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International Approaches to the Labeling of Genetically Modified Foods

By Colin A. Carter and Guillaume P. Gruere

The United States accounts for two thirds of bioengineered crops produced globally. Other major suppliers include Argentina, Canada, and China. More than 20% of the global crop acreage of soybeans, corn, cotton, and canola is now biotech varieties (International Service for the Acquisition of Agri-biotech Applications, 2003). In addition, biotech ingredients and biotech processes are used in producing a wide selection of food and beverage products such as meat, poultry, cheese, milk, and beer.

The United States first exported genetically modified (GM) food to Europe in 1996. It was tomato puree from California, and it was voluntarily labeled as genetically engineered. The product was a big hit with consumers in Britain, because it was cheaper than conventional tomato puree. However, when GM soybeans were imported into Europe later that year, there was a huge backlash from environmental groups such as Greenpeace. The European Union (EU) was then quick to introduce mandatory labeling, which took hold in 1997, for GM foods. The US government viewed the European mandatory labeling policy as a trade barrier, and so began another US-EU agricultural trade dispute that is still ongoing.

This transatlantic trade dispute has spread to many other countries. Governments around the world are developing GM labeling requirements, and they are finding themselves caught between the US and the EU approaches. Consumers are confused about what exactly GM foods are and whether these foods are harmful. Scientists have determined that precommercialization assessment procedures of bioengineered food ensure that GM food is nutritionally equivalent and as safe as conventional food (e.g., the World Health Organization, 2000). However, in Europe consumers do not necessarily trust scientists, especially after they were told in the mid-1990s that humans could not get mad cow disease.

The GM labeling issue is not just about science. Rather, the politicians and environmental groups in Europe and elsewhere say GM labeling is about consumer choice and consumer rights, and is not even a health issue. The Europeans are clearly taking a precautionary approach. Alternatively, the United States, Canada, and Japan are using science-based risk assessment procedures. The purpose of this article is to discuss international approaches to GM labeling and to shed some light on why the approaches vary so much across nations.

Labeling Issues

Any decision on labeling of GM food presents major challenges for policy makers. The most fundamental problem relates to DNA detection, because the measurement of GM material becomes difficult or impossible if the GM crop is highly processed. For example, products such as soybean oil or meat produced from GM feedstuffs do not contain any evident GM protein. In addition, biotechnology that is used in certain food and beverage manufacturing processes cannot easily be detected in the final product. Most cheese, for example, is made with genetically engineered enzymes.

Proponents of mandatory GM food labeling believe that consumers have the right to know whether they are eating GM foods. Opponents say that such a label implies a nonexistent food safety risk. Trying to label something that is not detectable invites fraud, and the fraud cannot even be detected. Mandatory labeling would result in unnecessary marketing costs due to segregation and identity preservation requirements, with no apparent offsetting consumer benefit. In addition, mandatory labeling requirements could inhibit further development of GM technology. Within the EU, there are concerns over a slowdown in biotech crop research and the long-run international competitiveness of EU agriculture (Mitchener, 2002).

Even with mandatory labeling, standards are inconsistent and consumers are not necessarily provided with greater choice. In Japan and the EU (where GM labeling is mandatory) it is virtually impossible to find food products on the shelf labeled as containing GM ingredients. Therefore, the approach taken by Japan and the EU is not really giving consumers a choice. Furthermore, a substantial amount of GM food eaten in the EU and Japan does not have to be labeled. These products include cheese, soya sauce, vegetable oils, baked goods, and numerous manufactured foods.

The strict European regulations are also serving to delay the introduction of GM crops in poor countries, such as vitamin A enriched rice (the so-called golden rice). Cotton remains the only GM crop planted in South Africa or India, because GM cotton does not have labeling requirements anywhere. Zambia's refusal of GM corn as food aid in the face of massive starvation caught the world's attention and resulted in criticism of the EU.

International Approaches to GM Labeling

Internationally, the Codex Alimentarius Commission (http://www.codexalimentarius.net), an international standards-setting body for food, has a Committee on Food Labeling. Since 1990, Codex has sought to develop guidelines for labeling biotech foods. So far, however, there is no agreement on the international standards. In all likelihood, a final Codex standard on the labeling of biotech foods will not occur for many years.

The approaches taken in different countries towards GM food labeling differ greatly (Sheldon, 2002) as shown on Table 1. The EU has very strict GM labeling guidelines. In contrast are the United States, Argentina, and Canada, the three big producers, whose governments do not believe in mandatory labeling. Japan, South Korea, China, and other countries have approaches that are between the EU and the United States on this issue.

Table 1. Sample of international guidelines for labeling GM foods

	Labeling scheme	% threshold for unintended GM material	Are some biotech foods and processes exempt?
Canada	Voluntary	5%[c]	N/A
United States	Voluntary	N/A	N/A
Argentina	Voluntary	N/A	N/A
Australia & New Zealand	Mandatory	1%	Yes
European Union	Mandatory	0.9%[a]	Yes
Japan	Mandatory	5%[b]	Yes
S. Korea	Mandatory	3% [b]	Yes
Indonesia	Mandatory	5%[c]	Yes

Notes: N/A—not applicable.
Proposed threshold in the EU, lowered from 1%.
Top 3 ingredients in Japan and top 5 ingredients in S. Korea.
Not yet operational.
Source: Personal interviews and various Attaché Reports from the USDA Foreign Agricultural Service (http://www.fas.usda.gov/itp/biotech/countries.html).

The US government's lack of support for mandatory labeling reflects the scientific evidence by the Food and Drug Administration (FDA) that GM foods are nutritionally equivalent to non-GM foods. As long as the food is safe from impurities, labeling is not needed.

This is not to say that a labeling debate does not exist in the United States. Antibiotech groups in Oregon put the GM labeling issue on the state's 2002 ballot (Measure 27). If it had passed, Measure 27 would have required the labeling of any product containing GM ingredients, or processed with GM material or biotechnology. The antibiotech groups plan a similar initiative for California in 2004.

In 2002, the EU's Parliament approved new GM labeling proposals. If implemented, they could jeopardize a large share of US food exports to Europe. These new guidelines were debated and modified in the EU Commission and in the EU Council at the end of 2002. The European Parliament is expected to deliberate over the proposal in the first half of 2003, with final adoption by the end of the year.

The proposed EU regulations would require the labeling of foods whose ingredients contain 0.9% or more of GM DNA or protein. The current tolerance level is 1%. The new EU regulations would require labeling of food and feed products containing even nondetectable GM material. Importantly, only authorized GM material would be allowed in food and feed sold in the EU. Compared to the US or Japan, only a small number of GM crops are authorized in the EU.

Partly in response to these new EU labeling proposals, the US government is threatening to file a World Trade Organization (WTO) trade action against the EU for restraining trade. The trade action would cover the EU moratorium on any new GM crops in Europe, in place since 1998, and the European labeling regulations. The costs of the labeling regulations in the EU are largely borne by US exporters. The 0.9% tolerance level will be costly to implement for food processors. It seems excessively low for a label with no intended food safety purposes. Besides, the absence of labeled GM products at the retail level makes this labeling policy a "political" moratorium.

Australia and New Zealand jointly adopted mandatory labeling with a 1% threshold for the unintended presence of GM product, but vegetable oils, food additives, and food processing aids (such as enzymes used in cheese and brewing) are exempt from labeling requirements.

Japan's labeling regulations are much more reasonable than those in the EU. The Japanese government requires mandatory labeling when GM material is present in the top three raw ingredients and accounts for 5% or more of the total weight. It also admits the presence of non-GM labels at the same tolerance level, if produced with identity preservation. So tofu can be made from non-GM soybeans and be labeled as such or else it must be labeled as containing GM material. Exemptions to Japan's labeling requirements include feedstuffs, alcoholic beverages, and processed foods such as soya sauce, corn flakes, and other vegetable oils. South Korea's regulations are similar to Japan's, except the tolerance level is 3% of the top five ingredients. In the EU, the threshold applies to each ingredient.

China leads the world in public biotech crop research (Huang, Rozelle, Pray, & Wang, 2002). Genetically modified crops in the field trial stage include rice, wheat, corn, soybeans, potatoes, cabbage, and tobacco. Genetically modified cotton accounts for about 30% of China's cotton acreage. China has not yet announced a firm position on GM labeling, but it has recently proposed restrictions on GM crop imports. Outside China, this is viewed as a trade barrier that limits soybean imports from the United States. China's position towards biotechnology in agriculture appears to be heavily influenced by EU policy.

After 14 years of testing GM crops in experimental fields, the Mexican government has drafted legislation authorizing the planting of GM crops from March 2003. In February 2001, the Mexican Senate approved a draft regulation requiring the labeling of GM food and feed, but the Mexican Chamber of Deputies, under pressure from the US, did not ratify this proposition.

Why These Differences?

So why do we observe the wide difference in approaches to GM labeling across countries? There are several possible explanations. The EU and Japan have experienced domestic food scares in recent years. Consumers in these countries do not believe scientists and politicians who say that GM food is safe. Political pressure from environmental groups plays on this fear and raises unscientific concerns about GM food safety (Bernauer & Meins, 2001).

Environmental and consumer groups support mandatory labels for the sake of consumer choice. But mandatory labels (such as "this product contains GM ingredients") are still perceived by consumers as warning signals. In this situation, processors prefer to avoid labeling, and thus do not exceed the threshold level. For some pressure groups, labeling appears as a first step towards an outright ban of GM products.

On a larger scale, labeling affects international trade. Consequently, the European policy affects the choices of other agricultural exporting countries. Australian GM policies were partially designed to fit the labeling requirement for exports to the EU or Japan. Eastern European countries and Russia have probably decided to follow the EU's 1% threshold labeling requirement for trade reasons. Those eastern European countries planning to join the EU really have no choice.

