

Gauging the Farm Sector's Sensitivity to Immigration Reform via Changes in Labor Costs and Availability

Prepared by:

WAEES

Commissioned by:

American Farm Bureau Federation

Patrick O'Brien

John Kruse

Darlene Kruse

Website: www.waes-llc.com

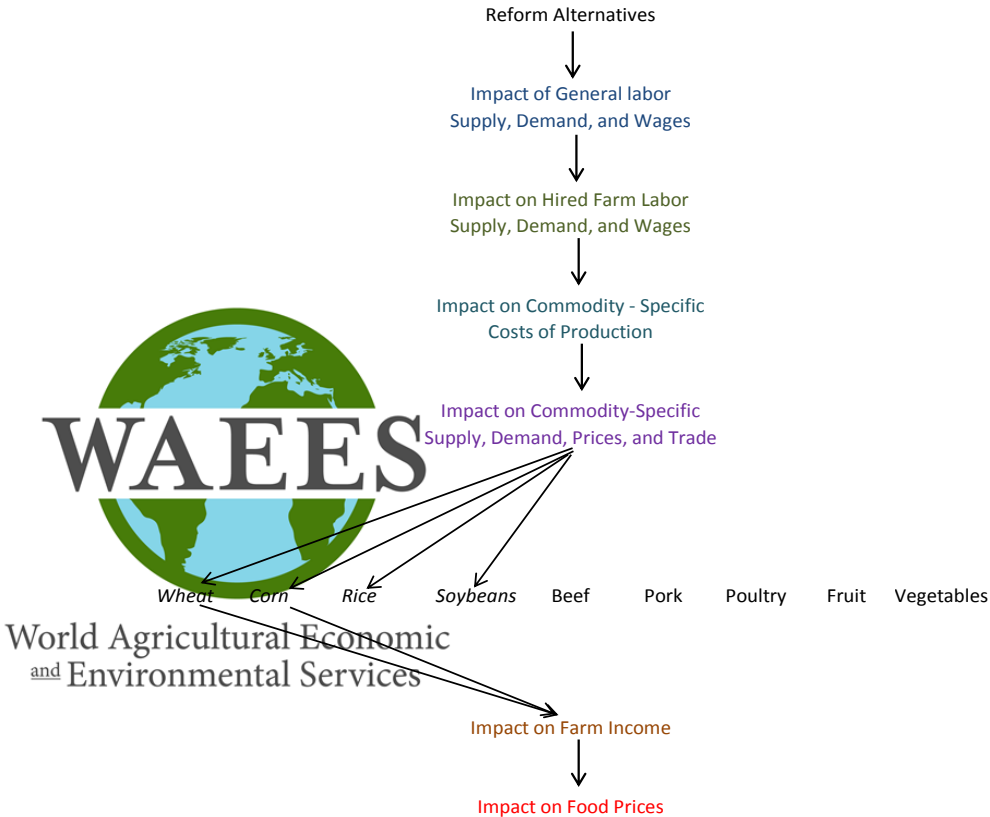
February 2014

Summary

The farm sector’s heavy dependence on undocumented workers in its hired farm workforce makes agriculture particularly sensitive to the changes possible with immigration reform depending on the nature and extent of the reform. This report describes the extent of the farm sector’s dependence on undocumented workers and the political, economic, and social forces that shaped this growing dependence since the last major reform effort in late 1980s as well as the possible consequences of reform during the 2013/14 Congressional legislative cycle.

The report draws on the current debate to identify three generic reform alternatives emphasizing: 1). enforcement only; 2). enforcement plus a pathway to legalization; and 3). enforcement plus a pathway to legalization and a guest worker program for sectors with special labor needs such as agriculture. The extensive survey information available on the sector’s hired farm work force and use of undocumented workers are then used here to develop commodity-specific estimates of hired labor costs for each of the reform alternatives. WAEES’s World Agricultural Modeling System is then used to translate these scenario-specific estimates of changes in farm labor costs into estimates of changes in farm output, commodity prices, farm income, farm asset values, and food prices using No-Reform Baseline Projections to 2020 as a reference point (See Graph 1.)

Graph 1: Report Schematic



The results of this analysis suggest that the enforcement-only option would have a significant disruptive impact on agriculture, leading to large enough losses in farm income by the end of a 5-year implementation and adaptation period to trigger a large scale restructuring of the sector, higher food prices, and greater dependence on imported products. This assumes a best-case reform path for this most disruptive alternative, with implementation of 2013/14 legislation assumed to stretch out over 2015-2017 followed by 2 added years of farm adaptation to arrive at a tentative post-reform equilibrium in 2020. Any faster implementation or shorter adoption period would exacerbate the sector's adjustment problems and worsen impacts on farm output, commodity prices, farm income, farm asset values, and food prices.

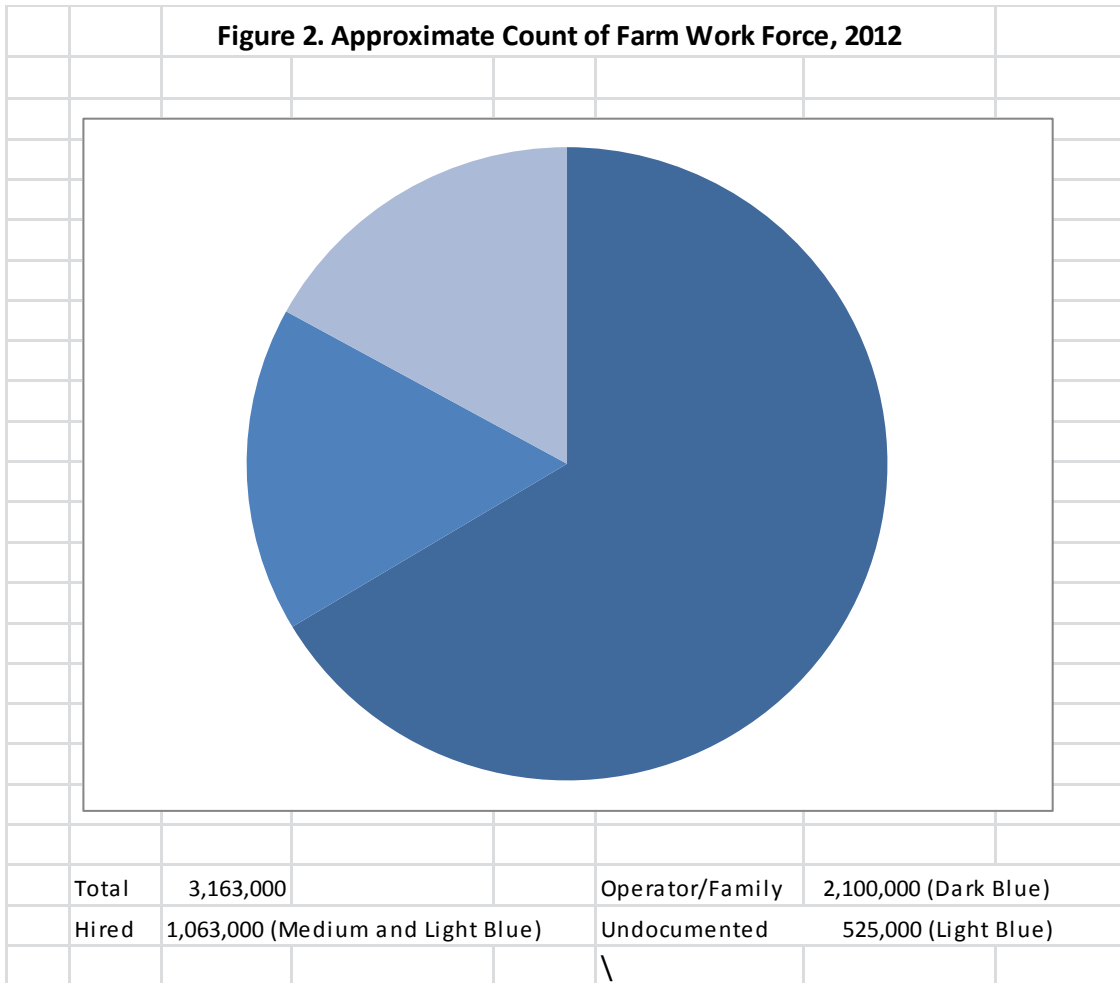
The second reform alternative—enforcement plus a pathway to legalization—is only slightly less disruptive because of agriculture's special role as a major entry point for new undocumented workers and undocumented workers' strong tendency to move out of agriculture to higher-preference jobs elsewhere in the economy as soon as possible. The impact of the third alternative—enforcement plus pathway to legalization plus guest worker program-- depends on the design of the agricultural guest worker program.

In summary, this report concludes both that immigration reform is one of the most important challenges facing American agriculture and that the potential impact of reform on the workings of the agricultural sector can provide policy makers with a microcosmic view of the full range of economic, political, and social concerns at work nationally.

Introduction

The current reform debate in Congress is the latest, most concerted effort to “fix” a widely acknowledged to be a broken U.S. immigration system. The system includes federal legislation but also a myriad of other related federal, state, and local laws, administrative orders, and regulations. The extent to which the system is broken is reflected in:

- The large number of undocumented workers entering/reentering the U.S. with relative ease despite more and increasingly costly border protection measures and enforcement efforts to identify and deport “undocumented workers” found within the country. Estimates vary but point to roughly 11 million undocumented individuals in the country currently with an added 4.5 million citizen-children (See Appendix 1);
- The extent to which employers must rely on undocumented workers, who hold up to 5 percent of the jobs in the U.S. labor market, despite continued high unemployment rates for local workers; and
- The impact on rural and urban communities already struggling to accommodate unprecedented demographic changes and their social, political, and economic implications now face the challenge of integrating large numbers of undocumented workers and their families.



Efforts to fix the broken U.S. immigration system have been made and are ongoing at all levels of government as reflected in Appendix 2's catalogue of recent reform efforts. In just the last 3 years, there have been no less than 10 noteworthy national and state-level legislative attempts to address the problem in Washington, D.C. in the Senate and the House and in the Arizona, Georgia, Pennsylvania, Utah, Florida, Alabama, and Virginia legislatures.

What emerges from this myriad of reform efforts is the basic contrast between:

- Those calling for comprehensive reform that addresses the three critical elements of strengthening enforcement (i.e. stopping the flow of undocumented workers into the country at the border and identifying and deporting undocumented workers found within the country), establishing a path to legalization and potentially to citizenship for at least some of the 11 million undocumented workers already in the country, and providing for the guest worker needs of several sectors of the economy with special labor needs such as agriculture; and

- Those providing for a series of stand-alone initiatives that generally focus on enforcement only or at least enforcement first, with follow-up treatment of related issues later - at best when much of the push for immigration reform could be spent.

Agriculture's Interest in Immigration Reform

Pressures within Agriculture...

As Appendix 1 and 3 indicate, agriculture is arguably the sector of the U.S. economy most sensitive to how the debate between comprehensive, versus stand-alone approaches to reform, is resolved as well as the particulars of any compromise. As the Appendices indicate, agriculture's link to undocumented labor is deeply rooted in the fundamentals of farm enterprise in the U.S. In short, it is no accident that undocumented workers currently account for more than half of all hired farm workers. Why?

