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Payments for Environmental Services: Who Gains and Who Loses?

David Zilberman

Direct payments for the provision of environmental services represent an innovative tool to improve the environment. However, our research shows that the dual goals of these programs to improve the environment and reduce poverty are difficult to achieve in practice.

Also in this issue

Paying for the provision of environmental services is a recent policy innovation attracting much attention in both developed and developing countries. This innovation, which is referred to as "payments for ecosystem services" (when the emphasis is on enhancing "nature" services) or "payments for environmental services" (when the amenities provided by the built environment are also included), will be referred to here as PES. PES programs aim to harness market forces to obtain more efficient environmental outcomes. Since many PES programs operate via farmers in poor regions, international aid agencies and private donors, looking for a double dividend, increasingly consider using PES programs as mechanisms for poverty alleviation. After a short overview of the outcomes of PES programs and their function relative to other environmental policies, we will present research results on the design of PES programs and on conditions that make them effective tools for achieving distributional objectives.

It is useful to divide PES programs into three categories according to their function. Some PES programs pay mostly for *pollution control*. For example, payments for elimination or reduction of animal waste or agricultural chemical residues that reach water reservoirs. PES may also be payments *for the conservation of natural resources and ecosystems,* including forest resources and wetlands, wild flora and fauna species, and agricultural crop and livestock species. Finally, some PES are used *to generate environmental amenities that are public goods.* Examples include planting trees to sequester carbon to reduce greenhouse gases in the atmosphere (a global public good), and/or to regulate water flows and soil erosion to improve watershed function (a local or regional public good). Another useful distinction is between land diversion and working-land PES programs. The Conservation Reserve Program (CRP) is an example of a land diversion program where farmers are asked to switch from the production of a commercial crop to other activities. A proposed PES system that will pay farmers near Kenya's Amboseli National Park (NP) to divert some of their cropland to allow elephant movement and access to sources of food is another example of a land diversion PES. An example of a working-land program is the Environmental Quality Incentive Program (EQIP) that pays farmers to engage in practices that reduce nonpoint source pollution (for example, emissions of chemicals to bodies of water) to improve water or air quality.

Effective management of PES programs requires detailed data on the distributions of economic profitability potential and various indicators of environmental quality across space. Better mechanisms to manage PES become feasible with the improvement of remote sensing technologies, emergence of geographic information systems, and improved monitoring and communication technologies. Initially payment programs for land diversion had a fixed per acre pay and thus attracted the least profitable lands while maximizing the acreage enrolled. This approach maximizes the environmental quality obtained given the program budget when there is a negative correlation between environmental amenities provided and profitability. However, when more profitable lands also provide more environmental amenities per acre, the targeting of cheaper lands by the program may misfire. An alternative approach is targeting the lands with the highest environmental benefits. This approach will maximize benefits obtained given the overall budget if, for example, all lands have the same production value but vary in their environmental amenities. However, when economic values generated per acre vary, targeting the lands with the best environmental benefits may misfire if those lands also provide the most economic value in production. The environmental benefits given the program budget are maximized if lands are selected to the program using an environmental benefits-per-dollar-paid criteria. Namely, only lands in which environmental benefits per acre exceed a given threshold are targeted for the program. Studies have shown that these targeting techniques may expand total benefits obtained with a given budget by 30 percent and more. Participation in the CRP is now based on proposals where each landowner provides information on several indicators of environmental quality provided by the land, and information on economic performance and the requested pay. This led to purchasing guided mostly by benefits-per-acre criteria. Of course, difficulties in quantifying values of various environmental amenities and comparing across amenities make the design of purchasing formulas challenging.

PES complement other market-based mechanisms in replacing the inefficient command-and-control approaches to controlling pollution. Pollution taxes and fees have been frequently recommended as remedies to pollution problems. Carbon taxes are favored by many economists as the main tool for addressing climate change problems. However, the "polluter pays" principle is difficult to introduce and implement because of political and legal reasons. A recent market-based alternative is the "cap and trade" approach, where policymakers establish an aggregate target level of, say, pollution emissions, allocate emission rights among firms, and allow trade in these rights to meet the emission targets at least cost. The polluting industries prefer "cap and trade" to pollution taxation because, with trading, income is redistributed within the industry, while taxation transfers resources to the government. PES is a third alternative, essentially a subsidy to address the environmental side effects of producers. Studies suggest that pollution control subsidies are likely to emerge when industries are either very strong politically, have well-established legal rights to emit, or when they are too financially weak to pay for the adjustments required for pollution control under alternative arrangements. The emergence of PES schemes in agriculture is explained both by the political clout of farmers in some countries and by the limited resources of farmers in others.

Prevalent poverty in the rural regions of developing countries has led to the growing perception of PES programs as tools for poverty alleviation. Our research uses economic logic to identify the situations where PES are likely to reduce poverty and those where they may actually hurt the poor. We distinguish between land diversion and working-land PES programs. We also recognize that the farm sector is very diverse and includes landowners and landless, and that landowners vary in the size of their landholdings. Furthermore, PES affect production activities and thus may affect the well-being of consumers.

First, consider the impacts of payments for land diversion. These activities are likely to lead to a reduced area of production and thus reduced output, which in turn may *increase the price of food produced* by the affected lands, especially if this food is consumed locally. Introduction of payments for land diversion may also lead to reduced employment and wages in agriculture, especially when the land diversion activities require little amounts of labor. PES can also directly benefit local regions, for example, by improving local water quality or providing flood protection. Here we consider situations where the *environmental services do not directly benefit the local population*. Considering the impacts of land diversion payments on various groups under these assumptions suggests (Table 1):

(1) The urban poor are likely to lose from this type of PES because of higher food prices;

(2) the landless are likely to lose due to both higher food prices and lower wages;

(3) landowners who participate in the PES benefit from the payments (which are higher than the farm income they gave up) and will likely gain from higher food prices; and

(4) landowners who do not participate in the program benefit from higher prices if they are net sellers of food, and lower labor costs if they are net buyers of labor, but they may lose if they are net buyers of food and/or net sellers of labor.