The labeling of GM food may be soon disputed at the WTO. The United States has waited to launch a WTO dispute against the EU, because they feared it could drive a deeper wedge between

EU and US GM policy. The US administration recently decided to further delay the WTO action to seek EU support for the Iraq war. US lawyers are confident they would win the dispute ("US hints," 2003). To reduce the negative effect of an international dispute, the US needs allies in developing countries. A dispute could actually help to generate a stable agreement on GM labels. According to international observers, a WTO jurisprudence on GM labeling regulations could be the only way to achieve an agreement on labeling based on Process and Production Methods (PPM) standards.

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Economic Dimensions of Invasive Species

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With the events of September 11, 2001, the anthrax mail attacks, and the establishment of the Office of Homeland Security to develop and coordinate the implementation of a comprehensive national strategy to secure the United States from attacks, many individuals have become aware of the threat of biological weapons directed towards people. However, few realize how vulnerable the US agricultural infrastructure is, and has been, to pests and disease outbreaks resulting from accidental or deliberate introductions, and few are aware of the constant battle that is being waged to prevent or mitigate the spread of invasive species. Over the past 200 years or so, more than 50,000 foreign plant and animal species have become established in the United States. About one in seven has become invasive,[1] with damage and control costs estimated at more than $138 billon each year (United States Department of Agriculture Animal and Plant Health Inspection Service [APHIS], 2001). The problem of invasive species has intensified in the last few years, making it a serious challenge to globalized trade. "Animals, plants, and microbes can now migrate across the planet to new homes with unprecedented ease" ("New flora," 2000, p.118).

The problems of biological invasives and the decision-making framework established to prevent their introduction and spread have traditionally been the domain of the biological scientific community. However, as present management systems have become overwhelmed by the increase in the introduction and spread of invasives, the scientific community is now calling for input by economics and other social science disciplines to answer questions and carry out strategic actions to address the problems.

The economic dimension of the problem of invasive species is growing from at least two perspectives. First, economics is central to the cause of biological invasiveness, and the consequences of pest incursions go far beyond direct damages or control costs. Most cases of invasiveness can be linked to the intended or unintended consequences of economic activities (Perrings et al., 2002). Consequently, economic applications are essential to understand the problem and provide more accurate and comprehensive assessments of the benefits and costs of control alternatives to increase the effectiveness and efficiency of publicly funded programs.

Second, modeling the economic and trade impacts of technical trade barriers is becoming more important. Common among such barriers are

1. *An "invasive species" is defined as a species that is nonnative (or alien) to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112;http://www.invasivespecies.gov). Invasive species can be plants, animals, and other organisms (e.g., microbes).*

those dealing with trade restrictions that can be imposed by a country in an attempt to prevent entry of invasive species. Such measures are within the rights of a country and often can be justified on the grounds of economic and social prosperity. However, they can also impose unnecessary social costs, thwart commercial opportunities, and reduce competition and economic growth. The challenge is how best to incorporate economics in sanitary and phytosanitary policy analyses to ensure that the benefits of the measures enacted exceed their costs.

The purpose of this article is to highlight aspects of the economic dimensions of the problem of invasive species.

Evidence of Increased Incidence of Invasives and Cost Implications

The increased spread of invasive species reflects rapid globalization and trade liberalization. These developments have spawned greater long-distance hitchhiking by invasive species of pests and diseases, especially in the trading of live animals, and horticultural and raw animal products. The US Animal and Plant Health Inspection Service (APHIS) has cited a dramatic increase in the incidence of invasive pests and diseases in the United States. Specifically, the study noted increased outbreaks of exotic fruit fly infestations in California and Florida, entry of the Asian longhorn beetle into New York and Illinois, the introduction of the Asian gypsy moth in North Carolina and Oregon, and citrus canker infestations in Florida (APHIS, 2001).

Invasive species can cause considerable damages and costs for eradication and control for societies; however, the full extent of the costs of damages caused by pest incursions has only recently received greater appreciation. Invasive species can harm agricultural systems and native plants and animals, particularly endemic species, because their natural predators and parasites in their native land are usually not present in the new environment. Thus, an invasive species that is not a pest in its native land could cause significant damage in a new environment. In the extreme, such damage could lead to the loss of biodiversity. For example, the Asian longhorn beetles that were first discovered in the United States (in New York in 1996 and Chicago in 1998) are expected to damage millions of acres of hardwood trees throughout US forests and suburban landscapes. The states of Illinois and New York City and local governments have already invested more than $30 million to eradicate this pest and protect 6.7 million trees in the infested regions. Since 1996, the state of Florida has spent in excess of $300 million dollars trying to eradicate citrus canker.

Invasive species can also adversely affect important environmental service flows such as cropping systems, livestock grazing, and recreational uses. Water systems can be affected when pests clog rivers, irrigation systems, and shorelines. In addition, invasive species can have negative impacts on ecological services provided by one resource for other resources or an entire ecological system (Evans, Spreen, & Knapp, 2002).

What Economics Has to Contribute towards Resolving the Problem of Invasiveness

Economics has traditionally been concerned with decision making, particularly with what decisions are made rather than how they are made—although to some extent the discipline has started to embrace the latter. The discipline has developed a set of analytical capabilities that can aid decision makers in arriving at a set of rational and consistent decisions. The analytical capabilities, as they pertain to the problem of invasives, include rationale decision making over a range of pest threats and management interventions; monetary valuations; cost-benefit analysis as a tool to evaluate public intervention strategies; allocation of scarce resources; and formal consideration of risk and uncertainty. The discipline has also developed several methodologies to assess the value of nonmarketed environmental and health effects. With increasing demand for transparency in decision making, due to commitments to international agreements and pressure from various interest groups, effective and convincing communication is essential to implement desired strategies. When such communications are based on sound economic analysis, efficiency in bargaining can be greatly enhanced.

Assessing the Economic Consequences of Invasive Pests and Diseases

Considerable effort is being devoted to assessing the full economic impacts of invasive pests and diseases. The goal is to develop effective management programs to help prevent, control, or mitigate such invasions. Previously, the focus was on identifying the most cost-effective means of treatment for of an outbreak. Now the emphasis is on the benefits and costs of treatments to determine how best to manage the particular pest or disease.

Assessing the impact is challenging and imprecise. First, as noted earlier, the full range of economic costs of biological invasions goes beyond the immediate impacts on the affected agricultural producers. Often included are secondary and tertiary effects, such as shifts in consumer demands, changes in the relative prices of inputs, loss of important biodiversity, and other natural resource and environmental amenities. The range of economic impacts can be broadly classified into two categories: direct and indirect impacts (Bigsby & Whyte, 2001). The direct impacts reflect the effects of the particular pest or disease on the host, whereas the indirect impacts are nonhost-specific. The latter would be the general effects that are created by the presence of a pest but not specific to the pest-host dynamics that could affect public health issues (such as compromising key ecosystem functions); general market effects (including possible changes in consumers' attitudes toward a given product); research requirements; market access problem; and impacts on tourism and other sectors of an economy.

Alternatively, six types of impacts can be identified: (a) production; (b) price and market effects; (c) trade; (d) food security and nutrition; (e) human health and the environment; and (f) financial costs impacts (Food and Agricultural Organization, 2001).

Production Impacts. These are considered the most direct economic impacts associated with the host, resulting in the loss or reduced efficiency of agricultural production (such as yield decline). Even though such impacts may be relatively easy to identify, they can be difficult to measure. Disease can have lasting effects on the host in ways that are not always obvious. In livestock, for example, there could be delays in reproduction resulting in fewer offspring. Pesticides applied to treat a given pest could pollute soil and surface water. Furthermore, distinguishing the impacts of the pests from other impacts (such as climate) could be difficult.

Price and Market Impacts. Outbreaks of pests and diseases can directly affect the quantities of a commodity demanded or supplied. The exact impact on the market and the duration of the impact depend on several factors, including the nature of the pests and diseases, market size, and the relative elasticities of demand and supply. In cases where consumer health is involved, as in the recent outbreak of bovine spongiform encephalopahy (BSE), consumer perceptions about an implicated product and the ability of a country to produce safe food after an outbreak or illness are usually slow to recover and can have a lasting influence on food demand and global trade. In addition, a range of secondary effects may result from the multiplier effect.

Trade Impacts. The introduction and/or spread of invasive species can have major trade implications that could outweigh direct production losses. Such trade impacts will depend on a number of factors, including the policy response of trading partners to news about outbreaks, the importance of traded commodities, the extent of the damage, and the demand and supply elasticities. Important are the prospects of losing competitive advantage in an export market and possibly the premium from supplying disease-free products. Such concerns are real, because unaffected countries will either prohibit entry of the commodities from the affected country or establish a set of precautionary measures. In either case, the competitive trade advantage could be lost.

Food Security and Nutrition Impacts. The extent to which invasive pests and diseases either reduce the domestic supply of foods directly or restrict a country's international trade could harm its food security, especially for developing countries.

Human Health and the Environment Impacts. Assessing the human health and environmental impacts of invasive pests and diseases are difficult, because in many cases the impacts are not fully understood. Available evidence does suggest, however, that the incidence of invasive food-borne diseases is growing and that their health and socio-economic impacts are increasingly being felt in both developed and developing countries.

Financial Costs Impacts. Measures taken at the individual, collective, and international levels to control, eradicate, or mitigate invasive pests and diseases may have budgetary implications. Such costs could include the costs of inspections, monitoring, prevention, and response.

Estimating these economic impacts requires a considerable amount of biological and nonbiological information that involves considerable time and expense. Most studies have easily calculated impacts such as costs of control, eradication, and prevention and the expected loss in productivity of the enterprise. However, such an approach is shortsighted, because in several cases the indirect effects arising from (say) the trade impacts could easily outweigh production loss impacts. A recent US General Accounting Office (GAO) report commented on the problem in its observation that:

> The scope of existing studies on the economic impact of invasive species in the United States range from narrow to comprehensive, and most are of limited use for guiding decision makers formulating federal policies on prevention and control. Narrowly focused estimates include analyses of past damages that are limited to a certain commercial activities such as agricultural crop production and simple accounting of the money spent to combat a particular invasive species. These estimates typically do not examine economic damage done to natural ecosystems, the expected costs and benefits of alternative control measures, or the impact of possible invasions by other species in the future.... In general the more comprehensive the approach used to assess the economic impacts of invasive species, the greater its potential usefulness to decision makers for identifying potential invasive species, prioritizing their economic threat, and allocating resources to minimize overall damages (US GAO, 2002, p. 3).

