who defend their interests.

Consequently, policy analysts and political theorists have long tried to understand whose interests officials defend and why. Olson (1965), Bates (1981), Anderson (1986), Lindert (1991) and Krueger, Schiff, and Valdes (1991) documented trends in historical biases and offered explanations based in “positive” political economy that explains public policy formation based on the assumed self-interested

rationality of policymakers. Bates (1998, pp. 238–9) explains:

“I have moved away from a form of analysis which views policy as the result of efforts to maximize the social welfare. I have moved instead to a set of approaches that looks at public policy as a solution to political problems. The general theme ... is that politicians are rational actors, but they are solving problems that do not take a purely economic form. What appear as economic costs may offer political benefits: noncompetitive rents or inefficient projects, for example, may be politically attractive in that they offer tools for building loyal organizations. What economists may evaluate as bad policy, then, is not necessarily the result of poor training, obduracy, or other deficiencies on the part of policy makers. Rather, policy makers may simply be solving a different problem than are economists. As policy analysts, it behooves us to represent explicitly the political problem as perceived by the policy maker and to use our analytic techniques to solve it, both in order to offer better explanations of government behavior and to advocate better policy more effectively.”

So what drives the decisions of these self-interested policymakers? De Gorter and Swinnen (2002) provide a long list of factors found empirically to influence agricultural policies over time and across space. They identify four key elements that political economy models of agricultural policy have considered: individual preferences of the citizenry; collective action by lobby groups; preferences of politicians; and political institutions. In the end, de Gorter and Swinnen conclude that the extensive empirical work on agricultural policies needs to be better integrated into political economy theory. The difficulty with this integration, however, is that the current theory is built almost exclusively on neoclassical foundations that have dubious assumptions about how individuals behave in the face of uncertainty and economic change. Two of the most pervasive policy tendencies have been for governments to stabilize their staple food

prices and to provide price protection to a sector with lagging incomes. Both tendencies are hard to explain within the neoclassical paradigm, but are obvious political choices from a behavioral perspective if most individuals base welfare judgments on “reference points”, and so dislike instability. Similarly, if individuals judge incomes based on relative standing, then lagging incomes generate direct political pressures for assistance.

Contribution #4: Establishing that individuals' and nations' food security status depends fundamentally not only on supply-side factors associated with agricultural productivity, but equally with demand factors related to incomes, risk exposure, health status, social protection policies, and caregiving within the household, and is best conceptualized and measured as a stochastic, dynamic status

Some of the most politically charged food policies relate to those that protect lives and livelihoods. For most of human history, lives were short and unhealthy due in large measure to insufficient nutrient intake. Malthus' well-known explanation was that human population growth routinely overtaxed the earth's capacity to provide sufficient food, leading to regular famines. Since the eighteenth century, however, dozens of countries have escaped widespread hunger and premature death due largely to dramatic advances in food availability and associated income growth broadening access to a satisfactory diet. The apparent reinforcing feedback between nutritional status and productivity has led several scholars to hypothesize that the escape from the nutritional poverty trap helped to catalyze the unprecedented rapid and widespread advance of living standards over the past 300 years (Dasgupta 1993, 1997; Fogel 2004).

Much of this progress stems from greater food availability made possible by agricultural technological change associated with plant breeding, improved agronomic practices such as intercropping and crop rotations, irrigation, and the emergence of mechanical implements and chemical fertilizers. Food security has therefore often been equated with food availability, typically measured in terms of satisfaction of dietary energy requirements, such as calories per person per day, such that food insecurity arises due to insufficient and unstable production.

An availability-based view of food security naturally leads policymakers to pursue food self-sufficiency strategies, to ensure domestic production will suffice to feed the population. But food self-sufficiency strategies neglect economic laws of comparative advantage based on factor endowments, and typically lead to higher prices as well as greater inefficiency and environmental damages than does international trade (Anderson 1986; Krueger et al. 1991; Johnson 1997).

The second generation of thinking on food security stems directly from Sen (1981, p.1, emphasis in original), whose famous opening sentences underscore that “starvation is the characteristic of some people not *having* enough food to eat. It is not the characteristic of there *being* not enough food to eat. While the latter can be a cause of the former, it is but one of many *possible* causes.” Ironically, Sen eschewed the concept of food security, focusing instead on the “entitlements” of individuals and households. Sen shifted the focus from supply-side issues associated with aggregate food availability toward individual access to food, and thus to the role of (perhaps idiosyncratic) demand failure due to unemployment, adverse movement in the terms of trade, production failure, termination of transfers, or other forms of “entitlement failure.” Sen thus placed increased emphasis not only on traditional economic variables of incomes and prices, but equally on human rights and on the legal institutions of the state, as well as the moral and social norms of cultures. This perspective mirrored the renewed attention paid to institutional issues in technology development and diffusion, and in agricultural commercialization.

The emergent third-generation view of food security builds on food availability and access measures to introduce more explicit attention to risk, dynamics, and the complex health consequences of nutrient deficiencies (Barrett 2002). By expanding the conceptualization of food insecurity beyond production, prices, and incomes, the literature of the past decade or so more closely relates food insecurity to poverty, to social, economic, and political disenfranchisement, and to structural patterns of control over (financial, human, and natural) resources, and of access to markets, technologies, and finance (Drèze and Sen 1989). But with dozens of countries still lacking adequate food availability to meet the dietary needs of their residents, even if distribution were perfectly equitable, long-standing concerns about food

production per capita maintain their currency in the twenty-first century.

Theme 2: Meso-level processes of technological and institutional change

It borders on the tautological to say that low-income countries are saddled with rudimentary technologies that are both cause and consequence of low incomes. Modern growth theory focuses heavily on technological change as an engine of economic growth, and on externalities as a source of endogenous growth (Solow 1957; Lucas 1988). Elegant as these models might be, they typically assume that processes of technology development and adoption, and market exchange are exogenous, irreversible, and relatively frictionless. In contrast, the micro-level agricultural development literature paints a picture of slow, halting, reversible, and ultimately incomplete adoption of improved inputs or production technologies, which, coupled with incomplete market participation and price transmission, impede productivity growth and slow structural transformation in agriculture.

Contribution #5: Understanding the productivity and distributional impacts of technical change in agricultural development

Technical change in agricultural development

What drives the emergence of more productive technologies for low-income agriculture? The dominant theory has long been the induced innovation model of Hayami and Ruttan (1985) and Binswanger and Ruttan (1978). Under the induced innovation hypothesis, technical innovations are guided by changes in relative incentives. As an input becomes dearer relative to prospective substitute inputs, there emerges a profit incentive to develop a technology that makes relatively greater use of the cheaper input and less of the dearer one. The hypothesis of induced innovation suggests that Hicks-biased technical change is causally driven by changes in relative prices that induce either profit-seeking innovation by private firms or political demands for public research to relieve increasingly binding constraints.

The empirical evidence on the induced innovation hypothesis is somewhat mixed, however, and at present, no general theory of technical

change really exists (Ruttan 1997). Some discoveries are stochastic, and path dependency sometimes seems to lock in even relatively inefficient technologies (David 1985; Arthur 1994). At the same time, many agricultural technological breakthroughs – perhaps especially the Green Revolution advances in improved rice and wheat germplasm in the 1960s and 1970s—emerged not from profit-seeking induced innovation but rather from scientific research following the non-profit motives of philanthropists, scientists, and governments.

Such investment is justified by the sizable externalities associated with innovation (Ruttan 1980; 1997). These spillover benefits take two major forms. First, because agricultural research generates nonrival—and often non-excludable—knowledge, it yields classic public goods benefits that justify public investment. Although much adaptive agricultural research is highly specific to particular agro-climatic regions, the resulting genetic material and especially basic research has had substantial international spillover effects (Alston et al. 2000; Evenson and Gollin 2003). Hence the high estimated annual rates of return on public (and non-profit) agricultural investment, typically in the 30–60% range both for individual commodities or factors of production and for total research systems (Alston et al. 1996, Raitzer and Kelley 2008).

