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Income Risk, Coping Strategies, and Safety Nets

Stefan Dercon

Poor rural and urban households in developing countries face substantial risks, which they handle with risk-management and risk-coping strategies, including self-insurance through savings and informal insurance mechanisms. Despite these mechanisms, however, vulnerability to poverty linked to risk remains high. This article reviews the literature on poor households' use of risk-management and risk-coping strategies. It identifies the constraints on their effectiveness and discusses policy options. It shows that risk and lumpiness limit the opportunities to use assets as insurance, that entry constraints limit the usefulness of income diversification, and that informal risk-sharing provides only limited protection, leaving some of the poor exposed to very severe negative shocks. Public safety nets are likely to be beneficial, but their impact is sometimes limited, and they may have negative externalities on households that are not covered. Collecting more information on households' vulnerability to poverty—through both quantitative and qualitative methods—could help inform policy.

High income risk is part of life in developing economies. Climatic risks, economic fluctuations, and a large number of individual-specific shocks leave households vulnerable to severe hardship. In Ethiopia, for example, rural households are exposed to a variety of risks, including harvest failure as a result of drought, floods, frost, and other climatic events; policy shocks, such as changes in taxation and bans on migration; and the death and illness of livestock (table 1).

Many studies have reported high income variability related to risks of various forms. Using the 10-year panel data for one of the three International Crops Research Institute for Semi-Arid Tropics (ICRISAT) villages in India, Townsend (1994) reports high yearly yield fluctuations (in monetary terms) per unit of land for the dominant crops. Kinsey and others (1998) report a high frequency of harvest failures in a 23-year panel of rural households in a resettlement area in Zimbabwe. Bliss and Stern (1982) estimate that in Palanpur, India, a two-week delay in the onset of production is associated with a 20 percent decline in yields. Morduch (1995) provides many other examples.

Table 1. Risk-Related Hardship Faced by Rural Households in Ethiopia

<i>Event</i>	<i>Percentage of households reported to have been severely affected in past 20 years</i>
Harvest failure	78
Policy shock	42
Labor problems	40
Oxen problems	39
Problems with other livestock	35
Land-related problems	17
Loss of assets	16
War	7
Crime/banditry	3

Source: Author's calculations based on Ethiopian Rural Panel Data Survey (1994–97).

This article reviews the strategies households and individuals use to avoid consumption shortfalls caused by risk. It draws on a growing empirical economic literature based mainly on panel data studies, supplemented by my own work on Ethiopia. This is not the first survey on this topic. Alderman and Paxson (1994), Morduch (1995, 1999), Townsend (1995), and Fafchamps (1999) have also published surveys. This article is different from those studies because I focus on the constraints households face in using these strategies and on the policies needed to strengthen the ability of communities, households, and individuals to avoid severe consumption shortfalls caused by risk. Most of the examples cited are from Africa and Asia. Lustig (2001) provides relevant examples from Latin America.

In the next section, I introduce the risk problem faced by households. In the following section, I focus on asset strategies. I then review income-based strategies, examine informal and formal safety nets, and briefly review ways of defining and monitoring vulnerability to poverty.

Types of Risks and Poor Households' Strategies for Dealing with Them

Households respond to risk in different ways. To understand their behavior, it is helpful to consider the nature of the different sources of risk they face.

Common versus Idiosyncratic Risks

Income risk is caused by a variety of factors. Common risks are aggregate, economy-wide, covariate risks that affect all members of a community or region. Individual

or idiosyncratic risks affect only a particular individual. In practice, even within well-defined rural communities, few risks are purely common or idiosyncratic. Data from a three-period panel data set on Ethiopia reveal that most of the shocks experienced by households included both idiosyncratic and common risk features (table 2).

Other studies also find that the idiosyncratic part of income risk is relatively large. Deaton (1997) finds that common components explain very little of the variation in household income for particular villages in Côte d'Ivoire in 1985–86. Townsend (1995) reports evidence from Thailand that suggests that there are few common regional components in income growth. The Indian ICRISAT data also suggest relatively limited correlation in incomes within villages. Morduch (2002) concludes that idiosyncratic risk (inclusive of measurement error) accounts for 75–96 percent of the total variance in income within these villages. Udry (1991) reports similar magnitudes for northern Nigeria.

Other characteristics of income risk include the frequency and intensity of shocks and the persistence of their impact (see Morduch 1999). Relatively small but frequent shocks, such as transient illness, are easier to deal with than large, infrequent negative health shocks, such as disability or chronic illness. Gertler and Gruber (2002) find that in terms of consumption levels, households in Indonesia can protect themselves against only 30 percent of low-frequency serious health shocks with severe long-term effects. In contrast, they are able to insure their consumption against about 70 percent of high-frequency smaller health shocks.

If shocks persist, coping is more difficult. In a theoretical study Deaton (1991) examines the effects of autocorrelation in income on consumption smoothing when credit markets are missing. Using panel data from Pakistan, Alderman (1998) shows that successive shocks make consumption smoothing more difficult than do single shocks. Some shocks, such as health problems, may also have persistent effects.