Valuing the nonmarket impacts can be challenging. In this regard, economists are employing such tools as dynamic optimization and ex ante simulation analyses to assist decision makers (Evans, Spreen, & Knapp, 2002). Use is also being made of methods such as "contingent valuation" and "willingness-to-pay to obtain or avoid similar benefits or losses."

A more general measurement problem is the unavailability of data, especially when there is no disease history. Complications also may arise from the uncertainty of the scientific evidence about the probability of entry and establishment, rate of spread, and the extent of damage. Closer collaboration between economists and biological scientists, as well as the increased availability of computer software programs (such as the Excel @RISK program that combines dynamic simulation procedures with probability distribution), allow analysts to combine actual, but limited, data with theoretical modeling in determining potential impacts.

Modeling the Impacts of Sanitary and Phytosanitary Regulations

The need for a government to protect its citizens and environment against imported externalities (such as invasive pests and diseases) is embraced by the WTO Agreement,[2] which promotes increased trade among countries. When legitimate externalities or other market failures are addressed through technical trade barriers, for instance, in a commodity with the potential to introduce disruptive pests and diseases, they can safeguard national welfare. However, when such measures are imposed to isolate domestic producers from international competition, they are welfare-decreasing. This dual nature of the SPS measures – providing externality-based protection versus economic-based protection – adds to the importance of comprehensive economic analysis of the issues of invasive pests and diseases.

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2. A separate agreement governing sanitary and phytosanitary issues, Agreement on the Application of Sanitary and Pytosanitary Measures, was negotiated during the 1986-1994 Uruguay Round multilateral trade negotiations.

As a consequence, many economists are busy trying to develop a framework for assessing the trade and welfare implications of trading a particular commodity under different management options when there is the potential for introduction of an invasive pest or disease. Developing such a framework, however, is far easier in theory than in practice. Although not insurmountable, the involvement of externalities in the form of unwanted pests and diseases, and specifically the risks and uncertainty associated with them, complicate the standard economic policy analysis.

Concluding Remarks

The invasive species problem is posing a serious challenge in an era of increased globalization and trade liberalization. The problem has as much to do with economics as with ecology. Any solutions advanced must be firmly grounded in both science and economics. Our economic discipline possesses the capability of valuing various market and non-market impacts and provides a means for assessing important tradeoffs among various management alternatives, which can improve greatly the decision-making process for managing such risks. In addition, it can improve the transparency of the decision-making process by providing justifications for the measures implemented. The true value of economics should therefore not be seen solely in the precision of the numbers generated, albeit this is important, but the extent to which the discipline aids decision makers to formulate consistent and rationale decisions.

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The Puzzling State of China's Meat Trade

By Yijun Han and Thomas Hertel

The potential impact of China's future meat trade on world markets, and in turn on US exports, has experienced considerable debate. Several articles have appeared in CHOICES over the past five years (Hayes, 1999; Hertel, Nin, Rae, & Ehui, 2000) as well as in China (Guoda & Zhang, 2001; Qiao, 2001; Lu & Yang, 2002). Some analysts believe that China will become an important net importer of livestock products (Beghin & Fabiosa, 2001; Organisation for Economic Cooperation and Development, 2000), while others argue that she will become a major net exporter (Delgado, Rosegrant, Steinfeld, Ehui, & Courbois, 1999). A third set of estimates stresses the wide range of possible outcomes depending on macro- and microeconomic uncertainty (Nin, Hertel, Foster, & Rae, in press).

A clearer understanding of China's imports and exports of livestock products is needed to address successfully the future of China's trade. In this article, we will show the difficulties in assessing China's meat trade, including the definition of national boundaries, the valuation of trade flows, and the role of smuggling and unreported imports into China. Although many studies assert that China is currently a net importer of poultry and pork products, consideration of these difficulties yields a very different picture.

Which China?

Any discussion of China's trade in livestock products must determine: Which China? The Food and Agriculture Organization of the United Nations Statistical Database (FAOSTAT, http://apps.fao.org/default-c.htm) has options for Greater China, Macau, Hong Kong, and China+ (which refers to China plus Taiwan). Hong Kong and Macau are part of China, but have separate customs territories with unique economic characteristics. They are largely trading hubs with zero tariffs, which thrive on buying and selling products as well as financial intermediation. Including them in the trade data for China makes the mainland economy look more open than it really is.

Taiwan is more complicated, because mainland China considers it a province, while the Taiwanese operate as an independent country. This political dispute is presumably why the FAO has not separated Taiwan from China in their data (even though separate customs data are available). Yet Taiwan is a more highly developed economy, with per capita income roughly 13 times that of mainland China. In recent years, Taiwan's growth rate has also been much lower than mainland China's. Separating the two when examining trade patterns and making future projections makes sense. We focus on mainland China, with data obtained from China's Ministry of Agriculture through the Chinese language version of FAOSTAT.

Which Units: Tons or Dollars?

The next key point in assessing China's meat trade is whether trade should be measured in physical volume (metric tons) or in value (e.g., $US millions). Units of measurement can make a big difference. Based on volume, China is a net importer of poultry meat (Figure 1). The net import status is widely reported in the agricultural trade literature. Based on *value* of trade, however, China is a substantial net exporter of poultry meat. The value of exports is more than double import values. Why is this? China tends to import low price products

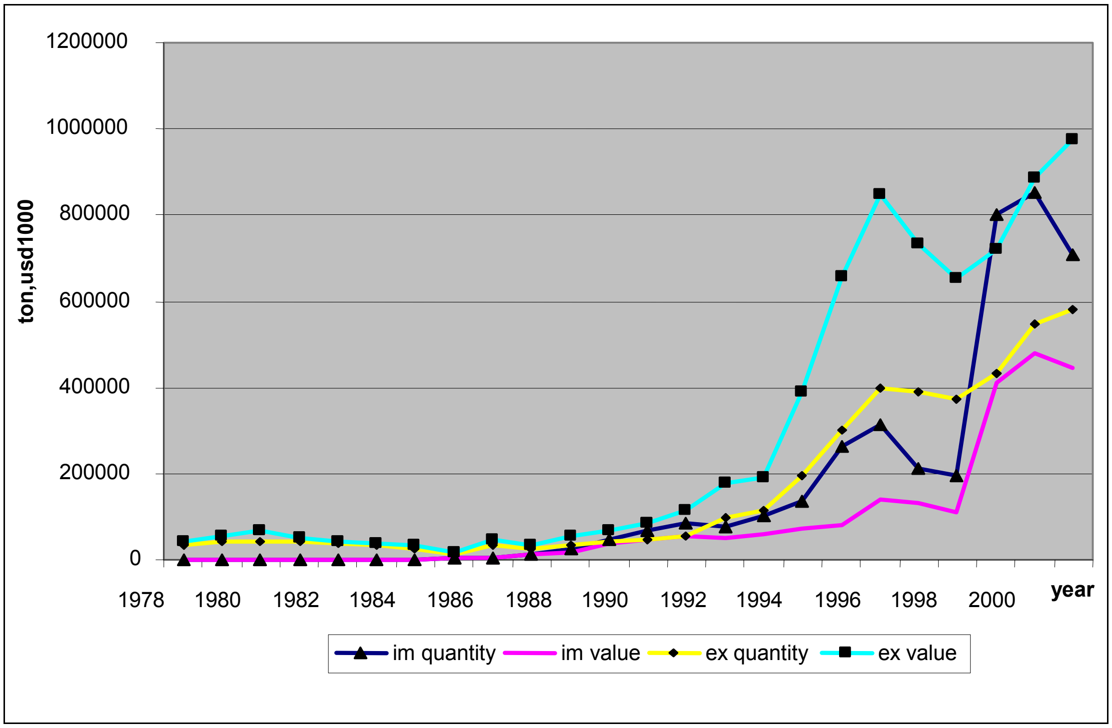

Figure 1. China's trade in poultry meat (FAOSTAT, 2003).

such as chicken feet and wings, while exporting higher priced products such as deboned chicken breast.

So, is China currently a net importer or exporter of poultry meat? This point is fundamental to forecasting future trends. Value data are more relevant. After all, the US trade deficit is not reported in terms of tons. It makes little sense to combine diverse products without weighting them by their economic value. Adding tons of chicken breast together with chicken feet makes no more sense than adding tons of coal and microchips. The conclusion is that China is currently a substantial net exporter of poultry meat products, with a trade surplus of $US 530.8 million.

Which Products?

In addition to fresh, chilled and frozen poultry meat, trade in live animals, viscera, and canned poultry products is substantial. Although few of China's imports fall into this category, the country exported nearly $400 million of canned poultry meat in 2001, a 100% increase over 1999. When all poultry products are combined (Figure 2), China is a substantial net exporter. China's trade surplus for all poultry products in 2001 amounted to nearly $1 billion. This dampens some of the enthusiasm for China's poultry market, based only on tons of meat traded.

Figure 2 suggests that imports and exports have been increasing strongly. This "intra-industry" trade characterizes an industry with considerable product differentiation. Producing the product for which imports are rising can be beneficial. However, by-products (e.g., chicken feet) do little to bolster the total demand for poultry production.

Poultry meat has garnered the attention of agricultural trade experts, but pig meat remains the largest consumption item in China. Figure 3 reports the volume and value of China's trade of pig meat. When trade is measured in tons, China was a net importer of pig meat in 1999 and 2000. Like poultry, however, China imports lower price items and exports higher price items, yielding a net export status in value terms.