The second major spillover effect arises from the “technology treadmill” inherent in agriculture (Cochrane 1958; Gardner 2002). In a small open economy in which producers face infinitely elastic demand, the gains from technological change accrue entirely to producers in the form of higher profits. By contrast, if demand is perfectly inelastic, all gains accrue to consumers in the form of lower prices. The distribution of welfare gains from technical change therefore depends crucially on the price elasticity of demand for the product. Since most agricultural products exhibit price inelastic demand, producers in aggregate tend not to benefit much in long-run equilibrium from technological change. Producers adopt new technologies because they reduce unit costs, thereby increasing productivity. But in general equilibrium, when many producers adopt the cost-reducing technology, the aggregate supply curve shifts and prices fall. Producers can wind up being worse off if demand is sufficiently inelastic. The empirical evidence on technical change in agricultural development suggests that most welfare gains are captured as consumer surplus due to lower prices, rather

than in producer surplus (Evenson and Gollin 2003; Minten and Barrett 2008). Of course, if the benefits from technical change in agriculture largely accrue to consumers in the form of lower prices, it may be socially optimal to pay for much technology development with tax revenues paid by consumers.

T. W. Schultz, human capital and the “poor but efficient” hypothesis

If W. Arthur Lewis built the intellectual framework supporting the “why” of agriculture’s role in economic development, T.W. Schultz built the framework for understanding the “how” of stimulating agriculture to play that role. Schultz came to development issues after a distinguished career analyzing problems with American agriculture, especially instability (Schultz 1945) and poverty (Schultz 1953). His classic volume on agricultural development, *Transforming Traditional Agriculture* (Schultz 1964) grew directly out of these earlier analyses.

Schultz had long been convinced that the problem of poverty in American agriculture stemmed from the intersection of rapid technical change, the industrial organization of the sector, and its dependence on an unstable macroeconomy to determine its output prices. The solution was to be found in greater macro stability (outside the agricultural sector’s purview) and greater capacity of farmers to adjust to change, both on the input side—new technologies—and to the prices of output. In Schultz’s view, new technology was the essential driver of higher farm incomes, but only in the context of new investments in human capital on the farm. He famously rejected the notion that small farmers were poor due to cultural characteristics, deeming them instead “poor but efficient” users of long-established technologies and limited available factors of production. Farmers needed new knowledge and skills to adopt new technologies, but also to cope with changing economic environments, especially with the need to exit agriculture as farm productivity increased and the structural transformation proceeded. *Transforming Traditional Agriculture* stresses both elements as the keys to a successful agricultural development strategy.

Schultz’s “poor but efficient” hypothesis sparked much debate around the importance of technology development to expand the

production possibility frontier for poor farmers versus improving productivity within the existing production frontier. Widespread estimates of considerable technical inefficiency among small farmers have often fueled arguments that investment in new technologies might not be as valuable as investment in extension services to increase adoption and improve the use of existing technologies (Ali and Byerlee 1991). An opposing thread of the literature notes the many econometric problems inherent in the technical inefficiency research and demonstrates that, as one begins to control for exogenous, stochastic environmental factors which influence productivity, apparent inefficiency diminishes appreciably and becomes essentially untargetable based on farm or farmer characteristics, supporting Schultz's hypothesis (Barrett 1997; Sherlund et al. 2002).

Contribution #6: Building an understanding of the dynamics of technology adoption and diffusion

Because technical change seems key to—arguably even the main driver of—agricultural development, understanding remarkably heterogeneous patterns of technology adoption and diffusion has been a major preoccupation of agricultural development researchers. Much of the literature traces back to the seminal work of Griliches (1957), who documented the now-standard S-shaped diffusion curve in studying the adoption of high-yielding corn varieties in the United States. Since that time, a large literature has focused on understanding better who will adopt a given technology, especially who will adopt first because, given the technology treadmill, the benefits of innovation accrue disproportionately to early adopters.

So who adopts first? In general, those with the most to gain, the lowest-cost access to the technology, and the lowest evaluation costs and least uncertainty about the technology. Precise hypotheses depend crucially on the specification of the adoption model and local context (Feder, Just, and Zilberman 1985). But in general, large farm operators adopt before smallholders. Agricultural technological change can thereby contribute to widening inequality within agriculture, although general equilibrium food price and wage effects eventually offset such effects for landless rural laborers and small, net buyer farmers who

sell surplus labor to larger neighboring farms (David and Otsuka 1994).

Several candidate explanations exist as to why large farms seem to adopt new technologies first. One is scale-biased technical change. If technology development occurs not due to induced innovation but rather to political research prioritization, smaller, more vocal groups of large landowners using inherently different production technologies and perhaps growing different crops might steer public research efforts toward technologies most likely to benefit them disproportionately (de Janvry 1981).

Even with scale-neutral technical change, larger farms might acquire technologies earlier due to superior credit and insurance access. If informational asymmetries and repayment enforcement problems induce creditors to require land or other real assets as collateral, then borrowing constraints will be an increasing function of landholdings (Feder 1985; Carter 1988). If the new technology demands increased input purchases, then borrowing constraints may bind, with larger landowners facing a lower shadow price of capital than smallholders, making the effective acquisition cost of the new technology lower. Similar arguments apply to risk bearing capacity if risk aversion is declining in farmer wealth. The effect of financial market imperfections can be magnified by fixed or sunk costs to technology adoption, which privilege scale. Simple models of technology choice in the presence of financial market failures thus underpin many poverty trap models (Azariadis and Stachurski 2005; Carter and Barrett 2006).

Another possibility is that large farms are more likely managed by well-educated operators or visited by extension agents promoting the new technology, and that human capital and information flow are the key drivers of technology adoption (Schultz 1975). This view is consistent with renewed recent emphasis on learning models of technology adoption in which farmers update their information on a technology, and refine their skills and efficiency applying the technology as they use it (Antle and Crissman 1990). Producers able to afford the costs and risks of experimentation therefore adopt earlier. The literature has focused anew on the dynamics of agricultural technology diffusion (Besley and Case 1993), particularly on processes of learning by doing and learning from others (Bandiera and Rasul 2006; Conley and Udry [forthcoming]; Foster and Rosenzweig 1995;

Moser and Barrett 2006). This more recent thread of the literature highlights, in particular, the empirical challenges of disentangling wealth, education, and social network structure as causal drivers of technology adoption and diffusion.

Contribution #7: Establishing ways of measuring the degree to which individuals and households participate in local markets and, in turn, local markets with broader national and global ones, and with what effects on behavior and welfare

Exploitation of comparative advantage so as to reap gains from market-based exchange is as much an engine of agricultural development as technological progress. Economists dating back at least to Adam Smith and David Ricardo have trumpeted the static and dynamic welfare gains from trade. Further, macroeconomic policies commonly require smooth market transmission of signals sent by governments. And well-functioning markets pool demand and supply shocks across markets, enhancing producer incentives to adopt improved technologies and dampening price risk exposure that can prove catastrophic for food-insecure peoples (Ravallion 1997).

In low-income rural settings, however, poor communications and transport infrastructure, limited rule of law, and restricted access to commercial finance often sharply limit the degree to which markets function as effectively as highly stylized models typically assume. Agricultural economists have contributed significantly to the literature documenting the institutional constraints to market development (Fafchamps 2004; Lin and Nugent 1995). The notion that state-controlled markets are allocatively inefficient undergirded most liberalization efforts in the 1980s and 1990s. But as economists have gradually come to appreciate the array of institutional failures that limit market performance, it has become increasingly clear that private markets may likewise be characterized by considerable allocative inefficiency. In particular, the agricultural development literature has documented considerable commodity price variability across space and time in developing countries, typically finding significant forgone arbitrage opportunities (Fackler and Goodwin 2001). In exploring such puzzles, agricultural development scholars have innovated extensively in spatial price analysis methods, dating from Jones' (1972) use

of correlations in price time series to determine the extent of markets in west Africa, to Ravallion's (1986) pre-Granger introduction of error correction modeling to study price transmission in response to shocks in the Bangladesh famine of 1974, to Baulch's (1997) introduction of the parity bounds model to study food market performance in the Philippines.