The analysis of the impacts on landowners suggests that large landowners are more likely to gain while smallholders may lose.

Overall, the poor may gain from the income generated by payments for land diversion, but are likely to lose from the indirect effect through the output and labor markets. Thus, PES are more likely to have a negative effect on the poor in regions which have a large population of landless and urban poor, and

Table 1. Negative and Positive Impacts of PES

Program/Groups	Land Diversion	Working Lands
Urban Poor	– if food prices are affected by regional production	+ if yield/per acre goes up – if yield/per acre goes down
Landless	–	+
Landowners	– if land is sufficiently small and the farmer is the seller of labor and buyer of food + if sufficiently large	+ in most cases – if food price reduction from high yield dominates other impacts

which are not well linked to the global economy, because food price and wage rates are affected by their production activities. Increased integration of a rural market with the global economy, providing alternative sources of food and income, will reduce the negative effects of PES programs.

If the environmental services benefit the local population, then these benefits need to be added to determine the net effect on poverty. When PES are used to produce flood control buffer zones protecting the residences of the poor and landless, the gains from extra protection have to be compared to the losses from higher food prices and lower incomes.

PES for modifying activities on working lands will not reduce acreage in production and in some cases may increase yield per acre, for example, when farmers are paid to terrace their land to reduce runoff and soil erosion. In other cases, yield may decline, as when farmers are paid not to use a chemical that harms the environment. Working land PES are likely to increase labor requirements for the extra environmental protection activities. Thus, the analysis of the impact of these PES on different groups suggests that (see Table 1):

1) The urban poor gain from PES when the environmental protection activities on working lands increase yields, but lose when the activities result in lower yields;

(2) the landless are likely to gain from PES when they increase yields because of lower food prices and higher wages (when PES reduce yield, the net effect is determined by comparing wage gains against extra food cost);

(3) landowners who participate in PES programs benefit from the payments (which are higher than the extra cost) but may lose from lower food prices; and

(4) landowners who do not participate in the program lose from higher labor costs. If food prices decline because of the PES, net losses will be inflicted on net sellers of food and, if food prices increase, net sellers of food will gain. This last effect will result in gains to poor, smaller landowners when PES increase crop yields, and losses when PES reduce them.

Therefore, working-land programs that increase agricultural productivity and employment opportunities can benefit the poor. Payments for cultural practices that sequester carbon and increase soil productivity are examples of such programs. Similarly, payments for schemes that allow combining preservation of natural species and earnings generated from ecotourism can also be interpreted as working-land programs that benefit the poor.

Our analysis suggests the perception that PES programs can serve to both eliminate poverty and improve environmental quality is not always true. Achieving two objectives for the price of one is tricky and depends on the specific conditions. PES programs for diversion of land from production are likely to worsen the situation of the poor, especially in locations with high population per acre and uneven distribution of landownership. Payments for land diversion may have an especially negative effect in cases where the environmental services program disallows indigenous and other poor people from utilizing natural resources in the name of environmental conservation. Concern about the well-being of the poor implies such programs should be accompanied by safety-net activities to compensate for any losses. On the other hand, PES programs that improve agricultural productivity and provide employment opportunities will more likely benefit the poor and improve the environment. While most of the analyses presented here apply directly to developing countries, even in developed countries like the United States, attempts to design programs that achieve both distributional and environmental objectives are tricky. Programs aiming to attain environmental quality may benefit larger farms, while programs aiming to reduce rural poverty may have a negative effect on the environment. The challenge for economists and policymakers is to identify circumstances and design payment schemes that achieve multiple objectives. When that is not possible, policymakers need to recognize the negative side effects of policies and introduce mechanisms to correct them.

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The analysis presented in this paper is part of research that contributed to the forthcoming annual report, *The State of Food and Agriculture 2007*, by the Food and Agriculture Organization of the United Nations. This report addresses payments for environmental services and will be available November 2007 (see www.fao.org).

Greener Pastures for Globalization: How European Farmers Can Help Save the Planet as Well as the Doha Round

Jenn Baka and David Roland-Holst

The advent of biofuels offers a new opportunity for agriculture to contribute to society by reducing trade rivalry. Biofuel production gives farmers a new source of income while helping to reduce external energy dependence. European farm support is also an impediment to global trade negotiations, and we believe a new food-fuel perspective can help overcome this by reconciling the needs of EU farmers and those in Europe and elsewhere who gain from more liberal international trade.

Two of the most momentous policy issues of modern times are climate change and globalization. Europe has shown consistent and remarkably unified leadership in the first context, yet the same cannot be said of its role in the latest round of WTO negotiations. The EU's path-breaking initiatives for carbon trading and affirmation of commitments beyond the Kyoto Protocol have given essential impetus to global greenhouse gas mitigation, and the European private sector has responded with alacrity to emerging green technologies and investment opportunities. In contrast to this, the EU (along with some other OECD economies) has consistently resisted the agricultural reforms necessary to facilitate competition in global food markets.

This paper poses a challenge to European farmers and policy makers to advance the trade agenda by expanding production of biofuels. Specifically, as the same feedstocks can be used to produce both food and fuel, we propose that EU policy makers alter EU farm policy to support the production of fuel rather than food and thus enhance competitiveness in global food markets. Doing so would help advance the current round of World Trade Organization (WTO) negotiations, the Doha Development Agenda (DDA), which seeks to further liberalize free trade but is currently deadlocked on the issue of agriculture protection.