Over time, exports of pig meat have fallen while imports have risen, especially since 1999. This same pattern is evident from Figure 4, which includes other pork products (live animals, skins, viscera, sausages, canned meat, etc.). Thus exporting pork to China may be more promising, even though the volume of poultry imports into China remains about four times as large as for pork.

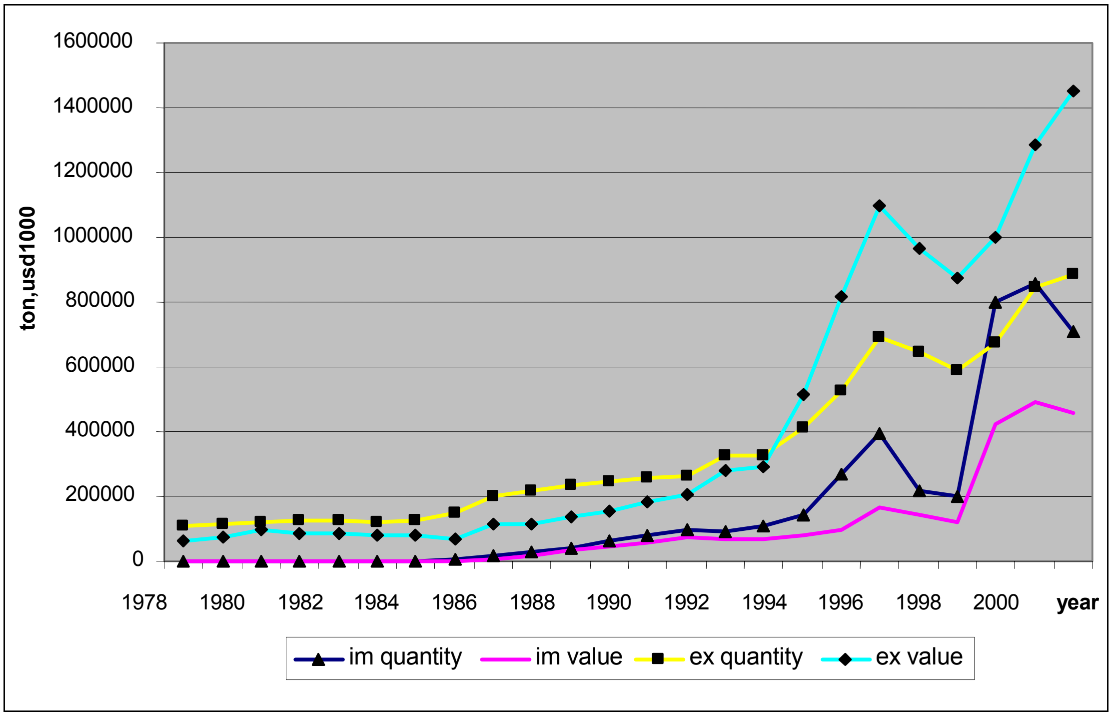

Figure 2. China's trade in all poultry products (FAOSTAT, 2003).

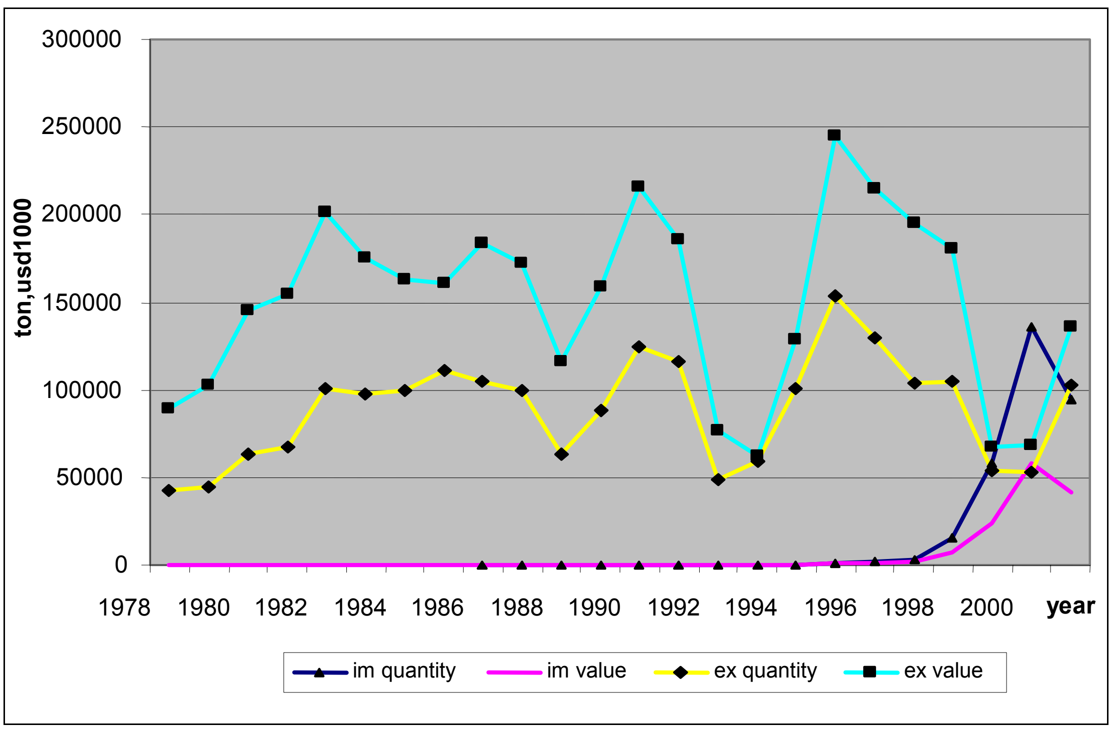

Figure 3. China's trade in pig meat (FAOSTAT, 2003).

Which Trade? The Role of Illegal Trade

Any discussion of recent rends in China's meat trade must consider smuggling and underinvoicing of imports. Substantial smuggling in meat products (Yu & Ma, 2000) occurred prior to 1999, when the costs were low due to lax enforcement. The benefits were high, as tariff rates were roughly 45% (and higher in earlier years). In 1999, government crack-downs greatly increased the costs of smuggling. Meanwhile in November 1998, as part of its prepa-

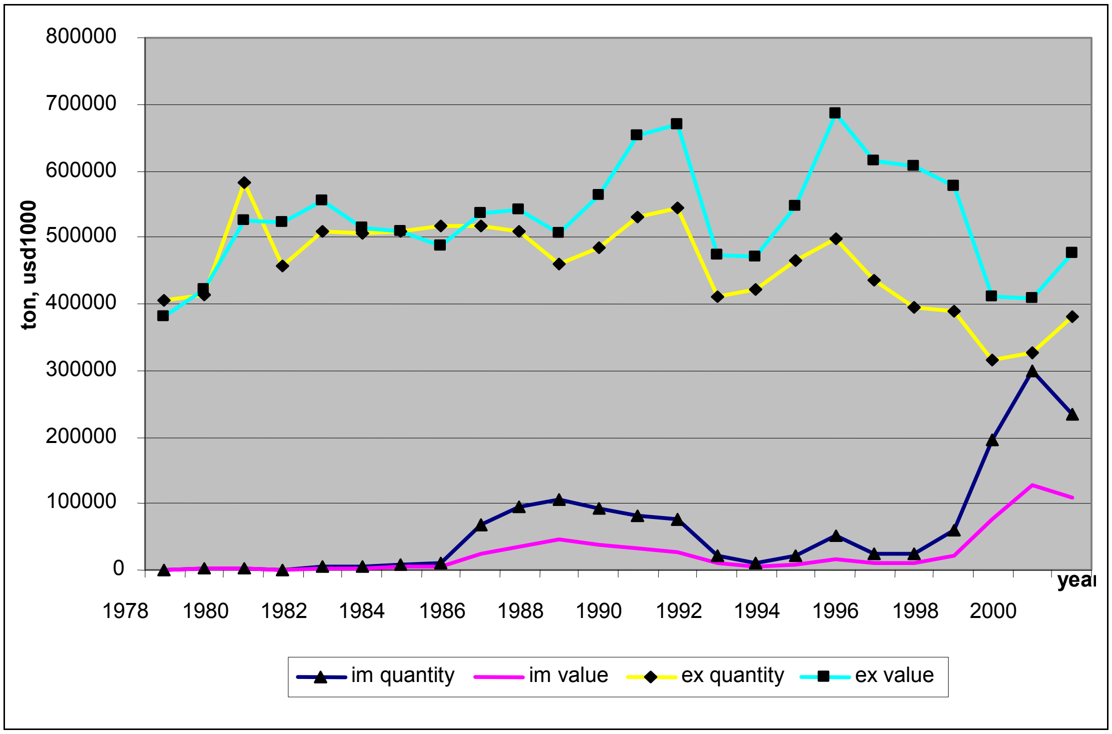

Figure 4. China's trade in total pig products (FAOSTAT, 2003).

ration for entry into the World Trade Organization (WTO), China sharply reduced tariffs on meat products to 20%. Both of these changes made smuggling into China less profitable, and led to sharp increases in reported imports from 1998 to 1999. Further indirect evidence of the significance of the crackdown on smuggling is provided by the fact that these changes coincided with a doubling of the price of chicken feet in China. This was the most popular item among smugglers (Wang, 2002).

Distinguishing between true import increases and reduced smuggling is difficult. One approach to measure underreporting of imports is to compare China's bilateral import data with the export data of its trading partners. This method should pick up any systematic discrepancies in reported imports and exports. Mark Gehlhar (2002), of the USDA Economic Research Service, has formalized this approach, although differences in data classifications hamper comparisons with the FAOSTAT data. Gehlhar's estimates for nonruminant meat imports into China show only a 1.1% increase from 1998-1999, after correcting for underreporting of China's imports. Thus, much of the previously "missing" imports were reported in the exporting country. They simply evaded the Chinese import authorities in order to avoid paying import duties. These findings suggest that the sharp increase in meat trade from 1998-99 is misleading and likely misinterpreted by some observers as the start of an import boom.

Which Trade Partners?

