The Farm Labor Problem
A Global Perspective

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1. Introduction

   The Problem of Farm Labor Demand 2
   The Agricultural Production Function 3
   Technological Change: Switching to a New Production Function 4
   Production Risk 5
   Timing and Seasonality 6
   Space 8
   Inequality and Concentration 10
   The Problem of Farm Labor Supply 10
   Equilibrium in Farm Labor Markets 12
   A Continuum From Family Farming to an Immigrant Farm Workforce 13
   The End of Farm Labor Abundance 15
   Robots in the Fields 16
   References 17

2. Agricultural Labor Demand

   Modeling Agricultural Labor Demand 22
   An Uncertain Relationship 24
   An Example: Lettuce Labor Demand on California’s Central Coast 25
   Rethinking the Production Function 27
   A Two-Stage Crop Production Function 28
   Volatility in Farm Labor Demand 29
   Impacts of Yield and Wage Shocks on Lettuce Labor Demand 30
   Weather Shocks and Labor Demand in a Multistage Production Function 30
   What Do the Data Show? 32
   Why Seasonality Matters So Much 34
   Appendix A 35
   Derivation of Farm Labor Demand 35
   Appendix B 42
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Multistage Crop Production Model</td>
<td>42</td>
</tr>
<tr>
<td>Reference</td>
<td>46</td>
</tr>
<tr>
<td>How Much to Work?</td>
<td>47</td>
</tr>
<tr>
<td>Where to Work?</td>
<td>54</td>
</tr>
<tr>
<td>The Mover-Stayer Model</td>
<td>54</td>
</tr>
<tr>
<td>The Lewis Model: Too Much Labor on the Farm</td>
<td>57</td>
</tr>
<tr>
<td>Migration and Unemployment: The Harris-Todaro Model</td>
<td>61</td>
</tr>
<tr>
<td>The Mover-Stayer Model With Heterogeneous Individuals</td>
<td>64</td>
</tr>
<tr>
<td>Harris and Todaro in a Mover-Stayer Model</td>
<td>64</td>
</tr>
<tr>
<td>Applying the Mover-Stayer Model to Data</td>
<td>68</td>
</tr>
<tr>
<td>Conclusion</td>
<td>71</td>
</tr>
<tr>
<td>Appendix A</td>
<td>73</td>
</tr>
<tr>
<td>Mathematical Derivation of Household Labor Supply</td>
<td>73</td>
</tr>
<tr>
<td>Appendix B</td>
<td>74</td>
</tr>
<tr>
<td>The Harris-Todaro Model in More Mathematical Detail</td>
<td>74</td>
</tr>
<tr>
<td>References</td>
<td>76</td>
</tr>
<tr>
<td><strong>4. Equilibrium and Immigration in the Farm Labor Market</strong></td>
<td>77</td>
</tr>
<tr>
<td>A Spatial Equilibrium</td>
<td>79</td>
</tr>
<tr>
<td>Immigration Changes Everything</td>
<td>83</td>
</tr>
<tr>
<td>Follow-the-Crop Migration Redistributes Workers Within Countries</td>
<td>86</td>
</tr>
<tr>
<td>Linking Labor Supply With Demand: Farm Worker Recruitment</td>
<td>88</td>
</tr>
<tr>
<td>Direct Hiring by Farmers</td>
<td>88</td>
</tr>
<tr>
<td>Farmer Associations</td>
<td>88</td>
</tr>
<tr>
<td>Unions and Hiring Halls</td>
<td>89</td>
</tr>
<tr>
<td>Public Employment Services</td>
<td>89</td>
</tr>
<tr>
<td>Farm Labor Contractors</td>
<td>90</td>
</tr>
<tr>
<td>Farm Labor Recruiting in the Internet Age</td>
<td>90</td>
</tr>
<tr>
<td>The Challenges of Seasonality for Workers and Communities</td>
<td>91</td>
</tr>
<tr>
<td>Immigration and Farm Labor Across Countries</td>
<td>91</td>
</tr>
<tr>
<td>Appendix A</td>
<td>93</td>
</tr>
<tr>
<td>Modeling Farm Labor Market Equilibrium</td>
<td>93</td>
</tr>
<tr>
<td>References</td>
<td>94</td>
</tr>
<tr>
<td><strong>5. Labor in an Agricultural Household</strong></td>
<td>97</td>
</tr>
<tr>
<td>Agricultural Households as Producers</td>
<td>100</td>
</tr>
<tr>
<td>Agricultural Households as Consumers</td>
<td>101</td>
</tr>
<tr>
<td>Putting Production and Consumption Together: An Autarkic Chayanovian</td>
<td>103</td>
</tr>
<tr>
<td>Farm Household</td>
<td></td>
</tr>
<tr>
<td>Labor in an Agricultural Household Model With Well-Functioning Markets</td>
<td>105</td>
</tr>
</tbody>
</table>
The Evolution of Agricultural Households 108
Household Response to Price Changes 108
Impacts of Rising Wages on an Agricultural Household 109
Welfare Implications 110
Migration, Education, and the Agricultural Transformation 110
Conclusions 112
Appendix 113
Mathematically Modeling Production and Consumption Decisions of Agricultural Households 113
References 120