Identifying the nature of the shock helps identify the possibilities for dealing with its consequences. Idiosyncratic shocks can be insured within a community. Common shocks cannot, because if everyone is affected, the risk cannot be shared. Formal or informal insurance transfers (credit or insurance) from outside the community or intertemporal transfers (such as depletion of individual or community-level savings) are therefore necessary to deal with common shocks.

Strategies for Reducing the Impact of Shocks

Alderman and Paxson (1994) distinguish risk-management from risk-coping strategies.¹ Risk-management strategies attempt to reduce the riskiness of the income process *ex ante* (income smoothing). Examples include income diversification, achieved by combining activities with low positive covariance, and income skewing, achieved by taking up low-risk activities, even at the cost of low returns.

Table 2. Shocks Affecting Income of Rural Households in Ethiopia, 1994–95

<i>Shock</i>	<i>Round 1</i>	<i>Round 2</i>	<i>Round 3</i>	<i>Village-level variance (as percent of total variance)^a</i>	<i>F-test of analysis of variance^b</i>
Village rainfall (percent above long-run mean)	0.06	0.12	0.12	100	n.a.
Rain index (individual)	0.57	0.57	0.63	40.6	64.6
Total nonrain shock index	0.65	—	0.80	28.2	37.2
Nonrain shock: low temperature, frost, storm, or other climatic event	0.71	—	0.82	34.4	49.9
Nonrain shock: crop pests and diseases (index)	0.59	—	0.77	28.9	38.7
Nonrain shock: animal damage, trampling, or related shock (index)	0.68	—	0.85	30.9	42.6
Nonrain shock: weed damage (index)	0.29	—	0.14	13.8	15.3
Crop index	0.33	0.65	0.43	34.0	49.1
Livestock affected by animal disease (index)	0.72	0.86	0.89	24.6	30.6
Livestock affected by lack of water and grazing land (index)	0.71	0.78	0.78	31.7	25.3
Number of days lost by adults in past month, per adult	0.66	0.45	0.39	5.2	5.3
Number of adults who died in past six months	—	0.04	0.02	5.6	5.8
Smaller harvest linked to not having labor due to illness (%)	0.19	—	0.13	15.9	17.8
Smaller harvest due to not finding labor when needed (%)	0.18	—	0.13	14.4	15.7
Smaller harvest due to not finding oxen at right time (%)	0.40	—	0.27	32.0	43.5

— = Not available.

n.a. = Not applicable.

Note: Number of observations = 1,450 households in 15 communities. Data collected in 1994 and 1995, with about six months between survey rounds. Index data are based on reported problems: 1 = no problems reported, 0 = all possible problems occur. Rain index (individual) is based on problems for own activities from rainfall, including whether it rained during harvest and whether the pattern of rainfall was irregular. Crop index is based on reported moderate or severe crop failures. For each index, the mean value of the index is reported. Percentages refer to the percentage of households reporting a problem.

^aResults on the variance decomposition are obtained allowing for time-varying village-level means on the pooled data set across rounds. In practice, this village-level variance is the R^2 of a regression on a full set of time-varying village-level dummies. The lower the contribution of the village-level variance to total variance, the more idiosyncratic is the shock.

^bAll tests are significant at the 5 percent level. The higher the F -statistic, the higher the contribution of village-level shocks to total shocks.

Source: Dercon and Krishnan (2000b).

Risk-coping strategies include self-insurance (through precautionary savings) and informal group-based risk-sharing. They deal with the consequences of income risk (consumption smoothing). Households can insure themselves by building up assets in good years, which they deplete in bad years. Alternatively, informal arrangements can be made among members of a group or village to support each other in case of hardship. These mechanisms are observed within extended families, ethnic groups, neighborhood groups, and professional networks.

Risk-coping strategies may also involve attempting to earn extra income when hardship occurs. Kochar (1995) reports increased labor supply as the key response in the ICRISAT villages in south India. During famines in Ethiopia or Sudan, villagers tried to earn additional income by temporarily migrating, collecting wild foods, and engaging in gathering activities, such as collecting firewood.

The social science literature on household strategies dealing with shocks often uses different terminology. Davies (1996) uses the term *coping strategies* to describe strategies employed during crises. In her terminology, *coping* refers to success in dealing with a crisis. *Adaptation* is a characteristic of a *vulnerable* household, using coping strategies as part of standard behavior. Adaptive strategies are then defined as a permanent change in the mix of ways in which households earn a living, irrespective of the year in question (for a good review, see Moser 1998).

I adopt a framework in which households develop strategies to deal with contingencies. The distinction between adaptation and coping seems less relevant. Any coping strategies will require ex ante actions, such as forming informal networks or building up savings. Consequently, all households will have adapted their livelihood to serve their own objectives as well as possible. Whether they do so using traditional coping strategies is conceptually irrelevant, however, as will be seen, it has analytical and policy implications (regarding long-term incomes, for example).