The analytical similarities between technology adoption choices and market participation choices are striking, although largely overlooked. If a production technology is quasi-concave and monotone, then exchange fits the general characteristic of a technology. In both the technology adoption and market participation cases, fixed costs play an important role, mirroring their importance to more general theories of imperfect competition and of multiple equilibriums and poverty traps. As Romer (1994) points out, when trade restrictions or marketing costs effectively extinguish markets beneath some critical threshold, efficiency losses in poor economies can become quite large. This point builds on the Johnston-Mellor (1961) hypothesis because in the presence of fixed and sunk costs, exogenous productivity gains can make the emergence of entire sectors profitable, leading to very large social returns to investment in the upstream sector.

Given the apparent massive static and dynamic gains from trade, it seems puzzling that many rural households opt out of market exchange for many goods and services. Market participation choices revolve around the tension between gains from specialization and corresponding increases in transactions costs that result from depending more on the market to procure one's needs. Transactions costs vary with social distance from counterpart transactors and economic distance from trading points, where this distance is defined over space, time or form. Fixed and variable costs are therefore household-specific and endogenous. People know exchange is costly and choose production and exchange strategies recognizing that they implicitly also choose transactions costs. This helps explain why some farmers forgo yield-increasing technologies and opt for activity diversification, not for reasons of self-insurance but rather because of demand for consumption variety in the face of costly commerce (Omamo 1998). For many, autarkic behavior is a low-level equilibrium (de Janvry et al. 1991; Goetz 1992; Key et al. 2000; Bellemare and Barrett 2006). Increased engagement in

the commercial agricultural marketing system is therefore a central feature of agricultural development, both cause and consequence of productivity growth and improved standards of living among rural households.

Of course, the commercial agricultural system itself has been undergoing a significant transformation over the past several decades. The rapid emergence in developing countries of supermarkets, fast food chains, and other retailers with downstream market power, as well as increased penetration by global agro-exporters, has shortened supply chains and tightened food quality and safety standards, while at the same time threatening to leave small farmers behind because of the high transactions costs involved (Reardon et al. 2003; Swinnen 2007; Reardon et al. 2009).

Theme 3: Microeconomics of Agricultural Development

In the first quarter of the twentieth century, Russian agricultural economist A.V. Chayanov published *The Theory of Peasant Economy* (1965). Rediscovered by post-war development economists eager to understand the choices and constraints that shape whether and how individuals participate in agricultural growth and development, the Chayanovian model became the cornerstone for the microfoundations of agricultural development.

Contribution #8: Developing and empirically testing an integrated model of household decision making under a wide variety of constraints, including limited access to credit, labor and land markets, as well as risk and uncertainty.

Chayanov set out to understand the resource allocation logic of peasant households that operated as integrated production–consumption units in a world with thin or even nonexistent markets for land and labor. Absent those markets to provide well-defined opportunity costs for land and labor, Chayanov argued that the peasant household allocates labor such that the “drudgery” associated with the additional labor input just equals the marginal utility of the additional output attainable with that labor input. Following Sen (1966), the household sets the marginal value product of labor equal to the marginal rate of substitution between consumption and

leisure, which can be naturally interpreted as the shadow price of labor, a function of the demographic structure of the household, its preferences and its endowments.

Several core propositions emerge from Chayanov’s model. First, changes in household demographic structure that decrease the shadow price of labor (e.g., an increase in the number of consumers) will lead to an intensification of production and an increase in output per unit land. Second, a household with a lower land endowment will have a lower shadow price of labor and produce more per unit area. This latter effect implies the inverse relationship between farm productivity and farm size that has been central to debates on land reform, as discussed below.

In Chayanov’s model, production choices are not separable from consumption choices. However, if instead of missing markets we assume all markets are perfectly competitive (and that hired and family labor are perfect substitutes) then household consumer and producer choices become mathematically separable. In production, the household will allocate resources like a profit-maximizing firm, equating the marginal value of product of labor to the market wage. Having maximized its income, the household then allocates its full income between consumption of goods and leisure according to its preferences and demographic structure.

Singh, Squire, and Strauss (1986) make clear that ‘non-separable behavior,’ in which households use resources differently with different productivity levels, is fundamentally a result of missing or imperfect markets, so that prices are not parametrically given to the household, rather than a reflection of the fact that the household is an integrated production and consumption unit. Indeed, such differentiated behavior can result in models in which the consumption decisions of the household are completely ignored. For this reason, such models are ‘endowment sensitive,’ meaning that the intensity with which the household uses and abuses its natural and human resources is influenced by its relative wealth.

The household model and its implications have been the empirical workhorse of development microeconomics. The Singh–Squire–Strauss volume emerged as agricultural prices were liberalized in many developing countries, with the expectation that agricultural production and market supply would buoyantly follow price increases. However, the non-separable Chayanovian model accurately

predicted muted supply response as price increases induce a compensating rise in the shadow price of labor, choking off production growth. Even when markets are complete and separability holds, the elasticity of marketed surplus can be markedly lower than that of output as income effects can lead the household to auto-consume a large share of the price-induced increase in output.

The relationship between farm productivity and farm size implied by the Chayanovian model induced massive empirical investigation. Beginning with Indian farm management studies in the late 1950s to the [Berry and Cline \(1979\)](#) compendium, through to studies that utilized ever more complex econometric methods, this relationship has been investigated in every world region. While the finding of an inverse relationship has been fairly robust, dissonant findings have helped spawn two other important advances in the economics of agricultural development: the endogeneity of market failure, and the centrality of capital constraints as agricultural technology becomes more complex.

The first of these advances results from critical reflection on the assumption that land and labor markets are completely absent. Consider what happens if labor markets exist, so that labor time can be freely bought and sold at a given wage, but that agency costs make the productivity of hired labor less than that of own family labor. Under this assumption, households with land endowments so small that hiring in labor becomes unprofitable face a constant wage, and behave according to the predictions of the separable model. Households with more land begin to hire in labor, but face an increasing marginal cost of labor, creating an inverse farm productivity–farm size relationship. [Carter and Yao \(2003\)](#) label this phenomenon “local” non-separability, and suggest that proper empirical accounting for the endogeneity of market failure would help make sense out of the inchoate empirical literature on farm productivity and size.

Endogenous market failure and local non-separability relate closely to work on market participation and transactions costs discussed earlier. In a paper aptly subtitled “paradoxes explained,” [de Janvry et al. \(1991\)](#) show that because transactions costs drive a wedge between producer and consumer prices, some households may fall into a non-participation regime in which they neither purchase nor sell the goods they produce. Because they

do not face parametrically given prices, such households exhibit behaviors associated with the non-separable Chayanovian model, including sluggish response to price incentives. While [de Janvry et al. \(1991\)](#) ignore the endogeneity of market participation, subsequent work by [Key et al. \(2000\)](#) and [Bellemare and Barrett \(2006\)](#) explores the endogeneity of market participation decisions in the face of fixed and variable transactions costs, and draws out its econometric implications.

The second advance that emerged from the inconsistent evidence on the relationship between farm productivity and size has been a deeper reconsideration of the role of capital in small-scale farming. While the simple Chayanovian model ignores purchased inputs, the advent of the Green Revolution revealed the tenuousness of this assumption. Authors began to ask whether the increasing importance of purchased inputs, and small farmers’ inability to access them because of market or financial constraints, might erode the inverse relationship.

Contribution #9: Showing how incomplete and thin markets, in the presence of transactions costs, influence technology adoption, on-farm productivity and welfare dynamics

Buttressed by ample descriptive evidence that working capital to purchase inputs was scarce and expensive in low-income agricultural economies, a literature grew up around the concern that capital constraints retard rates of growth and development. In an important contribution, [Feder \(1985\)](#) explored the impact of wealth-biased access to capital on the inverse farm size–farm productivity relationship, showing that if capital access improved with (collateralizable) land endowments, then the relationship between farm productivity and size could become positive even in the presence of the classic Chayanovian land and labor market failures.

