Global Agricultural Reform and U.S. Agricultural Adjustment Capacity

Mary E. Burfisher[1]
Kenneth Hanson
Jeffrey Hopkins
Agapi Somwaru

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[1] All authors are agricultural economists with the Economic Research Service, USDA, and the viewpoints and conclusions expressed in this manuscript are their own and not necessarily those of ERS/USDA. The authors thank David Skully, Karen Hamrick, and Mitch Morehart for comments on earlier drafts of the manuscript.

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1. Introduction

Despite the broad consensus of the recent economics literature that global agricultural policy reform can yield substantial welfare gains for all countries (eg., Diao, et al. 2001; World Bank, 2001; Tokarick, 2003), agricultural reform poses a serious obstacle for multilateral and many regional trade negotiations. Why do countries resist what is "good for them"? Although global reforms can lead to an improvement in national welfare, or gains in aggregate consumer purchasing power, policy-makers are often more responsive to the concerns that are vociferously expressed by those who expect to lose from policy reform. Their expected losses are based on the short-term and long-term costs of adjustment to a new economic environment.

Agricultural households adjust to shocks such as policy reform through market mechanisms, reallocating their production mix, and adjusting their labor inputs and investment on- and off-farm. Farm households' capacity to adjust through market mechanisms will influence their level of gains or losses from global reform. Potential losers are likely to lobby for compensation or trade adjustment assistance linked to a multi-lateral proposal.

Trade adjustment assistance (TAA) programs have been used in the U.S. for more than four decades to make trade reform possible by offering to facilitate adjustment. The introduction of the U.S. TAA program and its subsequent expansions have all been linked to passage of trade negotiation authority or trade agreements.[2] The 2002 Trade Act includes trade adjustment benefits for farmers for the first time (see box). TAA programs mainly compensate workers and firms for short-term adjustment costs, through unemployment benefits, re-training, and relocation and technical assistance.[3]

Three broad justifications have been made for a government role in trade adjustment. Richardson (1980) described these in terms of easing transition, compensating injury and bleeding political pressure for protectionism. Others have explored the efficiency and equity objectives of trade adjustment assistance (Aho and Bayard, 1984; Brander and Spencer, 1994; Magee, 2001). Adjustment programs can promote market efficiency by improving the capacity of workers and firms to adjust to trade shocks. Sticky adjustment matters because it results in a nation's output falling below its productive capacity - a real

[2] The first TAA program in the U.S. was established by the Trade Expansion Act of 1962, which provided President Kennedy with the authority to enter into the Kennedy Round of the GATT negotiations. NAFTA included the establishment of a NAFTA-TAA program to facilitate adjustment to injuries from increased imports from Mexico and Canada. The 2002 Trade Adjustment Reform Act was passed as part of the 2002 Trade Promotion Authority bill, which gave President Bush fast-track authority to negotiate trade agreements.

[3] U.S. GAO 2000a, 2000b and 2001.

loss that must be subtracted from the expected gains from trade reforms. Adjustment programs can be used to achieve distributional equity by compensating those who expect to lose most from policies, regardless of their capacity to adjust. Compensation linked to the expected size of loss may reflect notions about equity – that a few should not bear an unfair share of the costs of a policy change that benefits many – and it can help to target benefits toward those most likely to oppose reform. Adjustment policy design involves striking a balance between efficiency and equity objectives in the distribution of program benefits (Brander and Spencer, 1994).

Global agricultural reform can potentially lead to aggregate gains for U.S. agriculture; but adjustment issues likely will be important in the trade policy debate because of the prospects for both winners and losers within the sector. The equity and efficiency concepts that underlie adjustment policy design can be used to focus a distributional analysis of the expected gains and losses linked to global reform and the adjustment capacity of U.S. agriculture. In this paper, we develop a macro-micro model of the U.S. to simulate the effects of world price changes from global agricultural policy reform. We use the model to describe the diversity in U.S. farm households' exposure to the shock and in their capacity to adjust using measures of heterogeneous human capital adjustment capacity. In this analysis, we focus on the distributional aspects of the adjustment capacity of farm households, linked to their differential endowments of human capital. We develop *ex ante* measures of adjustment capacity across farm household types, using as proxies the probability of the operator working off-farm and the farm operator's managerial capacity to successfully respond to and compensate for changing relative prices. This paper is a part of a larger program of research on trade adjustment and U.S. agriculture.

Box – Provisions of Trade Adjustment Assistance for Farmers
TAA for farmers was introduced under the 2002 Trade Adjustment Reform Act. It provides producers of raw commodities, who have been adversely affected by import competition, free technical assistance and cash benefits up to $10,000 per year. TAA covers farmers, ranchers, fish farmers and fishermen competing with aqua-culture products. Complainants must petition the USDA Foreign Agriculture Service on behalf of regional or national producers in their sectors, who may then apply individually for benefits. To be eligible, producer prices in the previous marketing year must be less than or equal to 80 percent of the national average price during the previous 5 marketing years, and imports of like or competitive products must have contributed importantly to the demonstrated decline in farm income. Producers whose average adjusted gross income is under $2.5 million and who have received their free technical assistance from the Extension Service may receive up to $10,000 per year, but no more than $65,000 in combined counter-cyclical and TAA payments. The amount of cash payment will be equal to the quantity produced in the most recent marketing year multiplied by one-half the difference between the average price in the most recent marketing year and 80 percent of the average price for the 5 preceding marketing years. Payments may be available in subsequent years if imports keep increasing and prices remain below the 80-percent threshold. As of April 2004, 12 petitions have been approved. These cover Maine blueberries, Florida lychees, and salmon, shrimp and catfish producers in certain affected areas. Thirteen petitions were rejected, including applications for Virginia apples, California oranges, and national rice. More information on the program is available at http://www.fas.usda.gov/itp/taa/taaindex.htm

2. Global Agricultural Policy Reform: Impacts and Capacity to Adjust

Price and Trade Impacts of Global Reform

World agricultural markets are highly distorted by the widespread use of agricultural tariffs, domestic support and export subsidies. Economy-wide analyses concur that global agricultural reform could lead to substantial gains in world welfare, ranging from $56 billion to $248 billion annually (Diao, et al., 2001; Tokarick, 2003; World Bank, 2001.). There is a consensus that most of the gains from global liberalization are attributable to market access (tariff and non-tariff trade barriers) reforms.