6. Farm Labor and Immigration Policy 121
Immigration and Farm Labor Market Equilibrium 123
Immigrant Workers in US Agriculture 124
From Railroad to Farm Worker 125
Japanese Workers Replace the Chinese 128
Dustbowl Migration Crowds Out Immigrant Labor in the Fields 130
War Changes Everything 132
The Second Bracero Program (1942–64) 132
Illegal Immigration After the Bracero Program 134
The 1986 Immigration Reform and Control Act 138
Unintended Consequences: The Impacts of IRCA on US Agriculture 141
Importing Legal Farm Workers (at a Cost): The H-2A Program 143
Efforts at Immigration and Farm Labor Reform After IRCA 144
Guest Worker Programs in Other Countries 146
Immigration and the Domestic Farm Labor Supply: Chicken or Egg? 149
Immigration Policy and Agriculture: Some Final Thoughts 151
References 152
Further Reading 154

7. Farm Labor Organizing From Cesar Chavez and the United Farm Workers to Fair Foods 155
The Plight of Farm Workers in America 156
Cesar Chavez and the United Farm Workers Union 157
The Decline of Farm Labor Unions 159
How the “Salad Bowl Strike” Backfired 161
Boycotts: A More Effective Bargaining Tool 163
Farm Labor Unions Around the World 163
The Fair Food Movement 164
The Economics of Fair Food: Turning Market Power on Its Head 166
Fair Foods on a Country Scale? 171
“Pricing In” the Ethical Treatment of Farmworkers 172
Using Labels to Help Consumers Make More Informed Decisions 173
Chapter 1

Introduction

The fight is never about grapes or lettuce. It is always about people.

Cesar Chavez

Agriculture is different from other economic sectors of the economy in ways that have far-reaching implications for the analysis of labor markets (Timmer, 1988). A multitude of farms are scattered across a vast geographic space. Production and labor demands are seasonal and uncertain, separated in time and dependent on the whims of nature. Farmers make their planting decisions months (and in the case of perennial crops, years) ahead of harvest. Labor and other inputs have to be available exactly when farmers need them, sometimes with little to no advance notice. Perishable crops not harvested on time can rot in the fields. Late harvests can cause farmers to miss key marketing windows or contract deadlines, and crops left in the field are exposed to disease and weather risks. If labor is not available to plant crops and apply inputs on time, or if the rains do not come, there might not be anything to harvest at all. All of these considerations make the demand for farm labor uncertain and dynamic—that is, it changes over time.

The supply of farm workers is also uncertain and dynamic. As countries develop and their per-capita incomes rise, their workforces move out of agriculture and into nonfarm jobs, creating the specter of farm labor scarcity. Farmers in rich countries pressure their governments to open the doors to workers from poorer countries to fill the void. Even if there is an overall abundance of farm workers, local labor shortages materialize if workers are not available in the right place at the right time. Crops ripen unevenly across space, creating demand for follow-the-crop migrant workers. History shows that people do not choose to do follow-the-crop migration if they have other options.

This chapter introduces the complex challenges associated with farm labor demand and supply, the uncertain and seasonal equilibrium between the two, and the role of immigration in addressing the farm labor problem. It concludes with a view toward the future, discussing how agriculture must adjust to a new farm labor equilibrium as people move off the farm and the global demand for food continues to rise.
THE PROBLEM OF FARM LABOR DEMAND

The demand for farm labor derives from farmers’ production decisions, which we will learn about in detail in Chapter 2. Agriculture differs from other industries in intrinsic ways that differentiate the timing and magnitude of labor demand. The agricultural production process is biological. It relies heavily on inputs from nature (land and weather). Consequently, agricultural production is highly seasonal. There are long time lags between applying inputs and harvesting outputs. Although farmers can directly control how much they plant, uncertainty surrounds how large the harvestable crop will be and how the harvested crop will be valued on the market. Farming requires land, so agriculture is dispersed over a wide geographic area. Because agricultural production is spread out geographically, involves long time lags, and is highly seasonal and uncertain, timely access to labor, like other inputs, is critical to the success and competitiveness of farm operations.

Agricultural production and access to labor vary substantially around the world. In parts of the United States, large agribusinesses [which the American journalist Carey McWilliams referred to as “factories in the field”] dominate the farm landscape (McWilliams, 2000). Millions of small family farmers dominate production in low-income countries. In most of the world, households, not firms, make most of the agricultural production decisions, and the family provides most or all of the labor needed on the farm. Often, hired labor is an imperfect substitute for family labor, because hired workers might not work as hard, they might not be available for hire near the farm, and poor farmers might lack the cash to hire workers, particularly in the preharvest period prior to receiving payment for the harvest.

Agriculture is marked by a high degree of uncertainty; thus, considerations of risk are a hallmark of agricultural decision-making (Moschini and Hennessy, 2001). There are two broad categories of risk in agriculture: Production risk and marketing risk. On the plus side, nature provides inputs like sunshine and rainfall at no cost. The downside is that farmers cannot predict when the rains will or will not come, whether there will be a long season with no sunshine, or whether a swarm of locusts will devastate the crop. Shocks of nature break the engineering relationship between inputs and outputs. Variables outside farmers’ control determine how much of a harvestable crop there will be on the tree or in the field—not only the vagaries of weather, but also risks associated with pests and access to inputs, including labor.