The Role of Formal and Informal Credit and Insurance Markets

High risks are not easily insured by formal market mechanisms. Credit and insurance markets are typically absent or incomplete in developing countries, either for good theoretical reasons or because of bad policy (for surveys, see Bell 1988 or Besley 1994, 1995). Consumption loans are rare. Traditional credit systems (*roscas*, *susu*, *tontines*), however, often extend loans, which may be used for consumption purposes. Formal loans or loans in microfinance programs also often finance consumption because the funds they provide are fungible.

Informal credit markets appear to adjust to high-risk environments. Udry (1994) reports that informal loans in rural Nigeria appear to take the form of state-contingent loans. Repayment is conditional on income outcomes of both borrowers and lenders, with negative shocks translated into more favorable terms for the party experiencing them.

The Need for Safety Nets

Despite these strategies for managing and coping with risk, vulnerability to consumption shortfalls remains high in developing countries. Further development of safety nets is therefore necessary. Townsend (1995) notes that income variability remains high in the ICRISAT villages in south India, where diversification and other income strategies are used only to a limited extent and are in any case inadequate. Risk-coping strategies are also typically insufficient. Rosenzweig (1988) estimates that transfers in India amount to less than 10 percent of typical income shocks. Other studies also suggested imperfect risk-sharing or consumption smoothing (Chaudhuri and Paxson 1994; Deaton 1991, 1992, 1997; Morduch 2002; Paxson 1993).

The experiences during the famines in the Horn of Africa in the mid-1980s also illustrate the limitations of these coping strategies. Despite complex coping strategies, as documented by Rahmato (1991), the effects of the famines were severe. Dercon (2002) reports that 10 years after the famine, cattle holdings were still only two-thirds what they were just before the famine. Reardon and others (1988) report that transfers in the aftermath of the 1984 drought were equivalent to only 3 percent of the losses for the poorest households in the Sahel.

Events in east Asia during the financial crisis of the late 1990s also exposed the limitations of informal insurance and self-insurance. In Indonesia, for example, consumption poverty increased substantially, and household investment in health and education declined, affecting future generations (Chaudhuri and others 2001; Frankenberg 1999; Thomas and others 2001).

Rose (1999) finds that in rural India negative rainfall shocks are associated with higher child mortality rates in landless households but not in households with significant landholdings. Jacoby and Skoufias (1997) finds that households in some villages in south India send their children to work instead of school to supplement income after adverse shocks. Foster (1995) shows that child growth was affected during and after severe flooding in Bangladesh in 1988. He does not find evidence of a sex bias, but other studies do. Using ICRISAT data, for example, Behrman (1988) shows that the inability to smooth consumption negatively affects child health in the period before the major harvest, with girls affected more than boys. Using data on individual nutrient intakes from India, Behrman and Deolalikar (1990) report that estimated price and wage elasticities of food intake are substantially and significantly higher for females than for males, suggesting that women and girls share a disproportionate burden of rising food prices.

Dercon and Krishnan (2000a) examine risk sharing by rural households in Ethiopia. They studied adult nutrition to investigate whether individuals are able to smooth their consumption within the household over the seasons. Poor households in the southern part of the country do not engage in complete risk-sharing between husbands and wives: women in these households bear the brunt of adverse shocks. Be-

cause of imperfect risk-sharing, women in poor households lose an average of 1.6–2.3 percent of their body weight as a result of loss of labor caused by illness.

Using Assets to Smooth Income and Consumption

Saving in good times and depleting assets when the going gets tough are commonly observed consumption-smoothing strategies. Its effectiveness, however, is restricted by the circumstances faced by many of the poor in developing economies.

Self-Insurance through Savings

Deaton (1991) describes the benefits of self-insurance through savings when credit markets are imperfect. In his model, the household maximizes expected utility over time. The household is risk averse and has a precautionary motive for savings, so that it will save more if risk increases. Households can save, receiving a safe return on asset, which is assumed to be relatively low. Income is risky.² Because households are impatient (that is, they have a preference to consume today rather than in the future), interest rates are lower than the rate of time preference.

Deaton assumes further that households behave as if they have an infinite planning horizon. In that case, they will build up assets in good years to deplete in bad years. As a result of impatience, assets are not systematically accumulated to very large levels. High levels of fluctuations are observed in savings, and consumption is smoother than income. Severe crises are not easily insured, however. Despite these strategies, a sequence of bad draws can still mean that consumption is very low. Deaton argues that for many developing countries, this model fits well with some of the stylized facts of occasional low consumption, low asset holdings, and high frequency of asset transactions. It is not easy to draw immediate policy conclusions from this work, however. The key result—imperfectly smooth consumption—follows largely from the impatience of households. If only they were patient, they could build up sufficient assets to cope with future stress.

The Effect of Common Shocks on Asset Prices and the Terms of Trade

To understand household savings behavior in risky environments in developing economies, one needs to acknowledge that assets are risky. Deaton's model assumes that savings can occur in a safe form with a positive rate of return. In practice, this may not be possible. The lack of integration of asset markets and the difficulties the poor face in obtaining access to internationally traded assets means that the portfolio of assets available to them is limited. When a common negative shock occurs, incomes are low and returns to different assets are also low, often even negative.