- First, labor is farmers' third highest expense, accounting for 17% of production costs for the sector as a whole and up to 40-50% in labor-intensive subsectors such as fruit, vegetables, and horticulture. Hence, farm businesses focus heavily on labor availability and wages in an effort to control costs and maximize profits;
- Second, the sector's dependence on hired labor is also generally time-sensitive due to the role hired farm workers play in harvesting and marketing perishable fruit, vegetable, and horticulture products. Over the last decade, hired farm workers have also grown in importance in other subsectors, including dairy, hogs, and poultry, where larger farms have less operator and family labor to draw on and have to rely on hired labor to operate what are also time-sensitive, year-round enterprises;
- Third, farm labor needs are also concentrated geographically in states such as California, Texas, Michigan, Washington, and North Carolina, but more importantly within smaller areas within these states. Farmers' hired labor needs in these smaller areas typically exceed the local legal work force even if legal workers were willing to do farm work. This pattern of "local" demand far exceeding the "local" supply of willing legal workers is spreading to more areas of the country and to more commodity subsectors. Hence, farm businesses typically have to look outside their immediate areas and the local labor supply in an effort to find farm workers;
- Fourth, given the limited skills required for farm work and the manual nature of the work, the majority of Americans apparently believe that they have "outgrown" farm work as reflected in their unwillingness to take farm jobs even temporarily despite being unemployed. A 2010 national survey conducted by the National Council of Agricultural Employers of H-2A employers showed that 68% of the 36,000 domestic workers state agencies referred to H-2A employers did not accept jobs offered to them. Only 5% of referred workers worked through the contract period. While the generally low wages to paid farmworkers are consistent with the low-skill nature

of the work, far more Americans are willing to accept even lower minimum wage jobs rather than work in agriculture. In this setting, the local legal labor pool is not only small but unwilling to work in agriculture; and

- Fifth, while mechanization has reduced the need for hired labor sharply over time, increased farm size has boosted the need for more hired farm workers even more. The trend toward a declining number of hired workers in effect for several decades is reversing, with the number of hired farm workers stabilizing and showing small increases over the last few years. Hence, operator demand for hired workers is not likely to continue to decline and ease farmers' concerns.

In this setting, many farm operators have turned to hiring undocumented workers in an effort to insure that they have adequate labor at critical times in their production cycles and to control costs given the abundant supply of undocumented workers available and their willingness to accept transitory, seasonal, or physically arduous work that pays introductory wages that are unattractive to the U.S.-born. Such hires have grown to account for a far larger share (50%) of the sector's hired work force than any other sector of the economy including construction and services. This means that more and more farm operators are taking the calculated risk of employing undocumented workers and counting on not being audited or being able to use loopholes such as the 90-day grace period for firing undocumented workers identified through the E-Verify system if they are audited.

Factors Outside Agriculture...

At least three factors beyond farmers' control have also contributed to farm employer decisions to hire undocumented workers including:

- The very limited potential for farmers to pass production cost increases—such as higher wages—along to consumers, particularly in labor-intensive subsectors such as fruits, vegetables, and horticulture where consumers are both price sensitive and lower-cost imported products are readily available. Despite multiple surveys showing U.S. consumers' willingness to pay more for what is at least perceived as safer American product, cost appears to ultimately shape consumer purchases. Hence, the theoretical option of pushing farm wages up enough to rekindle American workers' interest in working in agriculture is not viable since substantially higher labor costs without any offsetting increase in commodity prices and farm income would quickly put farmers out of business;
- The broken immigration system that effectively allows a large number of undocumented workers to enter/reenter the U.S. with relative ease despite more and increasingly costly border protection measures and enforcement efforts to identify and deport “undocumented workers” found within the country; and
- The potential for low-skilled workers in Mexico and Central America to make double their local minimum low-skilled wages at home by working in the U.S. This insures

that a large and reliable undocumented workforce is available for farmers to draw on; and

- The extent to which farmers' primary alternative to hiring undocumented workers—the H-2A program—is broken. Despite the growing risks involved in hiring undocumented workers, farmers' use of the H-2A program accounted for only 10% of their hires at the highest in 2013. Both farm employers' and worker advocates have voiced their strong dissatisfaction with the existing H-2A program. As discussed below, the H-2A program has become a costly administrative nightmare for many farmers. Farm employers cite the cumbersome nature of the program and the high wage and benefit costs that the program imposes. Worker advocates cite inadequate protection for workers, poor housing conditions, and employer failure to live up to worker payment provisions by making prompt and full payment of wages due.

One summary measure of the problems with the H-2A program is the fact that H-2A visas have only increased from 31,538 in 2002 to approximately 65,345 in 2012 - despite generally accepted estimates putting the number of undocumented workers employed in agriculture at 525,000 or more - and despite the notable increase in enforcement identified in Appendix 2's catalogue of recent federal, state and local reform activities.

The Devil is in the Details

These links between American agriculture and undocumented workers make it clear that immigration reform is critical for the sector. However, agriculture's special relationship with undocumented workers also makes *how* the immigration system is reformed as much or more important than whether or not the system is reformed.

Agriculture's Special Role in the Undocumented Labor Market

For a number of reasons, agriculture serves as the bottom rung on the undocumented labor ladder. Many undocumented workers start working in agriculture but move on from agriculture as quickly as possible—particularly if/when changes in their legal status gives them entry into the labor market outside agriculture. This love-hate relationship is reflected in the survey interviews identified in Appendix 3 and more anecdotal sources. A closer look at the composition of agriculture's undocumented work force provides insight into why, and the extent to which, this phenomenon is at work.

As the NAWS and Pew surveys indicate, the undocumented workers employed in agriculture are typically younger, less educated, less fluent in English, and have fewer job skills than the general undocumented population. They typically have little or no previous work experience. Turnover in agricultural employment is high, with roughly 15% of undocumented workers in agriculture describing themselves as newcomers to the sector—with less than 3 years in the U.S.— and with no plans to stay in the sector. This profile fits well with the minimal skills and manual nature of farm work, farmers' interest in keeping wages low to protect their

profits and competitiveness, and the willingness of this newcomer population to accept relatively low wages and physically demanding jobs to get started. Hence, agriculture has considerable appeal for undocumented workers as an entry point into the U.S. labor market.

However, undocumented workers also leave agriculture as soon as possible for many of the same reasons. Perhaps the most dramatic illustration of undocumented workers' preference to get into agriculture initially but to move out as soon as possible is the change in the farm labor force following The Immigration Reform and Control Act of 1986. The law legalized roughly 1 million undocumented workers, many working in agriculture. Had that labor force been willing to stay in agriculture where they started, the sector would have been able to meet its hired labor needs without reverting within a few years to the large-scale hiring of undocumented workers.

However, the majority of those legalized Seasonal Agricultural Workers (SAW) quickly moved on to employment elsewhere in the economy once their undocumented status had been resolved. Farm employers soon had to return to hiring a large number of undocumented workers as these SAW workers moved on to different careers. Appendix 1 indicates that the share of undocumented workers in the hired farm labor force dropped to 14% over 1989-91 immediately after reform but rose back to pre-1986 levels (37%) by 1992-94, rose to 47% by 1995-97, and rose to 50% by 1998-2000 as farm employers had to replace exiting undocumented workers legalized by the 1986 legislation with new undocumented workers.

Reform Alternatives

Agriculture's complex relationship with undocumented workers and the unique role agriculture plays in the undocumented labor market means that different reform mixes will have dramatically different impacts on the sector. Three general reform options are considered here, along with more detailed provisions for the guest worker program included in the modified third alternative.

Alternative 1: Enforcement Only/Enforcement First

Given the reform proposals advanced to date, there is little doubt that increased enforcement (defined as both strengthened border security and expanded enforcement of existing laws combined with more aggressive use of deportation) will be a major part of any reform package.

Assuming that these efforts are effective, employers in the general economy will lose up to 4.7% (6.7 million) of their current work force and farm employers will lose most, if not all, of their 525,000 undocumented work force (Appendix 1). Employers in both labor markets will also no longer be able to depend on wage differentials for low-skilled workers in Mexico and Central American to generate a continuing flow of undocumented workers moving into the U.S. Fewer undocumented workers will be able to cross the border and those who succeed in crossing the border are increasingly likely to be caught in local enforcement actions such as widening application of the federal E-Verify system. Given stronger penalties for hiring

undocumented workers, many farm employers will opt to hire fewer, or no undocumented workers, if only to minimize their business risk.

Should immigration reform stop here with no provision for a path to legalization for undocumented workers already in the country or for a guest worker program, agriculture faces the loss of 50% or more of the hired workforce as the supply of undocumented workers dries up and as legal hired farm workers consider more attractive, higher paying jobs that have become available as a result of undocumented worker displacement in the general labor market. For purposes of this analysis, it was assumed that such a draconian program would be implemented over a 3- period starting in 2015 simply because the immediate loss of this large a share of the general work force would cause economic chaos.

Hence, agriculture's efforts to replace its disproportionately large loss of hired workers would be complicated by similar efforts by employers in the general economy who have more attractive jobs to both pull legal labor out of the farm sector and hold on to their own legal work force. As a result, farm employers would face not just the problem of having to pay higher wages to hold existing workers and attract replacement workers, but also the problem of simply finding replacements.

Alternative I Specifics

The Alternative I scenario analyzed here assumes specifically that:

1. Reform is legislated during the 2013/14 Congressional legislative session and provides for a 3-year implementation period from 2015 to 2017. The farm sector impacts reported here are measured in 2020 based on the assumption that the bulk of the sector's adjustment to the change would have been made during, and immediately following, implementation—that is, within a 5-year time period. Hence, 2020 can be viewed as the tentative beginning of a post-reform equilibrium;
2. Reform focuses on an enforcement package including effective closure of the border combined with aggressive federal and state efforts to identify and deport undocumented workers already in the country. This enforcement package would also include mandated employer use of the E-Verify system for filling job vacancies and periodic checks on the legality of existing workers. Tougher penalties for employers hiring undocumented workers would reinforce this enforcement effort. The assumed goal is 100% border surveillance and 90% apprehension and deportation.

While no enforcement program is likely to be 100% effective, it is assumed here for simplicity's sake that by the end of the 5-year implementation and adjustment period that the number of undocumented workers in the country would fall toward zero and undocumented workers employed in the general economy would drop from the 6.7 million estimated to hold full and part time jobs in 2012 (4.7% of the U.S.'s total employment of 144 million) to a negligible count approaching zero in 2020. (See Appendix 1); and

3. Reform effectively eliminates employment of undocumented workers in the agricultural sector. This is due not only to the effectiveness of the new immigration program in reducing undocumented workers in the general work force but also due to agriculture's unique role in the labor ladder for undocumented workers. With fewer or no new undocumented workers entering the country, agriculture has no new supply of undocumented workers to draw on as the existing undocumented work force is identified and deported or moves to higher preference jobs in the general economy. Moreover, with improved border security likely to be an initial priority, even farm employers who decide to risk hiring undocumented workers will not have the flow of "newcomers" to draw on.

The estimates included in Appendix 1 put this undocumented component of the hired farm work force currently at 525,000 workers using the 50% measure generated from the NAWS data. This is a conservative estimate of the problem that would face agriculture since it does not provide for any loss of agriculture's documented workers relocating to increasingly attractive, preferred jobs outside agriculture.

Linking Alternative I Worker Losses to Farm Sector Operations

With these 6.7 million and 525,000 job impact numbers in hand, the issue becomes one of translating these disruptions in the labor market into wage impacts as employers in the general economy and the agricultural sector seek to replace lost workers at least initially by offering higher wages designed to attract replacement workers. The approach used here does so by:

1. Translating reductions in worker numbers into changes in wages in the general economy and changes in agricultural wages into changes in farm production costs. USDA's detailed ARMS survey information makes it possible to develop commodity-specific measures of resulting changes in farm production costs based on the share of labor costs in the total cost of producing each of the major commodities as reported in Appendix 1; and
2. Inputting changes in individual commodity production costs into the WAEES World Agricultural Modeling System (WAMS) described in Appendix 4 and using WAMS to track reform impacts through the 2020 end of the implementation/adjustment period. The results of this "With Reform" analysis is then compared with a baseline "Without Reform" Scenario to gauge impacts on farm sector output, commodity prices, imports, farm incomes, and food prices.

Using this approach means that much of the critical wage analysis has to take place initially outside the WAMS Framework since farm labor and wages are endogenized in the model and two sets of changes in the labor supply and wages have to be considered—the first being changes in labor supply and wages in the general economy and only then labor supply and wages in the agricultural sector.