The farm support agenda has always been premised on the importance of agriculture to European society, until now defined primarily in terms of food and direct environmental services. The advent of biofuel offers two dramatic new contributions from agriculture, greater domestic energy self-sufficiency and global greenhouse gas mitigation. Biofuels represent the remarkable option of substitution between two leading commodities, food and energy, within a single sector. Both are essential to Europe; one is in excess supply and the other largely imported and increasingly scarce. Until now, Europe has leaned toward self-sufficiency in the first commodity, while becoming ever more import-dependent on the other. A one-sided approach like this is rarely optimal, yet agricultural support has strongly biased the European food-energy portfolio in this direction because food was the primary source of farm livelihoods. Now that farmers can use their resources to earn income as energy producers, the EU has a wider range of food-energy portfolio choices.

Using detailed data on EU agricultural production and energy conversion estimates, our results indicate that Europe's existing crop potential could displace over 23 percent of its transportation fuel imports through domestic ethanol and biodiesel substitution. This is far in excess of current EU renewables targets, and the same strategy would necessitate significant food imports (without, it must be emphasized, a corresponding loss of EU farm livelihoods). At the other extreme, if production of biofuels were confined only to land that now produces food crops beyond EU self-sufficiency, only five percent of oil imports would be displaced. Surely, the optimum mix of imported and domestic food and energy lies somewhere in between. An essential feature of the biofuel option is that these decisions can be made in a way that offsets revenue losses for domestic agricultural interests.

Finally, 34 percent of aggregate farm balance sheets would be revenue-neutral at current ethanol and biodiesel prices given existing farm support levels, meaning revenues from crops that would earn a premium in biofuel markets rather than food markets could be used to offset losses to crops that would earn a premium in food markets rather than biofuel markets. An essential difference in this case, however, is that producer support for biofuel is not currently recognized as a trade distorting measure, and a significant portion of EU agriculture could be removed from the Doha negotiations. Ultimately, in the face of rising energy prices, there may be significant scope for unwinding support levels in these crop categories ($27.5 billion in 2004, about a quarter of producer income) and redirecting the fiscal savings to other priorities.

European Biofuel Capacity and the Potential to Increase Production

Although the EU biofuel sector is only just emerging, a substantial amount of European agriculture is already dedicated to crops that are eligible as biofuel feed stocks, including corn, sugar beet, wheat, barley, soybean, sunflower, etc. Figure 1 shows these crop portfolios for the EU27 economies, indicating crop-specific yields and the percent of all European output represented by each country. Our results indicate that substantial potential exists across Europe to expand biofuel production, and this potential can be more fully realized if alternative uses (food) are evaluated with reference to more competitive international agricultural markets.

Food security must be a primary consideration for biofuel crop conversion, so it is reasonable to ask how self-sufficient EU economies are in these crops. Figure 2 shows that about half the EU27 are self-sufficient in aggregate biofuel crop production. Both France and Hungary, for example, are producing more than double their food requirements in biofuel-eligible crops. Clearly, there is significant potential within Europe to explore alternative uses.

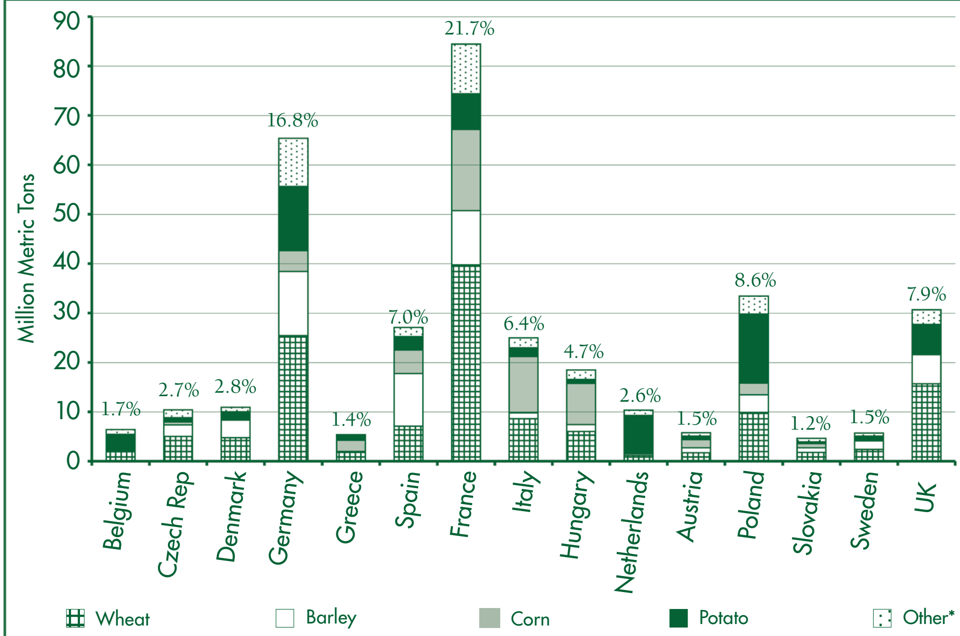
Opportunities to Mitigate Energy Import Dependence

Given the substantial existing production eligible for biofuel conversion, it is reasonable to ask how much Europe could reduce its current dependence on energy imports. Conversion of existing agriculture to biofuel raises issues of food security, but these have a compelling analogy in energy security. Food may be a more elemental human need, but energy is essential to modern society. Biofuel offers EU farmers an opportunity to defend basic living standards in both ways.

Using the crop- and land-use information of the previous section, combined with median estimates of biofuel yields and energy potential, our results indicate that the EU can reduce its current and long-term energy import dependence substantially.

Table 1, accompanied by country detail in Figures 3 and 4, represents two relatively extreme scenarios. In the first, we assume that all Europe's eligible crop production is converted to biofuel and used in the transportation sector. In this case, food needs in the same crops would have to be met by increased capacity (i.e., conversion from other crops) or imports.