Consequently, just when assets are needed, net stocks could be low as well. For example, if assets are kept in the form of livestock (as they are throughout most of the developing world), a drought causes both a decline in crop incomes and the death of and drop in fertility of livestock. The consequence is a smaller herd (or even loss of all livestock) just when these assets are needed as part of the self-insurance scheme.³ Similarly, stock market returns may be low when a crisis hits an economy, as they were during the Asian financial crisis. The likely covariance of asset values and income as a result of common shocks thus reduces the usefulness of self-insurance.

Another problem with holding assets to buffer consumption is that the terms of trade between goods for consumption and assets change as a result of a common shock. If a negative common shock occurs, households would like to sell some of their assets. However, if everyone wants to sell assets at the same time, asset prices will collapse and the amount of consumption that can be purchased with the proceeds will fall. Similarly, when a positive shock occurs, everyone will want to buy assets for future protection, pushing up prices (box 1).

There is a lot of evidence, albeit some of it anecdotal, that this effect is common. During the famine in Ethiopia in 1984–85, terms of trade between livestock and food collapsed (Rahmato 1991) Relative food prices rose by a factor of three, reducing the purchasing power of assets by two-thirds.

Box 1. Simulating the Effects of Asset Lumpiness and Risk on Consumption Smoothing

Dercon (2000) uses simulations to illustrate the effects of asset lumpiness and risk on the ability of savings to buffer consumption. Assuming reasonable values for the parameters of an extension of a model similar to Deaton's (1991), he calculates the risk premium (the amount one would be willing to pay in the first period to avoid risk) using different assumptions about assets. The model assumes a 20-year horizon, as well as logarithmic utility, risky income with mean of 50 and a standard deviation of 10, and a rate of time preference and an expected interest rate of 5 percent.

Without access to credit, insurance, or savings, the risk premium was 19.8 percent of mean income. This value can be viewed as the benchmark, a measure of the risk that needs to be covered. Expressing the risk premium in each case as a percentage of total risk provides a measure of how much risk remains uninsured; one minus this value is a measure of how well self-insurance works. For safe assets the value was 67 percent, meaning that two-thirds of total consumption risk is insured if households have access to safe assets and use them optimally. Including asset return risk (introduced as returns with a mean of 5 percent and a coefficient of variation of 0.2) reduces this value slightly to 65 percent. If the correlation of incomes and assets (covariate risk) is 0.5, the value drops to 58 percent.

The presence of covariance in the terms of trade is far more problematic for households to deal with. If asset prices are risky (a coefficient of variation of 0.2), then if price risk is independent of income risk, self-insurance can cover only 50 percent of the total risk premium. Given a positive covariance in the terms of trade (with a correlation coefficient of 0.5), the figure falls to just 16 percent. Introducing lumpiness in the assets (so that they need to be purchased in units of 10) reduces the figure to just 5 percent. Asset lumpiness and the terms of trade risk, especially if it is covariate with income, thus significantly reduce the usefulness of self-insurance through savings.

The same phenomenon occurs following positive shocks. Bevan and others (1991) describe the construction boom that took place in Kenya during the coffee boom in the mid-1970s, when prices for construction materials and other durables increased markedly. Households tried to put some of their positive windfall into more assets, but their choice set was sharply restricted by macroeconomic policies, such as foreign exchange and capital controls.

The Problem of Lumpy Assets

Though risk in asset returns and in the terms of trade may reduce the usefulness of assets for smoothing consumption, holding assets can nevertheless help smooth consumption. Rosenzweig and Wolpin (1993) show that bullock sales contribute to consumption smoothing in the south Indian ICRISAT villages, although Lim and Townsend (1994) argue that crop inventory appears to be the main strategy used by these households. Access to relatively safe and profitable assets may be limited, however. The lumpiness of assets may partly explain why the poor cannot protect themselves easily by holding assets. For example, buying and selling cattle is generally recognized as a common strategy for coping with income fluctuations in many rural areas (Binswanger and McIntire 1987; Davies 1996). But a large proportion of households often do not own livestock. Dercon (1998) finds that only half the households in a sample in western Tanzania own cattle, even though cattle are important in the farming system and the culture. The explanation is not that half of all households choose to engage in other activities but that investing in livestock requires a sizable surplus: livestock are lumpy. A cow, for example, costs about a fifth of mean annual crop income. Cattle ownership is generally determined by endowments in male labor and land. Households with small endowments cannot accumulate sufficient means to purchase cattle, leaving them more exposed to income risk (see box 1).

There is some evidence that household behavior is consistent with these predictions. During the 1984–85 famine, households in Ethiopia cut their consumption to dangerously low levels rather than sell their assets when asset terms of trade had collapsed (Rahmato 1991). Czukas and others (1998) find that livestock sales (both cattle and small stock) offset at most 30 percent and probably closer to 15 percent of the crop income shortfall during severe drought.