Elasticity-Based Estimates of Labor Supply and Wage Linkages

In economic jargon, how significantly a change in worker numbers affects wages depends on the wage elasticity of labor supply. This elasticity is simply the ratio of the percent change in the number of people willing to work generated by a percent change in the wages offered for their services. Such elasticities are generally estimated empirically based on observations of changes in labor supply and wages over a representative historical period. These elasticities are normally reported as a negative since the relationship between labor and wages means that the signs are different—that is, a rise in labor leads to a fall in wages and a fall in labor leads to a rise in wages.

In an elastic labor supply setting (a ratio or “elasticity” greater than -1.0), a 1% change in labor supply generates *less* than a 1% change in labor availability. In such a setting, the 4.7% and 50% reductions in Alternative 1 in the general supply of labor and the supply of hired farm workers would generate *less* than a 4.7% and 50% increase in wages as employers raised wages enough to recruit replacement workers and set a new balance between the smaller labor supply and wages. In an inelastic labor supply situation (an elasticity of less than -1.0), the opposite holds. A 1% change in labor supply generates *more* than a 1% change in labor supply. Hence, in an inelastic labor supply setting, the 4.7% overall and 50% reduction in hired farm worker supply would require more than a 4.7% and 50% increase in wages to replace lost workers.

Since the Alternative I reform would affect both the general labor supply and the more specialized labor supply in agriculture, both elasticities have to be considered here, keeping in mind that the two elasticities could be different based on differences in the underlying characteristics of the two labor markets. Considerable research has been done on labor-wage elasticities in both the general economy and agricultural economy. A thorough discussion of the elasticities chosen for this study is included in Appendix 4.

Labor-Wage Elasticity in the General Economy

Considerable research reported on in Appendix 4 has been done on the critical measure of how wages and labor supplies interact—that is, how a change in labor supply affects wages or the price of labor. This measurement is critical for the purposes of this study since the primary impact of immigration reform would be to change the supply of labor available in both the general and the agricultural economies.

For the purposes of this study, two wage elasticities (a -0.5 to -1.0) were used to translate Alternative 1’s permanent 4.7% reduction in the general labor supply into an economy-wide wage impact. As Figure 1 indicates, using -0.5 and -1.0 elasticities suggest that Alternative 1’s 4.7% reduction in the general labor supply would generate a 4.7% to 9.4% increase in the general wage rate. This indicates that any adjustment in the wages of hired farm workers would take place in a general economy where immigration reform had already raised general wage rates 4.7 to 9.4% from a 2012 average of \$20.48 per hour reported in Appendix 1 to \$21.44-22.40 per hour.

Figure 1. Elasticity Indicators for 2012

A. General Economy

All U.S. Wage and Salaried Workers ('000)	142,653
Illegal Wage and Salaried Workers	6,700
Illegal Share	4.7%
Elasticities Used in Report	(.5) to (1.0)
Changes in Wages Associated with 4.7% Decrease in Workers assuming -.5 Elasticity	9.7%
Changes in Wages Associated with 4.7% Decrease Decrease in Workers assuming -1.0 Elasticity	4.7%

B. Agricultural Economy

All Hired Farm Workers ('000)	1,050
Illegal Hired Farm Workers ('000)	525
Illegal Share	50%
Elasticities Used in Report	(.4) to (.8)
Changes in Wages Associated with 50% Decrease in Workers assuming -.4 Elasticity	125%
Changes in Wages Associated with 50% Decrease in Workers assuming -.8 Elasticity	62.5%

**C. Combined Impact of General Increase in Wages
and Agricultural Sector Increase in Wages** 70% to 146%

Labor-Wage Elasticity in the Agricultural Economy

Given the far larger percentage change in the hired farm workforce likely with Alternative 1 (50% versus 4.7%) and the different characteristics of the sector's hired work force compared with the general workforce, it is important to consider whether the elasticities used for the general economy can be used in analyzing the agricultural sector. As already noted here, many of the particular characteristics of hired farm worker jobs tend to make the jobs distinctly lower-preference than jobs elsewhere in the general economy. In broad terms, this would tend to make the increases in wages necessary to attract replacement workers from outside agriculture into agriculture higher. This worker-preference concern would tend to offset the low-skill threshold for farm jobs and the sector's ability to absorb virtually any worker from elsewhere in the general economy that would otherwise make the sector's labor supply more elastic.

Based on these considerations, two elasticities were used here—a $-.4$ and a $-.8$ —indicating that the hired farm worker market is somewhat less elastic than the general labor market. As Figure 1 indicates, these $-.4$ and $-.8$ elasticities suggest that the 50% change in the supply of hired farm workers would spark a 62.5-125% change in wages over and above the 4.7-9.4% rise in the general wage rate. The two impacts in combination would boost farm wages by 70% to 146% from the \$10.80 per hour reported for 2012 in Appendix 1 to \$18.36-26.57 per hour.

Alternative Approach to Estimating Hired Farm Worker Wage Impacts

This 70-146% increase in hired farm worker wages would likely spark a large-scale restructuring of the farm sector, especially for the third of the sector with the greatest dependence on hired labor. Given the uncertainty of applying historically based elasticities in so dramatically different a setting, an alternative approach based on looking at low-skilled labor availability and wages outside the farm sector can be used to test the elasticity-based 70%-146% results.

This alternative approach focuses on how much higher farm worker wages would have to be to attract replacement workers from other low-skilled job categories elsewhere in the general economy. Given the labor ladder described in Figure 2 based on the Current Population Survey (CPS) data, the most likely alternative for farm employers would be to focus on recruiting labor from the construction category with 4.4 million workers to ensure that they had a large enough recruitment pool to meet agriculture's needs. If this category is used as a benchmark, farmers would have to start the bidding for replacement workers at construction wages that have traditionally been one-third higher than farm wages.

This puts farm employers' starting bid for replacement workers at \$14.97 to \$15.69 per hour (2012's actual of \$14.30 times Alternative 1's 4.7-9.4% general increase in wages) compared with the pre-reform hired farm worker average of \$10.80 per hour reported by farm employers. It is important to remember that this new construction wage would be a minimum opening bid for replacement workers and that some added premium would likely be needed to convince construction workers to switch to lower preference farm jobs. Using the CGE model's $-.35$

Figure 2. Comparison of Low-Skilled Job Occupations

Job Category	Number of Workers	Average Salary before Reform	Average Salary After Reform
Hired Farm Workers	1,050,000	\$10.80 per hour	
Maids and Housekeepers	1,423,276	\$9.32 per hour	\$9.75 to 10.22 per hour
Construction Workers	4,355,374	\$14.30 per hour	\$14.97 to \$15.69 per hour
Shift in Construction Workers Needed to Fill Loss in Hired Farm Workers ('000)		525,000	
Shift in Construction Workers Needed to Fill Loss in Hired Farm Workers (%)		12%	
Farm Wage Premium needed to attract Construction Workers assuming .35 Elasticity (%)		34%	
Farm Wage Premium needed to attract Construction Workers assuming .35 Elasticity (\$ per hour)		\$5.09 to \$5.33 per hour	
Implied Hired Farm Worker Wage		\$20.06 to \$21.02 per hour	
Increase in Hired Farm Worker Wage		86% to 95%	

estimate of the wage elasticity associated with changing occupations, convincing the 12% of the construction category needed to switch to farm work would require an additional 34% boost in farm wages to the \$20 to \$21 per hour range.

Hence, this alternative approach suggests hired farm worker wages would have to increase in line with the \$18.35 to \$26.57 range calculated using an elasticity approach and the analysis of farm sector impacts that follows uses the 70-146% increase in hired farm worker wages estimated above.

Alternative 1 Farm Impacts

Figure 3 shows the conversion of farm sector wage increases into estimates of labor cost increases and in turn total cost of production increases for the major commodity subsectors. As already noted in the text and in Appendix 5, the changes in farm sector performance indicators were generated using the WAEES Modeling System to compare a No-Reform Scenario's projections to 2020 with an Alternative I Reform Scenario's projections to 2020.

Alternative I's higher costs of production due to added labor expenses generates:

- A 1% to 3% reduction in grain production due to lagging feed demand due to lower livestock production. This translates into a 3% to 6% drop in grain producer returns based on both lower production and higher costs;
- A 13% to 27% reduction in meat production linked to higher wages' double impact on the livestock sector. Alternative I impacts are significantly larger than the relatively small share of beef, pork, and poultry production expenses attributable to labor due to the secondary impact of higher labor costs on the slaughter and packaging industries. This leads to a setting where retail prices are higher and weaken demand, while farm prices and production are lower based on weakened returns. Given this combination of lower production, lower farm prices, and higher farm costs, returns in the livestock sector are down a third to two-fifths of their No-Reform levels; and
- A 15% to 31% and 30% to 61% drop in vegetable and fruit production, respectively, combined with an offsetting increase in imported products. With U.S. producers unable to pass most of their increased costs on to consumers, vegetable and fruit producers absorb most of the wage cost increases and face the loss of 30 to 40% of their net revenues due to lower production and higher costs.

For the sector as a whole, Alternative I's reform results in:

- A drop in net farm income of 15% to 29% due to lower production, lower gross receipts, and higher expenses;
- A drop in farm asset values linked both to the drop in farm income and the realization that the down-turn in the farm economy is due to a permanent shift in labor supply. Hence, the drop in asset values would most likely be stronger than the 10% to 15% generated in the model solution; and

- A rise in food prices of 5% to 6% as consumers bear a small part of farmers’ higher costs but face smaller supplies of products generally despite higher imports, with the change in supply largest for fruit and vegetables as well as meat and dairy products in particular.

This Alternative 1 outcome is the most severe for agriculture since the reform effort not only tightens labor supply in the general work force but eliminates half of the hired farm work force. Agriculture’s initial losses are exacerbated by the cut-off of further undocumented immigration and the drying-up of the pool of workers generally drawn on by farm employers. Lastly, there is no guest worker program available to provide farm employers with any access to overseas workers even while differentials between wages in the U.S. and undocumented workers’ host countries become even wider and undocumented worker interest grows even stronger.

Figure 3. Impact of Higher Wages on US Agricultural Sector Performance (%)

	Scenario 1 (Low)	Scenario 1 (High)	Scenario 2 (low)	Scenario 2 (High)	Scenario 3 (Low)	Scenario 3 (High)	Scenario 3A (Low)	Scenario 3A (High)
A. Wage Rate Change	70% Higher	146% Higher	30% Higher	68% Higher	25% Higher	28% Higher	6% Higher	9% Higher
B. SubSector Impacts								
Grains								
Production	-1%	-3%	-1%	-1%	0%	-1%	0%	0%
Farm Price	-3%	-6%	-1%	-3%	-1%	-1%	0%	0%
Livestock								
Production	-5%	-8%	-3%	-5%	-3%	-3%	-1%	-1%
Farm Price	-13%	-27%	-6%	-13%	-5%	-6%	-1%	-2%
Vegetables								
Production	-23%	-47%	-10%	-22%	-8%	-9%	-2%	-3%
Farm Price	15%	31%	7%	15%	6%	7%	2%	3%
Fruit								
Production	-30%	-61%	-13%	-28%	-11%	-12%	-3%	-4%
Farm Price	20%	40%	8%	19%	8%	9%	3%	4%
Net Farm Income	-15%	-29%	-7%	-14%	-6%	-6%	-2%	-2%

Alternative II: Enforcement with a Path to Legalization without a Guest Worker Program

Alternative II Specifics

The second reform alternative considered here is a compromise between the comprehensive and stand-alone enforcement approach that identifies some path to legalization—if not citizenship—as part of an expanded enforcement effort. The Alternative II reform is assumed here to:

1. Be passed in the 2013/14 Congressional legislative session and to provide for a 3-year implementation and 5-year adjustment period through 2020. The farm sector impacts reported here are measured in 2020 based on the assumption that the bulk of the sector's adjustment to the change would have been made during and immediately following implementation;
2. Include the same enforcement reform package assumed under Alternative 1, but with the key distinction that undocumented workers opting to take the path to legalization/citizenship are legalized immediately, on at least a temporary basis. This means that the 11 million undocumented individuals—6.7 million of whom hold jobs--can stay in the U.S. but that any future flow of undocumented workers is cut off. Legalization would likely touch-off some movement of workers between job categories as undocumented workers took advantage of their new status to find more attractive jobs. The general economy, however, would face a smaller net loss in workers than under Alternative I as at least some of the legalized undocumented workers eventually returned home and tougher enforcement prevents new undocumented workers from replacing them; and
3. Eliminate most, if not all, of the currently undocumented workforce employed in agriculture. This is due to two factors—the first being the well-established pattern of undocumented workers leaving low-preference jobs in agriculture for higher paying jobs elsewhere in the general economy once their legal status is clarified. The combination of this movement of legalized undocumented workers out of agriculture with enforcement stopping the flow of new undocumented workers into the U.S. means that the agricultural sector would eventually lose all of its existing undocumented workers and have no new undocumented workers to replace them with. Hence, the sector's workforce would have to be completely legalized by the 2020 end date for the analysis reported on in this report.