Differences in the magnitude of expected welfare impacts reflect the real-life complexity of multilateral agricultural negotiations, particularly with respect to domestic support. The WTO measures domestic subsidies in an Aggregate Measure of Support (AMS). The AMS includes only those domestic subsidies subject to expenditure limits under global trade rules. It excludes subsidies that are considered to be minimally production-distorting (e.g., decoupled income support, environmental programs, food distribution programs, and subsidies that are offset by supply constraints) and "*de minimus*" support that does not exceed 5 percent of the members' total value of production (10 percent for developing countries). Many studies simulate the elimination of domestic subsidies in addition to those included in the AMS, and model different kinds of farmer payments as having identical incentive effects on production.[4]

In this paper, we follow the partial-equilibrium analysis of global reform reported in Cooper, et al. (2003).[5] In contrast to economy-wide, global models, this agriculture-focused model has a more disaggregated coverage of agricultural sectors, and it accounts for differences among types of domestic support in the WTO constraints placed on the program and in their production incentives. It describes a "zero-zero-zero" (0-0-0) global reform scenario in which global tariffs, export subsidies, and the AMS are reduced to zero. Programs in the U.S. AMS include marketing loan benefits and commodity interest subsidies. Non-product-specific payments, such as market loss assistance payments, have not been included in the U.S. AMS because they have remained below 5 percent of the value of aggregate U.S. production.

In this stylized scenario, U.S. producers realize net benefits from global reform. Increased foreign demand due to tariff removal raises world prices, which reduces U.S. market price support. Higher world prices more than offset the impacts of fully eliminating the U.S. AMS (table 1). Aggregate returns to U.S. agricultural producers will

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[4] Diao, et al., accounted for the differential incentive effects of policies and they removed only domestic subsidies facing WTO expenditure limits (but included *de minimus*), which contributed to their smaller estimated welfare impacts from reform.

[5] Cooper, et al. describe results from a simulation by James V. Stout, at USDA-ERS, of global agricultural policy reform using the ERS-Penn State global mode. The model is documented in Stout (2004), found at: http://trade.aers.psu.edu/.

increase by 4%, with declining returns only for producers of rice and dairy products. However, achieving these aggregate gains for agriculture will require sectoral readjustment of U.S. agriculture. Producers make this adjustment through resource reallocation and diversification, as they change their farm's mix of production activities when relative prices change. Aggregate production of corn, other coarse grains, and poultry will increase, with declining production of rice, wheat, soybeans, beef, and dairy products.

Table 1 – Simulated changes in U.S. production, prices and returns to producers resulting from Zero-Zero-Zero reform of agricultural tariffs and subsidies (%)

	Change in production	Change in consumer price	Change in gross returns to producers
Rice	-1.2	13.2	-0.8
Wheat	-0.1	4.8	2.5
Corn	2.4	16.5	13.9
Other coarse grains	1.7	13.5	10.9
Soybeans	-0.7	7.5	3.9
Cotton	0.0	4.5	2.1
Beef and veal	-0.1	10.6	8.1
Pork	0.0	7.5	5.0
Poultry meat	1.6	13.0	10.5
Butter	-15.0	-12.0	-12.0
Cheese	-0.6	-1.9	-1.9
Non-fat dry milk	-15.0	-1.6	-1.6
Whole dry milk	-31.6	-13.4	-13.4
Total	0.27	9.19	4.2

Source: ERS/Penn State World Trade model, reported in Cooper, et al., 2003.

From a political perspective, the issues raised by a multilateral reform that results in expected net gains are different from one that results in expected net losses. From an economic perspective, the trade adjustment process is similar whether the shock is positive or negative. The capacity to offset losses and to take advantage of emerging market opportunities is distributed heterogeneously across the U.S. farm sector, with some farms better able to avert the losses or garner the rents from trade reform than others.

The shocks from the ERS-Penn State model, described in Cooper, et al., will affect U.S. farm households differently. Shocks will vary according to how farm households are situated with respect to production mix and dependence on farm subsidies as well as the role of farm activities in the farm household income and asset portfolio. We attempt to capture the diversity in impacts of trade reform on both farm production activities and farm household well-being, by describing farms and households using a 7-way typology. This typology categorizes households according to the primary occupation of the farm operator, and size of sales.[6]

[6] The typology is described in Hoppe, Perry and Banker (2000). The Farm Income and Costs Briefing Room (http://www.ers.usda.gov/Briefing/FarmIncome/) provides a comprehensive description of farm households in the farm typology. The distribution of farm households among these seven types, along with data for their on- and off-farm sources of income are discussed further in Hanson and Somwaru (2003).

There are notable differences across farm households with respect to their exposure to farm-related income shocks, and some of these are offsetting (table 2). For instance, very large farms receive more farm subsidies compared to other types of farms, and in a 0-0-0 reform would lose nearly $6000 on average, compared to an average payment reduction of $50 on retirement farms. But when normalized to cents per dollar of production, residential and farm occupation farm types are most dependent on farm subsidies.

Table 2 – Incidence of payment loss across farm types due to 0-0-0-global reform

Farm type	Number of farms	Total by farm type	Average per-farm	Average loss in cents per dollar of production
	Thousands	$US million	$US	US cents
Limited resource	127	9	69	0.57
Retirement	298	14	46	0.83
Residential/lifestyle	931	75	81	1.00
Farm occupation/low sales	480	161	336	1.17
Farm occupation/high sales	175	343	1955	1.20
Large	77	309	4000	0.45
Very large	58	341	5833	0.79
All	2,147	1,252	583	0.79

Source: ARMS, 1999 and ERS-USDA CGE model.

Commercial farms (high sales, large and very large farms) are more dependent on the farm operation as a source of household income and assets than other types of farms (table 3). However, they are less reliant on owned program acres in their farm operation than other types of farmers, and are therefore less exposed to changes in land asset values linked to subsidy reform. Moreover, larger farms are somewhat more diversified across agricultural enterprises within their farm business compared to limited resource, retired, and rural residence farms. Limited resource, retirement, residential and low sales farms diversify in other dimensions, as seen by their high share of nonfarm income and wealth in their overall portfolios.

Diversification across production mix and across income and assets allows households to balance the risk and returns associated with different economic activities. The production and income/asset diversification observed today represents actions taken in the past to balance profit and utility objectives with other goals, such as security, lifecycle planning, and possibly non-pecuniary preferences. Diversification can reflect past as well as anticipatory adjustments, such as the expectation of global agricultural reform. For the household, "pull" factors from local job markets and accessibility to these jobs also contribute to diversification. When farms and households are already diversified, then marginal changes in allocations across their economic activities can be presumed to be less costly than the initial entry, which might entail search costs, entry or training fees, and perhaps higher perceived levels of risk. The absence of diversification does not necessarily mean that it could not occur, only that adjustment may be more difficult than for already diversified farms and households.