Helping Poor Households Deal with Shocks

Policies that reduce asset market risks could help households deal with shocks. Maintaining macroeconomic stability during income downturns, for example, would allow self-insurance to function better. Providing households with access to more attractive and more diversified assets could also help them deal with shocks. Integrating asset markets with the wider economy could prevent much of the often-observed

covariance between asset prices and incomes. In rural Africa or India, for example, facilitating the holding of assets other than animals—low-cost financial savings held in post office accounts, for example—could help households weather shocks. Introducing a focus on savings for self-insurance in the booming number of initiatives related to microfinance operations could also help.

Macroeconomic policy could also reduce the effects of shocks in the terms of trade. For example, a worsening of the terms often coincides with inflationary increases in consumer prices relative to asset prices, as occurred during the famines in Bangladesh in 1974 and Ethiopia in 1985. Low inflation and exchange rate stability could limit large shocks in relative prices when incomes are low. Policies that reduce the macroeconomic impact of common shocks would enhance self-insurance.

Income-Smoothing Strategies

Income smoothing refers to strategies that reduce risk and fluctuations in income. They are commonly observed in developing countries, but they may come at a cost in terms of persistent poverty.

Income Diversification and Income Skewing

Income smoothing often involves diversifying income sources. Theoretically, as long as the different income sources are not perfectly covariate (that is, they have a correlation coefficient less than 1), combining two income sources with the same mean and variance will reduce the total income risk. Stated in this way, there appears to be no cost to diversifying, because mean income remains unchanged. A more realistic scenario is one in which mean income is reduced to lower risk. This strategy can be called *income skewing*, because it involves allocating resources to low-risk, low-return activities. It is different from diversification because it is possible that households specialize in only one activity, with low risk and a low return.

Widespread diversification of income sources is observed in developing economies. Across the developing world, farm households receive a substantial share of income from nonfarm activities. Reardon and others (1994) report an average share of 39 percent of income from nonfarm activities in eight countries in rural west Africa. In addition to engaging in nonagricultural activities, households fragment their land holdings into many plots, grow different crops, and engage in local farm wage employment.

Is diversification effective? Townsend (1995) notes that in the ICRISAT villages in south India substantial scope for diversification exists. Relatively little appears to take place, however, and income remains highly variable. Diversification does not always result in income smoothing, for several reasons. First, combining different

income sources is not always intended to manage risk. Different activities may be conducted at different times of the year, providing income throughout the year by smoothing labor over time. Second, though farm and off-farm activities may be relatively uncorrelated in normal years, during crises they may move together. In a severe downturn, this would severely limit the usefulness of diversification.

There is evidence that this is the case. Czukas and others (1998) show that non-farm income is positively correlated with shocks affecting crop income: drought adversely affects not only crop income but also nonfarm income. This finding is consistent with Sen's (1981) analysis of famine, in which crop failure sometimes leads to a collapse in demand for local services and crafts, limiting the usefulness of diversification to reduce risk.

There are also important constraints to entering into profitable and risk-reducing diversification. Nonagricultural activities or profitable alternative agricultural activities are not easily accessed. Entry constraints could take the form of working capital, skills, or other requirements (see Reardon and others 1988; Reardon 1997).

Dercon and Krishnan (1996) look explicitly at the role of different constraints in Tanzania and Ethiopia. They find that the poor typically enter into activities with low entry costs, such as collecting firewood and dungcakes, making charcoal, and working as casual agricultural wage earners. Entry into high-return noncrop activities, such as cattle rearing or shopkeeping, in which most households would like to engage, is restricted to richer households, presumably those with access to capital. Non-agricultural wage employment is restricted to people with education.

Recent data from Ethiopia on the investments needed to enter nonfarm business activities indicate that relatively high levels of capital are required for some activities (Dercon 2000). The median investment needed to enter into charcoal making, dung cake collection, handicraft production, weaving, or food processing—activities with relatively low returns—was 0–20 birr (up to US\$3). More lucrative activities, such as starting a shop, trading livestock, or providing transport services, required 300–550 birr (\$45–80). A mature cow costs about 400 birr (\$60). These are large sums in an economy in which mean per adult income is less than \$200/year (author calculation based on data from Ethiopian Rural Household Survey 1995). Dercon (1998) shows that barriers to entry were more important than comparative advantage in determining entry into high-return activities in rural Tanzania.

The Cost of Reducing Income Risk

Reducing income risk often comes at a cost, because it is difficult to diversify the sources of income without reducing the level of mean income. Although they face more severe consequences from risky incomes (because of more limited insurance and credit market imperfections), the poor are often less diversified than wealthier households. The reason may be that many diversification or income-skewing strategies

reduce mean income, making them less attractive for poor households. Capital and other entry constraints exclude the poor from diversification into activities with a higher return. This unwillingness (or inability) to accept lower returns may partly account for the limited income smoothing observed in developing countries. The long-term consequences for the asset-poor are lower average incomes and a higher income gap relative to asset-rich households.