The key distinction between Alternative I and Alternative II is the addition of a path to legalization. Presumably, virtually all undocumented workers would take the opportunity to legalize their status, if only to avoid enforcement impacts and to boost their ability to improve their economic standing through greater job security and mobility. In the longer term, however, Alternative II reform would reduce the overall count of newly legalized workers as some former undocumented workers opt to return home (where over a third reported leaving their families) and as enforcement stems the influx of new replacement undocumented workers.

For purposes of this analysis, it was assumed that this third of the existing undocumented workforce returned to home country by the end of the 5-year adjustment period assumed here. This means that the overall labor force would decline by 2.2 million or 1.5%--one-third of the decline under Alternative I. Using the same elasticity-driven approach as under Alternative I, this smaller loss in labor supply would result in a 1.5 to 3.0% rise in wages compared with 4.7% to 9.4% under Alternative I.

In this setting, agriculture's workforce would be legal but farm employers would still face the problem of worker preference for employment outside agriculture and the loss of undocumented workers choosing to return to their home countries. At issue is what proportion of newly legalized

undocumented workers currently in agriculture would stay. There is little hard information on which to base an empirical estimate other than the historical record following the 1986 legalization of undocumented farm workers as part of the Immigration Reform and Control Act. NAWS data suggests that after 5 years with a repeat of the SAW experience, at least half of undocumented workers—or 25% of the total hired farm work force--would have left agriculture.

Using the same elasticity-based approach as in Alternative I, this 25% reduction of the total hired farm work force would generate a 28% to 62% increase in farm wages which, when combined with the 1.5% to 3.0% increases in wages generally, would push up wages for hired farm workers by 30-69%--or from \$10.80 currently to \$14.04-18.25 per hour.

Alternative II Results

Using WAEES' WAMS system to translate these cost changes into production impacts, this broader reform would have less of a negative impact on agriculture than Alternative I described here. However, the adjustments would still be considerable in selected commodity subsectors. Figure 3 indicates that production, price, and income losses would be roughly half the magnitude likely under Alternative I. For example:

- Grain production would be roughly 1% lower due to a less pronounced lag in feed demand while lower production and higher costs would lower grain producers' net returns 2% to 4%;
- The reduction in meat production linked to higher farm wages and wages for workers in slaughter and packing facilities would be 3% to 5%, with the decrease in farm prices and increase in retail prices roughly half of the changes under Alternative I; and
- The drop in vegetable and fruit production would likely be 10% to 22% and 13% to 28%, respectively, with a comparable reduction in the income losses and import gains likely under Alternative I.

For the sector as a whole, Alternative II's reform would likely result in:

- A drop in net farm income of 7% to 14% due to less severe drops in production and gross receipts and less pronounced increases in expenses;
- A 5-10% drop in farm asset values; and
- A rise in food prices of 2% to 3% as consumers bear a small part of farmers' higher costs but face smaller supplies of products generally despite higher imports, with the change in supply largest for meat and dairy products and fruit and vegetables in particular.

Alternative III: Comprehensive Reform Including a Guest Worker Program for Agriculture

Alternative III Specifics

This third reform scenario is patterned after the comprehensive proposal debated in the Senate in early 2013. Alternative III is assumed here to:

1. Be passed in the 2013/2014 Congressional legislative session and provide for a 3-year implementation period from 2015 to 2018. The farm sector impacts reported here are measured in 2020 based on the assumption that the bulk of the sector's adjustment to the change would have been made during and immediately following implementation;
2. Include the same enforcement package assumed under Alternative 1, with the key distinction that undocumented workers opting to take the path to legalization/citizenship are legalized immediately, on at least a temporary basis. This means that the 11 million undocumented individuals—6.7 million of whom hold jobs--can stay, but that any future flow of undocumented workers is cut off. Legalization would likely touch-off some movement of workers between job categories as undocumented workers took advantage of their new status to find more attractive jobs.

The general economy, however, would still face the smaller net loss in workers under Alternative II assuming that at least some of the legalized undocumented workers eventually returned home and assuming that the guest-worker provisions of Alternative III were limited to only those sectors that demonstrated a particular need for foreign workers rather than simply a generalized reduction in labor availability. As in the 1986 reform, very few sectors of the economy are assumed to be able to meet this requirement;

3. Eliminate most, if not all, of the currently undocumented but newly legalized workforce employed in the agricultural sector. This is due to two factors—the first being the well-established pattern for undocumented workers employed in agriculture to leave for higher paying jobs elsewhere in the general economy. Secondly, enforcement essentially stopping the inflow of new undocumented workers means that the agricultural sector would have to have a completely legalized workforce by the 2020 end date for the analysis reported in this report; and
4. Establish a specialized program for sectors of the economy with specialized labor needs that could not be met without foreign workers. Assuming that agriculture qualified, farm employers would be able to hire foreign workers based on an established labor need that could not be met from the local labor supply.

Alternative III assumes that the farm sector successfully makes a “special needs” case for a customized guest worker program as part of an immigration reform effort. This would be consistent with the case made for the H-2A program during the 1986 passage of the last immigration reform package as a Seasonal Agricultural Workers (SAW) program.

Assuming for the moment that a new guest worker program mirrored the existing H-2A program, agriculture would still face two sets of labor cost increases. The first of these relates to the 1.5% to 3.0% (\$0.30 to \$0.60 per hour) higher overall wages likely with the same contraction in the general labor supply likely under Alternative II. The second set of agriculture-specific costs relates to replacing undocumented workers with guest workers—that is, the added costs involved in applying special guest worker wage and benefit provisions to what would likely be the entire hired farm work force consisting of both guest workers and U.S. workers. This would be in keeping with a new guest worker program being modeled along the lines of the existing H-2A program that requires farm employers to provide U.S. workers employed on farms using guest workers with the same wage and benefit package.

The magnitude of this second set of cost increases is more difficult to estimate due to the multiple forces at work (i.e. AEW wage and housing, meal, and transportation costs) and the lack of a comprehensive database to establish how many undocumented workers and U.S. workers are already receiving this package. Hence, a number of critical assumptions have to be made.

The largest of the higher labor costs facing farm employers under a guest worker program mirroring the existing H-2A program would relate to paying AEW (Adverse Effect Wage Rate) wages to 525,000 workers compared to a high of 95,000 in 2013, as well as paying AEW wages to the other half of the hired farm workforce who would now almost invariably be employed on a farm also employing guest workers.

The H-2A's mandatory AEW wage is the minimum wage set by the Department of Labor to insure that the employment of authorized aliens does not adversely affect employment opportunities and wages for comparable U.S. workers. The AEW is the highest of the Federal or State minimum wage, the prevailing hourly or piece rate, the agreed-upon collective bargaining rate, or the DOE's AEW rate. For 2012, the AEW's ranged from \$9.30 per hour (Arkansas) to \$12.26 per hour (Hawaii) and averaged \$10.40 for the United States. These AEW quotes do not include the added benefits that farm employers are required to provide H-2A works to pay for transportation, meals, and housing which can add another \$2 to \$4 per hour. This compares with a current Federal minimum wage of \$7.25 per hour.

Over the 2009-2012 period, the AEW averaged above \$10 per hour or below the \$10.50-11.00 per hour labor costs that agricultural employers reported in the Farm Labor Survey and below the \$10.80 per hour cost of labor reported in the ARMS and Census of Agriculture. While this suggest at first glance that there would be no increases in wages with a 5-6 fold increase in H-2A type employment, farmers report labor costs rather than wages which means that the \$10.50-11 per hour includes wages and benefits. The NAWS survey results based on worker surveys indicate that workers are generally being paid wages less—on average 10% less—than the AEW wage. Labor advocates claim that this \$1 per hour difference is a general indication of the lower wages paid to undocumented workers who make up half of the NAWS Survey and are paid well below the wages for U.S. citizens and H-2A workers.

If the wages of undocumented workers are indeed this far below the AEW level, farm employers could expect to pay at least \$1 more per hour under a more tightly scrutinized H-2A replacement program used to hire 525,000 foreign workers rather than 2012's confirmed 65,345

workers. Based on NAWS results indicating that the vast majority of farm production takes place on enterprises that currently hire or would hire H-2A type employees, the AEWB wage would effectively become the minimum wage for all hired farm labor.

For simplicity's sake, it was assumed here that: a). farm employers would face \$1 per hour higher wages for guest workers with application of an AEWB-type wage to an expanded guest worker force of 525,000; but that b). wages for existing legal employees already above the AEWB minimum would not change. Given that roughly half of the hired farm labor force would be guest workers, farm employers would face a sector-wide increase in labor costs of about \$0.50 per hour for a hired work force equivalent of about 1,050,000 full time equivalents.

The current H-2A program that would presumably serve as a model for the new guest worker program involves several other labor expenses including housing, transportation, and meals for H-2A workers and non-H-2A workers employed on the same farm. The debate surrounding the AgJOBS proposal over 2010-2013 sheds some light on the magnitude of these additional expenses associated with a guest worker program. The proposal to cash-out employers' housing responsibilities with a payment of \$1 to \$2 per hour indicates the order of magnitude for housing costs. A \$1.50 cost per hour equivalent was assumed here.

The information on transportation and meals is even more anecdotal. Many employers report transportation costs of \$500 per worker for bringing an H-2A worker to the work site and returning him/her home. Assuming a 26-week average stay with 50 hours per week, this translates into a \$0.50 per hour cost over the typical H-2A workers' stay. Many employers also report daily meal expenses of \$5 which, spread across a 10 hour work day, translates into another \$0.50 per hour. This puts the total for these 3 categories at \$2.50 per hour.

How many farm employers would face this added \$2.50 per hour costs—both for expanded H-2A-type employees and the U.S. workforce working on farms with guest workers? With confirmed H-2A employment in 2012 accounting for 65,000, at least 6% of the work force should already be getting these added benefits—along with the legal workers working on farms employing H-2A workers. With the NAWS, Labor Survey, and ARMS data suggesting that H-2A employment is concentrated in roughly 25% of farms, as many as 75% of farm employers could face these added charges assuming that they shifted entirely out of hiring undocumented workers and hired only legal and H-2A-type workers. Assuming that all farm employers followed the new program guidelines, the added cost for these three items would be \$1.88 per hour (\$2.50 times .75) as an H-2A-type standard became the standard for all paid employees in the sector.