Who is trading with China? The US dominates this market, supplying 93% of the poultry products and 75% of the pig products (China Customs, 2002; calculated by imports and exports data of poultry products in volume from January to September 2002). About 70% of the US poultry exports to China consist of chicken wings and chicken feet (i.e., byproducts) to meet the preferences of Chinese consumers. China's major export partners for poultry are Japan, Hong Kong, Saudi Arabia, and Russia, among others. Most exports to Hong Kong are live animals, whereas other countries mostly received processed poultry products. Russia also takes two thirds of China's pork exports — mostly frozen products. As with poultry, most of the Hong Kong imports from mainland China are live hogs.

Conclusion

Each measurement issue addressed above has likely led to excessive optimism about China's import potential for meat products. First, using the Greater China, or China+ data from the FAOSTAT website, which includes Taiwan and perhaps Hong Kong and Macao, will erroneously suggest a net importer position.

Second, most projections of China's future trade are based on tons of product. Currently China is a net importer in tons, but a net exporter in dollars because it imports low-value by-products, such as chicken feet, and exports higher value processed meat products.

Third, most discussions of meat trade focus on fresh, chilled, and frozen meat, ignoring trade in live animals and processed products. When the latter products are factored in, China's trade surplus in poultry products increases to more than $1 billion. Finally, the huge jump in China's reported meat imports from 1998 to 1999 disappears when previous underreporting of imports is considered.

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Traceability in the US Food Supply: Dead End or Superhighway?

By Elise Golan, Barry Krissoff, Fred Kuchler, Ken Nelson, Greg Price, and Linda Calvin

Calls for mandatory food traceability are making news in policy discussions ranging over homeland security, country-of-origin labeling, Mad Cow disease, and genetically engineered foods. A frequent underlying assumption is that unlike Europe, the United States does not have food traceability. Here we argue that although the United States does not mandate system-wide traceability, firms have a number of motives for establishing traceability systems; as a result, private-sector traceability systems in the United States are extensive. The breadth, depth, and precision of private traceability systems vary depending on the attributes of interest and each firm's traceability costs and benefits. Mandatory traceability that fails to allow for variation across firms may impose unnecessary costs on firms already operating efficient traceability systems.

Why Firms Have Traceability Systems

Food suppliers have three motives for establishing product tracing systems: (a) to improve supply-side management; (b) to differentiate and market foods with subtle or undetectable quality attributes; and (c) to facilitate traceback for food safety and quality. Firms establish traceability systems to achieve one or more of these objectives. As a result, the private sector has a significant capacity for tracing.

Traceability for Supply-Side Management

Firms have a strong incentive to establish product-tracing systems to manage production flows and track retail activity. Traceability systems help firms reduce expensive overstocks, coordinate orders and shipments, and manage inventories. Electronic accounting systems for tracking inventory, purchases, production, and sales are an integral part of doing business in the United States.

In addition to private systems, US firms may also use an industry-standard coding system. The vast majority of packaged food products bear bar codes, as do a growing number of bulk foods, like bagged apples and oranges. Bar codes contain a series of numbers reflecting type of product and manufacturer (the UPC code) and a series of numbers assigned by the manufacturer to nonstandard production or distribution details. While bar codes were originally intended to facilitate tracking of retail sales and food consumption trends and patterns, the codes are now used to track numerous product attributes.

The success of the original UPC system has combined with technological advances and e-marketing to spur the development of integrated systems that code, track, and manage wholesale and retail transactions. In some cases, buyers manage these systems to monitor supply flow. For example, a few big retailers such as Walmart and Target have created proprietary supply-chain information systems that their suppliers must adopt. In other cases, firms establish systems to link suppliers and buyers. For example, UCCnet, which is a subsidiary of the Uniform Code Council, has developed an integrated system to standardize and automate information systems across a supply chain.

Sophisticated tracking systems are not confined to packaged products. The food industry has developed a number of complex coding systems to manage the flow of raw agricultural inputs and outputs. Vegetable and fruit farmers routinely tag their produce crates to record location and date of harvest. This information aids in inventory management at the packinghouse and in tracking shipments. Ranchers have been using electronic identification eartags and corresponding data collection cards to track information on an animal's lineage, vaccination records, and other health data. This allows for efficiency gains through sorting of individual cattle in feed yards, recording preconditioning and other health regimes, and facilitating disease surveillance and monitoring.

Traceability for Food Safety and Quality Control

Product tracing systems are essential for good safety and quality control systems. Traceability systems help firms isolate the source and extent of safety or quality control problems. The better and more precise the tracing system, the faster a producer can identify and resolve food safety or quality problems.

A firm's traceability system not only helps minimize potential damages for individual firms—it also helps minimize damages to the whole industry and to upstream and downstream industries. Contaminated meat sales and foodborne illness outbreaks damage the reputation and sales of the whole meat industry. Because of these spillovers, some product tracing systems are supported by industry groups or buyers. For example, the California cantaloupe industry has incorporated traceability requirements in their marketing in order to monitor food safety practices. Firms offering liability insurance may also require traceability systems to ensure that insured firms have minimized risks.

If the failure of a firm's quality control system results in sales of unsafe or defective products, a traceability system helps to track product distribution and reduce the size and cost of recall. Most if not all voluntary recalls listed on USDA's Food Safety and Inspection Service website refer consumers to coded information on products' packaging to identify the recalled items.

Traceability for product safety and quality is becoming a necessary part of doing business. Good product tracing systems help minimize the production and distribution of unsafe or poor quality products, thereby minimizing the potential for bad publicity, liability, and recalls.

Traceability to Differentiate and Market Foods with Credence Attributes

Although the US food market successfully mass-produces homogenous commodities such as grains and meats, it also offers products tailored to the tastes and preferences of segments of the consumer population. Food producers differentiate products for micromarkets over such attributes as taste, texture, nutritional content, cultivation techniques, and origin. Consumers easily detect some quality innovations—green ketchup is hard to miss. However, other differences involve credence attributes—characteristics that consumers cannot discern even after consuming the product. Consumers cannot taste or otherwise distinguish between food products containing genetically engineered (GE) ingredients and those made with non-GE ingredients.

Credence attributes can be content or process attributes:

Content attributes affect the physical properties of a product, although they can be difficult for consumers to perceive. For example, consumers are unable to determine the amount of isoflavones in a glass of soymilk or the amount of calcium in a glass of enriched orange juice by drinking these beverages.

Process attributes do not affect final product content but refer to characteristics of the production process. Process attributes include country-of-origin, organic, free-range, dolphin-safe, shade-grown, earth-friendly, and fair trade. In general,

neither consumers nor specialized testing equipment can discern process attributes. No test conducted on a can of tuna, for example, could tell whether the tuna was caught using dolphin-safe technologies.

Traceability is an indispensable part of any market for process credence attributes—or content attributes that are difficult or costly to measure. The only way to verify the existence of these attributes is through a bookkeeping record that establishes their creation and preservation. For example, tuna caught with dolphin-safe nets can only be distinguished from tuna caught using other methods through the bookkeeping system that ties the dolphin-safe tuna to the observer on the boat from which the tuna was caught. Without traceability as evidence of value, no viable market could exist for dolphin-safe tuna, fair trade coffee, non-biotech corn oil, or any other process credence attribute.

Food producers have developed sophisticated systems for tracking and establishing value for credence attributes. For example, farmers have begun using Global Positioning Systems to create information to trace crops back to the precise location within a field to determine cultivation practices such as pesticide use. For ranchers, the chain of documentation generated by electronic eartags enables them to more easily sell their cattle at a price that reflects underlying quality.

Balancing Costs and Benefits in Private Traceability Systems

Private traceability systems are extensive, but what kind of traceability do they entail? Are they adequate for tracking production from farm to fork? From seed to finished product? The characteristics of a firm's traceability system depends on the firm's objectives and the costs and benefits of traceability. Firms balance costs and benefits to determine the breadth, depth, and precision of their individual traceability systems.

Breadth

Breadth is the amount of information the traceability system records. There is a lot to know about the food we eat, and firms must decide which information is of value. A recordkeeping system cataloging all of a food's attributes would be enormous and unnecessary. The beans for a cup of coffee could come from any number of countries, be grown with numerous pesticides or just a few, be grown on huge corporate organic farms or small family-run conventional farms, be harvested by children or by machines, be stored in hygienic or pest-infested facilities, or be decaffeinated using a chemical solvent or hot water. Even the most meticulous producer would not find it worthwhile to collect and maintain information on all coffee attributes.

Given the huge number of attributes that could describe any food product, full traceability is an unreachable goal. A traceability system that used DNA to track beef back to information on an animal's lineage, vaccination records, and feeding regime would be incomplete if pasturage hours or playtime were the attributes of interest. Only a handful of attributes—as determined by supply management requirements, consumer preferences, and food safety considerations—warrants the expense of traceability recordkeeping. Firms balance the costs and benefits of attribute information to determine the efficient breadth of the product tracing system.

Depth

The depth of a traceability system is how far back or forward the system tracks. Most businesses have one-up, one-back traceability. Firms must know who their suppliers are if they pay their bills and they must know who their buyers are if they cash their checks. Most businesses in the United States, and certainly all large businesses, maintain electronic bookkeeping systems to track their accounts. The bulk of the US food supply system is therefore

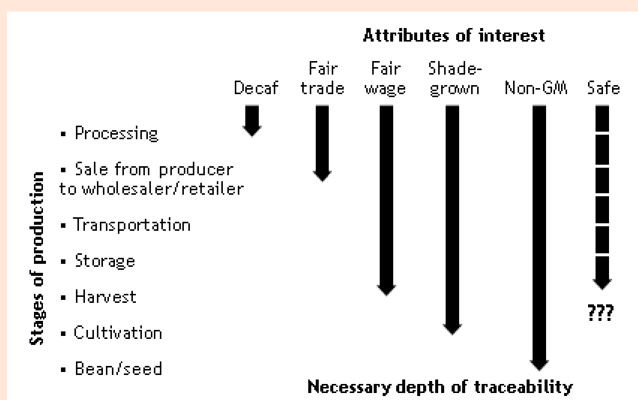

Figure 1. The depth of a traceability system (for coffee) depends on the attributes of interest.

monitored with electronic one-up, one-back traceability systems.