Figure 1. Production of Potential Biofuel Crops, 2004



** Includes rapeseed, sunflower seed, soybean and sugar beet.*

Notes: Percentages are country percentages of total EU potential biofuel feedstock production.

Sources for figures 1 and 2: (1) EU DG Agriculture & Rural Development (2005). Agriculture in the European Union- Statistical and Economic Information 2005. (2) Eurostat.

Table 1: Scenarios for Biofuel Production and Oil Import Substitution

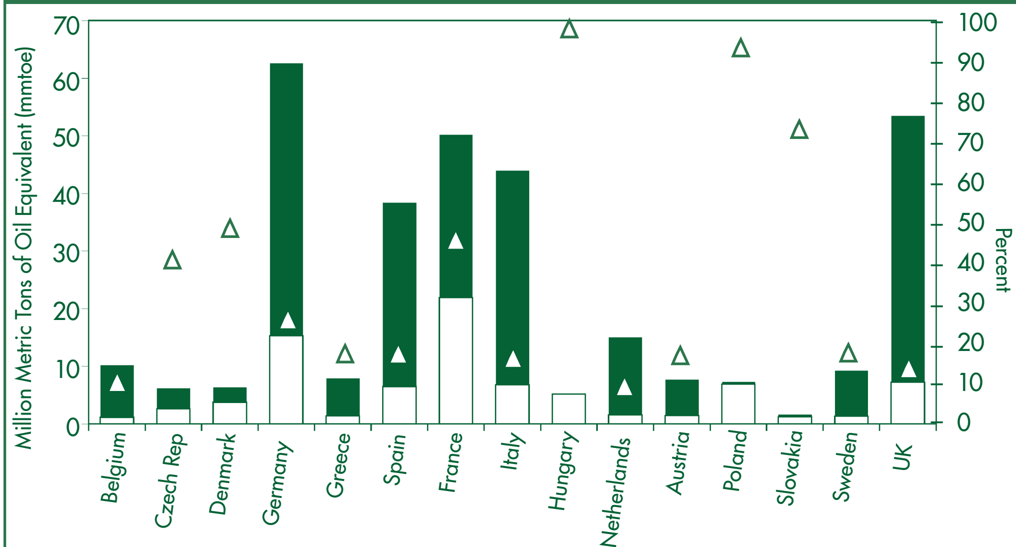
	Current Transport Energy		Energy-Equivalent Biofuel Production Potential			Displacement Potential	
Scenario	Total Oil Use	Imports	Biodiesel	Ethanol	Total	Total Oil Use	Imports
	---------(mtoe/year)----------					-----percent-----	
1	347	278	6.16	58.39	64.54	-18.62%	-23.22%
2	347	278	1.23	13.57	14.80	-4.27%	-5.33%

Note: mtoe=million tons of oil equivalent, which is equivalent to 7.37 million barrels of oil (mbbl).

Figure 2: Production-weighted Average Self-sufficiency Levels for Biofuel Crops, 2004

Note: Production weights assigned based on country-level percentages. 2003 self-sufficiency levels were used in instances where 2004 levels were not available.

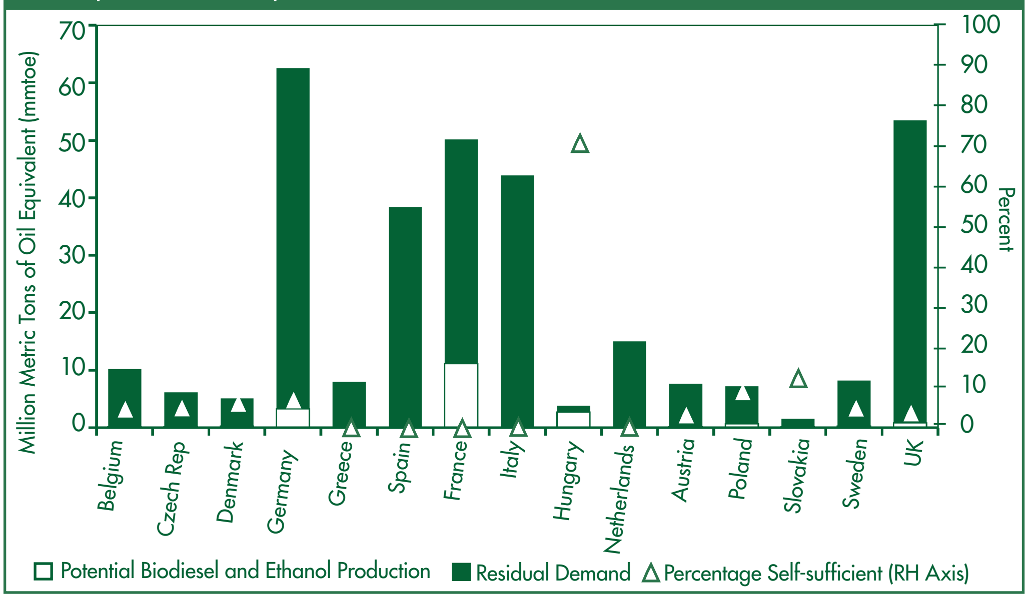
of Biofuel Crops



Note: Figures 3 and 4 based on converting total current biofuel feedstock crops to biofuel.

Sources: OECD (2005).

Figure 4. Scenario 2: Petroleum Displacement Potential for Conversion of Surplus Biofuel Crops



Scenario 2 evaluates the potential of converting only the eligible output in excess of today's self-sufficiency levels (i.e., crops with self-sufficiency levels greater than 100 percent).