In this setting, hired farm worker costs would increase \$0.30-0.60 per hour due to reform-related adjustments of 1.5% to 3% in the general labor market, \$0.50 cents per hour due to the rise of all wages to an AEWB minimum, and \$1.88 as essentially all hired workers collected H-2A-type housing, transportation and meal benefits. The total increase would be \$2.68 to \$2.98 or 25% to 28% from the current \$10.80 per hour base reported in the ARMS survey. This \$2.68 to \$2.98 estimate does not include intangibles such as the draw added draw on a farm operator's time or often hidden administrative costs

Alternative III Results

Using WAEES WAMS system, the impact of this broadest-gauge reform would have less of a negative impact on agriculture than Alternatives I or II. However, the adjustments would still be notable in selected commodity subsectors. For example:

- The impact on the grains sector would be less than 1% both in terms of the reduction in production and the drop in prices but 2% to 3% in terms of net returns due to the mix of weaker feed demand and higher labor costs;
- The livestock sector would face the same double impact as in Alternative I and II, with production off 3%, prices down 5% to 6% at the farm level, but up at the retail level, as consumer prices reflected higher slaughter and packaging costs; and
- Fruit and vegetable impacts would still be significant based on labor's higher share of their production costs. Fruit and vegetable production would drop 11% to 12% and 8% to 9%, respectively, in response to a cost-price squeeze even with prices up 8% to 9% and 6% to 7%, respectively.

For the sector as a whole, Alternative III's reform would likely result in:

- A drop in net farm income of 6%;
- A 2-3% drop in farm asset values; and
- A rise in food prices of 1% to 2% based on higher farm sector commodity prices.

Alternative III A: Redesigning an Agricultural Guest Worker Program

Modified Guest Worker Program

The three immigration reform alternatives considered here so far suggest that the agricultural sector faces significant adjustments with even the most favorable outcome—the comprehensive reform alternative including enforcement, a path to legalization, and an agricultural guest worker program modeled on the existing H-2A program.

This outcome reflects the extent to which the current H-2A program is broken. With both farm employers and worker advocates voicing their dissatisfaction with the existing H-2A program, an improved guest worker program included in a comprehensive immigration reform could look substantially different than the current H-2A program. Farm employers cite the cumbersome nature of the program and the high wage and benefit costs that the program imposes on employers for what are low-skilled jobs that Americans refuse to take. Worker advocates cite inadequate on-the-job health and sanitation protection for workers, poor housing conditions, and employer failure to live up to worker payment provisions by making prompt and full payment of wages due.

Regarding the cumbersome nature of the program, a farmer applying for an H-2A visa for a foreign worker typically has to begin the application process 2 to 3 months before the worker is needed. To win approval, the farmer must pay several fees and file separate applications to several different state agencies, the Department of Labor, and the U.S. Citizen and Immigration Service. The farmer must then arrange for the worker to get an interview with a State Department official at a consulate in the worker's home country and to be approved by the Customs and Border Protection Agency for entry into the U.S.

This paper-based process is further complicated by review delays. GAO's recent review of the application process found that over three-fifths of all applications were returned for changes or additional documentation. Hence, farmers can find themselves scrambling to find labor at their all-important harvest season and can find themselves without adequate labor even if their application has been approved if they change their production plans or if weather fluctuations change the timing on their labor needs. In addition, the AEW wage can be more than a third above the local minimum wage.

Worker advocates also see the program as broken for several reasons including: the tying of a farm worker to a single employer, skewing the balance of power between employer and worker and minimizing the worker's ability to address employer abuses; the potential for recruiter abuse both in workers' home countries and in the U.S.; lax enforcement of worker benefit provisions such as the provision of adequate housing; and employer abuse in denying workers full and prompt payment for all hours worked at the AEW wage.

An improved guest worker program could improve program operation from both an employer and a worker advocate perspective. Such a program could protect the essence of the program—that is, insuring that the hiring of foreign workers to fill worker shortages in the agricultural sector does not have any adverse impact on the jobs and wages of U.S. citizens and authorized aliens working in agriculture or elsewhere in the economy. Key elements of a more effective guest worker program could include:

1. Creation of a new agricultural visa program that gives employers and employees the flexibility to agree on the employment terms that work for them;
2. Stability via an agricultural visa that lasts at least three years and can be renewed;
3. A way for farm workers who are in the U.S. without documentation to apply for legal status as they continue working in agriculture;
4. Enforcement and verification to ensure that agricultural visa holders are here legally and, in fact, working on farms;
5. A requirement that visa holders return to their home countries when their visas expire, but allows employers to continue to recruit eligible workers;

6. An alternative to, and elimination of, the H-2A temporary and seasonal visa program, which simply has not met agriculture's needs;
7. A program that is available to all agricultural sectors, including dairy and livestock production; and
8. Streamlining program administration starting with the critical determination of whether or not there is a farm labor shortage to be filled with guest workers. Such a determination could be made earlier in the year to facilitate farm business planning.

The impact of an Alternative III reform with such a redesigned guest worker program would be substantially different. Using the guest worker program provisions included in the Senate's 2013 Bill, farm worker costs would increase by:

1. The general 1.5% to 3.0% (\$0.30 to \$0.60 per hour) increase in wages in the overall economy;
2. Half of the \$1 per hour increase in wages for guest workers who replace undocumented workers given the lower wages set in the Senate version compared with existing AEWR's. This puts the increase across the entire hired farm work force at \$0.25 per hour rather than the \$0.50 under Alternative III with a guest worker program based on the existing H-2A program;
3. A negligible change in the cost of guest worker benefits, although a significant change in who receives the benefits. Assuming for simplicity's sake that the benefits in question cost the same \$2.50 per hour as under the H-2A-type program, all 265,000 guest workers needed to replace agriculture's net loss of workers after legalization and the movement of workers out of agriculture to elsewhere in the economy would receive the payment. Of this 265,000, 65,000 were already receiving the payments in 2012 based on their H-2A status. Hence, employers would pay the added \$2.50 per hour to about 200,000 new guest workers. However, no payments would be made to non-H-2A workers working on farms with H-2A workers as required under the current program. Using the same assumption that 25% of non-H-2A workers are already receiving the payments, employers would no longer be paying up to 235,000 non-H-2A workers. Hence, while who got paid benefits would change dramatically, how much is paid in benefits would not; and
4. A fee charged farm employers to pay for the overall cost of running the program and payment of specific guest worker expenses such as transportation. This fee could be set at a percentage of guest worker wages paid at the time of employer application. Given that employers are already paying some of the expenses in question themselves (such as the cost of transporting guest workers from their homes to the work site), the net increase in employer cost could be as little as 1%--or \$0.10 per hour.

Summing up these changes in hired farm worker costs put the increase under Alternative III A at \$0.65 to \$0.95 per hour or 6% to 9%.

Alternative III A Results

Using the WAMS system, these cost changes have a much smaller impact on agriculture:

- As Figure 3 indicates, changes in the grain sector are negligible;
- Even with the combined impact of production and processing cost increases, livestock production is down 1% to 2%; and
- Fruit and vegetable production would drop 2% to 3% with prices up 2% to 4%.

For the sector as a whole, Alternative III A's reform would likely result in:

- A drop in net farm income of less than 2%; and
- Asset values would fall less than 2%.

In effect, Alternative III A's improvements in the guest worker program work, not only to provide farm employers with a legal option for meeting their labor needs, but also to keep hired farm worker wages in line with the minimum skill-levels required to do the jobs in question.

Conclusion

Few sectors of the economy have as much at stake in the immigration reform debate as agriculture. This relates not only to the extent to which agriculture has grown dependent on undocumented workers for half of the sector's hired workforce, but also to the labor supply and demand fundamentals underlying this growing dependence. Hired farm worker jobs are not only difficult to fill initially based on the demanding manual nature of the work and its seasonality but are also hard to keep filled given that even undocumented workers leave as soon as the opportunity to take less-demanding job arises elsewhere in the economy.

In an enforcement-only reform scenario, the sector faces the loss of over 525,000 workers and the prospect of having to attract replacements from higher-preference jobs generally paying higher wages in a labor market adjusting to the loss of possibly 4.7% of its own workers. The 70-146% increases in wages needed to fill this farm-sector void based on the historical labor supply and wage relationships would be high enough under an Alternative I enforcement-only reform setting to force a wholesale restructuring of the sector along with a sharp drop in output, a large drop in farm income and farm asset values, and the exit of large numbers of financially vulnerable operators. Even with a pronounced move toward more mechanization and a shift toward less labor-intensive commodities, the increase in wages needed to fill the remaining hired farm worker jobs would leave the sector smaller, with substantially lower incomes, and producing a smaller share of the higher-priced foods Americans consume.

The agricultural sector fares better under an Alternative II reform, combining enforcement with a path to legalization, but less so than the rest of the economy, as many newly legalized farm workers

move out of agriculture. In this setting, agriculture would have to attract possibly 265,000 replacement workers in a tightened labor market where farm employers were no longer able to draw on a steady stream of new undocumented workers, while continuing to face farm workers' general preference to take jobs outside of agriculture. The 30% to 68% increase in wages needed to meet this farm labor shortfall would be smaller than in Alternative I but would still be large enough to generate a restructuring of the sector, a reduction in output, higher commodity prices, lower farm incomes and asset values, and more dependence on imports by consumers faced with higher food bills.

How agriculture fares in a reform setting including enforcement, a pathway to legalization, and a guest worker program depends on the specifics of the guest worker program. Simply extending the H-2A program would leave the sector facing smaller but still disruptive 25% to 28% increases in wages as an H-2A-type package of wages and benefits became the standard for the sector. This reflects the extent to which the current H-2A program is broken. With a guest worker program modeled after the W-3 and W-4 provisions of the Senate's 2013 Bill, the sector would face 6% to 9% increases in labor costs that could be absorbed without major displacement, particularly over time as the trend toward mechanization continued.

In this setting, how the U.S. immigration system is reformed is as important as whether or not the system is reformed from an agricultural sector perspective.

Appendix 1. Undocumented workers and Their Role in U.S. Agriculture

A. Labor Profile (Data from 2007-2012 Census of Agriculture, Farm Labor Survey, National Agricultural Workers, Current Population Survey, Quarterly Census of Employment and Wages, California Unemployment Statistics, and PEW Hispanic Center based on frequency of data collection)

- **General Population**
 - 313 million US Population in 2012 (CPS)
 - 244 million(78%) US Eligible Work Force based on demographics (CPS and BLS)
 - 143 million Total Full and Part Time Employment (CPS and BLS)
 - 13 million (8.3%) Unemployed and Discouraged Workers (CPS and BLS)
 - 89 million (28.5%) Out of the Eligible Workforce
 - \$20.48 Median Wage for 2012 for All Wage and Salary Workers in the U.S. (CPS)
 - 11.2 million Undocumented workers (Unauthorized Individuals) in the U.S. (PEW)
 - 4.5 million “Citizen” Children (PEW)
 - 15.7 million Expanded Undocumented Population (PEW)
 - 12.2 million Estimate of Expanded Undocumented Population in the Eligible Workforce (78%)
 - 6.7 million Undocumented workers Full and Part Time Employment (calculated)
 - 1.0 million Expanded Undocumented Population Unemployed or Discouraged
 - 4.5 million Expanded Undocumented Population out of Eligible Workforce (28.5%)

- **Agricultural Sector**
 - 2.4 million Farm Workers (Census of Agriculture and FLS)
 - 1.2 million FTE equivalent of Farm Worker count (Census of Agriculture and FLS)
 - .9-1.3 million fluctuation in FTE based on seasonality (Census of Agriculture and Farm Labor Survey)
 - 1,063,000 2012 Total of All Hired Farm Workers (FLS)
 - 288,000 Agricultural Service Workers
 - 199,000 Part Time Hired Workers
 - 576,000 Full Time Workers
 - 2 workers per farm job after accounting for seasonality and part time work
 - 2-2.1 million operator and family workers on FTE basis (Census of Agriculture)
 - 2:1 ratio of operator and family labor to hired labor
 - 90% Share of Hired Farm Workers that are foreign born (NAWS)
 - 50% share of hired worker interviewees who reported being undocumented(NAWS)
 - 525,000 undocumented farm workers hired in 2012 assuming 50% share (FLS and NAWS)
 - \$10.80 cost per hour for hired workers as reported by employers (FLS)