Whether product tracing goes beyond buyers and sellers depends on the objective of the system—and the attributes of interest to the producer or consumer. A traceability system for decaffeinated coffee would only extend back to the processing stage (Figure 1). A traceability system for fair trade coffee would only extend to information on price and terms of trade between coffee growers and processors. A traceability system for fair wage would extend to harvest; for shade grown, to cultivation; and for non-GE, to bean or seed. For food safety, depth of the traceability system depends on where hazards and remedies can enter the food production chain.

Precision

Precision reflects the degree of assurance with which the tracing system can pinpoint a particular food product's movement. A precise traceability system would trace an apple to its orchard with high assurance, while a less precise system would only trace a crate of apples to two or three orchards with lower assurance.

The first decision a firm makes with respect to precision involves the acceptable error rate. In a shipment of white corn, how many yellow kernels are acceptable? In a shipment of non-GE soybeans, how many GE beans are acceptable? Error-rate specifications (driven by quality requirements) will determine the strictness of the segregation system with which the traceability system is paired. Low tolerances for yellow kernels in a shipment of white corn or for GE content in a shipment of non-GE soybeans will require strict segregation systems and accurate bookkeeping systems.

The second decision a firm makes with respect to precision is regarding the unit of analysis—container, truck, crate, day of production, or shift? Firms must determine the most efficient tracking unit for their objectives. Firms that choose a large unit (such as feedlot or grain silo) for tracking purposes will have poor precision in isolating safety or quality problems. A smaller unit of analysis (such as individual cow or crate) will allow greater precision.

Precision in traceability—as reflected in the accuracy of the segregation system and the size of unit of analysis—is more valuable the higher the likelihood and cost of safety or quality breaches. If the likelihood and cost of recall were high, a manufacturer would quickly see the benefit in accurately reducing the size of the standard recall lot. However, precision comes at a cost. In particular, the error tolerance rate strongly affects the costs of segregation and traceability. The benefits of strict identity preservation and product tracing will outweigh the costs for some firms but not for others. The accuracy of the traceability system and level of segregation will vary widely depending on the motivations driving their development.

Firms are Building a Traceability Superhighway

Technological advances are pushing improvements in supply-side management and quality control systems throughout the US food system. Electronic accounting and traceability systems are standardizing information on product attributes and synchronizing product tracking across the food system. Firms balance traceability costs and benefits so that the breadth, depth, and precision of private systems reflect technological limits and consumer preferences. In some cases, however, firms may not supply the socially optimal amount of traceability, as when private and social traceability costs and benefits differ. In these cases, mandatory traceability may be a policy option.

Paradoxically, the widespread voluntary adoption of traceability in the United States may increase firms' cost of compliance with mandatory traceability systems. Efficient traceability by firms results in systems with differing levels of breath, depth, and precision. Because government requirements rarely allow for variation in process and outcome, firms may be required to make changes to their traceability systems that do not improve efficiency. Mandatory traceability that allows for variation or targets specific traceability gaps could be more efficient than system-wide requirements.

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Bridging the Metropolitan-Nonmetropolitan Digital Divide in Home Internet Use

By Brian E. Whitacre and Bradford F. Mills

During the 1990s, an increasing share of US households became digitally connected to the vast amount of information available on the Internet. United States Bureau of Census data indicate that between August 2000 and September 2001 alone, the percentage of all households with Internet connections increased dramatically (Figure 1). At the same time, disparities in Internet access and use emerged among various segments of the population. Recent studies show that Whites have greater access to and use of the Internet than Blacks and non-Hispanics show greater use than Hispanics (Compaine, 2001; National Telecommunications and Information Administration and Economics Statistics Administration [NTIA], 2002). More educated and higher income individuals also show greater Internet use (NTIA, 2002). Although household use has increased regardless of location, the gap in use between metropolitan and nonmetropolitan areas has remained at about 13%.[1] These differences in Internet use reflect the "digital divide."

Characterizing the Divide

Concerns exist that the metropolitan-nonmetropolitan digital divide may widen regional differences in household well-being (Drabenstott, 2001). As a result, the digital divide has been the focus of several policy initiatives. The Rural Access Authority in North Carolina, for example, was created to provide local dial-up Internet access from every telephone exchange in the state. Other states (such as Washington and Virginia) have provided grants to rural areas to promote high-speed Internet access. Other initiatives have supported infrastructure investments in low-density regions. These policies will only stimulate home Internet use in nonmetropolitan areas if the current digital divide stems from differences in infrastructure for Internet connectivity between the two areas.

Digital infrastructure between metropolitan and nonmetropolitan areas can differ considerably. Greenman (2000) reports that less than one percent of towns with fewer than 10,000 persons have digital subscriber line (DSL) or cable modem services. On the other hand, 86% of cities with more than 100,000 persons have digital subscriber lines, and 72% of cities with more than 250,000 persons have cable modem services. The 2001 Current Population Survey (CPS) data also suggest that infrastructure differences may be contributing to the digital divide. For example, 9.9% of nonmetropolitan household Internet users had high-speed connections, compared to 20.9% of metropolitan users (Figure 2).[2] On the other hand, nonmetropolitan users are only slightly more reliant on long-distance carriers to obtain Internet access, suggesting mini-

1. *This paper uses 1993 US Census designations of nonmetropolitan and metropolitan counties to compare differences in home Internet use. Metropolitan counties generally have populations greater than 100,000 (75,000 in New England) or a town or city of at least 50,000. Nonmetropolitan counties are those counties not classified as metropolitan.*

2. *High-speed access is often more important for business applications than home applications.*

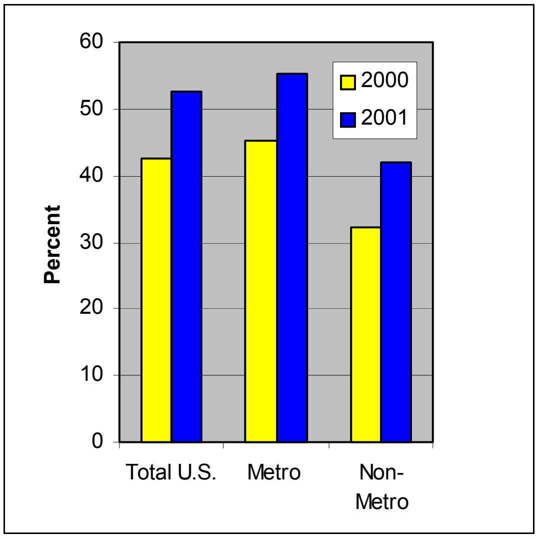

Figure 1. Household internet use for metropolitan and nonmetropolitan areas in 2000 and 2001 (Current Population Survey Internet and Computer Use Supplements, 2000-2001).

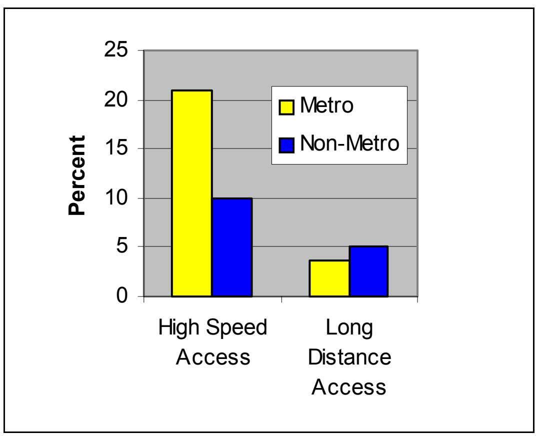

Figure 2. High speed and long distance access for metropolitan and nonmetropolitan areas (Current Population Survey Internet and Computer Use Supplements, 2000-2001)

mal differences in carrying costs between the two areas.

Differences in education, income, and other household attributes, rather than technology, may drive differences in metropolitan and nonmetropolitan region use. In this case, closing the divide would involve broader efforts to increase education and income in nonmetropolitan areas. Ensuring school children equal access to digital technology is also essential to avoid passing digital knowledge gaps to the next generation. We next explore how differences in education, income, and other household attributes influence the digital divide in home Internet use.

The Role of Income and Education

Nonmetropolitan areas trail metropolitan areas in both household income and household head education (Figure 3). Income and education levels are also higher in Internet-using households (Figure 4). Thus, income and education levels are likely to explain much of the digital divide.

Our econometric analysis indicates that 63% of the digital divide is due to area differences in household characteristics (Figure 5). The remaining 37% is linked to differences in the propensities of households with otherwise similar characteristics to use the Internet at home in metropolitan and nonmetropolitan areas.

Given the strong local composition of many online communities (Horrigan, 2001), a household's value of Internet access tends to increase as the share of other connected households (and businesses) in the same region increases. Adding regional density of home Internet use along with household characteristics explains 91.2% of the digital divide. Thus, household attributes and regional rates of household Internet use account for most of the digital divide.

Regional differences in Internet use could decline over time because of normal adoption patterns. The current findings, however, about the importance of differences in income and education on Internet use suggest greater persistence in the gap.

Policy Implications

Policy options to address the metropolitan-nonmetropolitan digital divide must be linked to the narrowing of income and educational disparities rather than focusing solely on digital infrastructure. Programs to increase general access for underserved populations also are important. Public support for such initiatives is currently weak. The two major federal program initiatives (The Technology Opportunities Program and Community Technology Centers) to foster Internet use by underserved populations are losing their funding (Harris and Associates, 2002).