This sort of uncertainty generally does not arise in manufacturing, where engineering relationships govern production processes. Farmers’ access to hired workers and other inputs, credit, insurance, and a market for the harvested crop

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1. There are an estimated 570 million farms in the world. A total of 35% are located in China and 24% in India. Small farms (less than 2 ha) constitute about 12% of farm operations worldwide, and family farms constitute about 75% (Lowder et al., 2016).
impacts how they will respond to seasonality and uncertainty in agricultural production. New evidence suggests that climate change is increasing agricultural production risk as well as impacting agricultural labor markets.\textsuperscript{2}

Once the harvestable stock of produce is mature in the fields or on the trees, agricultural production is largely a resource-extraction problem—how to harvest the crop and get it to market in the most economically efficient way. Most of the risk at this stage revolves around the availability of harvest labor and market prices. Seasonal variations in spot-market prices create critical timing windows for agricultural producers. Increasingly, grower-shippers have time-sensitive contractual commitments as preferred suppliers to mass merchandisers (e.g., Walmart and Costco), supermarket chains, and food service industries. This is true in developing as well as high-income countries (Reardon et al., 2003). Failure to harvest a field on time can result in the grower-shipper failing to meet delivery commitments to buyers under Vender Managed Inventory Replacement (VMIR) and other preferred supplier agreements. Some research suggests that, with the consolidation of the retail sector, shippers have less negotiating power and are more fearful of losing accounts if they fail to comply with buyer requests. Increasing trade integration creates price competition and narrows marketing windows, intensifying pressure on farmers. Having access to workers at critical moments in the production process can make the difference between meeting delivery commitments or not.

Labor supply risks are paramount at harvest time. An important potential component of risk is the lack of available labor at the times and places needed to harvest crops. Production risk can result from an insufficient labor supply if fruit spoils on the trees before it can be harvested or if labor shortages prevent farmers from marketing their harvest on time and complying with their contractual obligations higher up on the supply chain.

The Agricultural Production Function

The production function occupies center stage in farmers’ decisions, as it does in the microeconomics of all firms. It describes a technological relationship, a recipe to convert inputs into outputs. In most sectors of the economy, the production function represents a known engineering relationship between inputs and outputs, like how many copies of this book can be produced from a given amount of paper, ink, capital (printing machines), labor, and so on. Like a kitchen recipe, a production function can describe a fixed relationship between inputs and outputs. For example, a tomato harvester might pick an average of 30–33 1-pound buckets in an hour, implying around 1.9 min of

\textsuperscript{2} Examples include (Mendelsohn et al., 1994; Schlenker and Roberts, 2009; Deschenes and Greenstone, 2007; Jessoe et al., 2016).
Most production functions are not linear, though. They reflect decreasing marginal productivity of inputs as well as the possibility that inputs may substitute for one another (unlike flour and salt in a pancake recipe). Increased use of machinery can reduce labor needs. Even in the harvest, diminishing returns eventually set in if too many workers are added to the harvest crew.

The harvest depends on the stock of produce in the orchard or field ready to harvest as well as the inputs applied at harvest time. The harvestable stock, in turn, is uncertain, and it depends on decisions made prior to the harvest. Input-output relationships involved in putting a harvestable crop in the field or on the tree are different from those involved at harvest time. Agricultural production is sequential, with different production functions describing input-output relationships at different stages of the production process. The sequential nature of crop production and risk means that we should not treat farm labor like other production inputs or like labor in other sectors of the economy using a conventional single-stage production model—even though most researchers do just that.

Commercial farmers, like other producers, use the technology at their disposal to combine inputs and produce output, with the objective of maximizing profits. (They may have other objectives as well, but for most purposes, profits are a reasonable focus in agricultural models.) Profit maximization implies employing additional variable inputs, including labor, up to the point where the benefit of adding an additional unit of input (the marginal value product of the input) just equals the input’s per-unit price, given the production function. A farmer will not pay employees for an additional day of work unless this results in a sufficient increase in gross revenue to cover the wage bill. If by hiring an additional worker-day of labor the farmer will gain an increase in harvest worth more than the wages paid, she will do it.

Technological Change: Switching to a New Production Function

Over time, producers may invest in new labor-saving technologies to reduce the costs of hiring workers. This implies switching to a new production function. When mechanical harvesters (or more recently, robots) accompany humans in the fields at harvest time, the recipe changes: fewer worker-days are required per pound of harvested crop. The history of agricultural production is largely about the development and adoption of new technologies that change the input-output relationship. Labor-saving technologies, like the cotton gin and combine harvesters, dramatically reduced labor needs in cotton and grain fields.

4. One worker-day is a single worker employed for one day, two workers employed for ½ day each, etc.
New IT-intensive technologies use robotics to reduce labor needs for traditionally labor-intensive fruit and vegetable crops. The Green Revolution is another example of technology change. New high-yielding seeds dramatically increased yields the world’s major food crops, but Green Revolution technologies are land saving, not labor saving: They enable farmers to produce a larger output on the same amount of land. In most cases, they require additional labor to apply fertilizer and other inputs as well as to bring in a larger harvest.