Table 3 – Diversification of farms and households in production and income/assets				
Farm type	Entropy Index 1/	Share of owned acres in total acres operated	Farm net worth as a share of total assets	Off-farm income as a share of total household income
		Percent	Percent	Percent
Limited resource	0.05	34.6	44.5	50.9
Retirement	0.05	49.7	48.8	51.8
Residential/lifestyle	0.06	41.2	47.1	52.0
Farm occupation/low sales	0.11	41.3	64.4	49.1
Farm occupation/high sales	0.19	30.0	74.8	32.8
Large	0.19	27.6	72.8	29.8
Very large	0.14	30.7	71.4	24.4
All	0.09	40.7	54.9	48.2

1/ The entropy index measures diversification among all production activities on the farm, based on the value of output. An entropy value approaching zero means the farm is nearly a monoculture, and a value approaching one implies equal shares across all commodities.
Source: ARMS, 1999 and ERS-USDA CGE model.

Adjustment Capacity in U.S. Agriculture

Trade adjustment is the reallocation of productive resources in response to the relative price, income and wealth changes linked to trade policy reforms. If they can, producers and households will shift resources away from production, employment, or investment in sectors where returns are falling, and into the sectors where returns are rising. The process of adjustment can create both short-term and long-term costs. Short-term costs are those related to loss of income to owners of fixed resources – human, land and capital – that are unemployed or idled until they are re-employed in new production activities. Short-term costs also include one-time adjustment costs such as training and moving expenses for new employment. Short-term costs are those for which TAA programs have traditionally attempted to compensate.

Another policy concern is potential long-term adjustment costs, when resources permanently earn less following reemployment. These losses can accumulate over the long term, or be capitalized immediately after a shock. For example, an immediate loss in land asset values following a shock can be thought of as a long-term loss, in which the market capitalizes the long-run declines in expected market returns and/or changes in subsidy benefits linked to land ownership or operation. A focus on long-term losses in asset values is a feature that differentiates recent U.S. domestic farm policy reforms from both farm and non-farm trade adjustment programs.[7]

[7] The 2002 Farm Security and Rural Investment (FSRI) Act eliminated the peanut program's marketing quotas, providing lump sum buy-out payments to holders of peanut quotas, regardless of whether owners actually farmed or rented out their quota rights (Dohlman, Hoffman and Young , 2003; Wills, 2002). Proposals for a tobacco buy-out program all include lump sum payments to marketing quota holders (Capehart, 2002). In both the peanut and tobacco markets, marketing quotas are tradable assets largely owned by individuals who do not actively farm. Also, the alternative TAA program in the 2002 TAA

Adjustment capacity determines the size and duration of adjustment costs. In this paper, we consider two dimensions of potential adjustment capacity in U.S. agriculture to global policy shocks. The first is through changes in household labor allocations across farm and nonfarm labor, and leisure. For those operators and spouses who specialize in on-farm work, changes in farm wage and income will affect farm hours worked versus leisure or home time. Households in which farm operators already hold off-farm jobs have more flexibility to compensate for any changes in wages in one job by reallocating hours worked from one job to the other, as well as to changes in leisure and home time.

What characteristics make it likely that a household will be successful in making labor market adjustments? A large body of empirical research describes labor market adjustment to structural shocks in non-farm sectors. These analyses show the importance of demographic characteristics in determining the likelihood that an individual will successfully find reemployment following a loss of job or reduction in wages. Kletzer's (1998) review of recent literature on job displacement reported that higher education, younger age, low job tenure and non-minority race made reemployment more likely. Education is a critical factor, with a college education associated with significantly higher rates of reemployment compared to a high school education (Farber, 2003). Kletzer (2002) described the persistent, long-term losses faced by workers displaced specifically because of imports. Re-employed, import-competing workers on average lost 13 percent in earnings in their new jobs. Two-thirds earned less in their new job than in their old, and one-quarter lost 30 percent or more of their former wage. Tenure in the lost job makes it far more likely that a worker will face a permanent income loss, or long-term adjustment costs. Long-term job experience creates industry-specific human capital that generates wage premiums that cannot be recouped in a new industry. Tenure is also associated with length of unemployment. Some causes may be that more tenured workers are less likely to search for jobs in new industries, and their longer tenure may lead to a greater propensity to sit out what they perceive to be cyclical bad spells in their sector (Fallick, 1996).

Gardner (1992) describes a similar labor adjustment process in agriculture in response to long-term technological change, focusing on the human capital and tenure aspects of adjustment. "The difference between the farm and off-farm value of farm-specific skills is not an adjustment cost in the same sense as the costs of job search or moving expenses...The loss in earnings differs from adjustment costs in that the loss of specific-skill returns is not just a one-time cost. Rather the loss occurs continuously as the earnings difference cumulates over the period during which the farm-specific human capital would have depreciated if the worker had remained on the farm." The implication is that "the farm population should tend to become older as the demand for farm labor declines. Younger people have a longer period over which to recover the fixed adjustment costs, and will have less experience-derived specific human capital to lose." (p. 75)

Reform Act focuses on long-term losses by providing reemployed workers age 50 or older with a wage subsidy that partially compensates for lower wages in their new job for a period of up to two years. For details, see the legislation at: http://www.doleta.gov/tradeact/directives/107PL210.cfm.

The demographic characteristics of U.S. farmer operators suggest that for some, these labor adjustment costs could be high, based on their average length of tenure, although many already work off-farm (table 4). Across the farm typology, commercial farmers tend to be slightly younger than average, with fewer years experience on the farm, however, their labor is specialized with a relatively small share working any off-farm hours. Residential and lifestyle farmers are the youngest group, are relatively well-educated, with the highest off-farm job participation.

Table 4 – Labor-force characteristics of U.S. farm operators, by typology

	Mean age	Mean Education 1/	Mean number of years in farming	Percent of farm operators working-off farm	Mean probability of operator working off-farm 2/
	No. of years	Indicator	No. of years	Percent	Percent
Limited resource	54	1	26	22	41
Retirement	69	2	33	10	29
Residential/lifestyle	48	2	19	49	74
Farm occupation/low sales	59	1	32	24	46
Farm occupation/high sales	50	2	25	21	43
Large	49	2	25	19	36
Very large	49	2	25	15	35
Total	54	2	36	35	55

1/ A value of 1 for education indicates high school or GED; a value of 2 indicates some college education.
2/ Probability is calculated using ARMS, 1999, based on Ahearn et al., (2002), which includes farm and labor market characteristics in addition to the demographic variables in this table.
Source: ARMS, 1999 and ERS calculations based on Ahearn, et al. 2002.