European agricultural potential to reduce oil imports is substantial. In Scenario 1, we estimate that over 23 percent of overall EU27 transport-fuel imports could be displaced. This figure is far higher than EU targets for biofuel development, indicating that it might be appropriate to reconsider the food-fuel tradeoff. When biofuel conversion is limited only to the proportion of eligible crop output that exceeds national self-sufficiency, it is still possible to displace over five percent of EU transport-fuel imports. This number also exceeds current biofuel development targets, and suggests strongly that the latter may be too conservative. In France, for example, crops are over double food requirements in these categories, and biofuel conversion of the excess could displace over 10 percent of imported transport fuel.

By its nature, biofuel conversion is dominated by ethanol production, yet by global standards the EU has a relatively large share of diesel in transport fuel demand. This mismatch of fuel composition is relatively unimportant in the present case, since self-sufficiency levels remain below 25 percent. In any case, energy markets can reconcile these differences, so Europe can get the fuel it wants while its farmers reap the rewards of producing valuable energy crops.

European Biofuel and the Doha Development Agenda

Agriculture is widely seen as the primary stumbling block in the current Doha round of WTO-mediated trade negotiations. Within this category, farm support in higher-income countries is seen as trade distorting, putting taxpayer-subsidized downward pressure on global food prices and, by extension, impacting negatively the livelihoods of farmers in lower-income countries. While the degree of such price-income transmission is an independent empirical question, there is no doubt that existing patterns of farm support, particularly in Europe, are a highly contentious negotiating point. Biofuels offer the possibility of supporting farmers in a different way, one that recognizes their contribution to energy self-sufficiency rather than food self-sufficiency.

The general situation in terms of market value and support for the crops in question is summarized in Table 2. If a substantial share of existing EU agricultural production would be eligible for biofuel production, this in turn could reduce the likelihood that current surpluses might repress international prices by their diversion to international food markets. At current market prices for crops, biofuel, and crude oil, Table 2 summarizes the authors' estimates of crop values in the two alternative uses, including estimates of support and tax levels. The basic price of the crops (column 1) reflects the market price of

Table 2: Food, Fuel, Support, and Taxation Levels for Biofuel Eligible European Crops (millions of 2005 USD and percentage)

Crop	Value at Basic Price	Subsidies on Products	Taxes on Products	Net Support	Percent of Total Net Support	Value at Producer Price	Biofuel Value**	Food Premium
Wheat	61,610	18,370	126	18,244	66	43,409	25,630	17,781
Barley	13,110	4,137	4	4,133	15	8,983	8,470	513
Sugar beet	7,654	11	228	(216)		7,870	957	6,913
Grain Maize	14,685	2,799	50	2,749	10	11,936	13,136	(1,200)
Potato	11,057	112	2	110	0	10,948	5,597	5,350
Rape and Turnip Seed	5,560	1,537	0	1,537	6	4,023	4,336	(313)
Sunflower Seed	2,445	615	1	614	2	1,831	1,193	638
Soybean	444	153	11	142	1	302	144	158
Total	**116,566**	**27,735**	**422**	**27,529**	**100**	**89,302**	**59,463**	**29,840**

**The value at producer price is equivalent to the market price of a product, the price a producer would receive exclusive of subsidies and taxes. The value at basic price measures the total compensation a producer receives, including the market price and subsidies minus taxes.*

*** Biofuel value calculated using current market prices of ethanol and biodiesel and biofuel production under Scenario 1, complete conversion to biofuels. As of March 2007, the U.S. prices for ethanol and biodiesel were $124.32/bbl and $152.22, respectively. We assume EU prices are roughly equivalent.*

the crops plus subsidies and minus taxes. The subsidies and taxes paid by crop are shown in columns 2 and 3 while net support per crop, subsidies minus taxes, is presented in column 4. For reference, the percent distribution of subsidies across crops is shown in column 5. The producer price of the crop (column 6) reflects the market value of the crops, or for purposes of this analysis, the food price of the crop. Alternatively, column 7 shows the biofuel value of the crop, the price producers would earn from converting crops to fuel. Finally, column 8 presents the difference between the food and fuel value of the crops.

The two most arresting aspects of these results are somewhat contradictory. There is a significant aggregate value disadvantage for biofuel-eligible crops, but also apparent are highly diverse returns to crops between the two markets. The former helps explain the slow uptake of biofuel conversion, but the latter identifies important opportunities for Europe to pursue energy price risk management while reducing the scope of Doha actionable food support. Both maize and rape/turnip seed crops have a negative food premium, indicating that biofuel values exceed support- inclusive food value. In these cases energy markets not only offer alternative demand for farm products, but may also bear part of the cost of producer support. Alternatively, these savings could be used to step up support for crops with low food premia, making them revenue-neutral to farmers in fuel production. If barley, sunflower, and soybeans were brought in this way, fully 34 percent of net CAP support would be removed from food marketed commodities.

The magnitude of this kind of product diversion is of course very ambitious, and in all societies there are non-market reasons for domestic food production. The potential to influence Doha also depends how negotiators treat biofuels in comparison to food. Furthermore, many assumptions have gone into the present estimates, since support levels themselves are imprecise, and we have for convenience assumed food and fuel processing costs are comparable. Despite the need for more rigorous empirical work on this issue, we believe these preliminary results show the important role the food-fuel conversion issue plays in European agricultural, energy, and trade policy.

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For additional information, the authors recommend the following:

Farrell, A. E., Plevin, R. J., Turner, B. T., Jones, A. D., O'Hare, M. & Kammen, D. M. (2006) *Science* 311, 506–508.

Smeets, E.M.W., M. Junginger and Faaij A.P.C. (2006) Supportive study for the OECD on alternative developments in biofuel production across the world. Report commissioned by: OECD, Unit Science, Technology and Society, Copernicus Institute, Utrecht University, Utrecht, the Netherlands, NWS-E-2004-109, December 2005.