Adopting a new technology is costly. Farmers will only invest in a new technology if it passes the cost-benefit test (Chapter 9). The discounted benefits (cost savings) from the investment over time must be greater than the cost of the initial investment in order for a technology to be economically feasible. The cost savings depend on the nature of the technology and also on input costs. If the cost of an input (say, farmworker wages) is increasing over time, a labor-saving technology becomes more attractive. If, on the other hand, land is scarce, land rents are rising, and labor is abundant, a land-saving technology is more likely to pass the cost-benefit test.

Farmers are like any commercial producer in that one of their goals is to maximize profits. However, the differences between agriculture and other production sectors have profound implications when it comes to determining the optimal amount and timing of labor inputs with a given technology, or deciding whether it is optimal to switch to a new technology.

**Production Risk**

The agricultural production process is biological and filled with uncertainty. Thus, agricultural economists pay a great deal of attention to incorporating risk into the crop production function. In agriculture, the production function is random or stochastic [from the Greek word στόχος (stóchos), meaning “guess” or “target”]. We will learn about stochastic production analysis and what it means for labor demand in later chapters, but for now it is important to bear in mind this crucial difference between agriculture and other sectors. The amount of inputs farmers demand with a given technology depends on yield and price uncertainty.

The choice of technology also depends on risk. Often, there is a tradeoff between risk and expected returns from new technologies. A high-yielding seed might require greater investment in fertilizer and other inputs—not to mention labor to apply the inputs—in return for a yield that is higher on average but more variable than yields from conventional seeds. Yield risk is particularly a concern on the marginal, rain-fed lands most of the world’s farmers sow. If the rains do not come (or too much rain comes, or wind, or too much heat or cold), farmers risk losing the crop as well as the money they spend on inputs ahead of the harvest. It is not surprising, then, that marginal lands are where one is least likely to find high-yielding crop varieties (HYVs) around the world.

New technologies can also reduce risk. Agricultural research currently is underway to develop seed varieties that are robust to drought and other weather
shocks, without necessarily increasing expected yield in normal years. In effect, these new seeds come with their own built-in insurance policy. As labor becomes scarcer and its availability becomes less certain, labor-saving crop technologies can reduce production risks while making it possible to harvest the same crop with fewer (and no doubt more expensive) workers. A farmer might be willing to spend more on a labor-saving technology than the wage savings one expects to gain from it, provided that the technology makes one less vulnerable to unexpected labor shortages at harvest time. The difference between the adoption cost and expected wage savings could be justified as a “harvest labor insurance premium.”

Timing and Seasonality

Farm labor employment is highly seasonal. A 1938 study of California farm labor noted extreme fluctuations in seasonal labor demand (Barry, 2007):

“During the peak season of September of the year 1935...there were demands for more than 198,000 workers, while in the slack season of the same year, during December and January, but about 47,000 were required, leaving over 150,000 unemployed.”

More recent data from the US Bureau of Labor Statistics paint a similar picture. Fig. 1.1 shows the seasonal ups and downs of the two components of the US farm labor demand for fruit, vegetable, and horticultural production between 2001 and 2009: direct hiring by farmers and hiring by farm labor contractors (FLCs), who supply workers to farms. For both, the peak-to-trough ratios appear remarkably stable from one year to the next—and they are big.

Agriculture involves at least two production stages. In the preharvest season, the farmer’s objective is to efficiently create a stock of harvestable fruit on the tree (or vine, or field). In the harvest period, his objective is to turn the harvestable stock into a marketable product, picked and packaged. There is no reason to think that the demand for labor looks at all the same in these two periods.

Take a grape farm, for example. It employs a few workers year round to irrigate, weed, prune, and perform other tasks required for the vine to produce fruit. The harvest season, on the other hand, is short and intense. The Fresno, California, raisin grape harvest used to be the most labor-intensive activity in US agriculture, employing 40,000 to 50,000 workers for only a few weeks each fall to pick the grapes and spread them out on paper trays to dry in the sun. Today, many farms have switched to dry-on-the-vine technology, in which machines shake the dried raisins into bins. This reduces the need for farm workers during harvest dramatically, almost eliminating harvest labor risks.

A multistage production process means that agricultural labor demand tends to be highly seasonal. Combine this with risk and we can begin to understand

5. For example, see Lybbert (2006).
FIG. 1.1 Employment by FVH producers and farm labor contractors in the United States is highly seasonal. (Data from Bureau of Labor Statistics Quarterly Census of Employment and Wages (http://www.bls.gov/cew/data.htm).)
why agriculture and farm labor markets are so different. Agricultural production at each stage of the production process is stochastic. Nature’s surprises early in the growing season can create large swings in labor demand come harvest time.

Whenever there are time lags between input use and harvest, producers have to find ways to finance their inputs. They also have to find ways to put food on the family table if the crop fails. Credit is vital to most farmers in high-income countries; farmers can take out loans to purchase inputs, and then repay the loans after harvest. These inputs include labor. Workers might be willing to work on your farm, but only if you have the cash before harvest to pay them.