Our analysis develops an *ex ante* measure of labor adjustment capacity across farm household types, using as a proxy the probability of the operator working off-farm estimated by Ahearn, El-Osta, and Dewbre (2002). Their analysis describes the role of demographic characteristics including age and education of the operator and off-farm employment of the spouse. They also account for farm characteristics including capital intensity of the farm and government payments; and pull factors including labor market conditions within the farm commuting zone. The advantages of using this probability measure as a proxy for labor adjustment capacity in our micro-analysis is that it captures the potential for an individual farmer to adjust across labor markets following a shock, whether or not the operator already works off-farm. A high probability of working off-farm implies a stronger potential farm labor response to both positive and negative farm price shocks, and therefore a greater capacity to adjust farm output in response to price signals.

Across the farm typology, residential and lifestyle farmers are most likely to work off farm, and retirement farms are least likely to do so. Operators of very large farms are least likely to work off farm, based on their demographic, farm, and urban job environment characteristics.

The second adjustment mechanism we consider is through the exercise of a farm operator's managerial capacity to successfully respond to and compensate for changing relative prices. Recent research based on ARMS data has identified characteristics of farmers that are strongly associated with aspects of farm management skill.[8] El-Osta and Morehart (1999) found that age, education, and the share of labor hours in farming were positively correlated with adoption of management- and capital- intensive technologies in dairy. McBride and El-Osta (2002) found that age and education were positively correlated with the adoption of genetically modified corn, and number of years in farming was negatively correlated.

Table 5 – Probability of high farm financial performance, by typology

Farm type	Percentile distribution
Limited resource	.43
Retirement	.39
Residential/lifestyle	.40
Farm occupation/low sales	.52
Farm occupation/high sales	.83
Large	.87
Very large	.91
Total	.50

Source: ARMS, 1999.

In this paper, we argue that demonstrated high financial performance in farming is a likely predictor of the farmer's managerial capacity to adjust to changing market conditions linked to reform. Ideally, such management capacity could be explained by the underlying characteristics of the farm and farm operator. We use a proxy measure of high financial performance based on total economic costs of production relative to total value of agricultural output. This general measure of financial efficiency allows potential farm adjustment to occur through a range of mechanisms, such as changes in production mix, changes in scale of production, and adoption of technological and managerial innovations. This approach shows clear differences across farm types in the financial efficiency of their operations (table 5).[9] Large farms are more efficient than small ones, suggesting the importance of scale in explaining farm success. Very large farms are more efficient than 91 percent of farms, while limited resource, lifestyle, and retirement farms are the least efficient.

4. Macro-micro Simulation of Global Agricultural Reform with U.S. Adjustment Capacity

[8] The Agricultural Resource Management Survey (ARMS) is the USDA's primary vehicle for data collection on farm households. The survey includes data on farm household characteristics, resource use and costs, and farm financial farm conditions.

[9] Based on ARMS, 1999. Full resource ownership costs include cash costs and non-cash costs to the farm operation, measured separately for each observation (household) in the data. Cash costs are outlays incurred by the operation to produce commodities and are dependent on production practices and the prices and quantities of inputs. Non-cash costs include opportunity costs of owned assets land, the capital recovery of machinery and equipment, and unpaid operator labor. Methods used in constructing costs and returns are endorsed by the American Agricultural Economics Association (AAEA, 2000) and can also be found on the ERS website at http://www.ers.usda.gov/Data/CostsAndReturns/ . For each observation in the data, full resource ownership costs are divided by the total value of production, yielding a new variable called "financial efficiency." We used the cumulative distribution of financial efficiency across all farms to proxy any individual household's likely success in farming in response to changes in relative commodity prices. Values range from zero (the highest level of financial efficiency and the highest likelihood of success) to one (the lowest level of financial efficiency and the least likelihood of success).

The Macro-Model

We develop a macro-micro simulation model to analyze the distributional impacts of a global agricultural policy reform. The macro analysis is based on a U.S. CGE model developed and maintained at USDA-ERS (Hanson, 2002).[10] Households are segmented into 7 representative farm types, and non-farm household categories.[11] The CGE framework allows us to capture economy-wide impacts on farm and non-farm activities from trade reform. The micro-simulation model distributes the equilibrium changes from the macro model on household income, farm labor, non-farm labor, and taxes from 7 representative household types in the CGE model to the individual farm households described by ARMS. In the micro-simulation model, we introduce heterogeneity in labor adjustment capacity and farm success to describe the distribution of impacts across individual farm households within each typology. The contribution of the micro-simulation is to show variability within each of the 7 groups and therefore among all farm households.

The CGE is rich in detailed specification of industry, labor, and households. Households receive income from three main sources: earnings both from wages and salaries and from self-employment; capital income from the ownership of assets–dividends, interest, and rent; and transfer income from government programs. Households use their income to consume goods and services, pay taxes, and save. Labor supply and demand are treated with occupational detail. Only farm households supply "farm operator" as an occupation, while all households, including farm households, supply labor by the operator and the spouse to a number of other occupations. Similarly, each industry demands labor in its own unique mix of occupations. Model closure rules direct the impact of a policy change to take the form of a change in household real income rather than changes in the trade balance, real investment, and the government deficit. These closure rules allow the model to produce a measure of change to household well-being.

Each farm household type produces its own mix of agricultural commodities, based on ARMS data. Farm income includes coupled program payments that are tied to the production of specific commodities, and decoupled payments that are treated as government transfers to farm households. Income from farm sectors accounts for payments to hired labor and payments to non-operator owners of farm assets. The distribution of subsidies among farm households is in proportion to their production of the program commodities. Farm households adjust their production activities in response to changes in the farm income (self-employed earnings) they receive by commodity.

We simulate the stylized 0-0-0 scenario of agricultural policy reform from the ERS-Penn State model, reported in Cooper, et al., by introducing its world price results as exogenous shocks to the U.S. model and reducing program payments. Farms adjust their production mix by re-allocating resources to those production activities that would get the most benefit from the reform. Increased returns to agriculture lead to higher farm wages,

[10] This version of the model is described in detail in Hanson and Somwaru (2003).

[11] Household data are drawn from U.S. Department of Commerce, U.S. Census Bureau , Current Population Survey (CPS) and ARMS.

which give an incentive to the farm household to increase labor employed in agriculture, despite the loss of subsidy benefits. The net effect of the 0-0-0 reform is to increase total farm household income, our measure of household well-being, by $500 million (table 6). Higher world prices for some products, and the capacity of farm households to reallocate their production enable them to more than fully offset their loss in farm payments due to the reform.

