

Producers, Consumers, and Value Chains in Low- and Middle-Income Countries*

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Abstract

We present an overview of the literature on agri-food value chains in low- and middle-income countries. Starting from farmers' decision of whether to move away from subsistence agriculture to participate in agri-food value chains, we study the process whereby agricultural commodities make their way from the farm-gate to the final consumer, documenting the procurement relationships that arise and the organization of markets at every step of the way. In each step, we take stock of the empirical evidence, critically assess the research so far, and offer a number of directions for future research. We further discuss the challenges and opportunities for global agri-food value chains.

Keywords: Agri-food value chains, Producers, Consumers, Farmers, Smallholders, Rural Households, Agriculture, Value Chains, International Trade, Commodities

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1 Introduction

Graduate courses in economics typically begin with consumer theory or producer theory. In consumer theory, a utility-maximizing individual consumes goods and services subject to a budget constraint. In producer theory, a profit-maximizing firm produces goods and services given prices and available technology. Consumers and producers meet on the market and, given initial endowments, prices facilitate efficient transactions between the two textbook agents, who interact directly with each other.

This framework is useful in its simplicity, but it overlooks a number of real-world features. Perhaps most notably, the abstraction away from a world with transaction costs allows consumers and producers to effortlessly transact directly with each other. In the real world, however, transaction costs not only exist, but they are abundant and non-trivial. This abstraction is consequential, for as [Coase \(1990\)](#) writes:

"Without the concept of transaction costs, which is largely absent from current economic theory, it is my contention that it is impossible to understand the working of the economic system, to analyze many of its problems in a useful way, or to have a basis for determining policy. The existence of transaction costs will lead those who wish to trade to engage in practices which bring about a reduction of transaction costs whenever the loss suffered in other ways from the adoption of those practices is less than the transaction costs saved. The people one deals with, the type of contract entered into, the kind of product or service supplied, will all be affected. But perhaps the most important adaptation to the existence of transaction costs is the emergence of the firm."

Indeed, almost all of us rarely, if ever, transact directly with the primary producer of our food. Instead, we rely on a series of economic agents who process, package, transport, ensure consistency, check quality, monitor safety, and market products and services—including the food we eat. These many transactions combine to form agri-food value chains, which are central to the functioning, structural transformation, and economic development of modern economies ([Gollin, Parente and Rogerson, 2002](#)).

Our collective professional focus on consumer and producer theory, along with the explicit or implicit assumption that producers and consumers effortlessly transact, leads to an emphasis on researching the end points of our economic system. It is common for Ph.D. students—those who study agriculture or development, in particular—to focus entirely on the production or consumer side of the economy. It is rare to find a young researcher aiming to study the organization of agri-food firms and industries that bring consumers and producers together within low- and middle-income countries ([Bellemare, 2021a](#)). There are, of course, reasons for this—such as lack of data, methodological preferences, and

technical challenges—but as we will discuss in this chapter, none of these challenges are necessarily prohibitive.

Emerging research highlights that focusing on either of the extreme ends of agri-food value chains (i.e., farmers and final consumers of agricultural commodities or food) may overlook the other, perhaps more important, middle segments. First, [Yi et al. \(2021\)](#) estimate the distribution of consumer food expenditures between value-added activities on farms and in the post-farm value chain and find that more than 70 percent of consumer expenditure worldwide accrues to post-farm actors.¹ Second, [Dolislager et al. \(2021\)](#) show that the post-farm economy employs more people than the on-farm economy across Africa, Asia, and Latin America. Third, [Reardon, Liverpool-Tasie and Minten \(2021\)](#) find that the middle segments of agricultural value chains (e.g., processors, wholesalers, and logistics firms) are responsible for moving roughly 65 percent of all food consumed in Africa and South Asia. Despite these recent contributions, there is a paucity of research that empirically examines the size or distribution of agri-food value chains. We do not know, for example, which commodities generate the most value added or how that value added is distributed among workers, land owners, and firms along the agri-food value chain.

We are not the first to highlight the need for development economists to consider the intermediary links between primary producers and final consumers. In the 3rd volume of the *Handbook of Agricultural Economics*, [Reardon and Timmer \(2007\)](#) document the implications of the "supermarket revolution," which led to a consumer-driven transformation of the global agri-food system. Consumers—in the aftermath of this transformation—demand consistency, quality, safety, and variety in their food. Agri-food value chains around the world ensure that quality and food safety standards are consistently met all along the production process. [Reardon and Timmer \(2007\)](#), however, point out that,

"It is uncommon for the researchers that [understand] the management of global firms and their growth strategies—the agribusiness and retail researchers—to rub shoulders with development economists. It is not too late. These groups need to collaborate with each other, crossing cultural and methodological divides to create new approaches."

More than a decade later, [Barrett et al. \(2021\)](#) again point out that, "... most theories of agricultural development, structural transformation, and economic development abstract away from the important intermediation roles of agri-food value chains."

In this chapter, we extend existing reviews by [Reardon and Timmer \(2007\)](#) and [Barrett et al. \(2021\)](#) on agri-food value chains in low- and middle-income countries. While

¹These estimates are larger than those previously estimated by [Reardon et al. \(2012\)](#), which are described in [Reardon \(2015\)](#) as "too important to remain hidden."

these existing reviews are necessary treatments in and of themselves, we aim to fill gaps in each of these reviews to motivate and inspire future research on the important intermediary links between primary producers and final consumers within agri-food value chains. [Reardon and Timmer \(2007\)](#) discuss the transformation of agricultural markets in low- and middle-income countries by offering a primarily macro-oriented perspective and citing descriptive evidence along the way. We aim to discuss the credibility of the existing empirical evidence drawing on more recent innovations in causal inference and applied econometrics. [Barrett et al. \(2021\)](#) review recent research on agri-food value chains in low- and middle-income countries, and we aim to build on their contribution by emphasizing the industrial organization (IO) foundations of this literature. More fundamentally, we aim to build a structure for a number of studies associated with agri-food value chains in low- and middle-income countries, but which may not necessarily frame the contribution in terms of agri-food value-chains. In particular, we address three core questions: (i) What are the key findings of the wide range of studies associated with agri-food value chains and the economic development or structural transformation of low- and middle-income countries?, (ii) What are the gaps in this literature, and do we have the necessary data to fill these knowledge gaps?, and (iii) Can we define a new literature on agri-food value chains in low- and middle-income countries from the research that already exists, or must we build this literature from scratch?

But before we begin, we must discuss some preliminaries. First, what do we mean when we write about "agri-food value chains?" In the literature, the term "value chain" is often interchangeable with the term "supply chain." Thus, in its most generic form, an agri-food value chain is a system of economic agents (e.g., individuals, households, farms, and firms) which produce and move agricultural goods and services toward the final consumers of these goods and services. At a minimum, an agri-food value chain has two segments: an upstream segment, which produces raw agricultural commodities, and a downstream segment, which processes and markets the final food product to consumers. Thus even in the extreme but not uncommon case where a smallholder household grows a crop and a household member sells that crop at market, we can talk of an upstream segment (i.e., the cultivation of the crop) and a downstream segment (i.e., the marketing of the crop to consumers) that are fully vertically integrated because they both occur within the same economic agent (i.e., the agricultural household). We also follow [Barrett et al. \(2021\)](#) and use "agri-food" to modify our focus on value chains, rather than the more narrow terms "agricultural" or "food," since the value chain itself transforms the agricultural products grown on farms into the foods humans eat. The design of these value chains depends on the nature of innovation ([Swinnen and Kuijpers, 2019](#)) and therefore ultimately depend on learning and technology diffusion ([Zilberman, Lu and Reardon, 2019](#)).

Second, what do we mean by "structural transformation?" In economics, structural transformation is the name given to the empirical regularity whereby a decline in the relative role of an economy's agricultural sector is accompanied by a simultaneous rise of that economy's manufacturing sector (Lewis, 1954; Kuznets, 1957). Other outcomes of structural transformation include (i) increased agricultural output in spite of the decreasing share of the agricultural sector in the labor force (Johnston and Mellor, 1961), (ii) induced innovation fostering technological change (Hayami and Ruttan, 1985; Hanlon, 2015), (iii) increased specialization (Schultz, 1964), and (iv) the convergence of agricultural and non-agricultural earnings (Timmer, 1991).²

Third, what does the structural transformation of the economy have to do with agri-food value chains? Structural transformation requires market linkages between the rural agri-food sector and the urban or peri-urban industrial sector. Reardon (2015) notes that the structural transformation is often accompanied by (i) urbanization, (ii) the transformation of diets, and (iii) a transformation of the agri-food system to meet the demand for more consistent, safer, higher-quality, more processed, and more varied foods. Moreover, the structural transformation process is characterized as labor moving along the agri-food value chain—from on-farm production to post-farm processing and services providing support for industrial production. Thus, given that primary producers and final consumers rarely transact directly with each other, the structural transformation of an economy requires robust and effective agri-food value chains.

This chapter is organized as follows. In the next section, we focus on domestic agri-food value chains. In that section, we begin with the grower's decision to sell their agricultural products and proceed along the value chain by discussing intermediaries (i.e., traders and small retailers) and vertical coordination via contract farming before finally arriving at processors and large retailers. In Section 3, we discuss global agri-food value chains. As many of the concepts and topics are similar to domestic agri-food value chains, we focus our discussion on opportunities and challenges facing global agri-food value chains to promote structural transformation and economic development. This discussion leads to Section 4, where we explicitly discuss research gaps and offer directions for future research. Finally, Section 5 concludes.

2 Domestic Agri-Food Value Chains

Over 75 percent of the food produced for human consumption worldwide originates from the country where it is ultimately consumed (D'Odorico et al., 2014; FAO, 2020). Given

²For a more detailed review of the theoretical literature on structural transformation and economic development and empirical evidence of this transformation, see Michler (2020).

this, we begin by discussing domestic agri-food value chains, i.e., value chains that do not cross international borders as they make their way from the farm where agricultural products are produced to the final consumer.³ To do so, we discuss in turn a grower's decision to abandon subsistence agriculture in order to participate in agri-food value chains, the choice between contracts and spot markets, traders and small retailers, and finally processors and large retailers—all within the LMIC context.

2.1 Subsistence Agriculture vs. Participation in Agri-Food Value Chains

While there are a myriad of inputs that go into producing agricultural commodities and food, we consider farmers as the most upstream segment of the agri-food value chain. Depending on whether they are agricultural households or farms, farmers will maximize either their expected utility (regardless of whether the separation property holds) and/or their expected profits (if the separation property holds).⁴ More often than not in low- and middle-income countries, agricultural households—which combine in one economic agent both the production and the consumption of some of the same commodities—produce the bulk of agricultural commodities, with profit-maximizing firm-like farms producing considerably less thereof. This is especially so in low-income countries; generally, as incomes increase, so does the proportion of firm-like farms in the agrarian economy.

The adoption of "modern" and often "high-yielding" technologies can facilitate the transformation of a largely subsistence agrarian economy to a more productive economy with firm-like farms contributing to agricultural value chains (Feder, Just and Zilberman, 1985). The lack of technological upgrading, therefore, is a commonly cited explanation for low agricultural productivity in many contexts around the world (Foster and Rosenzweig, 2010). Technology adoption is associated with increases in welfare (Asfaw et al., 2012), and represents a critical first step in grower participation in agri-food value chains. In fact, cross-country differences in technology adoption explains at least one fourth of income differences across countries (Comin and Hobijn, 2010). This raises the question: if these technologies are "high-yielding," what holds back farmers from adopting them? Reviews by Sunding and Zilberman (2001), Wright et al. (2007), Foster and Rosenzweig (2010), and

³Here, we assume that the proportion of food produced for human consumption worldwide which is produced in country *A*, is exported to country *B* for processing, and is then imported back into country *A* before it gets consumed is extremely low. Though there are instances where countries import and export the same broad commodity in equal volumes, it turns out that the respected values of those imports and exports end up being significantly different given that a quality exchange takes place (Asche et al., 2015).

⁴The separation property holds when an agricultural household's maximization is recursive, and the household's utility-maximization problem is not constrained in anyway by the household's endowments (of labor, land, capital, and so on), preferences, or the technology it relies on to produce agricultural commodities. See Singh, Squire and Strauss (1986) for an exposition and applications, and see Bardhan and Udry (1999) for an introduction.

Magruder (2018) already sufficiently discuss the classic questions and recent evidence on the adoption of agricultural technologies and therefore, we merely flag this literature and point interested readers to these existing reviews.⁵

The use of technology facilitates integration into input and output markets. In the simplest unitary agricultural household model (Singh, Squire and Strauss, 1986; Bardhan and Udry, 1999), the household engages in three markets in the absence of market failures, viz. (i) the labor market, where the household can hire labor from or supply its own labor to the market, (ii) the land market, where the household can lease land in from or out to the rental market, and (iii) the market for the staple crop, where the household can buy or sell an agricultural commodity. Specifically how much a household sells of a particular agricultural product relative to how much they buy characterizes them as either a net seller (positive net sales), a net buyer (negative net sales), or autarkic (zero net sales).

Economic theory shows how relative prices motivate behavior when economic agents are homogeneous and transactions costs are negligible. Beyond that, however, how price changes motivate behavior is less obvious (i) when agricultural households can be net buyers, net sellers, or autarkic with respect to some commodity (Deaton, 1989), and (ii) in the presence of transaction costs which create price bands around market-clearing prices within which incentives are muted (de Janvry, Fafchamps and Sadoulet, 1991). We will discuss each of these points in turn.