Crop insurance is a different matter. Most farmers who grow labor-intensive fruit, vegetable, and horticultural (FVH) crops do not have an insurance policy that will pay out if the crop fails. Grain farmers in the United States and Europe do have access to crop insurance, but only because of generous government programs.\textsuperscript{6}

Credit markets are not available to most farmers in poor countries, and formal crop insurance is virtually nonexistent outside of a few development projects.\textsuperscript{7} Yet poor farmers in developing countries, like farmers in rich countries, take on a heavy risk burden when they buy inputs and hire workers prior to harvest, knowing that the crop might fail or the price of the harvested crop might tumble.

Space

Farming requires land, so agriculture is spread over wide geographic areas. Contrast this with, say, information and technology industries in California’s Silicon Valley or Bangalore, India, which reap economies of agglomeration by locating close to one another so that they can share ideas and build on one another’s innovations. Because farms are spread out, timely access to diverse markets is crucial. This includes markets for the output farmers produce, but it also includes markets for inputs—including labor.

Workers have to be available to farms in the right numbers and at just the right times, or else crop losses are likely. A farmer might do everything right in the preharvest periods, growing conditions might be ideal, and there might be a bumper crop in the field, but if workers are not available to pick the crop at the critical moment, the crop can rot before it is harvested. Even if labor shortages leave, say, the last 15% of the crop unpicked, that might represent the farmer’s profit margin.

\textsuperscript{6} You can learn about the Crop Insurance Program at the U.S. Department of Agriculture (USDA) website: http://www.rma.usda.gov/aboutrma/what/history.html. The European Union has a less comprehensive crop insurance program; e.g., see (Santeramo and Ford Ramsey, 2017).

\textsuperscript{7} An introduction to credit and insurance in developing countries appears in Taylor and Lybbert (2015).
On a small family farm, the farmer’s family is likely to supply most or all of the labor to cultivate and harvest crops. On many larger farms, including commercial farms throughout the developed world, family labor is largely irrelevant. A large number of hired farm workers are needed for a short period of time to bring in the harvest.

How do farmers find so many workers on short notice? In villages around the world, information flows through networks of contacts between farmers and workers and among workers. Sometimes landlords, worried about having sufficient workers for harvest, enter into complex “labor tying” arrangements in which they provide people with various benefits in return for a promise to work on the landlord’s farm at times of peak labor demand. The benefits might include one or a combination of employment during the off season (when people have a hard time finding work), access to plots of land to farm, credit, or inputs like seed and fertilizer.8

In John Steinbeck’s story of the great Dust Bowl migration, The Grapes of Wrath, desperate workers showed up at California farms begging for work at any wage. Many farmers rely on the same workers returning from one year to the next to harvest crops. Some encourage this by providing workers with extra hours of work, higher wages, and nonwage benefits; building personal relationships with individual workers; or even by providing support to the communities from which these workers come (in the US, some come from as far away as villages in southern Mexico). The classic 1960 CBS News documentary “Harvest of Shame” followed migrant workers making their annual trek harvesting beans and other crops up and down the US Atlantic Seaboard—often with children in tow.

Women play a key role in filling the harvest labor vacuum in many parts of the world. In Chile, many women enter the workforce to harvest fresh fruits and vegetables in the peak season, when wages increase, then return to their households after the harvests are in. In Morocco, women are far and away the main source of labor to harvest and process the crocus flower stamen from which saffron is produced. In Burkina Faso and many other African countries, women manage their own small plots of land and supply most of the labor—often with little or no help from men. Although tea harvesting machines exist (including a Japanese version with advanced laser technology), most tea harvesting or “plucking” is performed by women. A 2011 United Nations study found that women comprised about 43% of the agricultural workforce globally and more than 50% in some African countries (Jarvis and Vera-Toscano, 2004; Filipski et al., 2017; Udry, 1996; SOFA Team and Doss, 2011).

Today in California, FLCs match thousands of farm workers with jobs on many individual farms. Instead of hiring workers directly, a farmer can enter into a contract with an FLC to, say, harvest 20 acres of oranges. The FLCs’ comparative advantage is their network of contacts with farm workers mobilized on

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8. A classic work in this area is Bardhan (1984).
short notice and their intensive use of day labor markets, where workers gather in the hope of getting a seat on a contractor’s bus.

**Inequality and Concentration**

Some sectors, like energy, steel, or automobiles, are dominated by a few large producers. Agricultural production is different. It is by far the largest production sector in the world in terms of numbers of producers. Of the world’s 570 million farms, more than 475 million are less than 2 ha in size (Lowder et al., 2014). Thus, the vast majority of the world’s farms operate only a small share of the world’s farmland. The world’s farmers have unequal access to resources, from large agribusinesses with first-world infrastructure and market access to small-scale farms producing for farmers’ markets to hundreds of millions of poor family farmers struggling for subsistence in less-developed countries.

To understand the supply and demand for farm labor, we have to understand the behavior of thousands, millions, or (in China and India) hundreds of millions of heterogeneous actors. Influencing or simply understanding agricultural outcomes requires having good economic models of diverse agricultural producers and how they are likely to respond to different kinds of market, environmental, or policy shocks. To complicate matters, as we shall see, what is beneficial for large farmers may be detrimental for small farmers.