Thanks to public investments, Internet access in the nation's schools is far more uniform across race and income groups than use at home (Newburger, 2001; NTIA 2002). Similarly, the CPS data indicate that the current rate of Internet use by

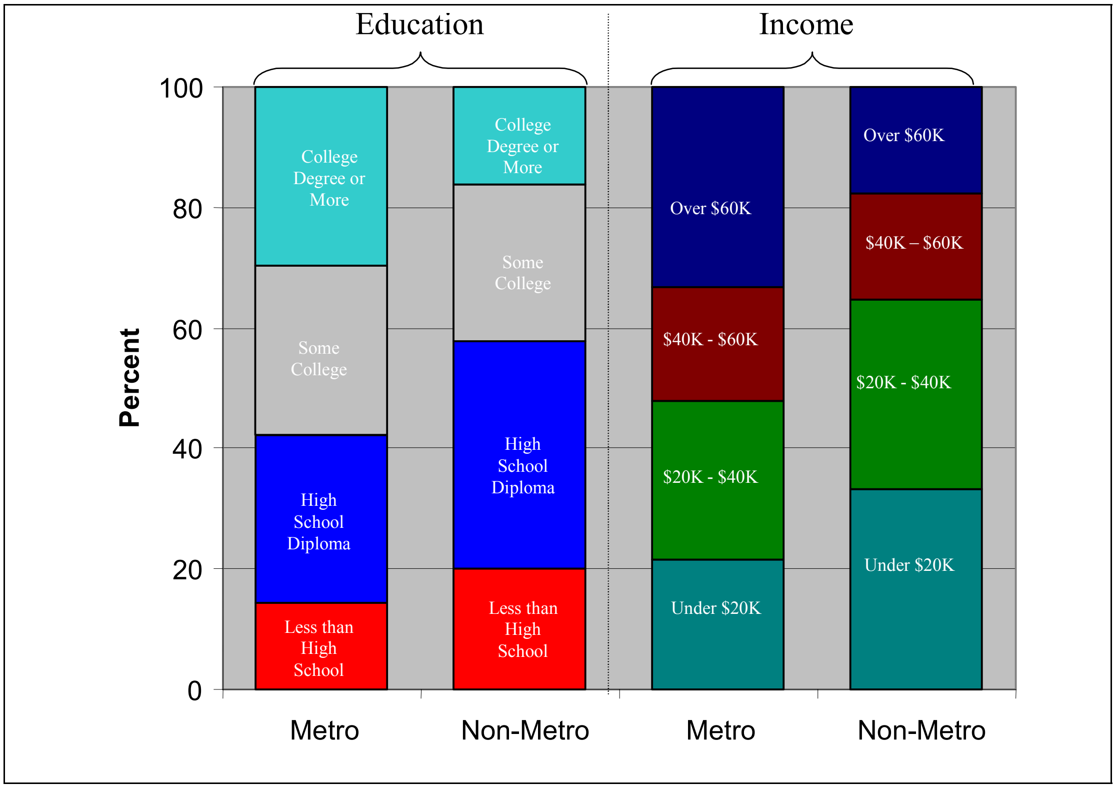

Figure 3. Household head education and household income levels in metropolitan and nonmetropolitan areas (Current Population Survey Internet and Computer Use Supplements, 2000-2001).

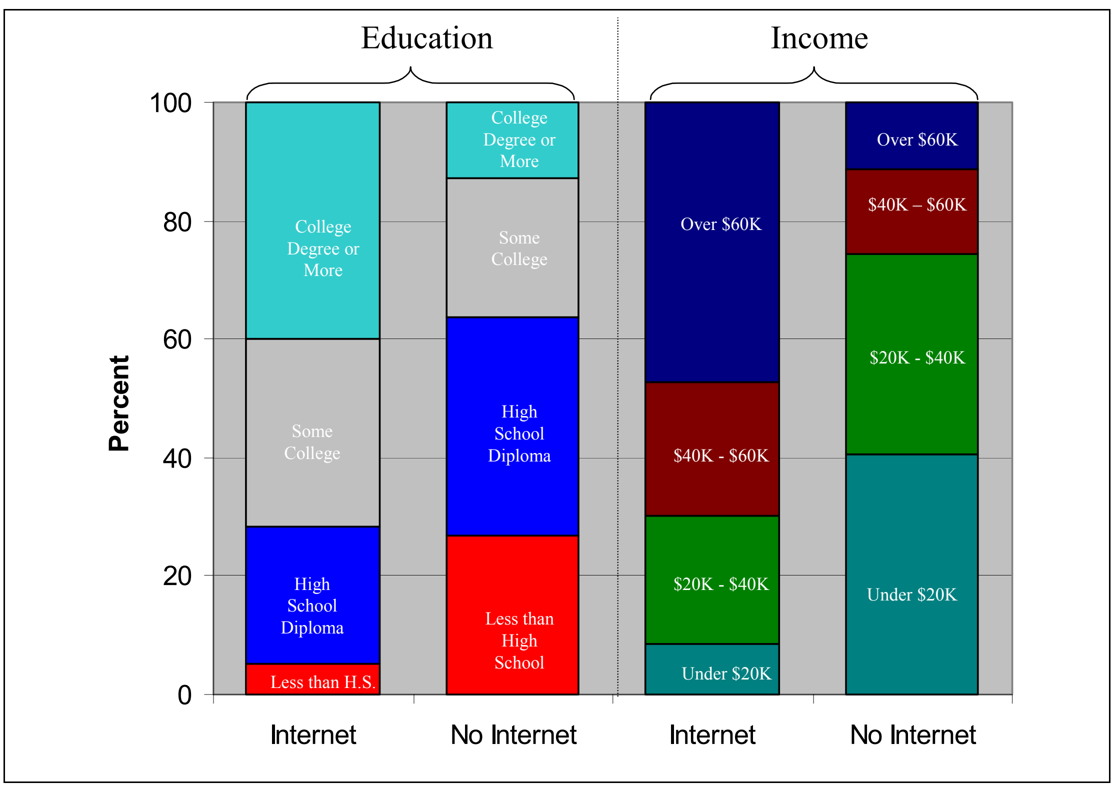

Figure 4. Household head education and household income levels for home internet users and nonusers (Current Population Survey Internet and Computer Use Supplements, 2000-2001).

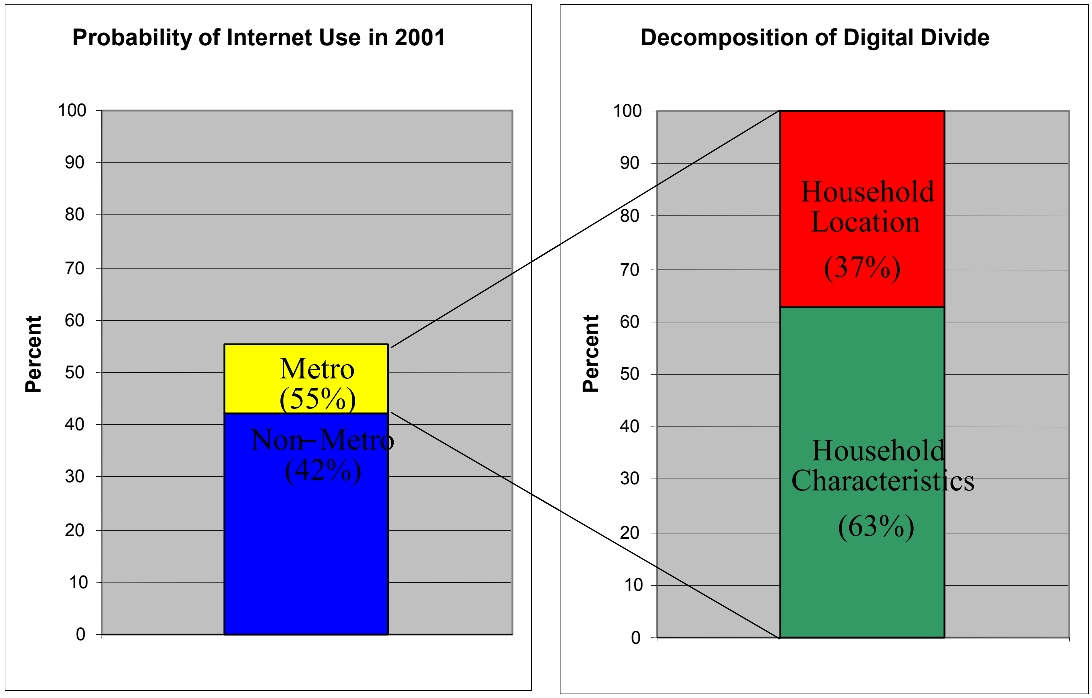

Figure 5. Decomposing the Digital Divide.

children at school is higher in nonmetropolitan areas than in metropolitan areas. School access is considered essential to avoid transferring the digital divide to future generations. A similar commitment to reduce disparities within the adult population is a policy choice.

For More Information:

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Policy Uses of Economic Multiplier and Impact Analysis

By David W. Hughes

A proposal being floated by a local economic development organization predicts that a new food processing plant will add 800 jobs and $100 million to the local economy. Jobs and income will be generated at the plant and in real estate, health care, and agriculture. The plant is also touted as having a local economic multiplier of $6. As an industry policy analyst, you are asked to evaluate the proposal. To do so, you will need to understand what these values really mean, the assumptions underlying their estimation, and whether they are realistic. Your reply is important, because public and private sector leaders, the general public, and even professionals can misinterpret economic impact and multiplier analysis. Worse yet, impact studies can be used to exaggerate the benefits of policies or proposals in some cases and their costs in others.

Outlined here are issues that should be considered in conducting and interpreting impact and multiplier analysis (see Checklist). These issues should influence choice of models and interpretation of results by policy analysts. The emphasis is on the regional (multistate, state, substate, or local) level, where such studies are normally conducted.

Multiplier and Impact Analysis

Although a variety of methods can be used to generate economic multipliers, the focus here is on input-output (I-O) models as the most popular tool for such analysis. This popularity has been engendered by the growth of ready-made I-O modeling systems such as IMPLAN, where a basic knowledge of personal computers is sufficient for generating models, multipliers, and impacts.