Another reason the poor have less diversified sources of income than other households is that income-based strategies are directly linked to asset-based strategies (and other forms of protections, such as those provided by informal insurance). As Eswaran and Kotwal (1989) show, credit can serve as an insurance substitute, but credit market imperfections usually imply collateralized lending. The consequence is that asset-poor households cannot enter into high-risk activities because downside risks are too high. Asset-rich households do not face this problem. Households with access to (liquid) assets can borrow in times of crisis or, if credit is not available, sell assets as part of a buffer stock strategy. In contrast, to reduce their income risk, asset-poor households have to enter low-risk, low-return activities. The consequence is further impoverishment, or at least increased inequality.

Evidence suggests that this is indeed happening. Morduch (1990), using the ICRISAT sample, shows that asset-poor households devote a larger share of land to safer traditional varieties of rice and castor than to riskier but higher-return varieties.⁴ Dercon (1996) finds that Tanzanian households with limited liquid assets (livestock) grow proportionately more sweet potatoes, a low-return, low-risk crop. A household with an average livestock holding allocates 20 percent less of its land to sweet potatoes than a household with no liquid assets. The crop portfolio of the wealthiest quintile yields 25 percent more per adult than that of the poorest quintile. Choosing a less risky crop portfolio thus has substantial negative consequences for incomes.

Rosenzweig and Binswanger (1993) suggest that the portfolio of activities (and investments) in the ICRISAT villages is affected by high risk. Increasing the coefficient of variation of rainfall timing by one standard deviation reduces farm profits of the poorest quartile by 35 percent; for the richest quartile, the effect is negligible. Efficiency is affected, and the average incomes of the poor decline. Wealthier farmers are not affected and are therefore able to earn higher incomes. This phenomenon affects wealth distribution: 54 percent of wealth is held by the top 20 percent of households. Jalan and Ravallion (2001) cite other examples, although their evidence is more mixed.

These results do not follow from differences in risk preferences: controlling for preferences, the poor select a low-risk, low-return portfolio, whereas the rich take on a riskier set of activities. These results reflect the constraints on the options available to poor households. As Kochar (1995) notes, "the set of options faced by farmers offers little role for preferences" (p. 159). The policy implication is that just promoting diversification is not necessarily a solution. Finding ways of reducing entry constraints into profitable low-risk activities is crucial.

Income-Based Strategies for Dealing with Crises

Several income-based strategies are invoked only when a crisis looms. These coping or survival strategies are especially important when the shock is economywide. Examples of economywide shocks include drought, floods, and large economic shocks, such as those affecting parts of Asia in recent years. When a large negative shock occurs, the usual household activities may not yield sufficient income. If all households in a community or region are affected, local income-earning activities are unlikely to be sufficient.

Kochar (1995) argues that labor supply adjustments, rather than asset or other strategies, are the main strategy used by households in India to cope with negative idiosyncratic shocks. Increased labor force participation in response to economic shocks is also found elsewhere. Moser (1998) reports increased female labor market participation and child labor in Ecuador and Zambia. Jacoby and Skoufias (1997) find that in response to adverse income shocks, children in the ICRISAT villages in south India were taken out of school to work, reducing the accumulation of human capital. In Indonesia female labor participation rose and children were withdrawn from school to help households weather the recent crisis (Frankenberg 1999; Thomas and others 2001).

During a severe crisis, such as a famine, additional action is often taken to prevent destitution. These actions include temporarily migrating to obtain work, working longer hours, and collecting and selling wild foods and forest products (Davies 1996; De Waal 1987; Rahmato 1991).

Informal Risk-Sharing and Safety Nets

Households use a variety of informal risk-sharing arrangements to cope with the consequences of risk. Typically, these arrangements involve a system of mutual assistance between family networks or communities.

Insuring Idiosyncratic Risks

There has been growing interest in the empirical analysis of informal risk-sharing and in the modeling of the sustainability and consequences of these arrangements (see Morduch 1999). Empirical studies have sought to determine whether there is evidence of complete risk sharing in developing countries and other settings, including the United States, and to understand how (partial or complete) risk-sharing is achieved. Results from the United States, communities in India, and nuclear households in Ethiopia suggest that complete risk sharing is not taking place (Dercon and Krishnan 2000a; Hayashi and others 1996; Townsend 1994) but that partial risk sharing may be occurring.

These studies test the presence of outcomes similar to those obtained by risk sharing. The tests cannot distinguish between the effects of self-insurance (that is, accumulating and depleting assets) and informal insurance (or insurance-like behavior through transfers or credit). Nevertheless, they reveal evidence of partial risk-sharing through transfer behavior or state-contingent (quasi-)credit. Udry (1994) presents evidence of state-contingent loans in northern Nigeria. Fafchamps and Lund (forthcoming) show that loans and transfers within networks play an important role in risk sharing. Grimard (1997) appears to have found more stable consumption by tribes in Côte d'Ivoire than for the full data set, suggesting that tribal networks facilitate consumption smoothing, including through transfers. Evidence of full risk sharing was not found, however.