Woods, J, Bauen, A. (2003) Technology Status Review and Carbon Abatement Potential of Renewable Transport Fuels in the UK. Available at www.berr.gov.uk/files/ file15003.pdf

Market Power in the Northwest D'Anjou Pear Industry: Implications for California Agriculture

Leslie Butler and Adam McCarthy

This study used the winter pear industry to illustrate some of the impacts of retail consolidation involved in the continuing market transformation experienced by the fruit and vegetable industries in California. Buyer market power used by retailers appears to be modest, but has been growing over the last 20 years.

According to a number of studies, the changing dynamics in the retail marketplace are having a significant impact on the California produce industry. Consolidation among grocery chains, aggressive buying practices, and new marketing strategies have altered the balance of power between suppliers and retailers. The rapid consolidation among grocery retailers in the late 1990s led to more market power in the hands of retailers and fewer opportunities for producers and/or shippers to influence prices. According to the Produce Marketing Association, in 1999 the top 10 chains accounted for 53 percent of grocery sales; in 2005 these firms accounted for 68 percent of sales.

A number of recent studies suggest there has been, and continues to be, an increasing disconnect between farm gate prices and prices at the retail level in the tree-fruit and vegetable industries. For example, the grower proportion of retail price (or the farm-retail price spread) for the California tree-fruit industry declined from 29 percent in 1985 to 16 percent in 2004. Similar changes have also occurred in other produce markets. The decline in producer prices for Green D'Anjou (winter) pears since the mid 1990s has prompted questions from Northwest tree grower organizations about the reasons why this long-standing stable market has changed to the extent that producer prices have declined while retail prices for D'Anjou pears have increased.

In a detailed analysis of the Northwest D'Anjou Pear Industry, we found evidence to suggest that, while there has been recent declining consumption and increasing imports of pears, retail consolidation is an important cause of declining producer prices in the face of consumer price increases. While the winter pear industry is concentrated in Oregon and Washington, it serves as a case study of what may be occurring in similar industries in California. Therefore, this article focuses on our analysis of the D'Anjou pear industry study to illustrate some of the economic issues involved in the continuing market transformation experienced by fruit and vegetable industries in California.

Retail Consolidation and Market Power

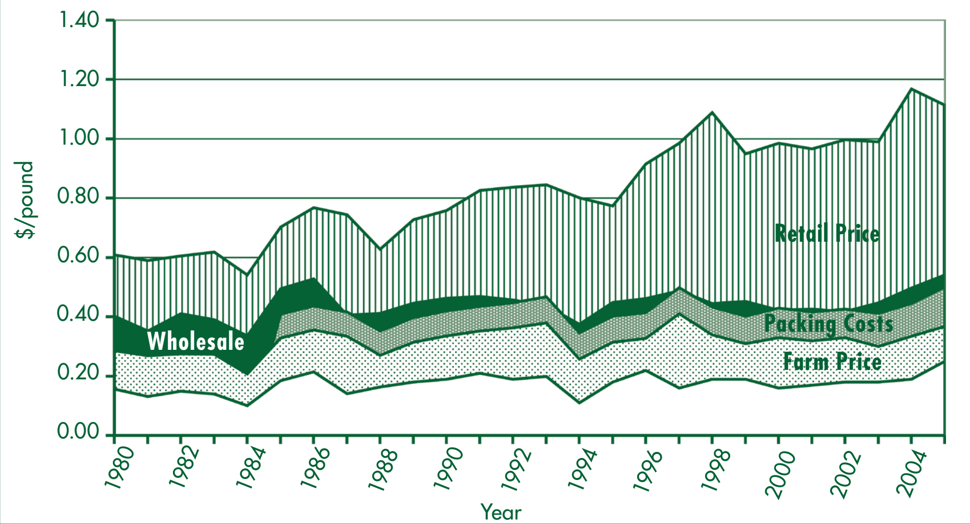
Mergers, acquisitions, and internal growth among grocery retailers are acknowledged to have been responsible for significant increases in the market shares of grocery retail outlets. Concentration of market shares, by itself, does not necessarily indicate the presence of market power. But they are one of a number of indicators of possible market imperfections that may lead to increased market power. For example, retail census figures from 1987 to 1999, show that the market share of the top four grocery retail outlets rose from 17 percent to 27 percent; the top eight firms from 26 percent to 38 percent; and the top 20 firms from 37 percent to 52 percent. Local (metropolitan area) market shares are much higher than national levels.

Another indicator of the impact of this increasing consolidation at the retail level is the increasing incidence of retailers dealing directly with shippers and bypassing wholesale and brokerage houses altogether. A recent analysis suggests that, while shippers are concerned that recent retail consolidation has led to increased market power and a growing incidence of fees and services, retailers argue that these new trade practices reflect their costs of doing business and the demands of consumers.

Econometric results confirming the presence of buyer or seller market power vary by commodity. For example, many studies indicate that evidence of some degree of retail market buying power is more likely to appear among highly-perishable commodities (tomatoes and lettuce, for example) than for commodities that are semi-storable and more elastic in supply. Apples, oranges, grapefruit, table grapes, and winter pears can each be stored to some extent, until prices are more favorable. The Red Delicious f.o.b.-retail margin was found to be significantly wider than it would be under competitive pricing, causing a reduction of both producer and consumer welfare. A study of table grapes confirmed seller market power, but found that buyer market power was inconsequential. Similarly, retail orange prices appeared to exhibit considerable market power on the selling side, but the use of buyer market power was inconsistent. Grapefruit retail prices also consistently exhibited seller market power, but exhibited buyer market power in only 60 percent of sample cases.

Only a handful of studies have been conducted on the Pacific Coast pear industries. One study evaluated promotion effectiveness by forming wholesale

Figure 1. D'Anjou Price Point Comparisons, 1980–2005



demand equations for winter pears, which were then estimated for eleven U.S. marketing regions. Empirical results found the average own-price elasticity for D'Anjou pears to be approximately -0.5 across the eleven regions. Another study investigated imperfect competition in pear processing using a "benchmarking" technique, and rejected the hypothesis of perfect competition in both the input (raw product) and output (wholesale) markets for fruit cocktail and fresh pack Bartlett pears. A more recent study of the Northwest D'Anjou pear industry found a fairly modest degree of seller market power exercised by D'Anjou packer-shippers for the 1993 to 1998 marketing seasons.