Export base theory underlies the use of economic multiplier and impact analysis. It springs from the idea that a region must earn income to survive by producing a good or service that the outside world will purchase. The use of I-O models has caused this idea to be extended to the sales generated by any industry—whether export oriented or not. The income injected into an economy by exports has a multiplier effect, as it is respent locally. The level of respending is based on how much local businesses and consumers buy from local businesses.

Impact analysis looks at the effects of a positive or negative change in economic activity. Impact analysis is based on economic multipliers, which account for the total effect across the entire economy of the event under study. For example, impact analysis is often used to estimate the effects of a new local industry on jobs and incomes in all parts of the economy. It is also used to estimate policy or investment impacts and the total contribution of an industry to an economy.

I-O Model Construction and Assumptions

I-O models examine the market flow of products between industries, sales by industries to households and other final users, and industry use of factors of production (labor and capital). Such models can be very detailed, containing several hundred industries.

Backward Linkages and I-O Multipliers

Several different types of multipliers are generated using regional I-O models. For a given local industry, the output multiplier measures the combined effect of a $1 change in its sales on the output of all local industries. All I-O multipliers measure the strength of backward linkages or the degree to which an increase in activity by a given local industry causes additional purchases from other local industries and local resource providers. The same relationships are used in impact analysis, but the initial change in output is much larger than $1 and is usually spread across several local industries.

Multipliers are generated in I-O models based on the key assumption of fixed-proportion production functions, where input use moves in lockstep fashion with production. For example, if a poultry processor doubles production, its use of each input also doubles. This production function is based on a completely elastic supply. That is, shifts in demand only result in changes in output, with no changes in real (inflation removed) prices. Such supply curves are based on the assumption that all units of a given input are equal in quality, and there are no barriers to firms entering or exiting markets.

Similar assumptions are also made in I-O models of regional economies. For example, if a local poultry processor doubles production, its current use of regional inputs will also double. Household spending (and implicitly population) is also assumed to move in a lockstep fashion with economic activity.

Limitations of Multiplier and Impact Analysis Including Possible Solutions

Several issues can influence the interpretation of results in multiplier-based studies. These issues may lead policy analysts to do additional analysis or use alternative models. Such issues include investment or project feasibility, employment impacts, effects on current residents, considerations about capital, impacts on local government, and accounting stance. Concerns about feasibility and profitability can be particularly important in interpreting model results.

Profitability and Other Feasibility Issues

Impact analysis does not by itself address several issues related to feasibility in project (investment) analysis—the most important being profitability. A local industry with a sizeable multiplier is not necessarily profitable, and multipliers do not account for this lack of profitability. If profitability is negative, then further development of the industry is not feasible. For a particular study, it is preferable to include profitability analysis as a separate component. For multipliers in general, policy analysts should be aware that by themselves multipliers do not speak to profitability.

Second, resource constraints are often ignored in multiplier impact analysis. For example, a local community may be considering a new paper mill, but the regional timber supply does not meet mill needs. In this case, the investment may be infeasible. A solution is to expand the study explicitly to include resource impacts. Basic I-O model textbooks contain examples of approaches to environmental and energy issues, which can be used in looking at resource pressures.

Another issue related to feasibility is possible impacts on prices. In a growing economy, supply pressures may lead to big price increases often ignored in multiplier-based studies. Rapid growth could lead to upward pressure on local wages, forcing businesses to cut back on employment. Such cutbacks would mute the expansion estimated with multipliers based on the no change in prices assumption. When price pressures are significant, policy analysts should be aware that more complex models are available (such as a computable general equilibrium model, which allows for changes in prices). Alternatively, they can interpret the quantity change (such as a change in output) as an upper bound on the expected actual change. Sound judgment is required in deciding if an I-O model yields appropriate answers in such situations.

Employment Impacts

The major concern in most impact studies is the effect on local employment. Under a growth scenario, job impacts are generally based on the assumption that new jobs go to new residents, which leads to population growth. This in turn leads to increased consumer spending on local products. However, any number of factors could break this chain of events. For example, the new jobs could go to current residents (the unemployed, job upgraders, or current out-commuters). New jobs could also go to new in-commuters. In either

What are SAMs and CGEs?

A Social Accounting Matrix (SAM) provides a detailed picture of the economy but in a more complete fashion than an I-O by explicitly accounting for all market and nonmarket (such as government welfare payments to households) income and resource flows. A CGE also provides a complete and detailed picture of an economy. However, prices are free to change and thus impact product, consumption, and trade relationships. Hence, more data is used in a complex set of nonlinear equations. Consequently, eliminating the fixed-price assumption may lead to less precise model estimates.

case, the increase in local population and spending would be less than expected.

For a decline impact scenario, job losses could be less than predicted. For example, those losing their jobs could commute to work elsewhere, with no loss in population and little decline in local spending.

An integrated I-O labor market model is one possible solution to this limitation. These models use other sources of information to help determine the distribution of job changes between new and current residents. If this approach is viewed as too resource intensive, policy analysts should be aware that the projected change in employment is an upper bound on the actual change with the caveat that model predictions could be wide of the mark.

Other considerations should also be raised in evaluating employment impacts. For example: Under a growth scenario, will new jobs be permanent and full-time? Another consideration is the type of occupations that will be generated (a key determinant of desirability in many rural areas). In addition, local workers may be unqualified for the new positions, and in-migrants or in-commuters will be employed instead.

Some of these issues can be examined with an I-O model. For example, wage estimates—an important part of desirability—are imbedded in such models. An industry occupation table (matrix), showing the distribution of occupations by industries, can be used to predict the types of generated occupations. The table translates employment estimates for each industry into a group of occupations. For example, ten new jobs in a given agricultural industry directly lead to one new farm management and nine new farm laborer jobs. Coupled with information about the local labor force, the matrix can show if local individuals can fill the new occupations. Other questions such as the permanence of employment impacts can be evaluated based on knowledge of the economy and the issue at hand.

Financial and Physical Capital Considerations

Another set of issues involves financial and physical capital. In evaluating a growth scenario, the level of the new capital investment and the residency of investors (local or otherwise) may be important. A regional SAM, which extends I-O by tracing all market income flows, could be used to shed light on these issues.

In evaluating a decline in economic activity, one should consider if the facilities involved (physical capital) could have an alternative use. For example, the impacts of the closure of military bases are important concerns for local economies. Economic impact analysis could indicate a major loss in local jobs and income when the base closes. However, the base is now available for other uses that may benefit the local economy. The proper response is to also evaluate the likelihood of success and economic impact of such alternative uses.

Impact on Current Residents and Activity

The effect on current residents and economic activity is another set of issues often ignored in multiplier-based studies looking at local economic growth. The value of the current housing stock may increase, especially if the economy is already growing and the anticipated impact is large. If population growth cannot be easily absorbed, surges in economic activity may create a tax burden for current residents by increasing property values.

Population growth can also place additional pressures on other industries that should be considered. In particular, local farms may close because of subdivision growth and other population-related impacts. Environmental degradation from a new industry could also have negative consequences for existing industries.

Local Government Impacts

The effect on government services and revenues is another important consideration, especially at the local level. A new industry may place pressures on locally provided public services. An impact study of a proposed casino touted the projected increase in local tax yield, but ignored possible increases in the cost of public services (such as additional police protection). If population growth occurs, local government may have to finance new roads, schools, and other infrastructure. Likewise, residents may have to endure crowding costs (such as increased traffic) if infrastructure development does not keep up with population growth.

An integrated public service I-O model can help shed light on these issues. Such models predict changes in employment and population and then

Table 1. What are some reasonable values for local economy multipliers?

County employment size class	Average multiplier	Probable range
1,000-2,999	1.7	1.5-1.9
3,000-4,999	1.8	1.5-2.0
5,000-9,999	1.9	1.6-2.1
10,000-19,999	2.0	1.8-2.2
20,000-49,999	2.2	2.0-2.4
50,000 and over	2.2	2.0-2.5

All things else equal, multipliers will tend to be higher where: (a) the community is larger with a more diverse economy; (b) the community is a substantial distance from competitive retail/service centers; and (c) the per capita income is low. Any output multiplier larger than 2.5 should be especially examined!
Source: Mulkey, 1978.

indicate how changes in both lead to increases in the cost of publicly provided services and government revenue. If using such a model is not possible, then the tax analysis should be eliminated from the study or at least tempered by indicating that changes in the cost of government services are not estimated.

Accounting Stance

Improper accounting stance (comparison of apples and oranges) also occurs in impact studies. For example, a statement sometimes made concerning the statewide impact of an institution of higher learning is the following: "$3 of output are generated in the state economy for every $1 that we receive in state funding". The comparison is one of apples and oranges because output measures gross sales while state government revenue has some type of income as its source.

Part of the solution to such accounting stance issues is not to compare apples and oranges. Education and proper interpretation concerning the different measures of economic activity estimated with I-O models should also help eliminate this problem.

Summary

Multiplier and impact analysis indicate the level of economic activity that may be generated by a given industry or event. Although useful, limitations of such work should always be discussed. Policy analysts should consider additional efforts to shed further light on critical issues when appropriate.

Table 2. Multiplier and impact analysis checklist (concerns and solutions).

Concerns	Solutions
Feasibility:	
Profitability	Include profitability in analysis; warn that profitability is not addressed
Resource constraint	Include resource impacts in analysis; warn that resource availability is assumed
Price impacts	Use price change model; interpret quantity changes as upper bounds
Employment impacts:	
Who gets job	Use integrated I-O labor market model; interpret local resident job changes as upper bound
Type of job	Include industry-occupation analysis; use knowledge of the situation to interpret results
Capital considerations:	
Financial capital	Use model that traces capital flows; use knowledge of the situation to interpret results
Physical capital	Determine likelihood of success of alternative uses
Current versus new residents:	
Housing stock	Use knowledge of situation to interpret results
Pressure on other industries	Include resource impacts; include declines in other industries in analysis
Local government impacts	Use integrated public service model; omit tax analysis; indicate public service impacts not considered
Accounting stance	Do not compare apples and oranges; properly interpret different variables

For Further Information:

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