**THE PROBLEM OF FARM LABOR SUPPLY**

The farm labor supply comes from households, which decide how much of their time to supply to farm and other work activities in order to maximize their welfare, or utility (Chapter 3). In poor countries, agriculture is large relative to other sectors in the economy, and agricultural labor is in abundant supply. Most countries start out rural and agricultural. In the early stages of economic development, the farm labor supply is elastic (Lewis, 1954). That is, workers are available to satisfy farm labor demands even at low wages, and they quickly increase their labor supply when wages increase.

In high-income countries, agriculture is a small sector compared with industry and services in terms of employment. The human capital (skill) requirements for agriculture are minimal. One might expect, then, that the supply of labor to agriculture, like any small sector, is elastic, easily expanding to meet seasonal increases in labor demand. Contrast this with high human capital jobs, like computer programming and health care, for which it might take several years to train new workers when labor demands increase. Human capital investment (in particular, investment in schooling) is a major focus of dynamic labor supply models. It is essential for doctors but not for farm workers.

Although it is possible to train farmworkers relatively quickly, people leave farm work as economies develop and off-farm employment expands. This results in a shrinking pool of domestic farm workers. In economic parlance,
the domestic agricultural labor supply shifts inward. People flee the farm. We can imagine an equilibrium model in which agricultural wages increase apace with nonagricultural wages, inducing domestic workers to stay on the farm instead of moving to factory or service jobs. There might have to be an extra wage premium to induce people to take farm jobs if nonfarm jobs bring other nonpecuniary benefits, like being more interesting and less onerous than farm work. Ask yourself: What would it take to get you out into the fields picking crops on a hot summer afternoon? How long would you be willing to continue doing field work?

History shows that rising farm wages do not induce large numbers of domestic workers to do farm work. You will not find US-born unemployed steel workers picking lettuce in California or oranges in Florida. The share of domestic workers in the US hired farm work force has fallen to the point where, by 2006, only 23% of workers (2% in California) were US-born.9 The rest were immigrants, earning a wage easily eight times what they could hope to earn by working in rural Mexico, which is where most hired farmworkers in the United States come from.

The wage rate in rural Mexico represents the opportunity cost of migrating to US farm jobs.10 It is the lower bound on the reservation wage, the lowest wage a worker would accept to migrate to the United States instead of working in Mexico. A rural Mexican’s reservation wage also includes the economic and psychic costs of migrating. Virtually all new immigrant farmworkers lack legal status, so their reservation wage reflects the risk of being apprehended, jailed, and returned to Mexico.11

The fact that most hired farmworkers in the US earn low wages and come from Mexico suggests that the foreign farm labor supply is elastic. An elastic foreign labor supply at a relatively low wage can explain why the farm workforce in the United States and other rich countries consists mostly of immigrants. The quantity of domestic labor supplied to agriculture drops as nonfarm employment expands, and foreign workers come in to fill the void. Any excess demand for farm workers gets filled by foreign workers, and this keeps wages lower than they would be without immigration. In the United States, a growing reliance on foreign agricultural workers and testimonials from farm workers, whose children usually eschew farm work, support Martin’s contention that the farm workers of tomorrow are growing up outside the United States (Martin, 2009).

Within farm labor-importing countries, the supply of labor to individual farms and farm regions may be elastic in the short run, in the sense that a farm

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10. The market wage and marginal value product of labor are the same in a “separable” agricultural household model; see Singh, Squire, and Strauss, 1986.
11. The migrant’s reservation wage may include other elements, as well: psychic costs of working abroad, cost of living adjustments, etc.
can attract more workers by offering a slightly higher wage if it needs to. There is an important spatial element to this story, though. Unless the total farm labor supply can quickly adjust, farms can attract new workers only at the expense of other farms. As fewer people in rural Mexico enter farm work, farm wages in the United States are rising. But as one observer put it:

*The one constant is that no matter how much we pay, domestic workers are not applying for these jobs. Raising wages only serves to cannibalize from the existing workforce; it does nothing to add new laborers to the pool.*

(Kitroeff, 2017)

The impacts of an excess demand for farm labor in one region reverberate into other regions. A late harvest in one locality can prevent workers from migrating to another locality. This produces the familiar pattern of localized seasonal farm labor shortages, even if there is overall labor abundance and average farm wages are low.

**EQUILIBRIUM IN FARM LABOR MARKETS**

Understanding how farm labor markets work requires integrating demand and supply into farm labor market equilibrium models (Chapter 4). We use the plural—“models”—here because there is no single farm labor market anywhere. Instead, there are many localized farm labor markets, often linked together by migration.

In 2007, a *Wall Street Journal* editorial claimed that “farmers nationwide are facing their most serious labor shortage in years.” The editorial asserted that “20% of American agricultural products were stranded at the farm gate” in 2006, including a third of North Carolina cucumbers, and it predicted that total crop losses in California would hit 30% in 2007.

These predictions did not materialize. The example of cucumbers illustrates that farm labor shortages tend to be local, not generalized across the nation. US cucumber production rose both in 2006 and 2007 (Farm Labor Shortages, Mechanization, 2007).

This and many other farm labor-shortage anecdotes suggest that, even if the medium-to-long run supply of foreign workers is elastic, fed by new immigration, in the short run farmers compete across regions for a relatively inelastic, or fixed, total supply of agricultural workers.