B. Hired Worker Concentration by Commodity, Region, and Farm Size

- **Hired Labor Costs as Share of Production Costs (2006-2012 Agricultural Resource Management Survey)**
 - 48% Fruit
 - 46% Nursery
 - 35% Vegetables
 - 26% Tobacco
 - 17% Other Crops
 - 17% All Farms
 - 16% Poultry
 - 15% Other Livestock
 - 14% Dairy
 - 12% Peanuts
 - 12% Cotton
 - 10% Rice
 - 10% Hogs
 - 9% Sorghum
 - 9% Wheat
 - 8% Cattle
 - 7% Cash Grain
 - 6% Soybeans
 - 5% Corn

- **Hired Workers by Region (ERS analysis of Current Population Survey Earnings and Census of Agriculture)**
 - 38.7% Southwest Including California
 - 21.8% South
 - 20.1% Midwest
 - 12.1% West
 - 7.2% Northeast

- **Hired Workers by Farm Size (ERS analysis of Agricultural Resource Management Study data)**
 - 77% Share of hired labor employed on 47,000 farms reporting sales of \$50,000 or more out of total of 2.1 million farms
 - 95,000 Number of farms reporting paying unemployment tax for 1.1-1.3 million hired farm workers \$10.80 cost per hour for hired workers as reported by employers (FLS)

C. H-2A Visas

O Approved Applications for H-2A Visa

1997	16,011	
2002	31,538	
2012	65,345	
2013	95,000	estimate\$10.80 cost per hour for hired workers as reported by employers (FLS)

D. % of Hired Worker with Undocumented Status

1989-91	14%
1992-94	37%
1995-97	47%
1998-00	54%
2001-03	50%
2004-06	50%
2007-09	50%
2010-12	50%

Appendix 2. Recent Federal and State Efforts at Comprehensive and Stand -Alone Immigration Reform

A. Stand-Alone Reform Proposals

1. Arizona SB 1070 (2010) Stand-Alone Enforcement

Act strengthens state- and local-level enforcement of federal immigration regulations by making it a misdemeanor for any undocumented individual to be within the state of Arizona. Act allows police to check immigration status and detain anyone that they suspect is undocumented. “Papers Please” provision upheld by Supreme Court.

2. Georgia HB 87 (2010) Stand-Alone Enforcement

Statute requires all state and local government agencies and private companies to check the immigration status of all applicants for any public service and all jobs. All state and local government benefits restricted to individuals who can prove their legal immigration status. Federal judge blocks most extreme provisions but remainder go into effect.

3. Pennsylvania HB 1502 (2010) Stand-Alone Enforcement

Prohibits employment of undocumented workers by state contractors. Mandates use of E-Verify for all employees.

4. Utah HB 497 (2010) Stand-Alone Enforcement

Requires Identification Cards for all “guest workers” and their families and requires that guest workers have a “clean record” and pay fees of \$1,000 to \$2,500 for card. Cards must be presented upon request of police and to qualify for public services and to qualify for employment.

5. Florida HB-1C (2010) Stand-Alone Enforcement

Prohibits any restrictions on state and local enforcement of immigration law. Makes it a misdemeanor for undocumented immigrants within the state to apply for work or work as an independent contractor. Requires check of all employment applicants through E-Verify.

6. Alabama HB 56 (2011) Stand-Alone Enforcement

Prohibits law enforcement officers from releasing any arrested person before checking his/her immigration status. Prohibits undocumented immigrants from receiving any state benefits, enrolling in state universities, applying for work, or soliciting work in a public space. Landlords prohibited from renting to undocumented immigrants.

7. Agricultural Guest Worker Act HR 1773

Bill creates a new agricultural guest worker program designed to insure sector access to immigrants documented through special visa program enables US farmers to recruit people in other countries for temporary or seasonal agricultural work based on demonstration of local labor shortage.

8. Legal Agricultural Workforce Act HR 242 (2013)

Bill creates new guest work program aimed at insuring agricultural sector's continued access to immigrant labor legalized through a special visa program

B. Comprehensive Reform Proposals

9. Comprehensive Immigration Reform Act of 2011 (S. 1258)

Comprehensive reform including enforcement, path to legalization, and Agnos Guest Worker Program (Agricultural Job Opportunities, Benefits, and Security Act) passes Senate but not the House.

10. The Border Security, Economic Opportunity, and Immigration Modernization Act (2013) Comprehensive Reform

Combines tougher border security and enforcement provisions with path to legalization/citizenship and provisions for guest worker programs.

Appendix 3. Data and Information Sources

A. Data Sources

Agricultural Resource Management Study (ARMS)

USDA/NASS and ERS annual probability-based survey of farm sector performance including financial profile identifying total labor requirements, use and cost of hired farm labor by state, region, commodity concentration, farm size, and farm management characteristics. Given ARMS' complete accounting for commodity costs of production, total and hired farm labor costs can be compared to total costs to determine importance of labor vis-à-vis other inputs and estimate sensitivity to variations in hired labor availability and costs.

Census of Agriculture (COA)

USDA/NASS comprehensive census of farm sector operations conducted every 4 years and structured to provide financial profile by farm size, type, commodity concentration, and location by state and county. Financial performance measures include total costs of production, cost by individual inputs including hired labor, and more detailed information on labor use and costs differentiated between hired and operator/family labor. ARMS and COA activities coordinated to insure compatibility between ARMS surveys and COA census so that annual more limited results can be used to update key Census results only available every 4 years.

Current Population Survey (CPS)

Department of Labor/Census Bureau probability-based survey of the general population by county and state including specialized information on employment, wages, and job characteristics for major employment categories that allows the breakout of farm labor use and labor use in other sectors of the economy. Results support comparison of labor use and wages in the agricultural sector and in comparable low-skill job categories in the general economy.

CPS's March Monthly Supplement/Earnings File provides most in-depth information on labor topics.

Farm Labor Survey (FLS)

USDA/NASS quarterly survey of farm workers generating information on hired farm worker numbers, hours, and wages by type of farm employment by type of farm, commodity specialty, farm size, and location. Results published for 16 states and 15 multi-state regions. Break-out provided for migrant workers verses settled workers in the hired farm labor category.

National Agricultural Workers Survey (NAWS)

Probability-based survey of crop workers conducted annually by USDA/NASS. Survey collects information on farm worker hours worked, wages, assets, employment history, and characteristics of farm workers including legal status, age, literacy/education levels, family status and composition, employment histories, and uses of social services.

Appendix 4. Labor: Wage Elasticities in the General and Agricultural Economies

Considerable research has been done on the critical measure of how wages and labor supplies interact—that is, how a change in labor supply affects wages as the price of labor. This relationship is critical for the purposes of this study since the primary impact of immigration reform would be to change the supply of labor available in both the general and the agricultural economies.

For the purposes of this study, two wage elasticities (a -0.5 to -1.0) were used to translate Alternative 1-III's reductions in the general labor supply into a wage impact. These elasticities are generally accepted in the research community and are consistent with the parameters included in USDA's partial equilibrium models and modeling work done at the land grant universities.

As Figure 1 below indicates, using -0.5 and -1.0 elasticities indicates that Alternative I's 4.7% reduction in the general labor supply would generate a 4.7% to 9.4% increase in the general wage rate. This indicates that any adjustment in the wages of hired farm workers would take place in a general economy where immigration reform had already raised general wage rates 4.7 to 9.4% from a 2012 average of \$20.48 per hour reported in Appendix 1 to \$21.44-22.40 per hour.

However, these elasticities can be limited in their usefulness in this analysis due to the following factors:

- More than wages determine worker responsiveness just as more than wages determine employers' decisions about how much they will use a change in wages to offset a change in labor supply. An employer can and tends to use a mix of options to replace lost workers as the size of the loss increases. These alternatives can include changing the scale of the operation, the product mix, and/or the input mix possibly by varying the mix of labor and capital in the form of increased or decreased investment in labor-saving mechanization; and
- Most of the elasticities available in the literature were estimated over time periods with slower, smaller, and more episodic changes in worker numbers and wages. Hence, the results are less reliable in estimating the impact of faster, larger changes—particularly if reform changes are viewed as permanent/fundamental changes rather than normal fluctuations in the labor market to be expected from time-to-time. Even the smaller changes in labor supply and wages in the general economy under Alternative 1 are outside the range of historical experience.

Keeping these concerns in mind, several studies provide insight into just how elastic labor supply and wages are in the general economy. The analyses reported by Haggler and Zanier as well as work by Dixon, Duffield, and Higgs using Computerized General Equilibrium Modeling frameworks (such as the Zanier USAGE Model described in Appendix 5) cite labor elasticities in the inelastic (-.3 to -.5) range. This indicates that a relatively large change in wages is needed to offset a change in labor availability—a 14.3% change in wages would be needed to offset a 5% change in the labor force. This is consistent with CGE's primary focus on optimizing resource allocation in what is generally assumed to be full-employment economy. Other CGE analyses

suggest elasticities in the -.4 to -.8 range for a U.S. economy operating at less than full employment. This higher range indicates that a 6.25 to 12.5% change in wages would be needed to offset a 5% change in the labor force.

The issue under Alternative 1, however, is a much larger and more permanent reduction in the labor supply that would presumably discourage employers from responding with a “business as usual” approach to the shock. If this is indeed the situation, these -.3 to -.5 and -.4 to -.8 ranges may overstate the wage adjustment associated with Alternative 1 as employers opt to mix wage increases with changes in the mix of inputs used in their production processes (i.e. substitute capital for labor in the form of more mechanization), changes in their mix of products to reduce labor needs, changes in their day-to-day business practices to reduce labor needs, and possibly scaling back or exiting the business. This broader perspective on the adjustment to the shock would boost the elasticity.

Labor Elasticity in the Agricultural Economy

Given the far larger percentage change in the hired farm workforce likely with Alternative 1 (50% versus 4.7%) and the different characteristics of the sector’s hired work force compared with the general workforce, it is important to consider whether the elasticities used for the general economy can be used in analyzing the agricultural sector. As already noted here, many of the particular characteristics of hired farm worker jobs tend to make the jobs distinctly lower-preference than jobs elsewhere in the general economy. In broad terms, this would tend to make the increases in wages necessary to attract replacement workers from outside agriculture into agriculture higher. This worker preference concern would tend to offset the low-skill threshold for farm jobs and the sector’s ability to absorb virtually any worker from elsewhere in the economy that would otherwise make the sector’s labor supply more elastic.

Based on these considerations, two elasticities were used here—a -.4 and a -.8—indicating that the hired farm worker market is somewhat less elastic than the general labor market.

As Figure 1 indicates, these -.4 and -.8 elasticities suggest that the 50% change in the supply of hired farm workers would spark a 62.5-125% change in wages over and above the 4.7-9.4% rise in the general wage rate. The two impacts in combination would boost farm wages by 70% to 146% from the \$10.80 per hour reported for 2012 in Appendix 1 to \$18.36-26.57 per hour.

Regarding specific elasticity estimates, several research efforts have addressed the issue empirically and arrived at estimates of -.3 to -.8. Research by Duffield published in 1990, work by Gunter published in 1992, and research by Coltrane published in 1992 established that the hired farm labor market was more wage-inelastic, as did subsequent research by Long in 2008, Orson in 2009, and Rurik in 2011. The most recent work done by Zanier (2012) in a CGE context reinforced this conclusion, suggesting an elasticity less than 1 and possibly as low as -.3.