On the first point, Deaton (1989) uses data from Thailand and defines the concept of the net benefit ratio (NBR), which measures how much money-equivalent utility changes when the price of some commodity changes for a given household and characterizes households as net buyers, net sellers, or autarkic. A NBR can be computed with data on prices, a household's production and consumption, and household income. Additionally, the NBR informs policymakers of the effects of price changes. If the price of some commodity increases; net buyers will be made worse off, net sellers will be made better off, and autarkic households will observe no change in welfare. All of this is determined by the household's position in the market. Studying the dramatic increase in the price of quinoa, Bellemare, Fajardo-Gonzalez and Gitter (2018) illustrate the usefulness of the concept of

⁵Being a classic question in this literature, several explanations exist. First, thin or fragmented markets (e.g., for risk and credit) limit the ability of farmers to invest in new and risky technologies (Zeller, Diagne and Mataya, 1998; Barrett et al., 2004; Matuschke, Mishra and Qaim, 2007; Croppenstedt, Demeke and Meschi, 2003). Second, lack of knowledge or behavioral constraints (e.g., self-control or commitment problems) limit the adoption of high-yielding technology (Duflo, Kremer and Robinson, 2011; Liu, 2013; Ashraf, Karlan and Yin, 2006). Third, farmers may hold uncertainty about the perceived benefits of the technology due to having to learn about those benefits from others (Foster and Rosenzweig, 1995; Munshi, 2004; Conley and Udry, 2010; Hanna, Mullainathan and Schwartzstein, 2014) or information constraints (Gupta, Ponticelli and Tesei, 2020). Fourth, farmers may be uncertain about the quality of the available technology (Bold et al., 2017; Barriga and Fiala, 2020; Michelson et al., 2021). Finally, other studies highlight that since the benefits and costs of technologies are often heterogeneous among farmers within a given population, farmers with low net returns will refrain from adopting the technology (Suri, 2011; Michler et al., 2019).

NBR among Peruvian households: Although quinoa is commonly consumed in Peru, it represents a small share of the average household's food consumption budget. At the same time, quinoa is a popular export crop. Therefore, rising quinoa prices on average lead to gains in welfare for Peruvian agricultural households.

On the second point, [de Janvry, Fafchamps and Sadoulet \(1991\)](#) begin by carefully defining several concepts relating to market failures and market participation. The authors define market failure as taking place, in the extreme case, when the cost of a transaction through market exchange creates disutility greater than the utility gain that it produces. In such as case a "surrogate institution" will emerge or the transaction will simply not take place. In the less extreme case, the market fails for only a specific group of households who do not participate in the market due to excessive transaction costs associated with market participation.

Demonstrating the role of transaction costs on market participation, [Key, Sadoulet and Janvry \(2000\)](#) investigate two distinct sources of transaction costs among corn producers in Mexico. The authors separate transaction costs into two categories: proportional transaction costs and fixed transaction costs. Proportional transaction costs vary based on the quantity of the good sold by effectively increasing the price paid by buyers and decreasing the price received by sellers thereby creating a price band around the market clearing price. Fixed transaction costs do not vary based on the quantity of the good sold and can include the cost associated with searching for customers, the cost of negotiating or bargaining, and the cost of enforcing contracts. Estimating a structural model, [Key, Sadoulet and Janvry \(2000\)](#) show that both proportional and fixed transaction costs influence market participation. The price band associated with proportional transaction costs make it unprofitable for some households to buy or sell agricultural products, and therefore directly influences market participation by limiting the ability of producers sell their products.⁶ Fixed transaction costs limit the ability of both producers and consumers to efficiently find each other and efficiently transact and therefore also directly influence market participation.⁷ [Bellemare and Barrett \(2006\)](#), which we discuss in more detail below, find that both fixed and proportional transaction costs impede participation in livestock markets by pastoralist households in northern Kenya and southern Ethiopia.

One particularly salient example of a fixed transaction cost in many contexts across low- and middle-income countries is the cost associated with searching for buyers. Limited communication and transportation infrastructure can prohibit the ability of farmers

⁶Also see [Eswaran and Kotwal \(1986\)](#), [de Janvry, Fafchamps and Sadoulet \(1991\)](#), and [Sadoulet, De Janvry and Benjamin \(1998\)](#) on the role of proportional transaction costs and price bands in influencing market participation.

⁷Also see [Goetz \(1992\)](#), [Skoufias \(1994\)](#), and [Holloway, Barrett and Ehui \(2005\)](#) on the role of fixed transaction costs in influencing market participation.

to participate in markets and for those markets to operate effectively. For example, [Moser, Barrett and Minten \(2009\)](#) examine the spatial integration of rice markets in Madagascar. Although the authors find that sub-regional markets are fairly well-integrated, at the national and regional level a meaningful dispersion of prices persists. The observation of spatial price dispersion found by [Moser, Barrett and Minten \(2009\)](#) and others ([Barrett and Dorosh, 1996](#); [Abdulai, 2000](#); [Fackler and Goodwin, 2001](#)) motivates research on the role of improving the transmission of market information on promoting market participation reducing spatial price dispersion.

Seminal work by [Jensen \(2007\)](#) and [Aker \(2010\)](#) use similar empirical strategies and estimate the effect of the staggered roll-out of mobile phone coverage on agricultural markets. Investigating aquaculture markets in Kerala, India [Jensen \(2007\)](#) finds that the introduction of mobile phone coverage within the state reduces price dispersion for fish and also reduces wasted products. This increased market efficiency leads to increased profits for fishermen and decreased consumer prices. Thus, the welfare of both producers and consumers improves as a result of the introduction of mobile phone coverage and the associated reduction in the cost of market information. Similarly, [Aker \(2010\)](#) investigates grain markets in Niger and finds that the introduction of mobile phones reduces the dispersion of grain prices. This effect seems to be partially explained by mobile phones providing actionable market information for grain sellers who usually incur relatively high transportation costs.

Likewise, in a study of the relationship between the farm-gate prices received by onion farmers and mobile-phone ownership by those same farmers in the Philippines, [Lee and Bellemare \(2013\)](#) find that the intrahousehold allocation of mobile phones matters, as mobile phone ownership by a farmer or his spouse is associated respectively with farm-gate prices that are 5 and 8 percent higher on average, without any significant association between mobile phone ownership by their children and farm-gate prices. Given these findings, mobile phones (and other information and communications technologies; see for example [Fafchamps and Minten \(2012\)](#) and [Nakasone and Torero \(2016\)](#), and see [Nakasone, Torero and Minten \(2014\)](#) for a review) have been seen to hold much promise for market integration in low- and middle-income countries.

But in a follow up study, [Aker and Ksoll \(2016\)](#), show that the introduction of mobile phones may not deliver on its promise if other binding constraints are not also resolved. there is little reason to believe that access to market information systems would lead to changes in agricultural outcomes in all countries for all crops. On the one hand, if markets are well-integrated, then increased access to information should have very little effect on agricultural outcomes. On the other hand, if markets are not well-integrated (i.e., because of relatively high transaction costs) then easier access to quality information could

give farmers more ability to compare market conditions across a variety of locations, consider alternative production approaches, or switch to produce an alternative set of crops. In spite all of this, if other market failures such as lack of access to credit or insurance persist, increased access to information may not lead to improved economic outcomes.⁸ These studies, which exploit variation market information access across time and space, largely use a two-way fixed effect estimation method. Therefore, given recent innovations in the applied econometric literature on the two-way fixed effect approach (Callaway and Sant'Anna, 2020; Goodman-Bacon, 2021), future research would do well do revisit the classic findings in the literature on the role of market information on market participation.⁹

Now that we have discussed the decision of farmers to participate in markets, the first link in any agri-food value chain, we move on to discussing the welfare gains associated with market participation. It may seem obvious that farmers who willingly choose to sell their produce will gain in some dimension of welfare, at least in expectation. Not all farmers, however, hold an expectation that participation in modernized agri-food value chains will increase their welfare. Studying the introduction of relatively new supermarkets in Nicaragua, Michelson (2013) finds that selling to supermarkets increases productive asset holdings, but that only farmers with advantageous agro-ecological land endowments choose to participate in this agri-food value chain. In a follow-up study Michelson (2017) finds a negative relationship between the number of neighbors who sell to supermarkets and a farmer's own decision to sell to supermarkets. This is a result that is akin to "learning from others" in the technology adoption literature (Foster and Rosenzweig, 1995), and suggests that farmers strategically delay their participation in this new value chain, perhaps due to uncertainty about the associated benefits.

Moreover, expectations of welfare gains may not always materialize. Market participation occurs at both the extensive (e.g., whether or not one buys or sells) and how agricultural households make this decision carries implications for market power and the welfare associated with market participation. As Bellemare and Barrett (2006) show, if an agricultural household makes extensive-margin (i.e., whether to participate on the market) and intensive-margin (i.e., how much to participate on the market) market participation decisions simultaneously, then traders and other downstream actors on the agri-food value chain may hold disproportionate market power over farmers. But if agricultural households make these choices sequentially, by first deciding whether or not to participate as either buyer or seller, and by then deciding how much to buy or sell, then farmers may be

⁸For a additional and more detailed discussion on the role of market information systems, see the classic reviews of market participation and agricultural input use can be found in Stiglitz (1988), Binswanger, Deininger and Feder (1995), and Aker and Mbiti (2010).

⁹More specifically, Goodman-Bacon (2021) shows that when treatment timing varies treatment effects can be biased when estimated using the popular two-way fixed effect regression specification and Callaway and Sant'Anna (2020) provide a new estimation technique that removes the two-way fixed effects bias.

less vulnerable to exploitation due to disproportionate market power. Using data on live-stock herders in northern Kenya and southern Ethiopia, [Bellemare and Barrett \(2006\)](#) develop a two-staged estimation method, i.e., which they dub "ordered tobit," to test whether these agricultural households make market participation decisions on the extensive and intensive margins simultaneously or sequentially. The authors find evidence supporting the sequential nature of decisions to participate in markets, which implies much less vulnerability to exploitation from traders and larger welfare gains associated with market participation. We note, however, that the results in [Bellemare and Barrett \(2006\)](#) are not causally identified, and so it remains possible that farmers with more bargaining power make market participation choices sequentially while farmers with less bargaining power make market participation choices simultaneously.

Finally, imperfect agricultural markets in low- and middle-income countries such as limited access to credit, combined with substantial price volatility, can also complicate the expected welfare gains associated with market participation. Studying farmers in rural Kenya, ([Burke, Bergquist and Miguel, 2019](#)) highlight that intertemporal price fluctuations often lead farmers to sell at low prices and buy at high prices. The authors design an experiment that provides farmers with timely access to credit. Farmers who receive this access to credit are able to sell at higher prices and buy at lower prices, which allows them to earn higher farm revenues.¹⁰ The findings of [Burke, Bergquist and Miguel \(2019\)](#) raise the question: Why do farmers not store their agricultural products while prices are low? Using data from 26 countries in sub-Saharan Africa [Cardell and Michelson \(2020\)](#) explain that risk aversion, combined with rational expectations of negative returns from delayed sales, incentivizes farmers to opt out of storing agricultural products when prices are low. The explanation that risk aversion reduces the incentive for farmers to store their agricultural output aligns well with findings of [Fafchamps and Minten \(2001\)](#), which we will discuss later, who find that traders also do not keep sufficient stock in the goods they sell due to the risk of theft.

2.2 Contracts vs. Spot Markets

A key difference between high-income countries and low- and middle-income countries is that, in the latter, agriculture represents a much larger share of the economy. Coupled with this reality is the observation that the agricultural sector in low- and middle-income countries can often be characterized as being at the subsistence level. So far, the transition from a largely subsistence-oriented to a more commercially oriented agricultural sector

¹⁰This finding contrasts with the existing experimental literature on the role of credit on firm and farm profitability ([Banerjee, Karlan and Zinman, 2015](#)), but highlights the importance of understanding the general equilibrium effect of credit on market outcomes ([Breza and Kinnan, 2021](#)).

has proven elusive for many low- and middle-income countries.

Contract farming, where a producer (e.g., a firm) and a grower (e.g., a farmer) come to an agreement about the production of a specific agricultural commodity, is a popular institution in many settings. [Grosh \(1994\)](#) points out that contract farming addresses a number of market failures common in developing countries. These market failures may include uncertainty and risk sharing, imperfect factor markets, and coordination failures. On the first, contract farming allows buyers to specify their exact preferences for commodities and limits the risk associated with vertical integration. On the next, since inputs for farming are provided on loan from firms to farmers, contract farming helps overcome some of the failures in capital markets. Finally, contract farming can mitigate some of the issues associated with first-mover problems and technology adoption.

Outside of the full vertical integration of the growing and processing stages (i.e., growing and processing done within the same firm) of the agri-food value chain, contract farming is an alternative to firms buying directly from spot markets. [Bijman \(2008\)](#) dubs contract farming a "vertical coordination" mechanism, since it allows coordinating the activities of two vertical actors in the growing and processing segments of the agri-food value chain. This is not to say that contract farming is a panacea. There are a number of potential drawbacks. Most clearly, it could be the case that firms exercise monopsony power over farmers and extract monopsonistic rent from them. We will discuss this and other concerns when we review the existing literature on welfare gains associated with contract farming.

But before that discussion, we must carefully define what we mean when we write about contract farming, as contracts can generally take many forms, not all of which are necessary relevant to the study of value chains in low- and middle-income countries. First, consider land tenancy agreements, or contracts between a landowner principal and an agent, which can take three general forms: (i) The principal keeps the crop, which is grown by the agent, for herself, in exchange for which she pays the agent a wage (i.e., a wage contract), (ii) The agent can keep the crop for himself, in exchange for which he pays a fixed rent (either a cash or crop rent, but more often than not cash) to the principal for use of her land (i.e., a fixed rent contract), or (iii) The principal and the agent enter a contract wherein each party receives a fraction of the crop, and in which the agent may also pay a fixed rent to the principal or the principal may pay a wage to the tenant (i.e., a sharecropping contract).