Marketing Margin Analysis

A marketing margin is the difference between the price consumers pay at the retail level and the price producers receive at the farm gate. All necessary processes and services required to transfer winter pears from the producer to the consumer are included in the marketing margin. For the marketing margin to change, retail and farm gate prices must change disproportionately to each other. Any degree of change in market competitiveness could cause a change in the margin without a corresponding change in marketing costs.

The D'Anjou marketing margin showed a significant increase between 1980 and 2005 (see Figure 1). Our detailed study of the marketing margins shows that packer-shipper costs, represented as the farm-f.o.b. margin, did not increase and, therefore, have not contributed to the widening marketing margin. Transportation costs did show an increase caused by rising fuel costs, primarily since 2000. However, despite higher transportation costs, the D'Anjou f.o.b.-wholesale margin showed no statistical increase over the study period. We concluded that increases in freight costs have been small enough to be absorbed by the distribution sector and not passed on in the form of higher prices.

Analysis of an index measuring grocery retail unit labor costs indicated a substantial increase in labor costs between 1987 and 2005. However, this increase was not unique to grocery retailers. Similar increases in labor cost were evident at the farm and wholesale levels. Data measuring farm and wholesale labor costs also explained approximately 80 percent of the variance in the wholesale-retail margin.

These results indicate that while input costs (particularly labor) have risen in several stages of the D'Anjou marketing chain, only grocery retailers have been able to pass these increases on in the form of higher prices. Retail prices also exhibit a positive correlation with the quantity of pears being supplied.

We concluded that such findings demonstrate that retailers do not operate under the same competitive market conditions as producers, packer-shippers, and distributors. Instead, grocery retailers are able to set D'Anjou prices at levels that allow them to maintain desired margins and profit levels.

Do Retailers Exhibit Buyer Market Power?

Seller and buyer market power can be represented in an economic equilibrium model that explains the farm-retail price spread in terms of the degree of seller market power, the degree of buyer market power, the price elasticity of retail demand, the price elasticity of farm supply, and retailer variable or marginal costs. We used the data from our study and a number of other studies to examine the potential magnitudes of buyer market power in the D'Anjou pear market using Monte Carlo simulation. Of the six parameters in the model, (retail price, farm price, price elasticity of retail demand, price elasticity of farm supply, degree of seller market power, and retail variable costs) the degree of buyer market power was most sensitive to changes in the price elasticity of supply in terms of its contribution to total variance, followed by seller market power and retail variable costs. The price elasticity of demand had little impact on the degree of buyer market power.

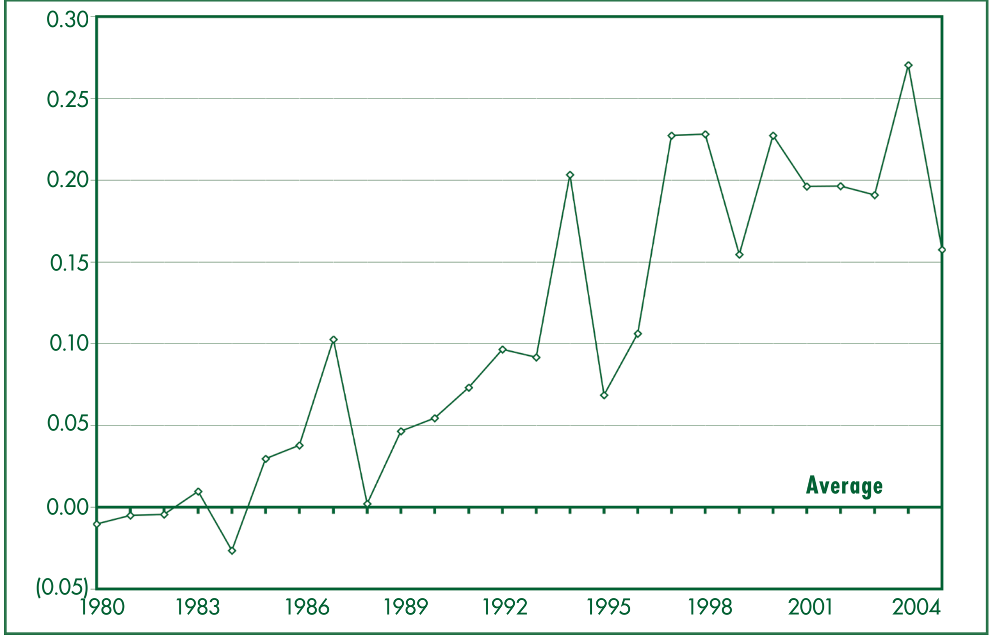
Assumptions about the price elasticity of supply are critical, and it is not clear what level should be assumed for the purposes of estimating the degree of buyer market power. Because D'Anjou pears are tree fruits that do not reach optimal production until the trees are 10-15 years old, are perishable and seasonal, and have few alternative uses, their supply will be highly inelastic. One study found that the short-run elasticity of Bartlett pears was 0.03. However, since D'Anjou pears are storable for up to nine months in controlled atmosphere conditions, then this would make them more elastic than 0.03. Thus, the price elasticity of supply was varied from 0.03 to 0.2 in the simulations.

The degree of buyer market power is also sensitive to assumptions about the degree of retail seller market power. The degree of seller/buyer power can be measured as an index ranging between zero and one, with zero indicating perfect competition and no market power, and one indicating maximum market power (monopoly/monopsony). The degree of seller power exercised by D'Anjou packer-shippers for the 1993 to 1998 marketing seasons was estimated to be 0.206. However there is reason to believe that this estimate may be higher than one would normally expect to find in the winter pear market. Therefore, it was allowed to vary from 0.05 to 0.25 in the simulations.