In an average year, what might be called a “first-order” equilibrium supported at the margin by follow-the-crop migration ensures ample labor at a predictable wage in a given place and season. However, within a network of migration-linked farm labor markets, a stochastic shock to one local market (e.g., a late pear harvest in the Sacramento Valley) reverberates into neighboring labor markets. One needs multiregion models to represent this spatial complexity of farm labor supply and demand.
A number of researchers point out an important caveat to the seasonal equilibrium just described. They note that the process of adjustment in farm labor markets often is sluggish and incomplete. Studies focusing on developing countries argue that wage rigidities force farm labor markets to adjust through changes in unemployment (Bardhan, 1979; Dreze and Mukherjee, 1989). Jarvis and Vera-Toscano (2004), in a study of seasonal farm labor markets in Chile, found that female workers absorbed most of the seasonal labor force adjustments, because they had the lowest reservation wage.

In the United States, the availability of welfare and unemployment insurance puts a lower bound on the reservation wage. Instead of migrating to follow the harvest, many workers can stay put and receive unemployment insurance and welfare support. Thus, farm labor markets are likely to adjust to demand shocks via changes in the demand for welfare and unemployment insurance, rather than through an endogenous wage adjustment that redistributes farm workers across regions. Minimum wage laws reinforce this. A study by three UC Davis researchers found that seasonal work, low earnings, and high unemployment in California’s agricultural counties promoted welfare use and limited the potential of local labor markets to absorb ex-welfare recipients. In California’s major agricultural counties, when unemployment peaks, welfare use increases (Green et al., 2003).

A CONTINUUM FROM FAMILY FARMING TO AN IMMIGRANT FARM WORKFORCE

Perhaps the most notable difference between agriculture and other economic sectors in poor countries is that most agricultural production is by households. Most farms in the world are family farms that supply their own labor and other inputs to the land and consume part or all of the harvest. Unlike firms that are focused exclusively on production decisions, agricultural households make both production and consumption decisions. This may seem like a technical distinction, but as we see in Chapter 5, it can drastically change the economic analysis of farm labor demand as well as supply.

Around the world, hired labor markets evolve over time in ways that mirror the agricultural transformation. At low levels of economic development, family farming dominates the agricultural landscape. Agricultural households provide most of the agricultural inputs and consume a significant part (in most countries, most) of the output from the farm. Not surprisingly, in predominantly subsistence economies, agricultural labor markets are relatively “thin” and often take the form of informal labor exchanges. In some areas, large plantations create a demand for wage labor that coexists with subsistence production on small farms.

The importance of hired labor expands as commercial production displaces family production. Consider, for instance, the United States, where both family and hired labor have declined over the last half century as a result of
mechanization, but the ratio of hired to family labor has increased, from 1:3 in 1950 to around 1:2 today (these averages mask large differences across US regions) (Kandel, 2008). Increasing reliance on hired workers frequently gives rise to internal migration to address labor market disequilibria across time and space. However, a collection of factors—seasonality, uncertainty of farm employment, aversion to follow-the-crop migration, the disagreeableness of working conditions in the field, and expanding income opportunities outside of agriculture—cause the domestic supply of agricultural labor eventually to shift inward and upward. This creates incentives for farmers to seek a less expensive source of labor abroad.

Migration policies evolve in imperfect harmony with farm labor market trends, because they are the outcome of a complex and frequently internally contradictory political process (Chapter 6). Rarely do countries implement policies explicitly to influence internal migration. Nevertheless, at the mid-stage of the agricultural transformation, there tends to be growing concern for the welfare of migrant farm laborers, their families, and the communities in which they live. In some places, most notably California, farm labor organizing efforts escalate (Chapter 7). At this stage, as Emerson (1989) states, “a major emphasis of governmental policy toward migratory farm labor is to shift the migrant out of the migratory stream, and if at all possible, to shift him to the nonfarm sector.”

This gives rise to an integration-immigration dilemma: In the absence of labor-saving technological innovations and/or a shift to crops requiring less labor, mobility out of agriculture for some workers implies the rotation of new immigrants into the farm workforce. Martin (2009) describes an agricultural “immigration treadmill” that perpetuates rural poverty by attracting a continual flow of new unskilled immigrants to take the place of workers who move from farm to nonfarm jobs.

In high-income economies, agriculture loses its importance as a generator of employment, while its dependence on foreign workers invariably increases. The political process becomes a battleground in which farm interests engage the interests of other actors, some of whom oppose the use of immigration policies to guarantee an abundant supply of agricultural labor.

If border enforcement restricts immigration, the farm labor supply decreases and wages increase. Meanwhile, the juxtaposition of high farmworker wages in high-income countries with low earnings abroad keep the supply of immigrant labor elastic, willing to cross borders to fill farm jobs. This intensifies pressure at the border and makes immigration policies difficult to enforce. According to conservative estimates, more than 50% of all US hired farmworkers are

12. Examples of government programs include the migrant and seasonal farm worker programs launched as part of the War on Poverty in the 1960s, including Migrant Headstart, Migrant Education, Migrant Health, and Job Training for Seasonal and Migrant Workers (Emerson, 1989).
Unauthorized immigrants. The unauthorized share of workforces in other high-income countries are not as well documented but certainly large.