Dating back to [Marshall \(1890\)](#) and, before him, to philosophers such as Adam Smith, economists have spent a great deal of time trying to understand why sharecropping exists. Relative to the contracting arrangement where the grower pays the landowner a fixed rent and keeps the agricultural crop, [Marshall \(1890\)](#) argued that other arrangements will be inefficient because the grower does not bear the full consequences of their effort. Later on,

Stiglitz (1974) argued that although sharecropping may be inefficient due to moral hazard when the principal cannot observe the effort of the agent, a fixed rent contract may well be too risky for a risk-averse farmer. Thus, sharecropping emerges to balance risk sharing and incentives in a context where insurance markets fail and labor supervision is too costly. This motivates work investigating the existence and relative role of moral hazard and risk aversion in the performance of specific types of contracting arrangements (Bell, 1977; Shaban, 1987; Laffont and Matoussi, 1995; Arcand, Ai and Ethier, 2007; Akerberg and Botticini, 2002; Dubois, 2002; Jacoby and Mansuri, 2009; Bellemare, 2012).

More recently, in a randomized controlled trial involving farmers in Uganda Burchardi et al. (2019) randomly vary the terms of sharecropping contracts. The farmers had all previously agreed to pay half of their output to the local landowner (i.e., the NGO BRAC) and were assigned to one of three groups. The control group received a contract stating that they could keep half of their output; the first treatment group received a contract stating that they could keep 75 percent of their output, and the second treatment group received a contract stating that they could keep half of their output and would receive a lump-sum payment at the end of the agreement. The authors find that tenants with higher output share use more inputs, cultivate riskier crops, and produce 60 percent more output relative to the control group. These results support the "Marshallian inefficiency" (i.e., moral hazard) hypothesis (Marshall, 1890).

But while land tenancy agreements can in theory be a means for households who were hitherto involved in subsistence agriculture to participate in agri-food value chains by selling the crop they grow within those land tenancy agreements, we know of no study that has approached land tenancy as such. Anecdotally, smallholder farmers tend to enter land tenancy agreements to grow the crops that will feed their households, but there is no good evidence on the relationship between land tenancy and participation in agri-food value chains.

Second, there is one type of contract discussed above which, when scaled up, can be part and parcel of agri-food value chains. Indeed, the wage contracts just described in the context of land tenancy can be successfully used by a processing firm that either owns the land on which the crop it processes is grown or has a long-term lease on that land to run a plantation-style operation. Such plantations are usually large tracts of land dedicated to growing a very small number of commodities—usually only a single commodity—and which employ local labor.¹¹

¹¹Much like sharecropping (Reid, 1973; Reid Jr, 1976), the idea of plantation agriculture may have a negative connotation in the minds of American readers due to its unfortunate association with slavery in the southern United States (Mandle, 1974). While Marxian social scientists certainly would posit both institutions as means whereby capital exploits labor (Byres, 1983), we note that economists have identified perfectly good reason why either sharecropping and plantation agriculture emerge in certain places at certain times, and that both

The literature on plantation agriculture in low- and middle-income countries is small compared to either the literature on sharecropping or the literature on contract farming, which we will discuss next. Looking at rice and sugar in Tanzania, however, [Herrmann \(2017\)](#) compares the incomes and poverty status of wage laborers working on a plantation and of smallholder farmers who enter contract farming (referred to in this case as "out-grower scheme") with those of individuals who do neither. [Herrmann \(2017\)](#) finds that presumed welfare improvements deriving from participation in agri-food value chains are largest for farmers participating in contract farming, but that they are also positive for individuals who sell their labor to a plantation. [Herrmann and Grote \(2015\)](#) had earlier found nearly identical findings when looking at the sugar value chain in Malawi.¹²

Third, let us now consider contracts between farmers who either own or lease in land, and a processing firm. This kind of contract farming is an arrangement between a buyer-processor and a grower-seller,¹³ an institution which involves several stages which each influence the extent of contract farming for a given crop in a given geographic location ([Barrett et al., 2012](#)). First, the processor decides where (i.e., geographically) to solicit potential agreements with farmers. Second, processors contract with those farmers whom they perceive as the most likely to maximize the processor's profits ([Michelson, 2013](#)). Third, farmers decide whether or not to accept the contract based on some form of expected-profit- or expected-utility-maximizing process where the grower accepts the contract if they perceive such an arrangement to be welfare improving ([Bellemare and Bloem, 2018](#)). Finally, both the buyer and the grower decide whether to honor the contract or renege ([Fafchamps, 2004](#)). As discussed in [Barrett et al. \(2012\)](#), these various stages of selection embedded in the institution of contract farming complicate the credible estimation of the effect of participating in contract farming on farmer welfare, and limit both the internal and external validity of extant estimates ([Bellemare and Bloem, 2018](#)).

Many early studies estimating the effect of participating in contract farming on farmer welfare only have access to cross-sectional data and are therefore only able to compare

institutions are commonly found in the absence of slavery.

¹²One side issue with plantations is that, being the result of large-scale land acquisitions (LSLAs, or "land grabs"), they are often politically fraught. This is best exemplified by the story of how Malagasy President Marc Ravalomanana had agreed in 2008 to let Korean *chaebol* Daewoo to lease a one-million-hectare tract of land in Madagascar. That agreement—and the subsequent purchase of a new presidential jet—is thought to have precipitated the political crisis and subsequent coup d'état of early 2009 in Madagascar, which saw Ravalomanana deposed. Less anecdotally, [Anti \(2021\)](#) quantitatively studies the effects of LSLAs in Cambodia and finds that while land grabs lead to a reorganization of rural land markets wherein more people work for a wage and fewer people farm independently, they have also led to a decrease in household welfare, as proxied by consumption expenditures.

¹³As we have alluded to above, contract farming arrangements are also referred to in the literature as out-grower schemes or grower-processor contracts, with the former term more common outside of economics and the latter term more common in agricultural economics when the focus is on high-income countries such as the US.

average outcomes between farmers who participate in contract farming and farmers who do not (Goldsmith, 1985; Singh, 2002). As discussed above, a limitation of these early studies is selection bias, or the fact that farmers choose whether to participate in contract farming on the basis of factors that are both unobserved by researchers and highly likely to be confounders. Aiming to improve on these early studies, many researchers employ econometric techniques such as a selection-correction methods or instrumental variables estimation (Bolwig, Gibbon and Jones, 2009; Briones, 2015; Miyata, Minot and Hu, 2009; Schipmann and Qaim, 2010; Simmons, Winters and Patrick, 2005; Warning and Key, 2002), propensity score matching (Bannor, Oppong-Kyeremeh and Adjei-Addo, 2017; Herrmann and Grote, 2015; Herrmann, 2017; Maertens and Velde, 2017; Mishra et al., 2016; Wendimu, Henningsen and Gibbon, 2016), selection-on-observables designs (Dedehouanou, Swinnen and Maertens, 2013; Maertens and Swinnen, 2012; Wendimu, Henningsen and Czekaj, 2017; Bellemare and Novak, 2017; Bellemare, 2018), or randomized control trials (Ashraf, Giné and Karlan, 2009; Arouna, Michler and Lokossou, 2019).¹⁴

Although the observation of the voluntary and persistent participation in contract farming should provide, via revealed preference, broad evidence that farmers *ex ante* expect participation in contract farming to be welfare improving, many outside of economics remain skeptical that the gains of participating in contract farming are positive. For, example, concerns persists about environmental degradation (Singh, 2002), exploitation of farm labor (Porter and Phillips-Howard, 1997), increased income or wealth inequality (Little and Watts, 1994; Isager, Fold and Nsindagi, 2018).

Reviews of the contract farming literature date back nearly 40 years and all come to a similar conclusion that it is difficult to draw any broad policy relevant conclusion from the literature on contract farming (Glover, 1984; Senanayake, 2005; Bellemare and Bloem, 2018). Much of this difficulty can be attributed to limitations of most of the existing literature in credibly estimating the effect of participating on contract farming on a variety of outcomes of interest. Most existing studies use observational data and rely on identifying assumptions that are either not well-defended or validated in the given empirical setting (Bellemare and Bloem, 2018). In addition, despite over 40 years of research, the existing literature on contract farming is largely based on evidence from a relatively small set of countries (Bellemare and Bloem, 2018). More recent studies aim to improve upon the credible identification of the welfare effect of various components of contract farming and improve on the external validity of the existing literature on contract farming.

¹⁴Although there is also selection on the part of the processor in that the processor selects whom to contract with and whom not to contract with among a set of potential farmers, that form of selection is more easily dealt with empirically since processors tend to have access to less information about farmers than the econometrician, who is often armed with detailed survey data on grower household does. In other words, selection of farmers by the processor, which can in practice bias one's estimates of the effect of participation in contract farming, is usually dealt via an all-too-often implicit selection-on-observables argument.

In a randomized controlled trial among rice farmers in Benin, [Arouna, Michler and Lokossou \(2019\)](#) randomly vary the terms of contract arrangements. As part of their treatment, they offer some farmers a contract that guarantees a fixed price and offer other farmers a guaranteed fixed price as well as extension training or loans to finance agricultural inputs. Farmers in the control group, of course, receive none of those things. The authors find that contracts that guarantee a fixed price lead to welfare effects that are just as large as the other, more involved contracts. These findings suggest that, at least in the context of rice production in Benin, reducing price uncertainty is the main benefit of participating in contract farming. Although this study improves on the identification of the relative benefits of specific contract attributes, it does not estimate the average treatment effect of participating in contract farming versus that of selling at spot markets. Rather, [Arouna, Michler and Lokossou \(2019\)](#) estimate an intent-to-treat (ITT) effect, which means they estimate the effect of being offered a specific type of contract (i.e., a fixed-price contract, a fixed-price-and-extension contract, or a fixed-price-and-input-loan contract), irrespective of whether one chooses to accept that contract or not. Even granting that contract farming can somehow be used as a policy instrument to foster economic development (and we know of no evidence to that effect), it is not entirely clear how useful knowing the ITT is to policy makers interested in the effect of participating in contract farming. This is because offering contracts to farmers by placing them in the treatment group at random fails to mimic farmer selection by processing firms which, in a market economy, is anything but random ([Barrett et al., 2012](#)). Thus, knowing the average effect of being offered to participate in contract farming tells us little about the effect of participating in contract farming itself. Nonetheless, in the literature on contract farming, the study by [Arouna, Michler and Lokossou \(2019\)](#) is the one with the most internal validity, and it clearly shows that reducing price uncertainty is one of the key features of attractive features of contract farming.

In a related study, [Bellemare, Lee and Novak \(2021\)](#) return to one of the core tenets of contract theory, viz. the idea that contracts can be used to redress market failures. In [Stiglitz \(1974\)](#), for instance, sharecropping contracts are used to remediate insurance market failures in that a risk-averse tenant who enters a sharecropping agreement does so to partially insure against production risk. With less internal validity than that in [Arouna, Michler and Lokossou \(2019\)](#), [Bellemare, Lee and Novak \(2021\)](#) rely on observational data and a selection-on-observables design to look at whether participation in contract farming is associated with a decrease in household income variability in Madagascar. Finding that participating in contract farming is associated with a 0.2 standard deviation decrease in income variability, they then use the tools of mediation analysis to look into the mechanism whereby contract farming provides that form of partial insurance. Consistent with the findings in [Arouna, Michler and Lokossou \(2019\)](#), they find that the reduction in income

variability is entirely driven by fixed-price contracts, which provide partial insurance to farmers by insuring them against price risk (Bellemare, Barrett and Just, 2013). More importantly from a policy perspective, the research design used by Bellemare, Lee and Novak (2021) allows the authors to estimate the average treatment effect, but also the average treatment effect on the treated (i.e., households that participate in contract farming) and on the untreated (i.e., households that do not participate in contract farming). This allows separately estimating (i) the effect of participating in contract farming on those households that choose to participate, but also (ii) the counterfactual effect of participation in contract farming on those households that do not participate. Surprisingly, Bellemare, Lee and Novak (2021) find that the average treatment effect on the untreated exceeds the average treatment effect on the treated. In other words, participation in contract farming is likely to benefit those households that do not participate more than those that do—at least from the point of view of reducing income variability. This is a finding that has important policy implications, as it could induce participation by households for whom the net gain of participation in contract farming is unclear when measured by income level.

So much for internal validity. What of external validity? As Bellemare and Bloem (2018) note, most contract farming studies focus rather narrowly on a single commodity, on a handful of commodities in a given region, and most of them certainly focus on a single country. Moreover, entire regions and countries have been entirely ignored by the literature on contract farming. Aiming to improve on external validity and to generalize beyond a particular contract scheme or crop, Meemken and Bellemare (2020) use nationally representative data from six countries in sub-Saharan Africa and Southeast Asia to estimate the welfare impacts of participation in contract farming, and they find that contract farmers only obtain higher incomes than non-contract farmers in some countries. This finding highlights that contract farming does not necessarily unambiguously improve welfare and motivates future research examining why contract farming schemes improve welfare in some contexts while not in others.

2.3 Intermediaries

The next stage in the agri-food value chain are intermediaries, i.e., agro-dealers, traders, small retailers, and co-ops. As commodities in the agri-food value chain begins to travel from farm households to village markets, and then to neighboring villages or urban areas, a host of intermediaries arise to reduce the transaction costs associated with meeting transportation, marketing, and contracting needs. A common assumption among policy-makers is that, precisely due to missing markets for credit and high transaction costs, intermediary firms entrap or exploit farmers who may have little alternative than to sell their products to traders (Reardon, 2015). This idea follows from the observation that agro-

dealers and traders provide funds to farmers in exchange for the promise that the farmer will sell their crop to that trader at harvest time. Many observers then suspect that hidden in this transaction is a high interest rate on the provided funds that then exploit the farmer who must accept a low price at harvest.¹⁵ Furthermore, traders can collude with each other to ensure that they themselves capture as much of the profits as possible, leaving little profit for the farmer.