The seemingly obvious solution to this problem of scarce and expensive agricultural capital was to impose interest rate ceilings, often augmented by the creation of public development banks that offered agricultural loans at concessional interest rates. Unfortunately, this experiment in public sector banking led to high default rates and a pattern of unsustainable lending that required annual infusions of capital. The influential USAID Spring Review of Small Farmer Credit ([Donald 1976](#)) documented this situation and became the

foundation for the “Ohio State” critique of rural financial market interventions (Adams et al. 1984). Buttressing this critique were the arguments that observed ‘usurious’ interest rates simply reflected the real costs of lending to small farms, and that well-intentioned efforts to assist with interest rate restrictions caused small farm credit to dry up completely through the operation of what Gonzalez-Vega called the iron-law of interest rate restrictions (Gonzalez-Vega 1984).

Even as the influential Ohio State critique moved policy toward laissez faire principles, a second generation of analysis influenced by the economics of imperfect information (Stiglitz and Weiss 1982) questioned what a laissez faire credit market equilibrium would look like in low-income agriculture. Carter (1988) showed that even a laissez faire credit equilibrium may exclude the small farm sector because lenders worried about the adverse consequences of moral hazard and adverse selection engage in non-price rationing (i.e., imposing their own interest rate ceilings) that leads to wealth-biased credit rationing of the sort Gonzalez-Vega attributed to government intervention. Binswanger and Rosenzweig (1986) added the important observation that covariant risk in agriculture further suppresses the development of deep agricultural loan markets in risk-prone, rainfed, low-income agricultural sectors.

Although its theoretical foundations are clear, the empirical relevance of non-price rationing in agricultural credit markets has remained a matter of dispute. One stream of econometric work has tried to identify credit constraints by estimating whether credit market interventions created returns in excess of the market price of capital. While the answer has generally been yes, even studies that control for non-random participation in credit programs (e.g., Sial and Carter 1996) may be confounding the impact of relaxing credit constraints with the intrinsic productivity of those farms that choose to participate in credit programs.

More generally, empirical efforts to identify the importance of credit constraints have struggled with a fundamental identification problem. Without additional information, it is unclear whether farms with no loans have zero demand for credit because such farms have cheaper sources of finance or simply have no productive investment projects, or zero loan supply because of non-price rationing. One approach to this problem has been

to employ the econometrics of unobserved regime switching, in which the probability that a farm is in the zero demand or the zero supply regime is simultaneously estimated with the parameters of the demand and supply functions (Kochar 1998; Bell, Srinivasan, and Udry 1999).

Feder et al. (1990) pioneered another approach that has since become labeled “constraint elicitation” (Boucher et al. 2009). In this approach, ancillary questions about credit application and demand are used to separate non-borrowing households into those with and those without (unmet) credit demand. Once this sample separation is attained, more conventional econometrics can then be employed to estimate the incidence and impact of non-price rationing in credit markets. Evidence based on this approach suggests that perhaps 40% of small farms suffer productivity losses related to non-price rationing in credit markets (World Bank 2007), figures generally in line with the literature that employs unobserved regime switching econometrics.

If there is at least imperfect evidence that credit constraints limit the productivity and income of small farmers, then the question of what to do about it retains its importance. The ‘microfinance revolution’ that employed novel incentive and contractual devices to enhance the credit access of collateral-poor households in the urban sector has had more modest impact on agricultural credit. This outcome is not surprising given that microfinance lending principles are undercut in agriculture by the preponderance of covariant risk. One resolution to this problem might be to use the sort of index insurance contracts discussed by Hazell (1992) to remove the covariant risk from the system, with the expectation that this can crowd-in credit supply from microfinance and other lending institutions. While there are now several experiments underway to test this proposition, its effectiveness has yet to be proven.

Contribution #10: Understanding how and why state efforts to change the nature of rights in land cause improved credit, productivity, security and welfare outcomes, and for whom they do not and why

While the basic Chayanovian household model suggests that small, family labor farms will have a productivity advantage in the face of land and labor market imperfections, wealth-biased capital access creates a countervailing market

failure that potentially offsets this advantage. Feder's (1985) work on countervailing market failures was closely followed by general equilibrium analysis that asked whether and how productivity is influenced by the distribution of land among rural households when there are imperfections in both labor and capital markets (Eswaran and Kotwal 1984). Their numerical analysis shows that an economy with high land inequality will indeed produce less than an economy with a more equal land distribution. They also show that a credit market reform that equalizes access to capital across farm households will have an effect similar to land redistribution.

These analyses reopened a long-standing debate about redistributive land reform. Much as the rural finance group at Ohio State played a key role in influencing policy on agricultural credit, the Land Tenure Center (LTC) at the University of Wisconsin played an important role in land reform policy in the 1960s and 1970s. LTC's work was predicated on the Chayanovian notion that small farms were more productive than large farms, and hence redistribution of land and from the large to small holders would improve economic performance and enhance social equity. Two books by Peter Dorner (1970; 1992) nicely capture the spirit of this argument.

Redistributive land reform, of course, proved politically contentious, with some of the more ambitious redistribution programs implemented as part of political coups or social revolutions. The economics of redistributive reform also came under attack by those who doubted the capacity of small farms to handle the capital and risk requirements of modern agriculture. Ironically, some of the more ambitious redistributive reforms in Latin America (Chile, Cuba, El Salvador, Nicaragua, and Peru) converted large-scale private farms into large-scale cooperative or state farms (rather than redistributing land to smallholders) because reform administrators doubted the productive capacity of smallholders. As discussed in Thiesenhusen (1989), these cooperativist reforms in most instances eventually decollectivized and shifted to smaller-scale, family farms, as also happened to similar farms in China and in much of Eastern Europe and the former Soviet Union.

Empirical work such as Lin (1992) on China, and Macours and Swinnen (2002) on Eastern Europe, finds substantial productivity gains accompanied the eventual shift to smaller-scale farming. At a policy level, recent years

have seen a renewed interest in redistributive reforms, although this time with redistribution pursued through market-assisted programs, in which beneficiaries receive grants that allow them to purchase land from large-scale farmers (Deininger 2001). Market-assisted reforms remain based on a Chayanovian logic that small farmers' superior productivity impart competitive advantage in land markets. While such programs have been implemented in several places (most prominently in Brazil and South Africa), the evidence on their effectiveness remains thin.

The growing literature on the security of property rights over land held by farmers has been closely intertwined with debates over land reform. Feder et al. (1988) found that policies that enhanced the formal, legal tenure security of Thai farmers offered substantial payoffs in the form of increased investment and enhanced productivity. Such payoffs were hypothesized to arise due to interactions between credit supply effects (which occur if legally titled land offers improved collateral to agricultural lenders) and investment demand effects (which occur if legal title increases farmers' willingness to make long-lived investments as they are assured or recouping the benefits of up-front investment costs over a longer time horizon). Influenced by these arguments, property rights reform policies quickly became and remain a staple of agricultural development policies.

The empirical evidence on these policies has been mixed, especially in areas of Africa characterized by customary tenure systems (Bruce and Migot-Adholla 1994). In these circumstances, property rights reform policies represent an individualization (or redistribution) of rights as well as change in the legal status of rights already held. An especially careful study finds no evidence of an investment effect in Burkina Faso, and suggests that the customary tenure system was not insecure and that the rural financial system was unresponsive to the putative increases in the collateral value of land (Brasselle, Gaspart, and Platteau 2002).

In a study in a Latin American economy with better-functioning credit markets, Carter and Olinto (2003) separately identified the credit supply from the investment demand effect. They found that the latter applied to everyone, but that the credit supply only expanded for medium- and larger-scale farmers, with the net result that property rights reform had substantial impacts for only relatively advantaged farmers. Evidence on

the effectiveness of these programs continues to trickle in (Deininger and Jin 2006) but remains subject to serious econometric attribution problems that may benefit from impact evaluation based on randomized program roll-outs now being attempted by the Millennium Challenge Corporation. Overall, agricultural economists have made a major contribution to improved understanding of the role of property rights in economic development.