Instead of seeking legal access to farmworkers from abroad, farmers could adopt labor-saving technologies, invest in improved labor management practices, or take steps to evade immigration laws. There is evidence that penalties against knowingly hiring unauthorized immigrants, which were included in the United States 1986 Immigration Reform and Control Act (IRCA), accelerated a shift away from direct hiring by farmers in favor of labor intermediaries, who are more difficult for immigration law enforcement authorities to monitor (Taylor and Thilmany, 1993).

THE END OF FARM LABOR ABUNDANCE

A pervasive theme in this chapter is that domestic agricultural workers become increasingly scarce as countries’ incomes rise. Both logic and emerging empirical evidence suggest that the same applies to the supply of foreign agricultural labor. Labor-intensive agriculture in high-income countries seeks out new migrant-source areas over time. What happens when foreign agricultural workers move out of farm work? The evolution of agricultural labor markets in farm labor-exporting regions raises questions about the sustainability of a labor-intensive agricultural system dependent on immigrant labor, and indeed of labor-intensive agricultural systems generally (Chapter 8).

Nowhere are agricultural labor markets more integrated across borders than in Mexico and the United States. New research finds that the supply of farm labor from rural Mexico is diminishing over time (Taylor et al., 2012; Charlton and Taylor, 2016). United States and Mexican farmers compete for an ever-smaller number of farm workers from rural Mexico. Migration is network driven; new migrants tend to follow past migrants to the same destinations and jobs (Sana and Massey, 2005; Mora and Taylor, 2006; Pfeiffer et al., 2007). As immigrant workers move out of agriculture and into factory and service jobs, future migrants do, too. The supply of labor to agriculture diminishes.

In Mexico, the regional shift in labor supply to US farms is happening quickly. Mexico has entered into agreements with Guatemala to import Guatemalan farmworkers. Thus, Mexico is in a transitional phase of being both an importer and exporter of farm workers. With a combined population one-third the size of Mexico’s and accelerating urbanization, Central America’s potential

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to replace Mexico as a significant source of US farm labor is limited. A 2017 headline in a major Mexican newspaper declared: “In agriculture, Mexico is left without young producers (Georgina Saldierna, 2017).”

In Western Europe, immigrants from African nations work the fields of Spain, France, and Italy; Albanians harvest crops in Greece; Polish workers toil the fields in Germany and the United Kingdom. Regional integration under the European Union (EU), including free labor movement among EU countries under the Schengen Accord, boosted farm labor migration from the former Soviet bloc countries. In time, one would expect that the migration networks currently channeling eastern European workers into agricultural jobs in the EU will become more urbanized, like networks from Mexico to the United States.

Worried about its heavy reliance on foreign agricultural workers, Germany offered farmers generous subsidies to hire German-born farm workers. That experiment failed, though, and the program was abandoned (Txortzis, 2006). Israel offered a different alternative to its farmers. In December 2009 it announced a new public initiative to invest in mechanization of Israeli farming “in an effort to reduce the need for foreign workers (Arutz Sheva, 2009).”

ROBOTS IN THE FIELDS

Countries dependent on imported agricultural labor have two options. The first is to seek out new sources of farmworkers and (through immigration policy) grant farmers access to them. This is not a long-run solution, though, because the same process that shifts workers out of agriculture as economies grow and contentious political processes limit rich countries’ ability to find—and import—new sources of cheap farm labor over time.

The second option is to invest in reducing farm labor demands through a combination of technological change, improved labor management practices, and trade. Instead of large crews of low-skilled and poorly paid workers toiling in the fields, this second option implies better-paid, skilled workers accompanying robots in the fields (Chapter 9).

Stepping into a Wellsian time machine and glimpsing the agricultural future in today’s farm labor-importing countries like the United States, we are sure to find a combination of higher capital intensity and labor productivity, big labor-saving innovations involving machine learning and robotics, a shift to more imports of crops that are hard to mechanize, and higher farm wages. The farm workforce will change; tekked-up workers will be needed to work in a tekked-up agriculture.

The transition to this new agricultural world is likely to proceed unevenly across countries, commodities, and agricultural tasks. The profitability of labor-saving technological changes and crop mixes at a particular place and

15. The Time Machine is a science fiction novel by H.G. Wells.
time depends on the availability of low-cost labor. Policies facilitating access to low-wage immigrant labor and developments abroad that stimulate emigration will continue to discourage the adoption of labor-saving technologies. Mechanical harvesters and new IT-assisted labor-saving solutions exist or are under development for most crops, their usage limited mostly by low wages for harvest workers and quality and productivity concerns that can be addressed by future research and development.

New developments in information and technology, machine learning, and artificial intelligence point to a future of robot-assisted agricultural production. Engineering departments at universities and high-tech startup firms in Silicon Valley are beginning to develop labor-saving solutions for a diversity of crops that combine mechanical engineering with artificial intelligence and machine learning. The perishable nature of FVH crops, imperfect substitutability between capital and labor, and consumer demands for high-quality locally grown produce will insure that some production of labor intensive crops persists even in high-wage countries. In time, though, the farm labor-immigration policy connection is bound to weaken, as changes in the availability of low-cost labor, technologies, crop mixes, and trade reduce countries’ reliance on imported agricultural workers.

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