How one views the arrangement between farmers and intermediaries carries considerable implications for agricultural policy. Concerns about the exploitation of farmers by intermediaries led to the establishment of parastatal grain organizations to provide a consistent buyer of agricultural products and agricultural banks to provide access to credit for farmers (Sitko and Jayne, 2014; Reardon, 2015; Dillon and Dambro, 2017). Support for these institutions peaked during the structural-adjustment period of the 1980s and 1990s. As with many agricultural policy instruments, this state of affairs persisted with many taking so-called stylized facts for granted, and with few questioning whether intermediaries actually held market power over farmers.

The implementation of these policies motivated a literature discussing the market environment surrounding intermediaries (Coulter and Golob, 1992; Dercon, 1993; Jayne and Jones, 1997; Barrett, 1997, 2008; Sitko and Jayne, 2014). The core question at the heart of this literature regards the competitive nature of the market for intermediaries in low- and middle-income countries. On the one hand, if agricultural output markets are competitive and, in particular, barriers to entry are low, then intermediaries may play an important role in improving the ability of farmers to access markets and improve the profitability of their farm (Dorward and Morrison, 2000; Dorward et al., 2004; Barrett, 1997). On the other hand, if marketing costs are high enough so that barriers to entry are prohibitive, then agricultural markets may exhibit characteristics of oligopolies or monopsonies and may hold market power over farmers (Dorosh and Bernier, 2019; Moser, Barrett and Minten, 2009).

Innovations within this system can lead to efficiency gains. Goyal (2010) studies a unique innovation on behalf of a large buyer of soybeans in Madhya Pradesh. Prior to the innovation, soybean farmers sold their crop to traders in agricultural markets who, in turn, sold the soybeans to processing companies. These traders often colluded with each other to avoid bidding up the price of soybeans too much and therefore extracted a larger share of the profits for themselves and left little for the soybean farmers. In 2000 a large buyer of soybeans decided to eliminate the intermediaries entirely. They installed internet kiosks in villages which enabled farmers to easily observe wholesale prices of

¹⁵Indeed, as we discuss above, the work of Burke, Bergquist and Miguel (2019) show that providing access to credit provides farmers with the ability to avoid selling their agricultural products at relatively low prices.

soybeans. The author finds that in villages with an internet kiosk, soybean prices increased by between 1 and 3 percent. This increased price seems to also have incentivized more cultivation of soybeans in villages with access to an internet kiosk. Not all innovations are successful, however. [Mitra et al. \(2018\)](#) implement a randomized control trial with potato farmers in West Bengal. In the experiment the authors provided potato price information via public boards and personal phone calls. Although the price information increased farmers' knowledge of price information, it did not have an effect on their prices received. The authors suggest that this result is due to the market structure in the area. It turns out wholesalers were not willing to buy directly from smallholders and negotiated only with middlemen. Therefore, even with the price information, farmers were unable to translate this improved knowledge into increased bargaining power.

Intermediaries themselves face challenges, and these challenges can also prohibit efficient transactions. In many low- and middle-income countries where the legal system is slow and sometimes corrupt, theft and breach of contracts can make the business of intermediary traders unprofitable. Studying traders in Madagascar, [Fafchamps and Minten \(2001\)](#) investigate contract compliance and despite traders reporting high risk of theft and breach of contracts, the authors find that the incidence of theft and breach of contract is low in their data. This finding suggests that traders may be too worried about theft and breach of contract. It turns out, however, that theft is rare because traders intentionally do not hold stock so to discourage theft. In addition, breach of contract is rare because traders often develop relationships with farmers and transact repeatedly so to mitigate the incentive for the farmer to break their contract. The work of [Fafchamps and Minten \(2001\)](#) shows how the existence of transaction costs can limit the scale and scope of intermediary markets within agricultural value chains and how nonmarket institutions develop to partially address these transaction costs.

Limitations in the ability to observe and enforce contracts arise in many contexts and are particularly salient in low- and middle-income countries ([Bellemare, 2010](#); [Antras, 2016](#); [Blouin and Macchiavello, 2019](#)), but some institutional innovations aim to mitigate these limitations. Existing evidence finds that relational contracting (e.g., repeatedly contracting with the same partner) reduces some difficulties associated with limited contract enforcement ([Antras and Foley, 2015](#); [Macchiavello and Morjaria, 2015](#); [Blouin and Macchiavello, 2019](#)), although relational sourcing clearly is not readily available in all contexts. Alternatively, principals can invest in monitoring the agents they contract with ([Bellemare, 2010](#)), and as we will discuss in the next sub-section, vertical integration can reduce contracting problems with quality upgrading and supply assurance ([Hansman, Hjort and Leon, 2019](#); [Macchiavello and Miquel-Florensa, 2019](#)).

Relational contracts are one such informal mechanism ([Michler and Wu, 2020](#)). Study-

ing the Kenyan flower export market, [Macchiavello and Morjaria \(2015\)](#) provide evidence of the importance of reputation in contract design. The authors use data from all exports of roses from Kenya and find evidence suggesting that limited contract enforcement constraints Kenya's flower industry and that the value of the buyer-seller relationship is increasing of the age of the relationship and the number of past transactions. Taken together, these results highlight the importance of reputation and relational contracts in settings where formal and legally enforceable contracts are infeasible. In a follow-up study focusing on the value chain for coffee in Rwanda [Macchiavello and Morjaria \(2021\)](#) show that relational contracts are more common in geographic areas where there is less competition among coffee mills. Interestingly, the authors find that farmers facing less competition among mills, and therefore who are more likely to use relational contracts, supply more coffee and are economically better off than farmers facing more competition among mills. However, relational contracts are not always feasible as the formation of relational contracts between farmers and traders can be complicated by frequent unanticipated and uninsured shocks to production and available side-selling opportunities for farmers when prices are high. Studying farmers associated with a milk co-op association in Kenya, [Casaburi and Macchiavello \(2015\)](#) show that even the threat of sanctions (e.g., fines, embargo, and expulsion) led to increased compliance to the co-op's rules.

Despite heavy interest from policymakers, empirical evidence on the competitiveness of crop markets in sub-Saharan Africa is relatively scarce. The evidence that does exist suggests that crop markets in sub-Saharan Africa are sufficiently competitive but are largely based on observational studies ([Dillon and Dambro, 2017](#)). In particular, although some studies point to evidence of relatively larger barriers to competition ([Barrett, 1997](#); [Minten and Kyle, 1999](#); [Fafchamps and Minten, 2002](#); [Tostao and Brorsen, 2005](#); [Muto and Yamano, 2009](#)) other studies find evidence of competition in sub-Saharan African crop markets ([Badiane and Shively, 1998](#); [Abdulai, 2000](#); [Fafchamps, Gabre-Madhin and Minten, 2005](#); [Osborne, 2005](#); [Fafchamps and Hill, 2008](#); [Moser, Barrett and Minten, 2009](#); [Chamberlin and Jayne, 2013](#); [Myers, 2013](#); [Sitko and Jayne, 2014](#); [Minten, Stifel and Tamru, 2014](#); [Minten et al., 2016](#)). This conclusion, however, is subject to a number of qualifications. Most notably, the available evidence represents only 13 countries which is hardly representative of the region, and empirical limitations in the existing evidence complicates a definitive conclusion. Therefore, with the exception of only a handful of recent papers, the literature on the competitiveness of agricultural crop markets in low- and middle-income countries has limited internal and external validity.

More recently, and with considerably more external validity, [Porteous \(2019\)](#) finds that median trade costs in sub-Saharan Africa are five times higher than they are elsewhere in the world. On the basis of a dynamic trade-and-storage model for agricultural commodi-

ties applied to all of sub-Saharan Africa, he finds that the welfare gains to reducing those costs are considerable and, in a region of the world where the budget share of food is often in excess of 50 percent, those welfare gains would mainly stem from lower food prices.

Yet more recent work directly examines the market structure of intermediaries (e.g., buyers facilitating transactions between farmers and processors) with three separate experiments in Kenya ([Bergquist and Dinerstein, 2020](#)). In doing so, the authors aim to build on the limited internal validity of the largely descriptive literature summarized in [Dillon and Dambro \(2017\)](#). In the first experiment, the authors offer traders a per-kilogram subsidy of each crop sold, which reduces the costs of treated traders and highlights how much of this cost reduction is passed through to end consumers. The authors find that only 22 percent of this cost reduction is passed on to consumers. In the second experiment, the authors randomly offer consumers a per-kilogram subsidy, which reduces the price of each product and allows the authors to estimate the slope of the demand curve for agricultural products. These first two experiments highlight that traders do not compete, rather the results are indistinguishable from a model in which traders collude with each other and behave as monopolist. In the final experiment, the authors randomly offer traders subsidies to enter randomly selected agricultural markets. The incentive to enter a market leads to less than one additional trader per market-day on average and has a relatively small effect on market price. This further highlights the lack of competition among traders in Kenya's agricultural sector and adds to the literature on competition and efficiency in agricultural markets ([Fafchamps, Gabre-Madhin and Minten, 2005](#); [Moser, Barrett and Minten, 2009](#); [Rashid and Minot, 2010](#); [Casaburi and Reed, 2017](#)).

Despite the recent contributions that improve on both the internal and external validity of the literature on intermediaries in agri-food value chains, this remains an urgent frontier. [Reardon \(2015\)](#) calls the middle intermediary segments of agri-food value chains the "hidden middle" because their role in economic development and the structural transformation are mostly neglected from mainstream academic literature and policy debates. As discussed by [Bellemare \(2021a\)](#), this area of inquiry is well-suited for a combination of methods from the field of industrial organization (IO) to classic questions from the field of development economics. The vast majority of research in agricultural development economics focuses on market failures faced by smallholder farmers, but as we have just discussed, markets can fail in the intermediary stages of agri-food value chains too. The lack of available data is a serious constraint. Typical data collected by, for example, the World Bank's Living Standards Measurement Study (LSMS) Team includes information on farm inputs and outputs, land use, and other variables. But these data do not include much information on employment, income, and expenditure outcomes on post-farm-gate or intermediary actors. This is problematic because recent research highlights that more

than 70 percent of consumer expenditure worldwide and the majority of employment opportunities accrue in the post-farm-gate economy (Yi et al., 2021; Dolislager et al., 2021). As discussed by Dillon and Dambro (2017), we do not know enough about the intermediary steps of agri-food value chains. For example, we cannot yet describe which commodities generate the most consumer value added or how that value addition is distributed among workers, land owners, and firms along the agri-food value chain in low- and middle-income countries. This is a critical knowledge gap. As discussed by Reardon et al. (2009), a long-standing debate focuses on the question of whether or not smallholder farmers are included or excluded from the structural transformation of the economy. But much of the analysis informing this debate does not, or cannot, consider the extent to which smallholder farmers use employment in the post-farm-gate economy as a viable and perhaps even preferred option to smallholder farming. Indeed, when asked about their preferred occupation, only 4 percent of children included in the Indian Young Lives sample indicate they want to be a farmer when they grow up (Ross, 2019). Perhaps our definition of "inclusion" in the structural transformation of the economy needs to expand beyond looking at only on-farm work and should consider other ways individuals can engage with agri-food value chains. Future work must address this knowledge gap by supporting and funding new and innovative data collection efforts, and prioritizing research on the role of intermediaries within agri-food value chains in promoting economic development and the structural transformation of low- and middle-income countries.

2.4 Processors, Wholesalers, and Distributors

In the third volume of the *Handbook of Agricultural Economics* Reardon and Timmer (2007) review the literature on the transformation of markets for agricultural output in low- and middle-income countries since 1950. The authors discuss five phases of thinking in the literature based on contemporaneous trends and policy debates. In phase one (1950s and 1960s), the focus of policy was to increase aggregate economic growth. In phase two (1970s and early 1980s), the policy objective shifted to focus on the distribution of income from agricultural commodity markets within countries. In phase three (mid 1980s and early 1990s), structural adjustment policies aiming to "get prices right" became popular and mainstream. In phase four (mid 1990s), the policy focus shifted instead to "get institutions right." Finally, in phase five (beginning in the 2000s), policy focused on harnessing globalization and the literature studied the ability of smallholder farmers to participate in modern agri-food industry given the rise of supermarkets. A review by Reardon et al. (2009) introduces a special issue in *World Development* including studies that specifically focus on the rapid transformation of the agri-food industry in low- and middle-income

countries and its effects on small farmers.¹⁶ Many of these studies provide a useful description and case studies of how smallholder farmers react to the transformation of the agri-food industry and, in particular, the rise of supermarkets. This literature finds mixed results, with some studies finding that structural transformation excludes and other studies find that it includes smallholder farmers.

More recent work by [Michelson \(2013\)](#) aims to improve on the causal identification of the effects of smallholder farmers supplying supermarkets. [Michelson \(2013\)](#) constructs a pseudo-panel using eight waves of survey data on farmers in Nicaragua. Once constructed, the dataset includes recall information on asset holdings at the household level and information on whether or not the farmers supplied supermarkets with produce. This data structure sets up the opportunity for a simple difference-in-differences research design estimated using a two-way fixed effects regression specification.¹⁷ [Michelson \(2013\)](#) finds that farmers who supply supermarkets increase their stock of household assets. Despite this encouraging finding, [Michelson \(2013\)](#) also finds that not all smallholder farmers choose to sell to supermarkets. Rather only those with more advantageous endowments of land and water resources are likely to sell their produce to supermarkets and, as previously discussed, some farmers strategically delay the entry into this new output market ([Michelson, 2017](#)). One of the reasons why it may make sense for smallholder farmers to forgo or delay selling to supermarkets is that supermarkets demand products with a consistent and relatively high quality. Not all smallholder farmers may have the resources to achieve this standard.