The distributional impacts across the farm typology from a change in farm commodity programs includes the change in government program payments, taxes that would have been paid to fund the program payments, and the impact of price changes to the cost of household food purchases. The greatest income gains accrue to residential and lifestyle farms. These are the farms with the most part-time spousal employment. They therefore have the greatest capacity for labor substitution in the macro-model, and the largest on-farm labor supply response. They also tend to specialize in beef production, for which market prices rise in this simulation.

Table 6 – U.S. farm household impacts from a zero-zero-zero global agricultural policy reform ($US billion)

	Program payments	Farm labor income	Returns to farm assets	Off-farm labor income	Other non-farm income	Tax relief	Total household Income
Limited resources	-0.009	0.006	0.009	-0.001	0.000	-0.001	0.004
Retirement	-0.014	0.046	0.017	-0.005	0.003	-0.006	0.041
Residential/lifestyle	-0.075	0.148	0.096	-0.021	0.003	-0.010	0.141
Farm occupation low sales	-0.161	0.087	0.179	-0.011	0.003	-0.010	0.087
Farm occupation high sales	-0.343	0.059	0.376	-0.008	0.000	-0.006	0.078
Large	-0.309	0.042	0.338	-0.006	0.000	-0.004	0.061
Very large	-0.341	0.084	0.338	-0.009	0.000	-0.004	0.068
All farms	-1.252	0.471	1.353	-0.058	.010	-0.040	0.484

Micro-simulation model

In the micro-simulation model, we combine the results from the macro-model reported in table 6 with characteristics of U.S. farm households, using survey data from the 1999 ARMS, a representative base year. The benefit of household unit-level survey data is its ability to show the distributional effects of a trade policy shock. Regardless of the objectives set for an adjustment policy that accompanies policy reform, targeting individual households rather than all households or even all producers of a specific commodity can improve policy performance. Policy design can take advantage of micro-data on both impact and adjustment heterogeneity.

We construct two scenarios showing the distribution of household-level impacts within each typology. Both scenarios correspond to the same general equilibrium response to policy reform found in table 6 for each representative household type. The two micro-simulation scenarios differ in how they include household unit-specific information to distribute the net impacts from policy reform. The first scenario uses information only on heterogeneity on the incidence of payment removal, or the payment "shock index". The second scenario used an "adjustment index," which combines information on heterogeneity in the incidence of payment removal with information on how adjustment capacity varies across the population.[12]

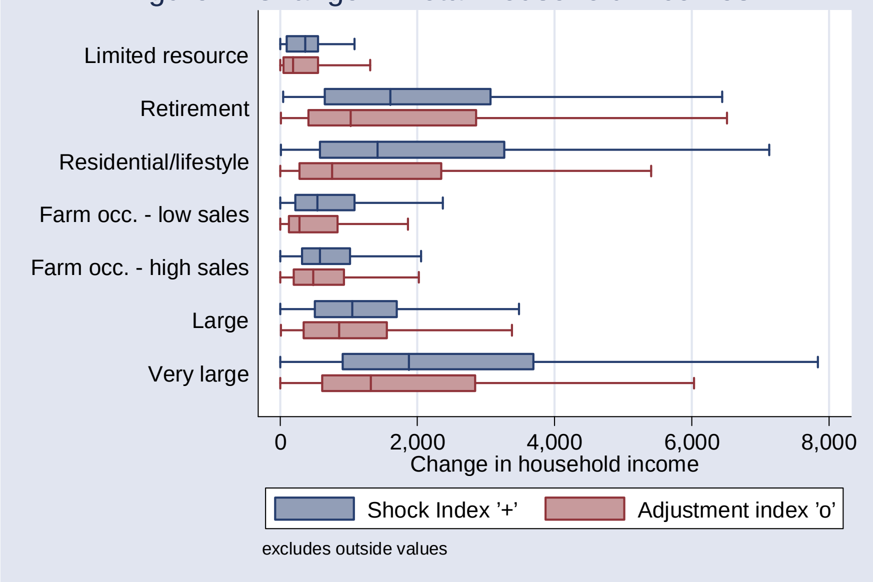
The micro-simulation Scenario 1 simply indexes all adjustment undertaken by households by the size of the payment shock each household receives. The behavioral assumption underlying the shock-indexed scenario is that adjustment response is proportional to the level of payment shock received by the household. *Ex-ante*, farm households receiving a large subsidy will adjust more than farm households receiving a small subsidy, and farm households that did not receive a payment will not respond at all. Proportional response is likely to capture the first-order effects of the 0-0-0 policy reform scenario because the type of payments removed in the scenario are based on the actual level of production of specific commodities by recipient households. For example, the size of marketing loan benefits received by a farm household is proportional to output of specific commodities, and translates into the removal of a per-unit price wedge that favors the produced commodity over all others. In contrast, households that did not produce the supported commodities are not affected by removal of the subsidy price wedge.

The source of variability highlighted in the adjustment-indexed scenario describes, in addition, differences among households in their opportunities to engage in alternative enterprises. Specifically, the set of skills and abilities held by farm operators and other household members are not identically distributed; nor do all regions of the country offer suitable farm and non-farm alternatives to households seeking to regain *ex-ante* levels of well-being after a policy reform. In micro-simulation Scenario 2, we represent heterogeneity in households' adjustment capacity by constructing an adjustment index based on firm, household and local labor market attributes that we expect to play an important role in adjustment. We calculate an adjustment index that includes the household-specific level of government payments (as in the shock index), and in addition includes household-specific information on the probability of the operator working-off farm and the probability of successful farming (financial efficiency).

Box and whisker plots (figure 1) show the distribution of outcomes associated with the 0-0-0 policy reform under both the shock-indexed and adjustment-indexed scenarios. The plots show the variation in impacts across households within each typology. Each box contains the range within the first and third quartile of impacts, while the whisker extends to 1.5 times the size of the box. The whisker does not extend to the left into negative territory because both farm and non-farm income increases in the scenario modeled in the 0-0-0 policy reform. In other words, all farms within each typology share at least in part in the gains from reform and there are no net losers as a result. (Distributing outcomes to households based on changes in returns to the specific products that they produce would allow us to identify both winners and losers; this aspect of our distributional analysis is an important next step in this research program.)