But given the 50% magnitude of the changes in the hired farm work force under Alternative 1, how relevant are these low elasticities calculated over a historical period when changes were dramatically smaller and represented short term fluctuations rather than permanent fundamental

Figure 1. Elasticity Indicators for 2012

A. General Economy

All U.S. Wage and Salaried Workers ('000)	142,653
Illegal Wage and Salaried Workers	6,700
Illegal Share	4.7%
Elasticities Used in Report	(.5) to (1.0)
Changes in Wages Associated with 4.7% Decrease in Workers assuming -.5 Elasticity	9.7%
Changes in Wages Associated with 4.7% Decrease Decrease in Workers assuming -1.0 Elasticity	4.7%

B. Agricultural Economy

All Hired Farm Workers ('000)	1,050
Illegal Hired Farm Workers ('000)	525
Illegal Share	50%
Elasticities Used in Report	(.4) to (.8)
Changes in Wages Associated with 50% Decrease in Workers assuming -.4 Elasticity	125%
Changes in Wages Associated with 50% Decrease in Workers assuming -.8 Elasticity	62.5%

**C. Combined Impact of General Increase in Wages
and Agricultural Sector Increase in Wages**

70% to 146%

change? Many of the concerns pointing to higher elasticities in the general labor market apply as much, or more, to the hired farm worker market. For example, Alternative 1's changes would discourage agricultural employers from adopting a "business as usual" response. As Martin and Calvin found in their study, farm employers have historically looked to other alternatives than raising wages to meet their labor needs and would be likely to do so even more in a setting with a 50% labor loss.

If this is indeed the situation, elasticities in at the lower end of the $-.3$ range despite the convincing case made by Zanier may be too inelastic as farm employers opt to mix wage increases with more basic changes in the mix of commodities produced, the combination of labor and capital used in their operations, accelerated development and adoption of labor saving machinery and business management practices, and possibly a decision to scale-back or exit agriculture.

Given the far larger percentage change in the hired farm workforce likely with Alternative 1 (50% versus 4.7%) and the different characteristics of the sector's hired work forced compared with the general workforce, it is important to consider whether the elasticities used for the general economy can be used in analyzing the agricultural sector. As already noted here, many of the particular characteristics of hired farm worker jobs tend to make the jobs distinctly lower-preference than jobs elsewhere in the general economy. In broad terms, this would tend to make the increases in wages necessary to attract replacement workers from outside agriculture into agriculture higher. This worker preference concern would tend to offset the low-skill threshold for farm jobs and the sector's ability to absorb virtually any worker from elsewhere in the economy that would otherwise make the sector's labor supply more elastic.

Based on these considerations two elasticities were use here—a $-.4$ and a $-.8$ —indicating that the hired farm worker market is somewhat less elastic than the general labor market.

As Figure 1 indicates, these $-.4$ and $-.8$ elasticities suggest that the 50% change in the supply of hired farm workers would spark a 62.5-125% change in wages over and above the 4.7-9.4% rise in the general wage rate. The two impacts in combination would boost farm wages by 70% to 146% from the \$10.80 per hour reported for 2012 in Appendix 1 to \$18.36-26.57 per hour.

Appendix 5. Description of the Modeling Systems Used in Study Analyses

This appendix describes the two modeling systems used in this study—the U.S. Applied General Equilibrium Model (USAGE) and the WAEES Partial Equilibrium World Agricultural Modeling System (WAMS). The two systems provide different but complementary insight into how the U.S. agricultural sector would likely adjust to alternative immigration reform initiatives.

The USAGE Model

The USAGE Model is a recursively, dynamic, general equilibrium model of the general U.S. economy. USAGE is based on fundamental work on the Australian economy that produced the MONASH Model. Both the MONASH and USAGE models are based on supply and demand equations for each of the major sectors of the economy that are linked and solved interactively to optimize the decisions made by firms, investors, consumers, and labor market participants in each of the sectors and across the general economy. Each sector chooses the mix of outputs that maximize its revenues from a given set of inputs and structures the inputs used to minimize the cost of producing any given set of outputs. The Model includes the primary product, intermediate product, and final product sectors and depends on fixed input-output coefficients to provide for cross sector linkages and optimized economy-wide solutions.

The version of the USAGE Model used in this analysis was enhanced by Steven Zahniser and reported on in a USDA/ERS report entitled “The Potential Impact of Changes in Immigration Policy on U.S. Agriculture and the Market for Hired Farm Labor.” Zahniser et al expand the labor components of the USAGE Model to differentiate between authorized and unauthorized labor in the agricultural sector and the other sectors of the economy. The Model was solved to develop a baseline—a set of 15 year projections--that assume continuation of current immigration policy and to develop an alternative set of projections that incorporate different immigration policy assumptions.

As with most CGE models, the USAGE model before and after Zahniser’s modifications generated what is generally referred to as a long term equilibrium solution. This means that Model output describes the state of the general economy and the agricultural sector after all the adjustments necessary to reach a steady-state equilibrium have been made. Hence, there is no time-path of adjustment to track as the economy and the sector adjust. Hence, the final equilibrium solution typically understates the short and medium term adjustments necessary to reach a new long term equilibrium.

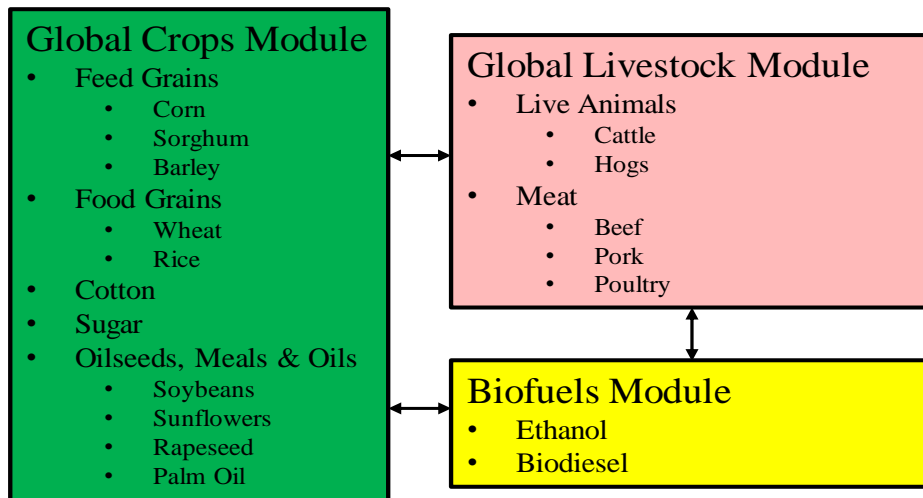
Zahniser’s work focused on solving the USAGE Model with two sets of alternative immigration assumptions. The first set of assumptions adds 156,000 H-2A workers over 3 years and describes the long term equilibrium likely at the end of a 15-year adjustment period. This set of assumptions reduced the undocumented labor force by 5.8 million over an initial 3 years and gauges impacts at the end of a 15-year adjustment period. The analyses are helpful in gauging the relationships at work in both the agricultural sector and the general economy. As noted in the report, the CGE results emphasize how elastic/inelastic the link is between farm worker number and wages and

overall labor supply and wages in the general economy. These relationships suggest a wage elasticity of labor supply in the -.35 to -1.1 range.

WAEES Partial Equilibrium World Agricultural Modeling System

The second WAEES analytic system to be used in the proposed project is the *World Agriculture Modeling System (WAMS)*. The WAMS is a partial equilibrium modeling system made up of a set of linked global econometric models emulating the behavior of the global agricultural sector. The partial equilibrium models can be broken down into crops, livestock and biofuels components encompassing feed grains, food grains, cotton, sugar, oilseeds, beef, pork, and poultry.

Model Coverage Overview



The WAEES models cover 38 countries/regions with an additional 12 regional aggregates including the world total. WAEES follows USDA's reported data coverage which may mean that a zero is reported for a particular commodity which USDA does not cover or has discontinued covering. USDA currently covers at least 90 percent of global production; therefore, the countries which are omitted represent a small portion of total global production.

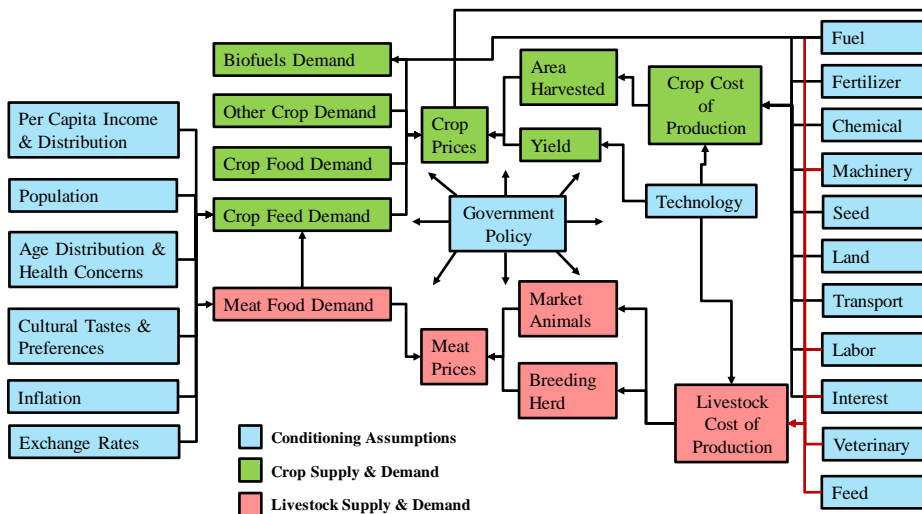
Specifically the WAEES model includes Canada, Mexico, the United States, Caribbean and Central America, Argentina, Brazil, Other South America, the European Union 27, Other Europe, Russia, Ukraine, Uzbekistan, Other Former Soviet Union, Saudi Arabia, Turkey, Other Middle East, China, Japan, South Korea, Taiwan, Other East Asia, India, Pakistan, Other South Asia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, Vietnam, Other Southeast Asia, Australia, Other Oceania, Egypt, Other North Africa, Kenya, South Africa, and Other Sub-Saharan Africa.

Partial Equilibrium Models

Each partial equilibrium module is broken down into commodities with a system of structural equations capturing the supply and demand components for each of them. The drivers of these equations are theoretically derived based upon the behavioral postulates from economic theory of profit maximization by the market participants and utility maximization by consumers subject to various domestic and international trade policies.

The diagram below illustrates the inter-linkages of the crops and livestock model. In the diagram, the blue boxes represent the key drivers (conditioning assumptions) of the agricultural sector including income, population, culture, inflation, exchange rates, domestic and trade policy, technology and input costs. The green boxes are an aggregate approximation of the crops sector. As relevant, each box represents an equation for each commodity covered. For example, there are specific feed demand equations for corn, sorghum, barley, soybean meal, sunflower meal, etc. The pink boxes are an aggregate approximation of the livestock sector encompassing beef, pork and broilers. The diagram illustrates how income, population, and other factors drive food demand for crops and meats. Crude oil prices (and policies) drive the demands for biofuels. As demand increases, crop prices increase providing an incentive for production expansion. Technology growth drives yield expansion providing much of the needed production. Crop area may also grow to meet demand needs although in developed countries this often amounts to tradeoffs among crops. Ultimately supply and demand are balanced via commodity prices. If demand is stronger than supply, commodity prices increase until demand growth is slowed and supply growth is increases enough for supply and demand to balance.