Smallholder farmers often need to upgrade the quality (broadly defined, as that includes food safety) of their agricultural products to satisfy standards requirements of supermarkets and modern wholesalers. This is because consumers increasingly hold preferences for relatively high-quality and consistently safe products ([Linder, 1961](#); [Verhoogen, 2008](#); [Asche et al., 2015](#)). Upgrading product quality, however, represents an important barrier for smallholder farmers who may want to supply modern wholesalers and supermarkets. Many supply-side market failures limit smallholder farmers' access to the necessary inputs and financial services to successfully upgrade the quality of their agricultural products. There are also demand-side challenges that similarly limit the ability of small-

¹⁶These studies include: [Minten, Randrianarison and Swinnen \(2009\)](#) who study small vegetable producers in Madagascar who export to supermarkets in Europe, [Dries et al. \(2009\)](#) who study cross-country variation in structural transformation in the dairy sector in Central America, [Herath and Weersink \(2009\)](#) who study the structural transformation of tea production and processing in Sri Lanka, [Stringer, Sang and Croppenstedt \(2009\)](#) who study vegetable processing companies in China, [Miyata, Minot and Hu \(2009\)](#) contracts for selling to supermarkets in Asia, [Wang et al. \(2009\)](#) who study farmers in China marketing their produce to supermarkets in Beijing, and [Neven et al. \(2009\)](#) smallholder farmers selling their crops to supermarkets in Kenya.

¹⁷As discussed above, recent innovations in applied econometrics call into question the validity of this two-way fixed effects estimation approach ([Goodman-Bacon, 2021](#); [Callaway and Sant'Anna, 2020](#)).

holder farmers to upgrade quality. These include relatively high margins embedded in the supply chain and a relatively noncompetitive market structure (Antras and Costinot, 2011; Atkin and Donaldson, 2015).

Despite the presence of challenges, a set of interventions along the entire agri-food value chain can facilitate the process of farmers upgrading the quality of their agricultural products. Between 2006 and 2012, and coinciding with the roll-out of the Sustainable Quality Program implemented on behalf of a multinational coffee buyer, Colombia nearly doubled their high-quality coffee exports (Macchiavello and Miquel-Florensa, 2019). The Sustainable Quality Program aimed to address both supply and demand-side challenges to quality upgrading. On the supply-side, the program provided agricultural extension services, technical training, and access to agricultural inputs. On the demand side, the program offered farmers a fixed price with a 10 percent premium for coffee that meets a given quality standard. The program also worked with cooperatives and exports along with the entire coffee value chain to ensure a smooth trade of high-quality coffee from the farmer's field to the port of export.

Macchiavello and Miquel-Florensa (2019) evaluate the Sustainable Quality Program using data from a variety of sources and several identification strategies and find that nearly all (i.e., 80 percent) of the increased high-quality exports can be attributed to the one multinational buyer. In addition, eligible farmers substitute old and relatively unproductive coffee trees with younger disease-resilient trees. As a result, roughly 60 percent of coffee production in the regions with the program upgraded to high-quality coffee varieties, which translated to larger export revenues. Finally, over half (i.e., roughly 56 percent) of these export revenues reached farmers, with the remaining pocketed by the exporter. These results highlight that large-scale quality-upgrading is economically feasible albeit with a multifaceted intervention that addressed both supply and demand-side challenges all along the value chain. In addition, supporting contractual arrangements between the exporter and the multinational buyer appear to play an essential role in facilitating quality upgrading. Counterfactual simulations by Macchiavello and Miquel-Florensa (2019) show that supply-side interventions alone would have generated less than half of the observed gains and thus the majority of the gains of the Sustainable Quality Program are driven by demand-side stability—a finding which brings to mind those regarding fixed-price contracts in Arouna, Michler and Lokossou (2019) and Bellemare, Lee and Novak (2021). This stability allows the price premium to extend from the export gate to the farm gate and allows the program to essentially mimic a vertically integrated exporter.

In addition to upgrading quality standards, consumers increasing demand environmental sustainability from the production of the food they produce. This is due to the observation that agri-food value chains run up against a triple challenge of (i) boosting

agricultural productivity and reducing global productivity gaps, (ii) producing a safe, sufficient, and healthy supply of food, and (ii) ensuring environmental sustainability by limiting climate change, deforestation, the production of greenhouse gas emissions, and losses in biodiversity (Foley et al., 2011). Standards and certification schemes aim to limit the environmental damages associated with the functioning of agri-food supply chains (Swinnen, 2016). However, in a recent review of the literature on sustainability standards Meemken et al. (2021) find that while these standards can help limit environmental externalities embedded in agri-food supply chains, existing sustainability standards are insufficient to ensure the sustainability of agri-food value chains at scale. This highlights the need for future work understanding what makes sustainability standards effective and what complementary policies can help ensure the environmental sustainability of agri-food value chains.

Given the foregoing, a worthwhile "sixth phase" (to borrow from Reardon and Timmer (2007)) might be to follow the example set by Macchiavello and Miquel-Florensa (2019) and consider how the entire agri-food value chain interacts with structural transformation. This will require new data and new empirical methods, but seems like a necessary next step for both the academic literature and ongoing policy discussions. Decades of research has focused on studying how smallholder farmers specifically engage with a transforming agri-food industry. This emphasis is well-motivated as smallholder farmers often experience high rates of poverty and are potentially vulnerable to being left behind by structural forces that can increase economic inequality within countries. But with the benefit of new data and empirical methods future research can extend beyond a narrow focus on the extreme ends of the agri-food value chain and study the entire value chain.

3 Global Agri-Food Value Chains

Although most food remains domestically produced (D'Odorico et al., 2014; FAO, 2020), agri-food value chains increasingly cross international borders and are becoming more globalized. To cite just one number to illustrate the globalization of the world's agri-food system, between 1995 and 2018 the volume of internationally traded agricultural commodities and food has more than doubled in real terms (FAO, 2020). Not all of this volume flows through global value chains; at the time of writing this chapter, roughly one third of all agri-food exports are traded within global value chains. Yet despite its globalization, disparities persist within global agri-food system. Agricultural workers in the richest 10 percent of countries, for instance, produce on average 50 times more output per worker than those in the poorest 10 percent (Gollin, Lagakos and Waugh, 2014). In this section we consider the role of *global* value chains in economic development and the structural transformation of economies around the world.

But first, we need to define "global agri-food value chains." Similar to our previous discussion of domestic value chains as facilitating transactions of intermediate goods between the primary producer and the final consumer, global value chains are the apparatus whereby products are sold across international borders as intermediate inputs rather than final goods (Antràs, 2020). A global value chain, therefore, refers to a production sequence for a final consumer good, with each stage adding value (e.g., production, processing, marketing, transportation, distribution) and with at least two stages taking place in different countries (Gereffi and Fernandez-Stark, 2011). As such, global value chains differ from conventional domestic value chains in which companies produce goods in one country and the final product is either consumed domestically or exported to other countries.¹⁸ A global value chain can be decomposed into forward linkages (i.e., exported raw products that are later used in another country and are exported once more to a third country) and backward linkages (i.e., the use of imported intermediate inputs in the production of exported products).

The production of Nutella provides an illustrative example of the level of specialization and global integration that can be involved in the production of some agri-food products (De Backer and Miroudot, 2014). Headquartered in Italy, Nutella has nine production facilities around the world—in North and South America, Europe, and Australia. Although some inputs are locally sourced, key inputs are sourced globally. For example, hazelnuts come from Turkey, palm oil comes from Malaysia, cocoa comes from Nigeria, sugar comes from Brazil, and vanilla comes from China. The international trade of each of these key inputs in the production of Nutella shows the reliance on global agri-food value chains in making Nutella, the final product which is then exported and sold in at least 75 countries.

The transformation of the modern production of goods and services from the international trade of final consumer products to the use of global value chains is fueled by institutional, political, and technological changes over the last few decades (Antras, 2016; Antras and de Gortari, 2020). As trade liberalization expanded in the 1990s, firms leveraged specialization and comparative advantage by using international trade to identify the least-cost location for each production stage, leading to increased integration of developing economies in world trade. In 2013, about 70 percent of international trade volumes of all goods and services involved global value chains by trading intermediate inputs and integrating value chains across countries (Miroudot, Rouzet and Spinelli, 2013). As such, Antras (2016) notes that "made in" labels in manufactured goods have become archaic symbols of a bygone era because most goods are now "made in the world."

The use of global value chains in agri-food production, however, lags behind that of

¹⁸This definition of global value chains relates them close to the concept of "global value added" as discussed by Johnson (2014).

other types of goods—manufactured goods in particular. In 1995 about 45 percent of all *exported manufactured goods* were traded within global value chains, and by 2008 more than half of all exported manufactured goods were traded within global value chains. By contrast, by 2008, about 35 percent of all *exported agri-food goods* were traded within global value chains, and the share of agri-food value chains within global agri-food exports remains similar today (FAO, 2020). In fact, for some foods—coffee, cheese, or wine, for example—a single-origin "made in" label carries an associated price premium that discriminating consumers or consumers wanting to signal specific class markers are willing to pay (Tregear, Kuznesof and Moxey, 1998; Dentoni, Menozzi and Capelli, 2012). We will discuss the challenge of consumer preferences and production standards facing global agri-food value chains later in this section.

From the 1950s to the early 1980s, the agri-food industry went through a pre-globalization phase by shifting from traditional, small-scale, and informal to modern, larger-scale, and formal production (Reardon and Timmer, 2007). Then, in the early 1990s, as trade liberalization expanded, transportation costs declined and trade barriers such as tariffs fell (Sexton, 2013). Specifically, shifts in trade regimes associated with regional trade agreements promoted participation in global agri-food value chains in Sub-Saharan Africa (Balié et al., 2019). Processors and retailers also became dominant players in global agri-food value chains by linking upstream farmers with downstream customers (Reardon et al., 2009; Sexton, 2013). Further, the rise of information and communications technology have also made vertical integration across borders cheaper, further promoting global value chains in low- and middle-income countries.

Driven primarily by differing factor endowments, the pattern of global agri-food value chain participation varies widely across countries (Antràs, 2020). Low- and middle-income countries with predominantly agrarian economies tend to be more involved in forward linkages in global agri-food value chains. This is because exports of raw agricultural commodities are used in a variety of downstream production processes that typically cross multiple borders. As such, low-income agrarian countries tend to specialize in the most upstream stages of global agri-food value chains (McMillan, Rodrik and Welch, 2002; WorldBank, 2019). In the remainder of this section, we will discuss both the opportunities and the challenges facing global agri-food value chains in promoting economic development and the structural transformation in low- and middle-income countries.

3.1 Opportunities for Global Agri-Food Value Chains

The 2020 World Bank Development Report *Trading for Development in the Age of Global Value Chains* suggests that linking smallholders farmers in low- and middle-income countries to global value chains has the potential to lift millions out of poverty (WorldBank, 2019).

More specifically, the Food and Agriculture Organization of the United Nations' *State of Agricultural Commodity Markets* report highlights that global agri-food value chains promote the integration of farmers in low- and middle-income countries into global agri-food markets (FAO, 2020). In particular, global value chains can be characterized as a "hyper-specialization" of production across international borders, which gives rise to a more narrow division of labor and an increase in the associated efficiency gains (Antràs, 2020). Thus, in broad terms, participation in global value chains tend to magnify the typical benefits associated with international trade in standard models. Counterfactual simulation analysis by Antras and de Gortari (2020) show that the gains associated with trade are on average 60 percent larger when countries participate in multi-stage global value chains relative to when they only trade final consumer products. In this sub-section, we discuss opportunities for global agri-food value chains by reviewing the literature on the benefits associated with participation in global agri-food value chains.

In general, both high- and low-income countries tend to benefit from participating in global value chains by leveraging their comparative advantage and realizing efficiency gains in productivity (Caliendo and Parro, 2015). We emphasize that the benefits derived from international trade are aggregate in nature because they are the result of a combination of diffuse benefits (i.e., lower prices for many consumers) and concentrated costs (i.e., increased competition, lower profit margins, and perhaps even exit for considerably fewer producers). Conceptually, participating in global value chains, local farmers and small agribusinesses in low- and middle-income countries can access global agri-food markets and can better leverage their comparative advantage at any stage of the value chain (De Loecker et al., 2016; De Loecker, Eeckhout and Unger, 2020; WorldBank, 2019). Rodrik (2018) points out (rather obviously in light of decades of literature on agricultural development) how low- and middle-income countries have significant opportunities to increase productivity in agricultural production through more efficient use of inputs, the adoption of new technologies, and diversification into new crops. The expansion of global agri-food value chains, therefore, can have numerous positive spillovers on the local economy and domestic agri-food value chains. We follow Feyaerts, Van den Broeck and Maertens (2020) and discuss four categories of spillovers, viz. spillovers on (i) investment and consumption, (ii) technology and managerial processes, (iii) infrastructure and agglomeration, and (iv) institutional spillovers. We then conclude this sub-section with a discussion of some emerging evidence suggesting that participation in global agri-food value chains is associated with economic development and the structural transformation of agrarian economies.

First, participation in global agri-food value chains is associated with increased agricultural investment and food consumption. Studying rural households employed in global value chains in Senegal, Maertens and Swinnen (2009) finds that these households invest

their earned income in the acquisition of land and in the purchase of inputs to expand and intensify crop production for local consumption. Following up on this study, [Van den Broeck, Van Hoyweghen and Maertens \(2018\)](#) finds that participation in global agri-food value chains is associated with improved food security and increased food demand. Similarly, [Scoones et al. \(2018\)](#) who studies tobacco farmers in Zimbabwe, finds that these farmers reinvest their earnings into livestock, farm inputs, and agricultural machinery. Finally, [Chiputwa and Qaim \(2016\)](#) finds that certified fair trade and organic smallholder coffee farmers in Uganda enjoy higher levels of food security and dietary diversity. Each of these findings are supported by the work of [Dreze and Sen \(1990\)](#), [Bellemare, Fajardo-Gonzalez and Gitter \(2018\)](#), and [Meemken, Spielman and Qaim \(2017\)](#) who each find that participation in export-oriented cash crops enhances the food security of both the households that directly participate in the production of those export-oriented cash crops and of those who live in surrounding areas.