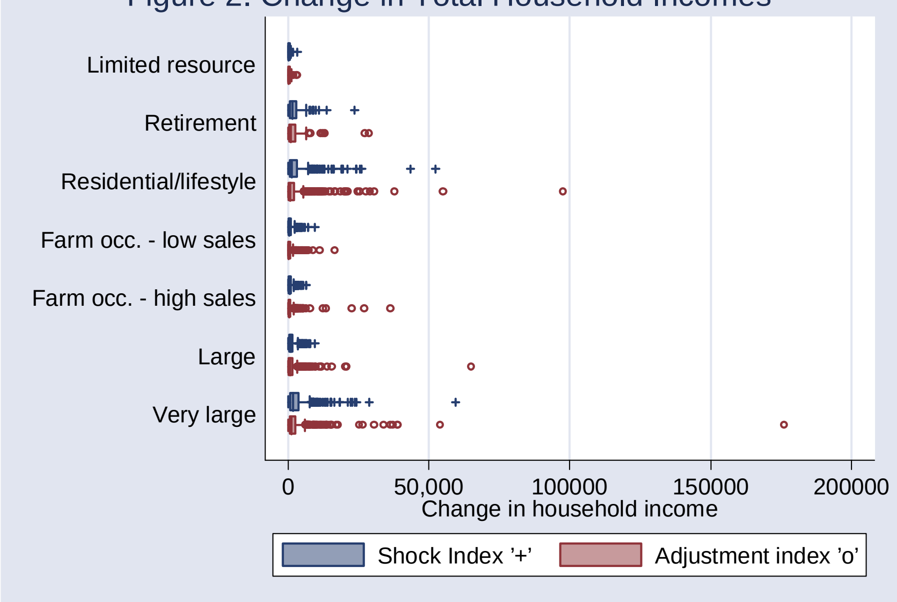
[12] See the appendix for the mechanics of the simulation itself as well as the some numerical examples.

Figure 1. Change in Total Household Incomes



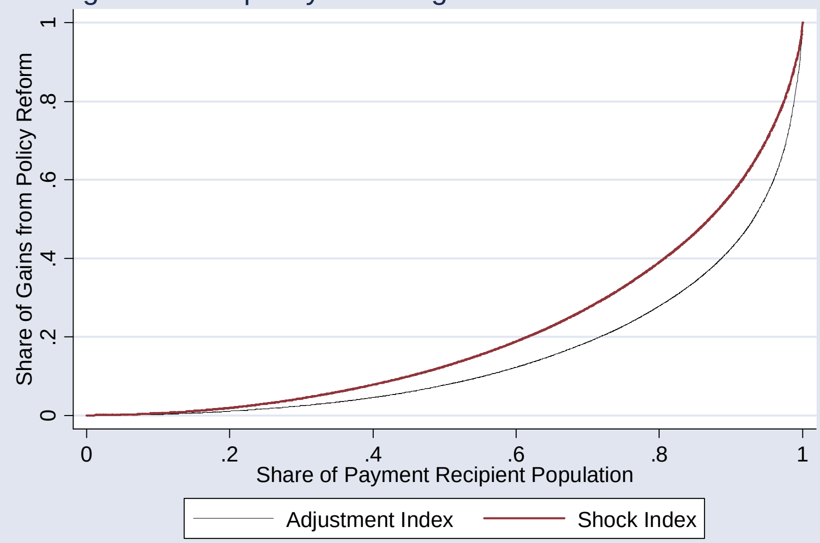
Although the adjustment index is shown to increase the potential for variability in results, note that the results for the adjustment-indexed scenario appear to be compressed relative to the shock-indexed scenario. At first glance, this is counter-intuitive, although recall that both scenarios have the same aggregate impacts. A comparison of outliers (figure 2) with the box and whisker plots (figure 1) demonstrates the key feature of the adjustment-indexed scenario and why it actually results in greater variability in outcomes than in the shock-indexed scenario. That is, when observations outside the whisker are included (figure 2), two things become clear. First, it is the outlier observations that are responsible for much of the aggregate impacts in both scenarios. In three of the seven typology types, some outliers record net income impacts of greater than $50,000, more than 25 times the median impact for any single group.

Figure 2. Change in Total Household Incomes



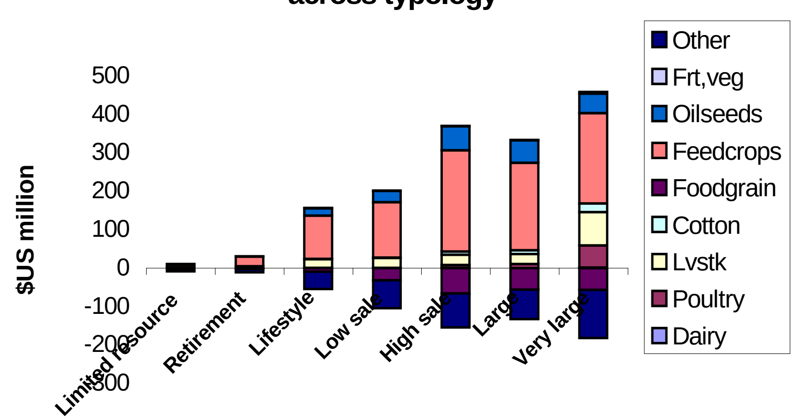
Second, the outlier impacts in the adjustment-indexed scenario are larger than the outlier impacts in the shock-indexed scenario. This is because all members of a group are measured relative to the group mean. Any farm household with an above-average adjustment index will garner more than they would have if response followed only the size of the payments removed. In effect, households with below-average adjustment capacity give up their gains to households with above-average adjustment capacity. This “division of the spoils” functions in much the same way that later adopters give up some of their rents to early adopters when a new technology is introduced. With such large gains by a few farms within a group there remain fewer rents available for other farms also affected by the reform scenario.

Figure 3. Inequality in Changes in Household Income



A generalized Lorenz curve (figure 3) gives a better idea of the distributional impacts that occur, based on the differences in adjustment capacity described in the micro-simulation. For example, in the shock-indexed scenario, 40 percent of the gains from policy reform are shared among 80 percent of the farm population that received payments, meaning that 60 percent of the gains from policy reform were shared among only 20 percent of the population. In the adjustment-indexed scenario, less than 30 percent of the gains were shared among 80 percent of the farm population, and the remaining 70 percent of the gains were shared among 20 percent of the farm population. Changes in income distribution and equality within the U.S. agricultural sector, based on heterogeneous adjustment capacity, presents another aspect of equity issues that could enter the debate on agricultural adjustment to trade reform. The potential for large disparities in the adjustment capacity and the related distribution of rents also offers some insight into the drivers of structural change in the sector.

Fig. 4 - Changes in sector income by commodity across typology



Source: Economic Research Service.