Contribution #11: Risk arising from multiple sources is omnipresent in rural areas, especially in agriculture, and households therefore actively manage such risk, sometimes in ways that may trap them in chronic poverty, in the absence of more effective risk management instruments

As discussed throughout this section, imperfect markets mean that household technology and other choices are fundamentally shaped by wealth endowments. At a theoretical level, these core insights have been based on static models, taking household endowments as given. Of course, household endowments of land, labor, and financial assets evolve endogenously over time. Perhaps households can use time as an additional degree of freedom to work around imperfect markets, by building up their own savings to offset non-price rationing in credit markets. If they can, then the endowment sensitivity explored by agricultural economists from Chayanov to Dörner to Feder to Binswanger might be a transitory phenomenon. Tackling this question with a dynamic general equilibrium analysis, Carter and Zimmerman (2000) find that, indeed, time can erase the impact of initial land ownership inequality on economic performance, although the transition is slow and costly. While provocative, the Carter-Zimmerman analysis ignores that time also introduces risk. Analysis of the dynamics of accumulation without attention to the economics of risk seems incomplete.

Risk and its impact on decision making has played an important role in the economics of agricultural development, especially from the pioneering work of Hans Binswanger measuring risk aversion in India and studying its impact on technology choice (Binswanger 1980; 1981). Perhaps one of the more important observations by Binswanger and his collaborators was that risk mattered most not because different individuals varied in their degree of subjective risk aversion, but because they differed in their access to credit and other

financial markets that could be used to mediate risk (Binswanger and Sillers 1983).

Under the assumption that income was generated by a stationary process (i.e., capital was not needed to produce income), Deaton (1991) showed that a modest amount of risk could be managed through the maintenance of a stock of savings which could be used to smooth consumption in the face of income fluctuations and credit constraints. Subsequent studies extended the Deaton model to consider the savings and accumulation decisions of credit-constrained agricultural households that needed capital in the production process.

One of the most important implications that emerged from this literature is the prospect of multiple dynamic equilibriums or poverty traps. As discussed by Carter and Barrett (2006), there are several types of dynamic models in which risk and capital constraints come together to create a poverty trap, understood as an initial wealth threshold below which the household will optimally settle into a low-level dynamic equilibrium. Households that begin with endowments above that threshold will optimally move toward a higher-level equilibrium. The implications are potentially profound because a poverty trap suggests that an unequal agrarian asset distribution which leaves large numbers of households below the critical asset threshold will stagnate and yield high levels of persistent poverty. Uninsured risk in the face of a poverty trap also has far higher costs than suggested by static models. While empirical evidence of the existence of poverty traps in low-income rural economies remains modest (Lybbert et al. 2004; Barrett et al. 2006), the poverty traps hypothesis is already motivating a reexamination of the index insurance ideas of Peter Hazell (1992), Jerry Skees, and others to see if sufficient risk can be removed from low-income agricultural systems to alter fundamental poverty trap dynamics (Barnett et al. 2008).

Contribution #12: Establishing models and evidence that underscore how failure to look within the household at intra-family distributional and behavioral heterogeneity, especially with respect to gender, can be as important an oversight as failure to look within a macroeconomy at interhousehold heterogeneity of behavior and well-being

The basic household model treats utility as a function of the per capita levels of

consumption and leisure. Such representations are only valid to the extent that intra-household inequality in the distribution of goods is trivial. While interhousehold inequality is clearly non-trivial, growing evidence that intra-household inequality can also be non-trivial sparked the growth of a literature, and eventually policies, focused on intra-household distribution.

Drawing on Philippine data, Folbre (1984) provocatively argued that observed patterns of intra-household inequality were hard to rationalize with any model that assumed beneficent maximization of a unified, family utility function. Building on the nascent intra-household bargaining literature (e.g., McElroy and Horney 1981), analysis of the rural household in developing countries began to explore models that replaced the unified maximand of the Chayanovian model with a household bargaining function based on individual utility functions and threat points based on the assets that the individual can carry away from the household should it dissolve, as well as the external legal and social environment that shapes individuals' ability to use those assets.

Even assuming that household members can make and costlessly enforce bargains over all resource allocation decisions, this individualized or deconstructed household models yields a number of important insights. Chief among these are that interventions influencing the exit option of one household member may affect the intra-household distribution of goods. For example, interventions that enhance men's legal and economic control over land resources in an effort to enhance 'household welfare' may actually weaken women's bargaining power and decrease their and their children's well-being. As a consequence of the weight of the theoretical and empirical evidence built up around this point (Haddad et al. 1997; Quisumbing 2003), a number of rural development policies have been designed with the intra-household bargaining equilibrium in mind. Examples include efforts to assure that both men and women benefit from land titling programs (Deere and León 2001), as well as efforts to target social transfers to women with the expectation that enhancing women's economic endowments improves child outcomes because women's preferences favor children relative to men's preferences.

Linking back to a core thread of the agricultural development literature, intra-household bargaining can also result in inefficient

production patterns in the sense of failure to equalize returns to factors of production allocated among different household production activities (Jones 1983; Udry 1996). While these production-side issues have proven difficult to study, the preponderance of evidence that bargaining matters for household expenditure priorities continues to shape and reshape a broad range of agricultural interventions in low-income countries.

An agricultural development research agenda for the twenty-first century

Agricultural development has regained prominence in global development and foreign policy debates after decades in intellectual and political exile. At a fundamental level, however, the core research questions have changed little over the past half century. The challenge for scholars is to theorize rigorously while contextualizing appropriately in order to generate empirically defensible models that can help explain, even shape and accelerate, the structural change necessary for a billion-plus people to escape chronic poverty and hunger. The specifics of an appropriate research agenda vary, however, so we chart a course forward by region.

Asia

East and Southeast Asia are often held up as examples of how to modernize agriculture on behalf of a broader development agenda. Certainly, agricultural productivity has risen rapidly in much of Asia in the past half century, and rates of hunger and poverty have fallen sharply. There are many positive lessons from Asia on how to "do" agricultural development. Yet much remains to be done on this basic agenda, and the problems of success raise further research issues. In particular, managing a rapid structural transformation presents transition problems that need to be solved in a generation or two, not the century or longer that most OECD countries had. The coexistence of millions of small-scale farms with modern industrial and service sectors is fraught with economic and political challenges. Can these small farms be integrated efficiently into modern supply chains? Will substantial consolidation be needed, requiring even faster urban job creation? No blueprints exist as to how the rural nonfarm sector might absorb many of the workers presently engaged on small farms.

Thus there is a growing recognition that the future of rural development in Asia may be largely through urban development.

Rural poverty remains endemic in much of South Asia, where issues of land tenure, access to modern inputs and technology, and institutions capable of managing price and yield risk are still prominent on the research agenda. In East and Southeast Asia, rural poverty remains significant in regions that are isolated from mainstream economic activities or face serious resource constraints and poor water control. In these regions, the research agenda looks strikingly similar to that for Africa.

Africa

Africa is the one continent on which the share of population living in extreme poverty or suffering hunger has not fallen in a generation. It is also the only major world region not to enjoy any appreciable growth in food production per capita over the same period, in spite of the fact that Africa remains the most rural of the inhabited continents.

The core challenges in Africa thus revolve around identifying the sources of rural poverty traps and effective intervention points for unlocking the continent's agricultural potential. Having been largely bypassed by the Green Revolution, what is the most effective means to stimulate technical change, enhanced market participation, and productivity growth? What are the tradeoffs between targeting higher potential agro-ecological zones with better market access versus areas that have been less favored by both nature and governments? What institutional changes are at once politically feasible, socioculturally acceptable, and economically and environmentally sustainable means of igniting pro-poor growth, especially in the rural nonfarm economy, so as to reduce the pressures of excessively rapid urbanization now felt in many African countries? Given the threat posed by expected increases in climate variability over the coming century, and continued commodity price and political instability on the continent, what new mechanisms can be devised to help vulnerable Africans cope with considerable, even growing, risk exposure? Finally, as Africa's natural capital is being rapidly depleted through soil, forest, and biodiversity losses, and with only 7% of cultivated area under irrigation, what can be done to improve natural resources management so as to enable and sustain productivity gains?