The farm-retail price spread is also influenced by the magnitude of the assumed level of retail variable costs, which we represent in the model as a percentage of retail prices. The higher the variable cost (percentage of retail price), the lower the degree of buyer market power is required to explain the farm-retail price spread. Variable costs at the retail level are likely to be in the vicinity of 15 percent. We allowed the retail variable cost to vary between 10 and 30 percent of retail price in the simulations.

Finally, the only estimate of the price elasticity of retail demand for D'Anjou pears we found was -0.5, so the question is, would we expect the price elasticity to be lower than this? A number of studies have found that the elasticity of retail demand for close substitutes of D'Anjou pears varies from -0.30 to as high as -2.0, with most in the range of -0.35 to -0.75. Therefore, we concluded that the estimate of -0.5 for D'Anjou pears is fairly robust and allowed the price elasticity of demand to vary between -0.35 to -0.6 in the simulation.

Figure 2. Inferred Degrees of Buyer Market Power over Time



The simulation results indicated that given the reasonable ranges of variables reported above, the degree of buyer market power ranges from -0.10 to 0.80, with a mean of 0.16 and a standard deviation of 0.12. The probability that the degree of buyer market power is positive (more than zero) is 98 percent. Therefore, the simulation results indicate that there would appear to be a relatively high probability that a modest amount of buyer market power can be attributed to retailers who sell D'Anjou winter pears.

We also used the means or most probable values of the variables discussed above to examine how the degree of buyer market power has varied over the period of the study (1980–2005). We found that the degree of buyer power most likely has increased quite dramatically over the time period examined (see Figure 2). In addition, we also found that when all externally determined variables were set at levels that would result in the lowest possible magnitudes of buyer market power, the changes in retail market power over time still indicated considerable buyer market power from the mid 1990s onward.

Our results appear to be consistent with many of the previous studies discussed above. There appears to be some market power associated with retailers in the D'Anjou winter pear market, and in all likelihood this market power has been strengthened by retail consolidation over the last 20 years. Although this buyer market power could be used to drive producer prices to levels that would be low enough to drive producers out of business (and there is some evidence of this in the California tree-fruit industries), it does not make any sense for retailers to do this because in such an event, winter D'Anjou pears and other fruits would eventually disappear from the market, hurting both consumers and retailers.

In all likelihood, market power is used by retailers to maximize their net revenues subject to maintaining an equilibrium in the market where producers have sufficient incentive to continue pear production, albeit with lower returns than they would obtain with competitive procurement.

Leslie Butler is a Cooperative Extension economist in the Department of Agricultural and Resource Economics at UC Davis. He can be contacted by e-mail at butler@primal.ucdavis.edu. Adam McCarthy received his M.S. degree from the ARE department at UC Davis in 2007.

Faculty Profile: Travis J. Lybbert

Travis J. Lybbert
Assistant Professor
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Travis Lybbert joined the faculty of the Department of Agricultural and Resource Economics at UC Davis as an assistant professor in August 2006. Travis earned M.S. and Ph.D. degrees in Applied Economics from Cornell University, where he also taught engineering economics in the Operations Research Department. Prior to coming to Davis, Travis was an assistant professor of economics at the Harriet L. Wilkes Honors College of Florida Atlantic University.

Travis conducts research in four interrelated areas of applied economics: risk, poverty dynamics, technology, and environment. Often motivated by international economic development problems, Travis has worked on projects in Morocco, India, and East Africa and in the Intellectual Property Division of the World Trade Organization. Using data from livestock herders in Ethiopia and Kenya, Travis and co-authors were among the first to empirically estimate wealth dynamics among the poor. In this region, cultivating crops is always inferior to migratory herding livestock, but when a herd collapses below roughly four animals the herd can no longer sustain a herder during the migration. The family then has no choice but to settle down and begin cultivation, which makes growing the herd very difficult. Travis continues to research how this type of dynamic threshold affects individual decision making under risk.

Building on his work at the World Trade Organization and on a variety of projects relating to patent policy and strategy, Travis recently launched a research initiative with the World Intellectual Property Organization to analyze firms' strategic use of patents in non-OECD countries. This project links patent application data with trade data at an unprecedented level of resolution, which will permit detailed modeling of the decision to apply for patent protection in various countries.

Travis' research interests ultimately stem from a desire to inform and influence policy. With his move to California, Travis started devising projects with direct relevance to California in order to engage policy at a local and domestic level. Travis is currently leading a project in collaboration with Doug Gubler, UC Davis plant pathologist, that aims to assess grape growers' use of disease forecasts in their treatment of powdery mildew. This project will integrate detailed pesticide use data at the grower level with spatially explicit disease forecast data. The project will also use economic experiments to understand growers' treatment tendencies and to improve the use of disease forecasts in order to reduce aggregate pesticide applications. To conduct these experiments, Travis will use a mobile lab with handheld and laptop computers that he recently developed.

Travis lives in Davis with his wife Heather, daughter Hannah (age 6) and son Rockwell (age 4). A two-year LDS Church mission in southern France (1992–94) sparked Travis' initial interest in languages and international work. After graduating together from Utah State University, Travis and Heather moved to Morocco on a Fulbright grant (1997–99) to learn Arabic and research the conservation and development implications of bioprospecting—the search for novel and potentially valuable biological resources—in the argan forests of southwestern Morocco. He has subsequently lived and worked in Geneva, Switzerland and Tamil Nadu, India. In his sparse but jealously guarded free time, Travis loves to be outdoors, running, cycling, or hiking—and never more than when he is with Heather, Hannah, and Rockwell.

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