Second, participation in global agri-food value chains is associated with the adoption of improved technology and managerial processes. Studying rural households in Madagascar, [Minten, Randrianarison and Swinnen \(2007\)](#) shows that farmers use soil fertility management practices advised to them by vegetable export companies within a contracting scheme on their rice fields. The authors, in turn, find that rice productivity increases despite the fact that the management advice was not specifically provided to them for use on their rice crops. Following up on this finding, [Bellemare \(2018\)](#) similarly finds that participation in contract farming is associated with increased incomes from livestock. These spillover effects are not unique to Madagascar. Similar findings are reported by [Govere and Jayne \(2003\)](#) who study farmers in Zimbabwe and Mozambique and by [Orr \(2000\)](#) who studies farmers in Malawi. The extent of spillover effects depends on the degree and type of horizontal coordination in the agri-food value chain via participation in production cooperative groups. Studying farmers in Ethiopia, [Shumeta and D’Haese \(2018\)](#) find that membership in coffee cooperatives explains which smallholder farmers gain access to the technical and managerial spillovers driven by the export of coffee. Other studies that find evidence of positive spillovers on the adoption of improved technological and managerial processes include [Masakure and Henson \(2005\)](#); [Theriault and Tschirley \(2014\)](#); [Jayne et al. \(2016\)](#); [Deininger and Xia \(2018\)](#); [Matenga and Hichaambwa \(2017\)](#); [Krishnan and Foster \(2018\)](#); [Krishnan \(2018\)](#); [Brüntrup et al. \(2018\)](#).

Third, participation in global agri-food value chains is associated with spillovers on investments in infrastructure and agglomeration. Prior to the structural adjustment period starting in the 1980s, agricultural marketing boards and parastatal organizations in Western and Central Africa invested in regional infrastructure and agricultural extension services ([Theriault and Tschirley, 2014](#)). The authors find that these investments are asso-

ciated with increased productivity of local crop production. Similarly, both [Yaro, Teye and Torvikey \(2017\)](#) (who studies farmers in Ghana) and [Van den Broeck and Maertens \(2017\)](#) (who studies farmers in Senegal) find that export-oriented companies and more export-oriented farms invest in local transportation infrastructure projects. By contrast, however, [Zaehringer et al. \(2018\)](#) find that less than a third of the farmers in their study sample report that horticultural companies invested in local infrastructure development. Clearly, the extent of positive spillovers from participation in global agri-food value chains onto investments in local infrastructure is context-dependent. Future research could expand on the current literature which, to date, almost exclusively includes case studies, ideally by combining remotely-sensed data on infrastructure density with socio-economic data on agri-food value chain activity. Other studies that find evidence of positive spillovers measured in terms of investment in infrastructure include [Wessel and Quist-Wessel \(2015\)](#) and [Scoones et al. \(2018\)](#).

Fourth, participation in global agri-food value chains is associated with institutional spillovers. As discussed by [Feyaerts, Van den Broeck and Maertens \(2020\)](#), institutional spillovers are innovations in the market structure of the agri-food industry. Examples of such institutional innovations include the emergence of contract farming, of quality standards, of productive differentiation mechanisms, and of other changes in industrial organization. Studying farmers in Kenya, [Krishnan \(2018\)](#) finds that the standards placed on the export of avocados to Europe (i.e., a less fibrous product with a longer shelf-life) gradually led to preference for this improved variety of avocados locally, within Kenya. Other studies that find evidence suggesting institutional spillovers due to participation in global agri-food value chains includes [Tallontire et al. \(2011\)](#); [Sitko et al. \(2018\)](#); [Sitko, Burke and Jayne \(2018\)](#); [Minten et al. \(2019\)](#).

Before continuing, we pause for a brief note about the limitations of the empirical methods used in these studies. Although each of the studies discussed in the previous few paragraphs represent important contributions to the literature at the time of their publication, many do not meet the modern-day standards of evidence in applied microeconomics. In particular, many of these studies use cross-sectional data, which limits the ability of the authors to adequately account for selection into global agri-food value chain participation. As we will discuss in more detail below, better quality and more detailed data—data which, at the very least, follow farmers and households over time—will help improve the credibility of this literature.

Finally, emerging empirical research finds that participation in global agri-food value chains is associated with economic development and the structural transformation of primarily agricultural economies. The conventional narrative of the structural transformation, as discussed by [Timmer \(1991\)](#), is that as a country with a primarily agricultural

economy begins to experience economic growth, agricultural productivity growth frees up agricultural labor which gets reallocated to the industrial sector. As this economy further grows a similar process occurs between the industrial sector and the services sector. [Lim \(2021\)](#) uses data from 155 countries from 1991 through 2015 to specifically study the relationship between participation in global agri-food value chains and the structural transformation—measured via the share agriculture, manufacturing, and services to total GDP. The author finds that increased participation in global agri-food value chains is associated with a decrease in the GDP share of the industrial sector and an increase in the GDP share of the services sector. When disaggregating global agri-food value chains into forward vs. backward linkages, [Lim \(2021\)](#) finds that increased participation in global agri-food value chains is associated with an increase in the GDP share of the agricultural sector. The author interprets these findings to suggest that modern economies "leapfrog" the industrial sector to directly develop their services sector due to their increased participation in global agri-food value chains. This finding adds important nuance to the conventional wisdom about the structural transformation.

Additional findings support the general conclusion that participation in global agri-food value chains stimulates economic development. A report by the [FAO \(2020\)](#) finds that a 10 percent increase in global agri-food value chain participation is associated with a 1.2 percent increase in labor productivity. Similarly, [Greenville, Kawasaki and Jouanjean \(2019\)](#) finds that global agri-food value chains generate between 20-26 percent of the total value-added in the global agricultural workforce. Finally, using the same data as in [Lim \(2021\)](#), [Lim and Kim \(2021\)](#) find that increased participation in global agri-food value chains is associated with agricultural employment growth. The authors also find that the estimated relationship between global agri-food value chain participation and agri-food job creation is mostly driven by the processed food sector than the raw agricultural commodity sector.

3.2 Challenges for Global Agri-Food Value Chains

Although participation in global agri-food value chains is associated with a myriad of positive spillovers and opportunities for economic development, challenges persist as well. Given the conceptualization of global value chains as a form of "hyper-specialization" that deepens the traditional consequences associated of international trade ([Antràs, 2020](#)), participation in global value chains can exacerbate economic inequality while having little influence on poverty. Indeed, one of the core insights of the Stolper-Samuelson theorem suggests that deeper integration into international trade is likely to increase income inequality within an economy by placing upward pressure on the wages of those with in-demand skills. In this sub-section, we first discuss these distributional consequences and

discuss the influence of global agri-food value chains on poverty and the welfare of smallholder farmers. Following that, we discuss several other challenges, such as political considerations, standards and transparency, foreign exchange risk, and nontariff barriers to international trade.

First, as we already alluded to, participation in global agri-food value chains can increase inequality. Discussing global value chains more generally, [Antràs \(2020\)](#) highlights three reasons why low- and middle-income countries that increase their participation in global value chains may experience increased economic inequality. First, global value chains often lead to the off-shoring of "low-skill" labor from high-income countries to low- and middle-income countries with relatively high endowments in "low-skill" labor. It may be the case, however, that this so-called "low-skill" labor is relatively "skilled" labor in many low- and middle-income countries. This places upward pressure on the wages of those who hold these skills and increases income inequality. Second, global value chains are often "high-skill" labor intensive, and thus concentrate benefits associated with participation among those who hold these skills. Finally, global value chains are often capital-intensive and similarly concentrate benefits associated with participation among those who own the capital necessary for those value chains to operate.

These general insights translate reasonably well to more specific global agri-food value chains. In food processing, a small number of large multinational corporations such as Nestlé, PepsiCo, Unilever, and Danone dominate global food processing. The same goes in food retailing, where a small number of multinational corporations such as Walmart, Costco, Lidl, Aldi, and Carrefour also dominate global food distribution and marketing. While those corporations promote vertical integration in global agri-food value chains, they often distort the agri-food market with their market power ([Reardon et al., 2009](#); [Sexton, 2013](#)). In retail markets, highly concentrated food retailers also likely increase retail prices while seeking oligopoly rents and reduce commodity prices for farmers while seeking oligopsony rents ([Sexton and Zhang, 2001](#)).

A common concern is the exclusive nature of global agri-food value chains, which can ignore and even crowd out production by smallholder farmers ([Reardon et al., 2009](#); [Feyaerts, Van den Broeck and Maertens, 2020](#)). As previously discussed, [Reardon et al. \(2009\)](#) summarize the literature on the transformation of agri-food industry around the world and find mixed evidence suggesting that in some cases global agri-food value chains include smallholder farmers but in other cases smallholder farmers are excluded. For example, [Michelson \(2013\)](#) shows that although selling agricultural commodities to supermarkets is associated with an increase in household welfare, only farmers with advantageous endowments of geography and water are likely to participate. Therefore, not all farmers participate in global agri-food value chains and often times smallholder farmers

with access to fewer resources are the farmers that end up being excluded.

Moreover, the expansion of global agri-food value chains can create competition for scarce resources such as land, labor, water, and other natural resources (Feyaerts, Van den Broeck and Maertens, 2020). Although most studies find that participation in global agri-food value chains is associated with little crowding out of smallholder participation in domestic agri-food value chains,¹⁹ absence of evidence is not necessarily evidence of absence. Indeed Brüntrup et al. (2018) find results suggesting that the expansion of sugarcane contract farming schemes in Tanzania is associated with local land redistribution that disadvantages smallholder farmers. Another exception is found by Dolan (2001), who studies export-oriented contract farming schemes in Kenya, and who finds that the increased use of land for contracted horticulture crowds out vegetable production for local consumption, a sub-sector that is a predominant income-earning activity for women in Kenya. Although this finding is consistent with the idea that participation in global agri-food value chains leads to the structural transformation (Lim, 2021), it also highlights potential unintended consequences on gender equality, women's empowerment, and intra-household arrangements, and represent barriers to a more holistic understanding of well-being than perhaps included in a classical notion of economic development.

Second, political pressures on and the political consequences of international trade also present a challenge for global agri-food value chains in low- and middle-income countries. On the one hand, as highlighted by Swinnen, Olper and Vandevælde (2019) in a review on the political economy of global agri-food value chains, political forces may influence strategic interactions among various domestic interests in any public policy-making process. Since the work of Grossman and Helpman (1994, 1995), a strand of literature studies the political economy of bilateral trade and related trade policies. Focusing on the agri-food sector, Anderson, Rausser and Swinnen (2013) provides an extensive review of the literature investigating trends and fluctuations in agri-food policy distortions with the political-economic theories that elaborated such distortion in international trade markets. As global value chains reshape existing bilateral trade networks and trade dependency across countries, the international political economy of global value chains has increasingly received academic and policy attention and more recent literature has focused on the political economy of global value chains (Neilson, Pritchard and Yeung, 2014; Fernández, 2015; Kim and Spilker, 2019). International trade can and almost surely has political consequences. In a recent review, Rodrik (2020) develops a conceptual framework through which to study the relationship between globalization—and thus greater participation in

¹⁹For instance, Warning and Key (2002) find that groundnut value chain participants are indistinguishable from nonparticipants in their Senegalese data when looking at wealth levels. Key and Runsten (1999), however, find that in the value chain for frozen vegetables in Mexico, processors prefer to contract with large-scale landowners, which means that smallholders tend to be excluded.

international trade—and the rise of populism in recent years. He then uses that framework to assess the empirical literature on the topic, focusing on trade, the globalization of finance, and immigration. That said, the bulk of the literature on the political consequences of globalization focuses on high-income countries such as the US, and so the remainder of this discussion will focus on the consequences of politics on international trade in those countries.

Several studies develop theoretical models that characterize how global value chains influence trade policy decisions. For example, [Antràs and Staiger \(2012\)](#) show that governments are unlikely to rely on conventional trade agreements in response to the rise of off-shoring via global value chains. Their theoretical model indicates traditional trade agreements or policies are politically less necessary in the era of global value chains. Therefore, [Antràs and Staiger \(2012\)](#) suggest that institutions need to transition from a reliance on simple and broadly applied trade policies to a collection of more individualized agreements in order to reflect member-specific needs. Furthermore, [Blanchard, Bown and Johnson \(2017\)](#) study how global value chain linkages modify incentives to impose import protection. The authors find that governments have fewer incentives to manipulate the final goods terms-of-trade when their country is more deeply engaged in global value chains. Therefore, increased participation in global value chains leads to lower import tariffs. In the same vein, a recent study by [Beshkar and Lashkaripour \(2020\)](#) finds that participation in global value chains rarely lowers governments' incentives to adopt protectionist trade policies such as tariffs and export restrictions.

Other studies investigate how trade policy decisions influence the rate of participation in global value chains. Using a gravity model, [Orefice and Rocha \(2014\)](#) find that signing deeper preferential trade agreements increases global value chains links between member countries. They also find that preferential trade agreements between high-income countries and low- and middle-income countries include a higher number of World Trade Organization provisions. Similarly, [Balié et al. \(2019\)](#) investigate the relationship between trade agreements and participation in global value chains by decomposing global agri-food value chains participation into backward and forward global value chain participation. The authors show that trade agreements among sub-Saharan African countries appear to have an important influence on the participation in global value chains. These findings suggest that a restriction imposed by one country not only decreases a partner countries' exports but also the country itself through reduced linkages via global value chains.