Perhaps, because Africa has seen the least progress in the half century or so since agricultural development research became vibrant, the essential research agenda there has evolved least.

Latin America

With the exception of a few countries, most of Latin America is now urbanized, with some 75% of the population living in cities, and less than 10% of GDP emanating from agriculture. At the same time, the poor reside disproportionately in rural areas, and the continent continues to struggle with its legacy of agrarian inequality. While a generation of redistributive land reform policies managed in some cases to reduce that inequality, Latin America has yet to develop the small farm-friendly market and institutional structures that facilitated agricultural development and a smooth agrarian transition in East Asia. Without those structures, new agricultural growth opportunities—be they based on exports or on supplying domestic supermarket chains—will likely bypass if not squeeze out the small farm sector, as has happened in the past.

A central question facing agricultural policymaking in Latin America is whether it is worthwhile to enhance the competitiveness of the small farm sector or even to expand its size through asset transfers or other redistributive measures. Some argue that it is not, and that rural poverty is best managed with conditional cash transfers that address intergenerational poverty transmission by facilitating children's human capital formation. Others argue that novel efforts to manage risk and facilitate the emergence of a financial sector able to deal with small farm agriculture are within reach and well worth the effort in terms of their capacity to achieve broadly based growth. An even bolder step would be to push further with market-assisted land reform as a mechanism to redress rural poverty that is perhaps more cost-effective than cash transfers.

The responses to these challenges will surely differ over time and between the different regions that comprise Latin America. In the meantime, as in all the world regions, the economics of agricultural development will continue to support those responses with an understanding of what makes agricultural economies function and dysfunction.

References

- Adams, D., D. Graham, and J. D. von Pischke. 1984. *Undermining Rural Development with Cheap Credit*. Boulder, CO: Westview.
- Alston, J.M., C. Chan-Kang, M.C. Marra, P.G. Pardey and T.J. Wyatt. 2000. A Meta-analysis of the Rates of Return to Agricultural R&D: Ex Pede Herculem? Washington: International Food Policy Research Institute.
- Ali, M., and D. Byerlee 1991. Economic Efficiency of Small Farmers in a Changing World: A Survey of Recent Evidence. *Journal of International Development* 3: 1–27.
- Anderson, K. 1986. Economic Growth, Structural Change and the Political Economy of Protection. In K. Anderson, *The Political Economy of Agricultural Protection*. Boston: Allen and Unwin, pp. 7–16.
- Antle, J. M., and C. C. Crissman. 1990. Risk, Efficiency, and the Adoption of Modern Crop Varieties: Evidence from the Philippines. *Economic Development and Cultural Change* 38: 517–37.
- Arthur, W. B. 1994. *Increasing Returns and Path Dependence in the Economy*. Ann Arbor: University of Michigan Press.
- Azariadis, C., and J. Stachurski 2005. Poverty Traps. In P. Aghion and S. Durlauf, eds. *Handbook of Economic Growth*. Amsterdam: Elsevier.
- Bandiera, O., and I. Rasul 2006. Social Networks and Technology Adoption in Northern Mozambique. *Economic Journal* 116: 869–902.
- Barnett, B., C. B. Barrett, and J. R. Skees 2008. Poverty Traps and Index-Based Risk Transfer Products. *World Development* 36: 1766–85.
- Barrett, C. B. 1997. How Credible Are Estimates of Peasant Allocative, Scale or Scope Efficiency? A Commentary. *Journal of International Development* 9: 221–9.
- . 2002. Food Security and Food Assistance Programs. In B. L. Gardner and G. Raussier, eds. *Handbook of Agricultural Economics*, vol. 2b. Amsterdam: Elsevier.
- Barrett, C. B., P. P. Marennya, J. McPeak, B. Minten, F. Murithi, W. Oluoch-Kosura, F. Place, J. C. Randrianarisoa, J. Rasambainarivo, and J. Wangila. 2006. Welfare Dynamics in Rural Kenya and Madagascar. *Journal of Development Studies* 42: 248–77.
- Bates, R. H. 1981. *Markets and States in Tropical Africa: The Political Basis of Agricultural Policies*. Berkeley and Los Angeles: University of California Press.
- . 1998. The Political Framework for Agricultural Policy Decisions. In C. K. Eicher and J. M. Staatz, eds. *International Agricultural Development*, 3rd edn. Baltimore: Johns Hopkins University Press, pp. 234–9.
- Baulch, B. 1997. Transfer Costs, Spatial Arbitrage, and Testing for Food Market Integration. *American Journal of Agricultural Economics* 79: 477–87.
- Bell, C., T. N. Srinivasan, and C. Udry 1997. Rationing, Spillover and Interlinking in Credit Markets: The Case of Rural Punjab. *Oxford Economic Papers* 49: 557–85.
- Bellemare, M. F., and C. B. Barrett 2006. An Ordered Tobit Model of Market Participation: Evidence from Kenya and Ethiopia. *American Journal of Agricultural Economics* 88: 324–37.
- Berry, R. A., and W. Cline. 1979. *Agrarian Structure and Productivity in Developing Countries*. Baltimore: Johns Hopkins University Press.
- Besley, T., and A. Case 1993. Modeling Technology Adoption in Developing Countries. *American Economic Review* 83: 396–402.
- Binswanger, H. P. 1980. Attitudes Toward Risk, Experimental Measurement in Rural India. *American Journal of Agricultural Economics* 62: 395–407.
- . 1981. Attitudes Toward Risk, Theoretical Implications of an Experiment in Rural India. *Economic Journal* 91: 867–90.
- Binswanger, H. P., and M. Rosenzweig 1986. Behavioural and Material Determinants of Production Relations in Agriculture. *Journal of Development Studies* 22: 503–39.
- Binswanger, H., and D. Sillers 1983. Risk Aversion and Credit Constraints in Farmers' Decision-Making: A Reinterpretation. *Journal of Development Studies* 20(1): 5–19.
- Binswanger, H., and V. W. Ruttan. 1978. *Induced Innovation: Technology, Institutions and Development*. Baltimore: Johns Hopkins University Press.
- Boucher, S., C. Guiringer, and C. Trivelli. 2009. Direct Elicitation of Credit Constraints: Conceptual and Practical Issues with an