More direct evidence on the extent of risk sharing also reveals its limitations. Using detailed data on northern Ghana, Goldstein and others (2001) show that many idiosyncratic shocks are not insured by community contacts or even spouses. De Weerd (2002) uses a detailed survey of all networks in a Tanzanian village to show that poorer households have fewer contacts to which to turn in times of need and that they can typically rely only on other poor households.

Theoretical work also reveals the limits of risk-sharing arrangements. Hoff (1996) highlights the possible negative consequences of informal risk sharing on poverty. Fafchamps (2002) discusses the persistence of inequality and patronage linked to risk-sharing arrangements. Coate and Ravallion (1993), Platteau (1997), Ligon and others (2001), and Attanasio and Rios-Rull (2000) examine the nature and sustainability of (partial or complete) risk-sharing arrangements given the lack of formal enforcement. Ligon and others (2002) present evidence that the constrained risk-sharing model fits the data on household food consumption in the ICRISAT villages in India better than the perfect risk-sharing model.

Insuring Common Risks

Even if imperfect, these risk-sharing networks are crucial in helping many poor households in developing countries cope with misfortune. Such groups can insure only idiosyncratic shocks, however, not common shocks. Savings or public safety nets could be developed to cope with common risks and to protect against idiosyncratic shocks not covered by communities. Informal risk-sharing arrangements can complement public safety schemes. For example, targeting the most needy is notoriously difficult. If, however, a risk-sharing arrangement exists within a community, poorly targeted transfers would be redistributed within the risk-sharing group (Ligon 2002). Dercon and Krishnan (2002) discuss evidence from Ethiopia suggesting that despite poor targeting of food aid, some of this aid reaches a large part of the community. But such programs often have other unintended consequences, which need to be clearly understood.

Much attention has been paid in the public transfer literature to the problems of crowding out. The impact of public transfers for the poor is typically smaller than the total transfer, because net private transfers to the poor are reduced (see Cox and Jimenez 1992). Public safety nets can also crowd out informal arrangements. If the safety net provides full protection to all vulnerable households and individuals, this is hardly a serious problem from a welfare point of view (even if the budgetary cost may be high). The problem is more complicated in the case of informal risk-sharing arrangements in which enforcement is not self-evident.

Some households may have incentives to leave a risk-sharing arrangement if they feel that staying in the arrangement—supporting others when the going is good to receive support when the going gets bad—may not be in their interest. For example, following a series of lucky income draws, individuals may prefer to hold on to and invest their income themselves, rather than use it to support others. The arrangement may also come under pressure if some households in the network have access to a new source of risk reduction or protection. Sometimes renegotiating the reciprocal arrangement may allow the arrangement to continue, albeit on new terms. When that is not possible, the arrangement may break down (Ligon and others 2002; Platteau 1997).

Public safety nets create a change of circumstances that may have undesired welfare effects by putting pressure on informal arrangements. Information, budget, or other constraints often mean that some needy households are excluded from these programs, even if targeting methods, including self-targeting, are used. The result may be a specific type of crowding out. Some households covered by the safety net may have incentives to leave their informal risk-sharing arrangements, leaving other households less protected. As a result of the safety net, then, some households may be made more vulnerable.⁵ This problem is not limited to public safety nets: any policy intervention that improves an individual's position outside a private group-based informal risk-sharing arrangement may provide incentives to break down the informal arrangement (Dercon and Krishnan 2002; Ligon 2002). Some researchers have suggested that this form of crowding out is significant (Albarran and Attanasio 2002). However large the effect may be, it is important that policymakers recognize that informal schemes for dealing with idiosyncratic risk may be negatively affected by other interventions, including better functioning safety nets for common shocks or support for more self-insurance activities.

One way of avoiding these problems is to target groups rather than individuals—by creating employment schemes for an entire group or community involved in an informal scheme, for example. Of course, doing so requires detailed information about the informal schemes in place. Another alternative could be to encourage and support groups involved in informal insurance arrangements to develop group-based self-insurance mechanisms. The notion that individual-based self-insurance can deal best with common shocks whereas informal arrangements are suitable for idiosyncratic shocks is misleading. Groups have incentives to self-insure, especially if there are

economies of scale in asset holdings (lower transactions costs, for example, or better opportunities for risk pooling of assets). Groups could build up assets in good years to deplete in bad years for the benefit of their members, adopting the same transfer rules and mechanisms used to manage idiosyncratic shocks.⁶ Policy interventions could provide incentives for this type of behavior. Better savings instruments, access to banking, and macroeconomic stability would facilitate this process. Policymakers could also try to include a stronger savings-for-insurance component in group-based credit programs, a current favorite in donor interventions. Group-based targeting and insurance schemes have their own problems, however.⁷

Monitoring Income Risk, Vulnerability, and Coping Strategies

The presence of significant income risk in developing countries and the limited ability of poor households to smooth resulting shocks have implications for measuring poverty. Furthermore, it begs the question whether alternative measures capturing risk and vulnerability should be developed.