Although the past several decades have seen general optimism toward greater global value chain expansion and integration, [Ruta \(2017\)](#) points out several questions for future research. In particular [Ruta \(2017\)](#) states that the a future expansion of global value

chains should not be taken for granted because individual firms' offshoring decisions depend on expectations of future international trade policies. Therefore if firms expect a general shift away from liberalized trade policies, they are likely to re-nationalize their production processes. In addition, the loss in aggregate welfare associated with trade disputes can be exacerbated among countries deeply engaged in global value chains. For example, using Mexican customs data, [De Gortari \(2019\)](#) finds evidence that the global agri-food value chain network between the US and Mexico amplified the welfare cost from a NAFTA trade war. Similarly, [Wu et al. \(2021\)](#) also find evidence that a series of tariff escalations during the recent US-China trade war resulted in an indirect tariff burden to third-party countries in global agri-food value chains.

Third, quality standards and transparency present a challenge for global agri-food value chains. Requirements posed by specific standards (e.g., Fairtrade) are a critical challenge for smallholder farmers ([Meemken, Veetil and Qaim, 2017](#); [Meemken, Spielman and Qaim, 2017](#); [Meemken and Qaim, 2018a,b](#); [Meemken, 2020](#); [Sellare et al., 2020](#)). At each stage of a global agri-food value chain, public regulations and standards can aim to ensure food safety, public health, and environmental stewardship by the importing countries wherein those standards are often regulated by World Trade Organization agreements ([Rodrik, 2018](#); [Feyaerts, Van den Broeck and Maertens, 2020](#)). Because of various standards across governments,²⁰ international agribusinesses often impose their own standard to ensure the quality of products imported from low- and middle-income countries; this is similar to how, in the US, hazard analysis and critical control points (HACCP) food-safety protocols are voluntary for foods that are neither meat or seafood.

Another key challenge is the need to track any agricultural product through all stages of production, processing, and distribution across countries ([FAO, 2020](#)). Smallholder farmers and small-scale processors in low- and middle-income countries often lack the technical and financial capacity needed to comply with requirements to ensure transparency in product origins ([Banterle and Stranieri, 2008](#); [Pouliot and Sumner, 2008](#); [Souza-Monteiro and Caswell, 2010](#)). The case of "conflict mineral" legislation in the US provides a stark example of the challenge of transparency and quality standards for global value chains.²¹ The Democratic Republic of the Congo (DRC) has an abundance of natural resource wealth. The DRC is also home to decades of violent conflict between numerous armed rebel groups. These armed rebel groups are known to finance their activities via the international trade of "conflict minerals" mined in artisanal mineral mines largely found in the DRC ([Vircoulon, 2011](#)).

²⁰Or even within governments. In the US, for example, food-safety protocols for meat are regulated by the US Department of Agriculture. For seafood, they are regulated by the Food and Drug Administration.

²¹Although minerals are not an agricultural product, they are a natural resource that can provide valid insights relevant to the agri-food industry.

Motivated by this observed link between the international trade of "conflict minerals" (e.g., tin, tantalum, tungsten, and gold)—which are key inputs into popular consumer products such as mobile phones, computers, jewelry, and medical equipment—the United States Government passed legislation in hopes of breaking the link between US consumers and armed rebel groups. Section 1502 of the Dodd-Frank Wall Street Reform and Consumer Protection Act requires publicly traded US companies to report on the origins of any of these conflict minerals in their supply chains. If a company knows that their minerals did not originate in the DRC or surrounding countries, then the company must document this knowledge and file a form with the United States Securities and Exchange Commission. If a company knows, or cannot plausibly claim to the contrary, that their minerals may have originated in the DRC or surrounding countries, then they must perform due diligence on the source mine and report any connections to armed rebel groups.

So, was the the Dodd-Frank Act successful in breaking the link between US consumers and armed rebel groups, thereby reducing conflict? Quantitative studies, compare conflict events between regions with and without 3TG mineral mines within the DRC and find evidence that this legislation may have led to unintended consequences—such as increased infant mortality (Parker, Foltz and Elsea, 2016) and increased conflict (Parker and Vadheim, 2017; Stoop, Verpoorten and Van der Windt, 2018). More recent quantitative work finds similar results using by comparing conflict events across countries, rather than comparing conflict events within only the DRC (Bloem, 2021). This allows for a full evaluation of the policy not only within the DRC but within the DRC and all surrounding countries. Bloem (2021) finds that the unintended consequences of the Dodd-Frank Act's "conflict minerals" trade policy is larger than previously estimated within the DRC and he also finds no evidence of reductions in conflict within the surrounding countries. Taken together, numerous qualitative and quantitative studies—each using slightly different methods—find that the "conflict minerals" trade legislation was not only not effective in achieving its intended outcomes but also lead to important and devastating unintended outcomes.

What led to these unintended consequences? Using data collected by the International Peace and Information Service, Bloem (2021) uncovers two findings that may help understand the broad ineffectiveness of this legislation. First, the passage of the Dodd-Frank Act is associated with a robust and large decline in the number of workers at mines mining tin, tantalum, or tungsten. This finding suggests that the Dodd-Frank Act led to unintended continuances because it may have caused a negative shock on the mineral mining industry in the DRC, which may lead to either reductions in income, job losses, or both. Ultimately poverty and social frustrations may be two more fundamental causes of conflict in the DRC than the export of tin, tantalum, or tungsten. Second, although the passage

of the Dodd-Frank Act did lead to a reduction in the presence of an armed rebel group at mines mining tin, tantalum, or tungsten, this effect estimate is relatively imprecise and is not statistically significant. While this effect may seem to be consistent with the intended outcome of this legislation, the shift away from artisanal mineral mines and to an alternative revenue source could itself be a violent process that disrupts existing relationships between armed rebel groups.

The case of "conflict mineral" legislation highlights the challenge of implementing policy reforms that aim for increased transparency and tracking to align with the quality standards of end consumers. Unless the policy reform is carefully designed and attentive to the potential unintended consequences it may have on some of the most vulnerable people participating in the value chain, implementing blunt policies intending to address complicated political challenges intertwined with a global value chain may end up leading to more harm than good.²²

Fourth, risks associated with foreign exchange rate fluctuations generate challenges for global value chains in general. Since [Friedman et al. \(1953\)](#), exchange rate regimes in developing countries have been studied in relation to international trade because exchange rates affect international trade flows.²³ In particular, exchange rate volatility is a risk associated with uncertainty in the exchange rate in international trade and is often driven by macroeconomic factors including the interest rate, the balance of payments, and inflation. Since the breakdown of the Bretton Woods system, many countries changed their fixed exchange rate regimes to floating exchange rate regimes, which led to both real and nominal exchange rates have fluctuated largely across trade partners. Dating back to the early 1970s, a strand of literature developed a theoretical mechanism through which exchange-rate stability influences trade flows ([Clark, 1973](#); [Cushman, 1983](#); [Baldwin and Krugman, 1989](#); [Bacchetta and Van Wincoop, 2000](#); [Gali and Monacelli, 2005](#)).

In support of these theoretical considerations, the vast empirical studies find negative effects of exchange volatility on trade. [Laws, Monitor and Outlook \(2004\)](#) find that if exchange rate volatility were to increase by one standard deviation, trade would fall by seven percent. [Rahman and Serletis \(2009\)](#) find exchange rate uncertainty negatively affect on US export. Using data from East Asian economies, [Chit, Rizov and Willenbockel \(2010\)](#) find that not only absolute volatility but also relative volatility among trade partners negatively

²²Another example of such a blunt policy, the Sanders amendment to the Tariff Act of 1930, named after its proponent independent Senator Bernie Sanders of Vermont, is discussed by [Basu \(1999\)](#). The goal of the Sanders amendment was to deter the import of goods produced with forced or indentured child labor. But as [Basu \(1999\)](#) discusses, preventing the importation of goods produced with forced or indentured child labor may well mean a fate worse than simple labor for the children involved if banning those imports means that they are put to work in alternative occupations such as prostitution. As it happens, the Sanders amendment was adopted in 1997.

²³For the specific study of how changing exchange rates affects agriculture, see [Schuh \(1974\)](#).

affecting export flows. In the agricultural sector, [Cho, Sheldon and McCorrison \(2002\)](#) explore the effect of exchange rate uncertainty on the growth of agricultural trade as compared to other sectors. They argue the negative effect of real exchange rate uncertainty on agricultural trade had been more significant compared to other sectors. Using data from Taiwan, [Wang and Barrett \(2007\)](#) also find monthly exchange rate volatility negatively affects agricultural trade flows, but not trade in other sectors. Following [Cho, Sheldon and McCorrison \(2002\)](#)' approach, [Kandilov \(2008\)](#) find that the effect of exchange rate volatility is much larger for developing country exporters than for rich country exporters.

A recent study by [Steinbach \(2021\)](#) investigates the impact of exchange rate risk on global agri-food value chains by using product-level panel data covering 159 countries in the period of 2001-2017. The author's findings suggests that exchange rate volatility adversely affects global agri-food value chains in the short run while it positively affects global agri-food value chains in the long run. His finding further indicates that positioning in global agri-food value chains matters. The results show agri-food products produced in high upstream (downstream) have positive (negative) trade effects. Although agrarian developing countries positioning in global value chains might differ from rich countries, he finds no evidence of differences in the trade effects according to the stage of economic development.

Finally, non-tariff barriers to international trade remain an important challenge for global agri-food value chains. Lacking infrastructure and inefficient supply chain systems hinder low- and middle-income countries to participate in global value chains. Some studies estimate that transportation costs are 40 to 100 percent higher in Africa than in other regions of the world, with even higher costs in landlocked African countries ([MacKellar, Wörgötter and Wörz, 2000](#)). Other studies, however, estimate that transportation costs are even larger, at over five times higher in sub-Saharan African than elsewhere in the world ([Atkin and Donaldson, 2015](#); [Porteous, 2019](#)). [Graff \(2019\)](#) studies the efficiency of transport networks for African countries by using spatial data. By comparing his own developed African-specific unique optimal trade network to the current road system, he identified spatial inefficiencies in Africa's trade network driven by colonial infrastructure projects. Another study by [Fiorini, Sanfilippo and Sundaram \(2021\)](#) also provides evidence from Ethiopia that a reduction in input tariffs increases firms' productivity in towns with better market access from roads that connect them to other international markets. In addition, using data on the colonial Indian economy, [Donaldson \(2018\)](#) finds that railroads reduced trade costs and increased trade volumes of agricultural commodities.

4 Research Gaps

We now turn to the research gaps in the literature on agri-food value chains, some of which we have already alluded to in the foregoing. These research gaps are what we see as the proverbial stones left unturned over the last few decades of research on agri-food value chains. In some cases, this is because of data limitations—and indeed, we note below that data limitations *are* a research gap in and of themselves—but in other cases it is because the consequences of recent shocks to agri-food value chains (e.g., climate change or the global pandemic) have not yet been studied to their full extent. We see this section as the most useful for graduate students and early-career researchers who are looking to work on frontier topics related to agri-food value chains, and thus as the one with the most value added in this entire chapter.

4.1 Data Needs

The study of agri-food value chains is necessarily limited by the data available for doing so. Although there are good data sets one can use to track international trade flows, either aggregate trade flows or the trade flows of specific commodities, this is not true when it comes to studying domestic value chains. Indeed, while there exist many publicly available household surveys that allow studying the most upstream levels of domestic value chains (i.e., participation in agri-food value chains by households; see for example the World Bank's LSMS-ISA data sets), and while there exist a number of privately collected data sets that allow studying the most downstream levels of those same value chains (i.e., consumer panel and retail scanner data; see for example the data sets available for purchase from Nielsen), the universe of data sets that allow studying what happens once a commodity passes the farm gate and before it gets to a retailer is very small, and it is virtually of measure zero if one tries to combine any of its constituent parts with data sets at either end of the value chain. Given that, data on the midstream of agri-food value chains (i.e., anything that takes place as a commodity makes its way from the farm gate to the retailer) are so uncommon that that midstream sector is often referred to as the "hidden middle" (Reardon, 2015).²⁴

When it comes to studying global agri-food value chains, one of the primary challenges in measuring global value chains arises from the fact that customs data provide information on where the transacted good or service was produced, but not on which countries contributed value to it. Unlike bilateral trade analysis, which mainly uses customs

²⁴Reardon (2015) notes that even when data on the hidden middle are available, those data are of limited usefulness to researchers: "[d]ata sources on part of the midstream, in particular processing, like the United Nations Industrial Development Organization (UNIDO), do not offer sufficient disaggregation to track the midstream segments in detail."

data records, global value chain analysis necessarily requires data that indicate whether a traded commodity is fully consumed in the importing country as a final product or whether it will be re-exported after the importing country adds value to it as an intermediate good.

Some frontier work in measuring global value chains has combined information from customs offices together with national input-output tables to construct global input-output tables (e.g., the World Input-Output Database, the OECD TiVA database, and the Eora Global Supply Chain Database). While these global input-output tables provide publicly available county and industry-level global value chain measures, [Antràs \(2020\)](#) highlights their main limitation. Because data are highly aggregated at the industry level, these data lack the necessary tracking of each global value chain activity occurring within these broadly defined sectors. In particular, all agricultural and food-related industries are only defined as two aggregated industries: agriculture on the one hand, and food & beverage on the other hand. As a result, the intermediate goods traded along the global value chain are recorded several times (i.e., whenever they cross borders), which is likely to overestimate the contribution of the country exporting the final goods and underestimating the role of countries producing intermediate products ([Scoppola, 2021](#)). As developing countries including sub-Saharan Africa increasingly participate in upstream agri-food global value chains ([Balié et al., 2019](#); [Lim and Kim, 2021](#)), aggregated global input-output tables are likely to underestimate the participation of low- and middle-income countries in agri-food global value chains.