- Application to Peruvian Agriculture. *Economic Development and Cultural Change* 57: 609–40.
- Brasselle, A. -S., F. Gaspart, and J.-P. Platteau. 2002. Land Tenure Security and Investment Incentives: Further Puzzling Evidence from Burkina Faso. *Journal of Development Economics* 67: 373–418.
- Bruce, J., and S. Migot-Adholla. 1994. *Searching for Land Tenure Security in Africa*. Boulder, CO: Kendall/Hunt Press.
- Carter, M. 1988. Equilibrium Credit Rationing of Small Farm Agriculture. *Journal of Development Economics* 28: 83–103.
- Carter, M. R., and P. Olinto. 2003. Getting Institutions Right for Whom? Credit Constraints and the Impact of Property Rights on the Quantity and Composition of Investment. *American Journal of Agricultural Economics* 85: 173–86.
- Carter, M., and Y. Yao. 2002. Local versus Global Separability in Agricultural Household Models: The Factor Price Equalization Effect of Land Transfer Rights in China. *American Journal of Agricultural Economics* 84: 702–15.
- Carter, M., and F. Zimmerman. 2000. The Dynamic Costs and Persistence of Asset Inequality in An Agrarian Economy. *Journal of Development Economics* 63: 265–302.
- Carter, M. R., and C. B. Barrett. 2006. The Economics of Poverty Traps and Persistent Poverty: An Asset Based Approach. *Journal of Development Studies* 42: 178–99.
- Chayanov, A. V. 1965. *Peasant Farm Organization*. Homewood, IL: Richard Irwin Press.
- Chenery, H. B., and M. Syrquin. 1975. *Patterns of Development, 1950–1970*. London: Oxford University Press.
- Cochrane, W. W. 1958. *Farm Prices: Myth and Reality*. Minneapolis: University of Minnesota Press.
- Conley, T. G., and C. R. Udry. Forthcoming. Learning About a New Technology: Pineapple in Ghana. *American Economic Review*.
- Dasgupta, P. 1993. *An Inquiry into Well-Being and Destitution*. Oxford: Oxford University Press.
- . 1997. Nutritional Status, the Capacity for Work, and Poverty Traps. *Journal of Econometrics* 77: 5–37.
- David, C. C. and K. Otsuka. 1994. Modern Rice Technology and Income Distribution in Asia. Boulder, CO: Lynne Rienner.
- David, P. A. 1985. Clio and the Economics of QWERTY. *American Economic Review* 76: 332–7.
- Deaton, A. 1991. Savings and Liquidity Constraints. *Econometrica* 59: 1221–48.
- Deininger, K. 2001. Market Assisted Land Reform. In A. de Janvry, E. Sadoulet, and G. Gordillo, eds. *Land Reform and Public Policy*. Oxford: Oxford University Press.
- Deininger, K., and S. Jin 2006. Tenure Security and Land-Related Investment: Evidence from Ethiopia. *European Economic Review* 50: 1245–77.
- Deere, C., and M. León. 2001. *Empowering Women: Land and Property Rights in Latin America*. Pittsburgh: University of Pittsburgh Press.
- De Gorter, H., and J. Swinnen. 2002. Political Economy of Agricultural Policy. In B. Gardner and G. Rausser, eds. *Handbook of Agricultural Economics, Vol. IIA*. Amsterdam: North-Holland, pp. 1893–943.
- De Janvry, A. 1981. *The Agrarian Question and Reformism in Latin America*. Baltimore: Johns Hopkins University Press.
- De Janvry, A., Fafchamps, M., and Sadoulet, E. 1991. Peasant Household Behavior with Missing Markets: Some Paradoxes Explained. *Economic Journal* 101: 1400–17.
- Delgado, C., J. Hopkins, and V. A. Kelly. 1998. *Agricultural Growth Linkages in Sub-Saharan Africa*. IFPRI Research Report 107. Washington, DC: IFPRI.
- Donald, G. 1976. *Credit for Small Farmers in Developing Countries*. Boulder: Westview Press.
- Dorner, P. 1970. *Land Reform*. New York: Penguin Press.
- . 1992. *Latin American Land Reforms in Theory and Practice*. Madison: University of Wisconsin Press.
- Drèze, J., and A. Sen. 1989. *Hunger and Public Action*. Oxford: Clarendon Press.
- Eswaran, M., and A. Kotwal 1984. Access to Capital and Agrarian Production Organization. *Economic Journal* 96: 482–98.
- Evenson, R. E., and D. Gollin, eds. 2003. *Crop Variety Improvement and Its Effect on Productivity: The Impact of International Agricultural Research*. Wallingford, UK: CABI.

- Fackler, P., and B. K. Goodwin. 2001. Spatial Price Analysis, in B. Gardner and G. Rauser, eds. *Handbook of Agricultural Economics*, vol. 2A. Amsterdam: Elsevier.
- Fafchamps, M. 2004. *Market Institutions in Sub-Saharan Africa: Theory and Evidence*. Cambridge, MA: MIT Press.
- Feder, G., L. Lau, J. Lin, and X. Luo. 1990. The Relationship between Credit and Productivity in Chinese Agriculture: A Microeconomic Model of Disequilibrium. *American Journal of Agricultural Economics* 72: 1151–7.
- Feder, G., T. Oncham, Y. Chalamwond, and C. Hongladaron. 1988. *Land Policies and Farm Productivity in Thailand*. Baltimore: Johns Hopkins University Press.
- Feder, G. 1985. The Relation between Farm Size and Farm Productivity: The Role of Family Labor, Supervision and Credit Constraints. *Journal of Development Economics* 18: 85–101.
- Feder, G., R. E. Just, and Zilberman, D. 1985. Adoption of Agricultural Innovations in Developing Countries: A Survey. *Economic Development and Cultural Change* 33: 255–98.
- Folbre, N. 1984. Household Production in the Philippines: A Non-neoclassical Approach. *Economic Development and Cultural Change* 32: 303–30.
- Fogel, R. 2004. *The Escape from Hunger and Premature Death, 1700–2100*. Cambridge: Cambridge University Press.
- Foster, A. D., and M. R. Rosenzweig, 1995. Learning by Doing and Learning from Others: Human Capital and Technical Changes in Agriculture. *Journal of Political Economy* 103: 1176–209.
- Gardner, B. L. 2002. *American Agriculture in the Twentieth Century: How it Flourished and What it Cost*. Cambridge, MA: Harvard University Press.
- Goetz, S. J. 1992. A Selectivity Model of Household Food Marketing Behavior in Sub-Saharan Africa. *American Journal of Agricultural Economics* 74: 444–52.
- Griliches, Z. 1957. Hybrid Corn: An Exploration in the Economics of Technological Change. *Econometrica* 25: 501–22.
- Gonzalez-Vega, C. 1984. Credit Rationing Behavior of Agricultural Lenders: The Iron Law of Interest Rate Restrictions. In D. Adams, D. H. Graham, and J. D. Von Pischke, eds. *Undermining Rural Credit with Cheap Credit*. Boulder, CO: Westview Press.
- Haddad, L., J. Hoddinott, and H. Alderman, eds. 1997. *Intrahousehold Resource Allocation in Developing Countries: Methods, Models and Policies*. Baltimore: Johns Hopkins University Press.
- Haggblade, S., P. B. R. Hazell, and T. Reardon, eds. 2007. *Transforming the Rural Non-farm Economy: Opportunities and Threats in the Developing World*. Baltimore: Johns Hopkins University Press.
- Hazell, P. 1992. The Appropriate Role of Agricultural Insurance in Developing Countries. *Journal of International Development* 4: 567–81.
- Hayami, Y., and V. Ruttan. 1985. *Agricultural Development: An International Perspective*. Rev., exp. edn. Baltimore: Johns Hopkins University Press.
- Johnson, D. G. 1997. Agriculture and the Wealth of Nations (Ely Lecture). *American Economic Review* 87: 1–12.
- Johnston, B. F., and J. W. Mellor. 1961. The Role of Agriculture in Economic Development. *American Economic Review* 51: 566–93.
- Johnston, B. F., and P. Kilby. 1975. *Agriculture and Structural Transformation: Economic Strategies in Late-Developing Countries*. Oxford: Oxford University Press.
- Johnston, B. F., and W. C. Clark. 1982. *Redesigning Rural Development: A Strategic Perspective*. Baltimore: Johns Hopkins University Press.
- Jones, C. 1983. The Mobilization of Women's Labor for Cash Crop Production: A Game Theoretic Approach. *American Journal of Agricultural Economics*, 65: 1049–54.
- Jones, W. O. 1972. *Marketing Staple Food Crops in Tropical Africa*. Ithaca, NY: Cornell University Press.
- Jorgenson, D. 1961. The Development of a Dual Economy. *Economic Journal*. 71: 309–34.
- Key, N., E. Sadoulet, and A. de Janvry. 2000. Transactions Costs and Agricultural Household Supply Response. *American Journal of Agricultural Economics* 82: 245–59.
- Kochar, A. 1998. An Empirical Investigation of Rationing Constraints in Rural Markets in India. *Journal of Development Economics* 53: 339–72.
- Krueger, A. O., M. Schiff, and A. Valdes. 1991. *The Political Economy of Agricultural Pricing Policy*. Baltimore: Johns Hopkins University Press.