Interlinked Crops and Livestock Econometric Modeling System

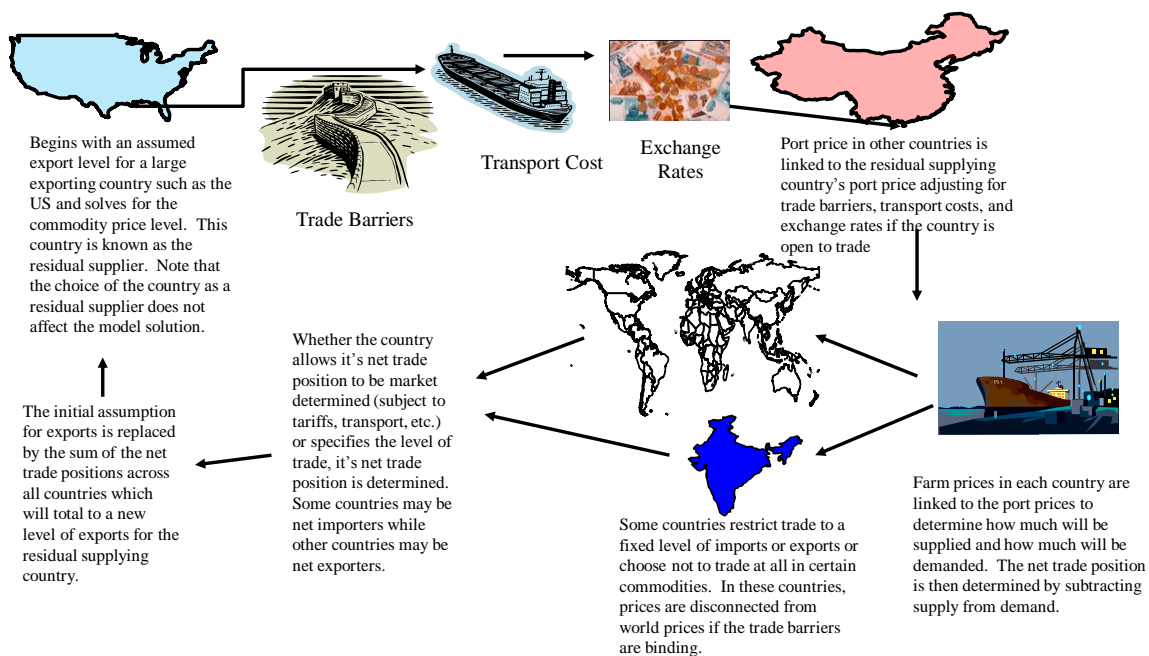


Partial equilibrium models solve iteratively to balance global supply and demand. This occurs at the country level for each commodity. Most countries are at least somewhat open to trade all-be-it

with tariffs. The trade diagram below illustrates conceptually how global supply and demands are balanced within a “global” price equilibrium solution. Typically a large exporting country is chosen as the residual supplier for the world. The choice of this country does not affect the solution. The commodity price in the residual supplying country is solved for by assuming an initial level of exports. This price is then transferred to other countries through trade barriers, transportation costs, and exchange rates.

Based on a given price level, each country determines how much it is willing to supply or demand at that price and subsequent how it wants to import or export. Occasionally a country has tariffs high enough that no trade will occur or only a fixed amount of trade will occur at the lower tariff level. Note that in those countries internal prices may not reflect the world level of prices because supply and demand must be balanced from domestic sources. After the supply and demand in each country is determined and the implied trade position, these trade positions are summed to find the new level of exports for the residual supplying country replacing the initial assumption. The process then repeats itself until prices adjust to balance global supply and demand. For example, if the sum of trade across all other countries is lower than the initial starting assumption for the residual supplying country, the price level in the residual supplying country will fall to balance supply and demand. This lower price level will then get transferred to all other countries affecting their supply and demand and ultimately net trade positions and of course replace the exports again in the residual supplying country. This process continues until global supply and demand balance.

How do partial equilibrium models solve for a global supply and equilibrium price?

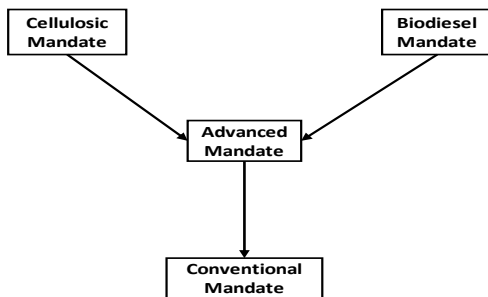


An Example of the US Partial Equilibrium Model for the Biofuels Sector

Within the model, the US ethanol and biodiesel sectors are set up as partial equilibrium models with supply and demand equations and an endogenous ethanol and biodiesel price. The structure of the model is rooted in the ethanol specifications documented by John Kruse, Patrick Westhoff, Seth Meyer, and Wyatt Thompson in a 2007 journal article in *AgBioForum* (“Economic Impacts of not Extending Biofuel Subsidies.”) With the second Renewable Fuel Standard, these original specifications have been updated to reflect the hierarchical system of mandates. The biofuels mandates require compliance with each specific mandate type including biodiesel, cellulosic, advanced and the overall renewable fuel mandate.

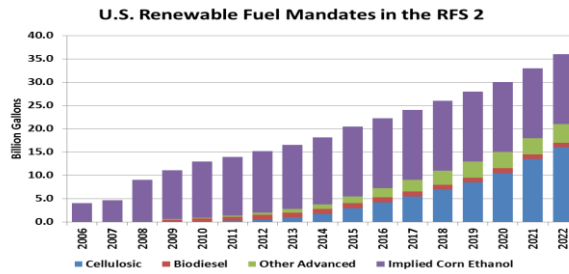
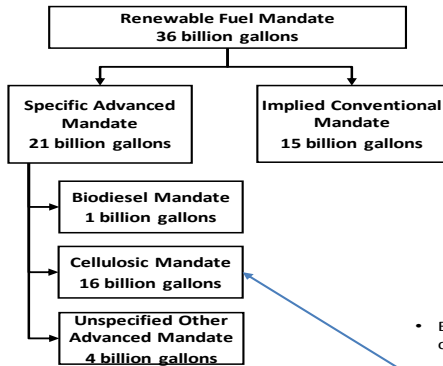
The rationale for different mandates in the legislation was to encourage biofuel producers to move towards feed stocks that provided the greatest level of greenhouse gas (GHG) reductions compared with conventional petroleum. The term “advanced biofuels” was used to describe biofuels that reduced GHG emissions by at least 50 percent compared with a 20 percent reduction requirement for conventional feed stocks. Cellulosic derived biofuels must reduce GHG emissions by 60 percent. Compliance with the mandates by the obligated parties is enforced by the EPA through a system of Renewable Identification Numbers (RINS) assigned to each type of biofuel produced. Obligated parties must demonstrate that they have met their assigned obligations through the number of RINS they have for each type of fuel. Theoretically there could be a specific RIN value for each type of mandate – cellulosic, biodiesel, advanced, and conventional, if each mandate was binding. Mandates are binding when the market is forced by policy to produce more than what normal economic conditions would suggest. The advanced biofuels are typically more expensive to produce than conventional biofuels resulting in those mandates being more binding than conventional biofuels mandates. Therefore RIN values (or prices) are typically significantly higher for advanced biofuels than conventional biofuels.

Hierarchical RINS Modeling



- Theoretically there can be 4 different RIN prices specific to each mandate if all the mandates are binding.
- Mandates are binding when the market is forced by policy to produce more than what normal economic conditions would suggest.
- Given the hierarchy of the mandates, it must be the case that RIN values for biodiesel are greater than or equal to advanced RIN values and advanced RIN values must be greater than or equal to conventional RINS. This is because biodiesel RINS can be used as advanced RINS and advanced RINS can be used as conventional RINS. (This process is referred to as demotion.)
- Biodiesel RINS can have the same value as advanced RINS if the biodiesel mandate is less binding than the advanced mandate.

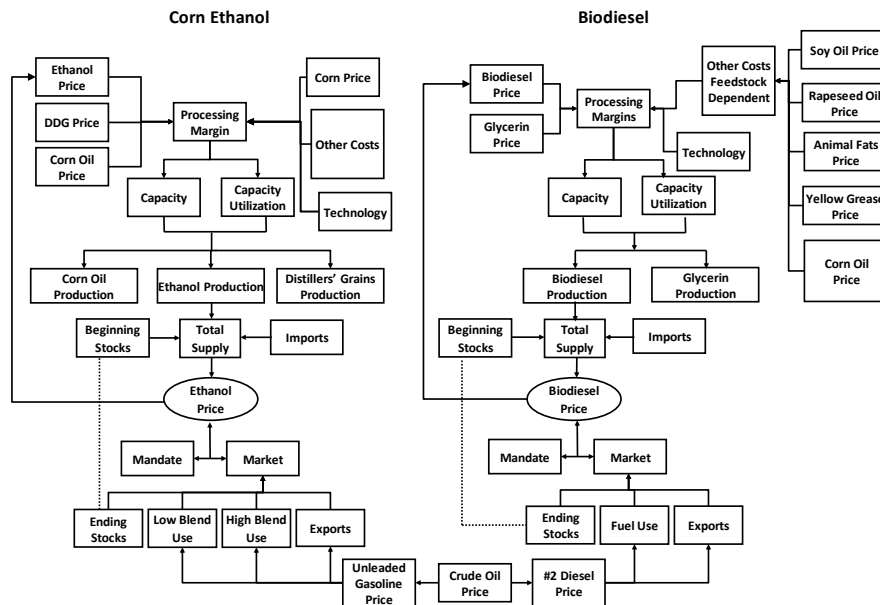
US Biofuels Mandates in 2022



- EPA has waived the cellulosic mandate in 2011 and 2012 because cellulosic biofuels are still very expensive to produce.
- While the cellulosic mandates has been waived, the overall advanced mandate continues to be retained forcing more demand for other advanced fuel feed stocks such as biodiesel and sugarcane ethanol.

A detailed diagram of the US biofuels models is presented below. The demand for biofuels is largely mandate driven now that the tax credits have expired. Although as crude oil price edge higher it is possible for ethanol demand to be driven by market forces although the blend wall presents another hurdle. The supply of biofuels is driven by the profit margins of the biofuel plants. Profit margins are derived by subtracting the cost of the feed stocks and other variable costs of production from the valued of the products. In the case of ethanol, the value of the ethanol plus the

US Biofuels Partial Equilibrium Models



value of the byproducts including corn oil and distiller's grains form the gross returns. The cost of ethanol is composed of the feed stock cost, primarily corn, and the other inputs. In the case of biodiesel, the value of biodiesel and the byproduct glycerin form the gross returns. The cost of producing biodiesel is composed of the feed stock costs, soybean oil, and other inputs. The respective margins for ethanol and biodiesel drive capacity expansion in the longer term and capacity utilization in the short term for each sector. Equilibrium between biodiesel supply and demand is found by solving for the biodiesel price.

Appendix 6. Selected Bibliography

- Artz, Georgeanne *Immigration and Meatpacking in the Midwest* 2012
- Calvin, Linda and Martin, Philip *Labor-Intensive U.S. Fruit and Vegetable Industry Competes in a Global Market* December, 2010
- Carroll, Daniel *Changing Characteristics of U.S. Farm Workers* May, 2011
- Dixon, Peter *The USAGE Model Labor Extension for Study of Illegal Immigration* August 2008
- Duffield, James *Estimating Farm Labor Elasticities to Analyze the Effects of Immigration Reform* March 1990
- ERS/USDA *Farm Labor Background* August 2013
- Farmworker Justice *Immigration Reform and Farmworkers* 2013
- Gustin, Sarah *Immigration Reform Impacts Agriculture Industry* June 2013
- Higgs, Peter *Adaptation and Survival in Australian Agriculture: A Computable General Equilibrium Analysis* June, 1986
- Kandel, William *Profile of Hired Farmworkers, A 2008 Update* July 2008
- Martin, Philip *Immigration and Farm Labor: Policy Options and Consequences* April, 2012
- Martin, Robert *Immigration Reform, Agriculture, and Public Health* March, 2013
- Passell, Jeffery A *Portrait of Unauthorized Immigrants in the United States* April, 2009
- Rosson, Parr *The Economic Impacts of Immigration on U.S. Dairy Farms* June 2009
- Ruark, Eric *Illegal Immigration and Agribusiness* 2011
- Zahniser, Steven *Immigration Policy and Its Possible Effects on U.S. Agriculture* 2012
- Zahniser, Steven *The Potential Impacts of Immigration Policy on U.S. Agriculture and the Market for Hired Farm Labor: Simulation Analysis* 2011
- Data Bases cited in Appendix 3.