When it comes to domestic agri-food value chains, one obvious limitation to the assembly of data sets that can allow eventually studying entire value chains is that many of the actors involved in the midstream are private firms that (i) have every incentive to keep data on their operations secret for fear of losing out to the competition, and (ii) operate on markets where there are so few actors that it may be near impossible to guarantee confidentiality to those firms that do choose to share their data with researchers.

We see four ways around those limitations. The first is for researchers interested in studying what goes on within-firm in the midstream of value chains to explore the use of confidentiality agreements. While this will necessarily limit the replicability and transparency, and thus ultimately the credibility of the findings generated using these data ([Christensen and Miguel, 2018](#)), there is no other way out. The second way around those limitations is for researchers to rely on publicly available data on those midstream firms, which will generally be limited to market level information such as the number of firms in a given midstream sector, where those firms are located, how long they have been in operation, and so on. The third way around those limitations may be to start by studying value chains that have been nationalized, such as West African *filières* like the cotton value

chain in Mali (Elabed et al., 2013), although the very fact that those value chains have been nationalized, by reducing the role of markets proper to virtually nothing, makes the study of those value chains considerably less interesting for (when not downright anathema to) economists. Finally, and more easily, researchers could combine remotely-sensed data on infrastructure density with socio-economic data on agri-food value chain activity to study the presumably two-way causal relationship between infrastructure and agri-food value chains.

When it comes to global agri-food value chains, in order to track value-added contribution and trade flows along the value chains, across borders, across firms and within firms, ideally one requires (i) firm-level data, (ii) recording transactions of each subsidiary in every country, (iii) detailed by product and by the party involved in the transaction and (iv) all this for the whole value chain (Scoppola, 2021). More recent global value chain research has used firm-level data that capture multinational activities in manufacturing global value chains (Alfaro et al., 2019; Del Prete and Rungi, 2020). Here, too, firm-level data that capture multinational activities in the agri-food sector are not available.

Given the foregoing, we believe international organizations like the Food and Agriculture Organization of the United Nations, the International Food Policy Research Institute, and the World Bank can and should lead the way by developing ambitious global agri-food value-chain data collection programs, thereby adapting their data collection efforts to the needs of researchers in the 21st century and beyond.

4.2 Empirical Methods

The empirical study of value chains—agri-food or otherwise—by economists has not only been limited by a paucity of data; it has also been limited by a lack of a common methodological language to study value chains. On the one hand, social scientists outside of economics and some economists have relied on case studies to study value chains. Given that many upstream agri-food commodities are used in the making of a myriad other downstream final commodities (e.g., apples are consumed raw, in apple juice, in apple cider, in Calvados, sliced and dried, in apple sauce, in pie filling, in some sausages and stuffings), it makes sense to pick one or two of those final commodities and go up the value chain to trace out all of the stages of processing, transformation, distribution, shipping, transportation, and so on which that commodity experiences before becoming final and discuss that section of the apple value chain in the context of a case study. But the reverse is considerably more difficult, and case studies that start from one upstream commodity have the potential to either get lost in the multitude of final goods that commodity eventually is used in or to ignore some of those final goods altogether, thereby painting an incomplete portrait of the value chain. Even for commodities that have relatively fewer uses

(e.g., coffee), there may be too many such uses for an upstream-starting case study to be very useful, and so we deem downstream-starting case studies to be more useful. Either way, case studies are useful in generating hypotheses to be tested by applying quantitative methods to data.

The common methodological language of economists to study most phenomena—our empirical *lingua franca*, so to speak—remains the language of econometrics. And while economists have had considerable success studying simple dyadic links in agri-food value chains (e.g., grower–processor contracts, or consumer–retailer interactions), they have been relatively silent as regards studying longer segments (e.g., grower–processor–wholesaler) of agri-food value chains.

How can one do so empirically? As [Bellemare \(2021b\)](#) explains, one can in theory write a maximum likelihood function to study any segment of a value chain. For instance, suppose one is interested in studying the grower–processor–wholesaler segment. One can write a likelihood function involving both, say, the multinomial grower decision of which processor to contract with and how much to sell to that processor as well as the processor decision of which wholesalers to sell to and how much to sell to each wholesaler. An example of this kind of work, but one focusing on the dyadic producer–trader link is [Bellemare and Barrett \(2006\)](#), who study (i) whether East African livestock herders participate on the market as buyers or sellers and, conditional on participating as either buyers or sellers, (ii) how much livestock those households buy or sell. This method can be used for descriptive purposes (i.e., identifying the relevant correlates of a given outcome) or for causal inference (i.e., determining whether a given treatment variable causes a change in a given outcome and, if so, by how much). For the latter, one can exploit plausibly exogenous shocks at any given point of the value chain to study how those shocks propagate through the segment of the value chain under study. In the grower–processor–retailer segment just discussed, one could exploit the fact that a natural disaster prevents some growers from delivering contract output to study how this affects both processors and retailers.

4.3 Disruptions, Congestion, and Bottlenecks

The global SARS-CoV-2 pandemic has laid bare the fragility of value chains, both global value chains overall and domestic value chains in particular. On the former, the shock of the pandemic and associated lockdowns in March 2020 caused global value chains to whiplash. Consumers in high-income countries, who had initially reduced their spending on non-necessities due to the financial uncertainty associated with lockdowns, started spending to purchase those non-necessities once again when vaccines became available, thus causing the global trade infrastructure to go from handling a relatively evenly distributed flow of goods over time to a drastically flow of such goods, and then to a dras-

tically increased flow of such goods well beyond pre-pandemic levels, to the point where the cost to send a container from China to the United States more than quadrupled in less than a year, according to a recent story in *Time* magazine (Semuels, 2021). The stop-go shock caused by the pandemic to global trade flows has disrupted value chains by causing congestion and bottlenecks everywhere, to the point where some industry experts predict that it will take two to five years for regular shipping times to resume and shipping prices to come back down to pre-pandemic levels.

On the latter, the resilience of domestic agri-food value chains the pandemic has been a mixed bag. On the one hand, downstream segments (e.g., grocery stores and restaurants) have adapted remarkably well to the so-called new normal by rapidly repurposing their operations to satisfy the significantly increased demand for food delivery or curbside pickup. On the other hand, the media reported on prominent disruptions to specific value chains (e.g., the meat value chain in the US) as a result of clusters of COVID-19 cases at specific food-processing plants which saw entire plants shutdown, and thus shortages of specific food items. Likewise, consumer hoarding of specific items, both food (e.g., bottled water) and nonfood (e.g., toilet paper) during the initial round of lockdowns, also exposed the weakness of value chains.

While pandemic-related disruptions to value chains are the most salient such disruptions at the time of writing, disruptions due to extreme weather and other natural disasters are more common than pandemic-related value-chain disruptions, and they are increasingly frequent as a result of anthropogenic climate change. There is thus an opportunity to look to climate modeling to study global agri-food supply chains under various scenarios. This is especially important given that unlike many other goods, everyone consumes foods, and so disruptions in agri-food value chains can have serious, permanent consequences on human welfare.

While these disruptions in value chains, both global and domestic, fall under the purview of engineers more than economists, economists nevertheless have their role to play in ensuring that future disruptions—such as those disruptions caused by climate change—do not compromise value chains, and to help build value-chain resilience. If anything, economists should be involved in the design and testing of value-chain insurance, viz. insurance against disruptions in specific value chains.

4.4 Environmental Consequences

International trade often affects environmental outcomes and can affect domestic environmental policy and the international political economy surrounding the environment (Antweiler, Copeland and Taylor, 2001; Copeland and Taylor, 2004, 2013). In particular, numerous studies on international trade and the environment have looked at the pollu-

tion haven effect, a hypothesis according to which regulatory stringency in rich countries reallocates polluting industries from high-income countries to low- and middle-income countries where environmental standards are less stringent (Eskeland and Harrison, 2003; Cole, 2004; Copeland, 2008; Levinson and Taylor, 2008; Kellenberg, 2009; Grether, Mathys and De Melo, 2012). The environmental consequences of global value chains have recently come under the spotlight of researchers interested in the environment because global value chains are associated with more shipping and more waste than conventional (i.e., bilateral) trade (WorldBank, 2019). Much more than the manufacturing and services sectors, global agricultural production comes with negative environmental consequences such as pollution of air, water, and soil that are likely to result in climate change and ecosystem disruptions (Aneja, Schlesinger and Erisman, 2008).

There is, however, an important research gap in the literature on agri-food global value chains and the environment. We know very little about how participation in global value chains by low- and middle-income countries affects environmental outcomes, either domestic or international. Conceptually, the environmental consequences of international trade result from different features of agri-food global value chains between high-income countries and low- and middle-income countries, such as positioning in global value chains, geographic dispersion of production, economies of scale, and the market power of multinational agribusinesses (WorldBank, 2019). Based on the pollution haven hypothesis, one might argue that greater participation in agri-food global value chains leads to worse environmental outcomes. For instance, Ponte (2020) shows that in Southern and Eastern Africa, firms operating within the wine value chain capture value for themselves by extracting more surplus from their upstream suppliers in low- and middle-income countries while leaving serious environmental challenges unaddressed.

4.5 Globalization and Politics

As discussed above, the bulk of the literature on the political consequences of globalization focuses on the US and other OECD countries, with very little is written by economists on the consequences of globalization and greater participation in global value chains in developing countries. Although one might think of those political consequences as falling under the purview of political scientists more than of economists,²⁵ we view this area of research as being fair game for economists because unlike other areas of research where economists stand to be accused of trying to "colonize" other disciplines, this one lies squarely at the

²⁵And indeed, some political scientists have looked at the consequences of globalization on politics. Malesky (2008), for instance, looks at the relationship between foreign direct investment (FDI) and whether local leaders act more autonomously relative to the central government in Vietnam, and finds evidence that increases in lead to local leaders acting more autonomous, which he argues is de facto decentralization.

intersection of the two disciplines.

A forthcoming article by [Dippel et al. \(2021\)](#) is a good example of the type of work we would like to see done in low- and middle-income countries. In that article, the authors establish a causal link between exposure to imports from low-wage countries on the one hand and, on the other hand, support for populist countries in Germany. Similar questions could and should be investigated in several low- and middle-income countries, with a special focus on agri-food global value chains. This is especially so given that the agricultural and food sector occupies a large share of the economy, both in terms of GDP and of labor, in most low- and middle-income countries, and so any significant change to the agricultural economy of an low- and middle-income countries has the potential to cause significant political changes. One example of the type of work we have in mind is by [Belle-mare \(2015\)](#), in which the author finds a link between rising food prices and social unrest but finds no such link between food price volatility and social unrest.

5 Conclusion

In this chapter, we first summarized the literature on agri-food value chains in low- and middle-income countries. Starting with domestic agri-food value chains, we discussed the move from subsistence agriculture to participation in agri-food value chains, the choice of contracts versus spot markets for procurement, the role of intermediaries (e.g., traders), and the role of processors, wholesalers, and distributors. From there, we turned to global agri-food value chains. Here, we discussed the opportunities presented by and the challenges posed by global agri-food value chains.

Secondly and, in our view, more importantly, we identified a number of research gaps in the economic literature on agri-food value chains. First and foremost, while greater data availability has made advances possible in several areas of economics, that has been less true of the study of value chains, agri-food or otherwise. While there exist many household surveys, retailer scanner data sets, and consumer panels for low- and middle-income countries, those only allow for studying the endpoints of domestic agri-food value chains, and there is a dearth of data on the so-called hidden middle of agri-food value chains ([Reardon, 2015](#)). Moreover, many of the research gaps we discuss below can also benefit from more and better data on agri-food value chains.

First, finding and collecting better and more detailed data relevant to agri-food value chains represents a critical frontier for the future of this literature. Much of the existing literature is limited by data that complicates the estimation of credible causal effects or, even more fundamentally, is aggregated to a level that prevents within-country and within-industry analysis. Developing the resources and networks necessary to improve on the

availability of data relevant to agri-food value chains in low- and middle-income countries is a necessary first step in successfully answering the original call by [Reardon and Timmer \(2007\)](#) for development economists to collaborate with agribusiness researchers—two groups which have so far been like ships passing in the night—to study the middle segments of agri-food value chains.

Second, while economists have always been at the cutting edge when it comes to empirical methods, we have yet to develop methods that allow looking beyond mere dyads (e.g., grower-processor contracts) to look at longer segments within value chains. Here, the use of maximum likelihood methods appears promising ([Bellemare, 2021b](#)) to identify both correlates as well as causal relationships.

Third, recent disruptions to the flow of goods within value chains due to the SARS-CoV-2 global pandemic have shown both how vulnerable value chains based on the just-in-time principle are, but also how resilient some parts of the agri-food value chains (e.g., restaurants and grocery stores) have turned out to be. Both these facts point out directions for future research. On the one hand, economists have a role to play in the development of insurance markets for value chains; on the other hand, the "delivery revolution" is interesting in and of itself.

Fourth, the relationship between the environment and agri-food value chains involves many questions that have yet to be answered. While we certainly know a lot more about the impact of climate change on agri-food value chains than we did a mere ten years ago, we know much less about the impact of agri-food value chains—especially global value chains, which involve more shipping pollution than shorter, domestic value chains—on the environment.

Fifth, and finally, the effects of agri-food value chains on politics in low- and middle-income countries seems like a promising area of research for scholars interested in the political economy of development. While we know a great deal, say, about the effects of exposure to international trade on support for populist politicians in OECD countries ([Dippel et al., 2021](#)), we know much less about the impact of global agri-food value chains on low- and middle-income country politics.

Even in the face of Brexit and of four years of a populist American president, we argue that our food system will only increasingly—not decreasingly—rely on global agri-food value chains in the future because of rising incomes the world over driving consumer demand for a greater diversity of foods of better quality. As such, it behooves us to understand what gives rise to global agri-food value chains, how they operate and respond to changing circumstances, and what their consequences are for human welfare and the environment. This chapter has surveyed what we know on the topic, but there is much more which we do not know, and there is much work left to be done.

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