- Lewis, W. A. 1954. Economic Development with Unlimited Supplies of Labor. *The Manchester School* 22: 3–42.
- Lin, J. Y. 1992. Rural Reforms and Agricultural Growth in China. *American Economic Review* 82: 34–51.
- Lin, J. Y., and J. B. Nugent. 1995. Institutions and Economic Development. In J. Behrman and T. N. Srinivasan, eds., *Handbook of Development Economics*, volume 3. Amsterdam: North-Holland. pp. 2301–70.
- Lindert, P. H. 1991. Historical Patterns of Agricultural Policy. In C. P. Timmer, ed. *Agriculture and the State: Growth, Employment and Poverty in Developing Countries*. Ithaca: Cornell University Press, pp. 29–83.
- Lipton, M. 1977. *Why Poor People Stay Poor: Urban Bias in World Development*. Cambridge, MA: Harvard University Press.
- Lucas, R. E. 1988. On the Mechanics of Economic Development. *Journal of Monetary Economics*, 22: 2–42.
- Lybbert, T. J., C. B. Barrett, S. Desta, and D. L. Coppock. 2004. Stochastic Wealth Dynamics and Risk Management among a Poor Population. *Economic Journal* 114: 750–77.
- Macours, K., and Swinnen J. 2002. Patterns of Agrarian Transition. *Economic Development and Cultural Change* 50: 365–95.
- McElroy, M. B., and M. J. Horney. 1981. Nash-Bargained Household Decisions: Toward a Generalization of the Theory of Consumer Demand. *International Economic Review* 22: 333–49.
- Mellor, J. W. 1966. *The Economics of Agricultural Development*. Ithaca: Cornell University Press.
- . 1976. *The New Economics of Growth: A Strategy for India and the Developing World*. Ithaca, NY: Cornell University Press.
- . 1986. Agriculture on the Road to Industrialization. In J. P. Lewis and V. Kallab, eds. *Development Strategies Reconsidered*. New Brunswick, NJ: Overseas Development Council.
- . 2000. *Agricultural Growth, Rural Employment, and Poverty Reduction: Non-Tradables, Public Expenditure, and Balanced Growth*. Washington, DC: World Bank.
- Minten, B., and C. B. Barrett. 2008. Agricultural Technology, Productivity and Poverty in Madagascar. *World Development* 36: 797–822.
- Moser, C. M., and Barrett, C. B. 2006. The Complex Dynamics of Smallholder Technology Adoption: The Case of SRI in Madagascar. *Agricultural Economics* 35: 373–88.
- Mosher, A. T. 1966. *Getting Agriculture Moving: Essentials for Development and Modernization*. New York: Praeger.
- Mundlak, Y. 2000. *Agriculture and Economic Growth: Theory and Measurement*. Cambridge, MA: Harvard University Press.
- Olson, M. 1965. *The Logic of Collective Action*. Cambridge, MA: Harvard University Press.
- Omamo, S. W. 1998. Transport Costs and Smallholder Cropping Choices: An Application to Siaya District, Kenya. *American Journal of Agricultural Economics* 80: 116–23.
- Prasada Rao, D. S., A. Maddison, and B. Lee. 2002. International Comparison of Farm Sector Performance: Methodological Options and Empirical Findings for Asia-Pacific Economies, 1900–94. In A. Maddison, D.S. Prasada Rao, and W.F. Shepherd, eds. *The Asian Economies in the Twentieth Century*. Edward Elgar. pp. 27–52.
- Quisumbing, A. 2003. *Household Decisions, Gender and Development: A Synthesis of Recent Research*. Baltimore: Johns Hopkins University Press.
- Raizter, D. A., and T. G. Kelley. 2008. Benefit–Cost Meta-analysis of Investment in the International Agricultural Research Centers of the CGIAR. *Agricultural Systems* 96: 108–23.
- Ranis, G., and J. C. H. Fei. 1961. A Theory of Economic Development. *American Economic Review* 51: 533–65.
- Ravallion, M. 1986. Testing Market Integration. *American Journal of Agricultural Economics* 68: 102–09.
- . 1997. Famines and Economics. *Journal of Economic Literature* 35: 1205–42.
- Reardon, T., C. P. Timmer, C. B. Barrett, and J. Berdegue. 2003. The Rise of Supermarkets in Africa, Asia, and Latin America. *American Journal of Agricultural Economics* 85: 1140–46.
- Reardon, T., C. B. Barrett, J. A. Berdegue, and J. F. M. Swinnen. 2009. Agrifood Industry Transformation and Small Farmers in Developing Countries. *World Development* 37: 1717–1727.

- Romer, P. 1994. New Goods, Old Theory, and the Welfare Costs of Trade Restrictions. *Journal of Development Economics* 43: 5–38.
- Ruttan, V. W. 1980. Bureaucratic Productivity: The Case of Agricultural Research. *Public Choice* 35: 529–47.
- . 1997. Induced Innovation, Evolutionary Theory and Path Dependence: Sources of Technical Change. *Economic Journal* 107: 1520–9.
- Schultz, T. W. 1945. *Agriculture in an Unstable Economy*. New York: McGraw-Hill.
- . 1953. *The Economic Organization of Agriculture*. New York: McGraw-Hill.
- . 1964. *Transforming Traditional Agriculture*. New Haven: Yale University Press.
- . 1975. The Value of the Ability to Deal with Disequilibria. *Journal of Economic Literature* 13: 827–46.
- . ed. 1978. *Distortions of Agricultural Incentives*. Bloomington: Indiana University Press.
- Sen, A. K. 1966. Peasants and Dualism with or without Surplus Labor. *Journal of Political Economy* 74: 425–50.
- . 1981. *Poverty and Famines*. Oxford: Oxford University Press.
- Sherlund, S. M., C. B. Barrett, and A. A. Adesina. 2002. Smallholder Technical Efficiency Controlling for Environmental Production Conditions. *Journal of Development Economics* 69: 85–101.
- Singh, I., L. Squire, and J. Strauss, eds. 1986. *Agricultural Household Models*. Baltimore: Johns Hopkins University Press.
- Sial, M., and M. Carter. 1996. Is Targeted Small Farm Credit Necessary? A Microeconomic Analysis of Capital Market Efficiency in the Punjab. *Journal of Development Studies* 32: 771–98.
- Solow, R. M. 1957. Technical Change and the Aggregate Production Function. *Review of Economics and Statistics* 39: 312–20.
- Staatz, J. M., and C. K. Eicher. 1998. Agricultural Development Ideas in Historical Perspective. In C. K. Eicher, and J. M. Staatz, eds. *International Agricultural Development*. 3rd edn. Baltimore: Johns Hopkins University Press, pp. 8–38.
- Stiglitz, J. E., and Weiss, A. 1981. Credit Rationing in Markets with Imperfect Information. *American Economic Review* 71: 393–410.
- Swinnen, J. F. M., ed. 2007. *Global Supply Chains, Standards and the Poor: How the Globalization of Food Systems and Standards Affects Rural Development and Poverty*. Wallingford, UK: CABI.
- Syrquin, M. 2006. Structural Transformation. In D. A. Clark, ed. *The Elgar Companion to Development Studies*. Cheltenham, UK: Edward Elgar Publishers, pp. 601–07.
- Thiesenhusen, W. 1989. *Searching for Agrarian Reform in Latin America*. Boston: Unwin-Hyman.
- Timmer, C. P. 1988. The Agricultural Transformation. In H. Chenery and T.N. Srinivasan, eds. *Handbook of Development Economics*, vol. 1. Amsterdam: North-Holland, pp. 275–331.
- Timmer, C. P. 1993. Rural Bias in the East and Southeast Asian Rice Economy: Indonesia in Comparative Perspective. In A. Varshney, ed. *Beyond Urban Bias*. London: Frank Cass, pp. 149–76.
- . 1995. Getting Agriculture Moving: Do Markets Provide the Right Signals? *Food Policy* 20: 455–72.
- . 2002. Agriculture and Economic Growth. In B. Gardner and G. Rausser, eds. *Handbook of Agricultural Economics*, Vol. IIA. Amsterdam: North-Holland. 1487–546.
- . 2009. *A World without Agriculture: The Structural Transformation in Historical Perspective*. Henry Wendt Lecture, American Enterprise Institute, 2008.
- Udry, C. 1996. Gender, Agricultural Production and the Theory of the Household. *Journal of Political Economy* 104: 1010–46.
- World Bank. 2007. *World Development Report 2008: Agriculture for Development*. Oxford: Oxford University Press.