Finally, we consider gains and losses linked to the production mix of the farm operation. Figure 4 describes changes in income across the typology, with losses associated with production of food grains and the aggregate "other" sector, and gains in income associated with production of feedcrops, livestock and other commodities. Differences in impacts of reform associated with the initial production mix and the ability to diversify within the farm operation is a key aspect of the distributional impacts of reform at the household level. Linking sectors in farm operations to changes in income at the household level represents the next step forward in our macro-micro simulation project.

5. Conclusions

Global reform offers significant opportunities for U.S. agricultural producers and farm households because the stimulus to foreign demand for U.S. products can offset losses of U.S. farm payments. But even with prospects for net gains, adjustment to policy reform is likely to remain an important element in the trade policy debate because U.S. farm households are diverse, both in their exposure to policy reform shocks and in their capacity to adjust to changing market conditions. This paper focuses on the heterogeneous distribution of adjustment capacity linked to human capital to describe the impacts of global reform on U.S. agriculture. We developed two measures of human capital to describe adjustment capacity: probability of off-labor worker and farm financial management skills.

Policy makers will define the equity and efficiency goals set in any adjustment policy. Regardless of the balance of objectives that are set, policy design can be informed by analysis that identifies the farm households who are most likely to be impacted by the trade reforms, and that accounts for heterogeneity in their ability to take compensating actions. The characteristics that may define these farm households are likely to be not only their farm's production mix and current program benefits, but also the household's demographic characteristics such as age, education, and managerial capacity, and their access to alternative employment. An emphasis on individual adjustment capacity rather than industry is consistent with new directions in non-farm trade adjustment programs; some new benefits are being tied to the worker's age, and they are not dependent on the sector in which he or she is newly employed (Kletzer and Litan, 2001).

This paper is part of a larger program of work on the distribution of trade adjustment shocks and adjustment capacity in U.S. agriculture. There are other aspects of trade shocks and adjustment that present important additional areas for research in this program. Defining the links between farm households and their specialization in sectors affected by trade reform; and describing ownership of fixed assets, particularly of farmland, can provide a more disaggregated perspective on the household distribution of income and asset shocks. Incorporating adjustment mechanisms directly into the macro-simulation is another objective of this project. In addition to the adjustment capacity measures included in this analysis, farm households have other ways to adjust to and cope with change. They make dynamic adjustments by changing their savings and investment behavior in response to changes in income, asset values, and wealth. The age of household members is linked to life-cycle considerations, and within-household dynamics also influence the way that households are likely to adjust. Understanding the ways that U.S. farm households adjust in an economy-wide approach, and the flexibilities and constraints that characterize different households, can contribute to a more realistic debate on the benefits and costs of domestic and global policy reform.

References

AAEA Task Force on Commodity Costs and Returns. "Commodity Costs and Returns Estimation Handbook." Ames, Iowa, February 2000. Accessible at http://waterhome.brc.tamus.edu/care/Aaea/AAEA%20Handbook.pdf

Ahearn, Mary, Hisham El-Osta and Joe Dewbre (2002). "The Impact of Government Subsidies on Off-Farm Labor Supply of Farm Operators." Paper presented to the American Agricultural Economics annual meeting, Long Beach, CA.

Brander, James A. and Barbara J. Spencer (1994). "Trade Adjustment Assistance: Welfare and Incentive Effects of Payments to Displaced Workers," *Journal of International Economics*. Vol. 36, pp: 239-261.

Capehart, Thomas (2003). "U.S. Tobacco Industry Responding to New Competitors, New Challenges," *Amber Waves*, Vol. 1, No. 4, pp. 14-21.

Cooper, Joseph, Robert Johansson, and Mark Peters. "Some Domestic Environmental Effects of U.S. Agricultural Adjustments under Liberalized Trade: A Preliminary Analysis. Paper presented to the International Conference "Agricultural Policy and the WTO: Where are we Heading?" Capri, Italy, June 23-26, 2003. http://www.cec.org/files/PDF/ECONOMY/cooper-et-al.pdf

Diao, Xinshen, Agapi Somwaru and Terry Roe, 2001. "A Global Analysis of Agricultural Reform in WTO Member Countries," in *Agricultural Policy Reform in the WTO: The Road Ahead.* Agricultural Economic Report No. 802, pp: 25-42.

Dohlman, Eric, Linwood Hoffman, C. Edwin Young (2003). "U.S. Peanut Markets Adjust to Policy Reform." Paper presented to the Policy Reform and Adjustment Workshop, Imperial College, Wye Compus, October 23-25.

El-Osta, Hisham S., and Mitchell J. Morehart (1999). "Technology Adoption Decision in Dairy Production and the Role of Herd Expansion," *Agricultural and Resource Economics Review*. April, pp: 84-95.

Fallick, Bruce C. "A Review of the Recent Empirical Literature on Displaced Workers," *Industrial and Labor Relations Review*. Vol. 50, No. 1, pp: 5-16.

Farber, Henry S. (2003) "Job Loss in the U.S., 1981-2001." NBER Working paper 9707. National Bureau of Economic Research, Cambridge, MA.

Gardner, Bruce L. (1992). "The Disappearance of the Farm Problem," *Journal of Economic Literature.* Vol. 30, No. 3, pp: 62-101.

Hanson, Kenneth. 2002. "Scenario Analysis with a U.S. Computable General Equilibrium Model." The 12th Federal Forecasters Conference - 2002: Papers and Proceedings. Washington DC. http://www.va.gov/vhareorg/ffc/PandP/FFC2002.pdf

Hanson, Kenneth, and Agapi Somwaru. "Farm and Non-Farm Households Distributional Effects of U.S. Farm Commodity Programs." Selected paper at the Sixth Annual Conference on Global Economic Analysis, The Hague, The Netherlands, June 2003. http://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=1268

Hoppe, Robert A., Janet E. Perry, David Banker (2000*).* *ERS Farm Typology for a Diverse Agricultural Sector*. ERS No. 759. 8 pp, September 2000.

Kletzer, Lori G. (1998). "Job Displacement," *The Journal of Economic Perspectives*, Vol. 12, No. 1, pp: 115-136.

Kletzer, Lori G. (2002). *Imports, Exports and Jobs: What Does Trade Mean for Employment and Job Loss?* W. E. Upjohn Institute for Employment Research. Kalamazoo, MI.

Kletzer, Lori G. and Robert E. Litan (2001). "A Prescription to Relieve Worker Anxiety," *International Economics Policy Briefs*, PB01-2. Institute for International Economics, Washington, DC.

Magee, Chistopher (2001). "Administered Protection for Workers: An Analysis of the Trade Adjustment Assistance Program," *Journal of International Economics*. Vol. 53, pp: 105-125.

McBride, William D. and Hisham S. El-Osta (2002). "Impacts of the Adoption of Genetically Engineered Crops on Farm Financial Performance," *Journal of Agricultural and Applied Economics.* Vol. 34, No. 1, pp: 175-191.

Richardson, J. David (1980). "Trade Adjustment Assistance Under the U.S. Trade Act of 1974: An Analytical Examination and Worker Survey." NBER Working paper No. 556.

Stout, James V.(2003). "ERS/Penn State Model Documentation." http://trade.aers.psu.edu/pdf/ERS_Penn_State_Trade_Model_Documentation.pdf

Tokarick, Steven (2003). "Measuring the Impact of Distortions in Agricultural Trade in Partial and General Equilibrium." Research Department, International Monetary Fund.

Wills, Dave (2002). "Grass Roots Impacts of the New Farm Bill on Rural Communities." The University of Georgia College Of Agricultural and Environmental Sciences, Symposium 2002. Downloaded from http://www.uga.edu/caes/symposium02/wills02.html

United States General Accounting Office (2000a). “Trade Adjustment Assistance: Impact of Federal Assistance to Firms is Unclear.” GAO-01-12.

United States General Accounting Office (2001). “Trade Adjustment Assistance: Improvements Necessary, but Programs Cannot Solve Communities’ Long Term Problems.” GAO-01-988T.

United States General Accounting Office (2000b). “Trade Adjustment Assistance: Trends, Outcomes and Management Issues in Dislocated Worker Programs.” GAO-01-59.

World Bank (2001). *Global Economic Prospects and the Developing Countries, 2002*. World Bank, Washington, DC.

Appendix: Scenario construction

For both scenarios, the first step is to translate Table 5 factor shocks into terms relative to the quantity of payments removed. This is accomplished by normalizing the endogenous effects on household indicators (farm labor, other household income, tax relief, and total household income, found in columns 2-5, respectively) by the amount of government payments removed (found in column 1). This normalization (shown in Table 6) will allow us to express impacts relative to the quantity of payments removed. For example, for limited resource farms, the farm labor income effect is 0.67 times (or 67 percent of) the value of government payment removed from limited resource farms. The negative value indicates that the net effect on farm labor has the opposite net effect on household income from government payments, which are negative in the reform scenario.

Table 6. Impacts normalized by the amount of payments removed

	farm labor	other household income	tax relief	total household income
Limited resources	-0.67	-0.89	0.11	-0.44
Retirement	-3.29	-1.07	0.43	-2.93
Residential/lifestyle	-1.97	-1.04	0.13	-1.88
Low sales	-0.54	-1.06	0.06	-0.54
High sales	-0.17	-1.07	0.02	-0.23
Large	-0.14	-1.07	0.01	-0.20
Very large	-0.25	-0.96	0.01	-0.20
All farms	-0.38	-1.04	0.03	-0.39

The “shock indexed” scenario is carried out by simply multiplying the quantity of government payments removed as a result of policy reform. If $1,000 was received by a farm household pre-reform, then the net effect on the household from removal of $1,000 can calculated by multiplying columns 1-4 in Table 6 by $1,000 (results seen in Table 7). Of course, actual payments received varied widely across recipients.

Table 7. Net impact on households from removing $1,000 in payments

	Payments removed	farm labor	other household income	tax relief	total household income
Limited resources	-1000	667	889	-111	444
Retirement	-1000	3286	1071	-429	2929
Residential/lifestyle	-1000	1973	1040	-133	1880
Low sales	-1000	540	1062	-62	540
High sales	-1000	172	1073	-17	227
Large	-1000	136	1074	-13	197
Very large	-1000	246	965	-12	199
All farms	-1000	376	1042	-32	387

The adjustment index is calculated for each observation in ARMS and consists of two variables estimated to proxy the ability of a household to reallocate resources, relative to similar households. The first variable is an estimate of a household’s ability to reallocate labor resources in response to a shock through off-farm employment. The second variable is an estimate of the farm firm's ability to reallocate farm-based factors of production into new or expanded agricultural enterprises, based on their current level of success. For each farm household, the adjustment index is calculated as the unweighted average of the probability that the farm operator will work off of the farm and the probability that the farm is successful. The index value is calculated relative to the mean for each typology. The mean probability for operators to work off of the farm is reported in Table 3 (last column) and the mean probability of farming success is found in Table 4.

The adjustment-indexed scenario also uses all information contained in the shock-indexed scenario. From the shock-indexed scenario above the example of a $1000 loss of payments were shown for each typology group. Now we show three additional examples for a household that differs from the representative household depicted by the typology group. Example 1 is the case where the household has 10 percent greater adjustment capacity than the average for the group. Net income in each case would be 10 percent greater than the average impact from the loss of $1000 in payments. The impact on net incomes is a constant 10 percent greater, regardless of which typology is used.

Table 8. Net impacts under Adjustment-indexed scenario

		Example 1		Example 2		Example 3	
	Baseline	Adjust ind.	Income	Adjust ind.	Income	Adjust ind.	Income
Limited resources	444	1.1	489	3.46	1538	0.69	308
Retirement	2929	1.1	3221	3.91	11457	0.78	2291
Residential/lifestyle	1880	1.1	2068	3.34	6275	0.67	1255
Low sales	540	1.1	594	2.94	1591	0.59	318
High sales	227	1.1	250	1.43	326	0.29	65
Large	197	1.1	217	1.34	265	0.27	53
Very large	199	1.1	219	1.16	232	0.23	46
All farms	387	1.1	425	2.95	1142	0.59	228

Column 1: Change in total household income from $1000 in payments removed
Example 1: Adjustment index 10 percent greater than typology mean
Example 2: Prob off-farm work = 0.5; Prob of farm success = 0.9
Example 3: Prob off-farm work = 0.1; Prob of farm success = 0.5

Example 2 posits the case where the farm operator's probability of working off of the farm is 0.5 and the probability of farming success is 0.9 (i.e. the farm had lower total economic costs per dollar of output than 90 percent of all farm households. Because each typology has a different probability of working off of the farm, and because each typology on average occupies a different part of the ex-ante distribution of farm success, the adjustment index is different, although in all cases it is greater than 1 (implying increased flexibility and adjustment).

Example 3 shows the case of a farm household whose attributes place it with a likelihood of working off of the farm of 10 percent. The observation further had a probability of farming success of 50 percent, meaning the farm's total costs per dollar of output are at the median for all farm households. As in Example 2, the adjustment index varies depending on which typology contains the household. As can be seen from these examples, including an adjustment index allows for a much greater range of outcomes than that based on the size of the shock alone.