Measuring Poverty

Using income as a measure of welfare to identify poverty has long been recognized as problematic. As an alternative, current consumption, as found in cross-sectional surveys, has been used for most quantitative poverty analysis. The argument is that because risk-averse households prefer less variable consumption, consumption is smoother than income. However, the combination of high income risk and the observed inability of households to smooth consumption through risk-management or coping strategies, especially when faced with severe shocks, would suggest that alternative measures are needed.⁸

If time-series data are available, dynamic poverty definitions can be used. If data on consumption over time are available, it is possible to take into account the fact that some households may be poor only in some years.⁹ One could distinguish those who are poor in every period from those who are poor in only some of the periods sampled. In all panel data sets on developing countries currently available, large consumption fluctuations mean that a large number of households move in and out of poverty. For example, in the Indian ICRISAT data set, about 25 percent of the poor in each period move out of poverty in the next period. Gaiha and Deolalikar (1993) report that only 12 percent of households in the ICRISAT sample were never poor. Jalan and Ravallion (2000) report that about half the poor in each year were not poor on average in their sample from rural China. Using data from rural Ethiopia, Dercon and Krishnan (2000b) report that although poverty remained essentially unchanged between 1994 and 1995 (at about 40 percent), about a third of the poor were differ-

ent households each year. More evidence can be found in Baulch and Hoddinott (2000) and other articles in the same special issue of the *Journal of Development Studies*.

One needs to be cautious in interpreting the evidence on widespread poverty transitions and fluctuations. Measurement error in the data would show up as increased movement above and below the poverty line, increasing the apparent mobility. Still, because most studies find variables correlated with fluctuations that are unlikely to be correlated with measurement error in consumption, it is likely that a substantial part of the observed consumption fluctuations are genuine.

Ravallion (1988) proposes a way of measuring chronic and transient (including risk-related) poverty. Using consumption as the underlying welfare measure, he defines the chronically poor as those with average consumption below the poverty line. A measure of transient poverty for an individual is then derived as the average value of the individual's period by period poverty level minus the value for chronic poverty. Additive poverty measures can then be decomposed into transient and chronic components. For example, using the squared poverty gap, Jalan and Ravallion (2000) report that roughly half of total poverty observed in their rural Chinese panel data set covering 1985–90 is transient poverty. Transient poverty is highest for households with average consumption near the poverty line, with about 40 percent of transient poverty found among households that are not poor on average. Almost all transient poverty is experienced by households whose mean consumption is no more than 50 percent above the poverty line. This evidence implies that in any given year, the measured poverty level will exclude some people at risk of being poor in the near future.¹⁰

Dercon and Krishnan (2000b) look explicitly at the link between shocks and poverty transitions, using panel data from Ethiopia. They use a fixed-effects model of consumption in which changes in consumption are linked to idiosyncratic and common shocks, such as rainfall, other crop shocks, illness, and the death or sickness of livestock. Their results suggest that some of the fluctuations appear to be seasonal responses to prices and labor requirements and that shocks matter. Most areas in the sample experienced a fairly good harvest in the sample period. In the best period of the year (the postharvest period), the incidence of poverty was about 33 percent; in the worst period, it was about 40 percent. During the worst period of the year, up to 60 percent of the population could be poor. This estimate is substantially larger than poverty estimates from the (relatively good) 1990s would suggest.

Measuring Vulnerability to Poverty

Work on poverty dynamics, including work on transient poverty, has highlighted the limitations of current static poverty measures (see Baulch and Hoddinott 2000 for a review). In response, researchers are currently developing measures of vulnerability to poverty. These measures, however, remain backward-looking: they describe the past

consequences of shocks and fluctuations. Information on the characteristics of households experiencing poverty transitions may help identify those most at risk for consumption shortfalls, but it does not provide a measure of vulnerability to poverty. Such a measure should be *ex ante* (forward-looking). One could define "vulnerable households" as those liable to fall below an agreed-on poverty line (more than 50 percent below the current poverty rate, for example) with a particular probability. Some nonpoor households could be classified as vulnerable to poverty, whereas some poor households could be classified as not vulnerable to poverty in the future. Christiaensen and Boisvert (2000), Chaudhuri and others (2001), Pritchett and others (2000), and Alwang and others (2001) propose measures. More generally, one could construct measures of vulnerability for different dimensions of poverty (such as health or nutrition) or measures that take into account the extent to which households are likely to fall below the poverty line (Kamanou and Morduch 2002). Vulnerability measures and profiles based on these measures could help policymakers design better policies.

Some researchers have proposed measures based purely on cross-sectional household data (Chaudhuri and others 2001), but the assumptions needed to identify common and idiosyncratic risk are very strong. Panel data have the advantage that recent shocks and responses to risk can be modeled and households less able to cope with risk identified. These data can be used to measure and analyze vulnerability (Amin and others 1999; Dercon and Krishnan 2000b; Kamanou and Morduch 2001).

Quantitative analysis of the effectiveness of households' risk-reducing strategies requires detailed panel data. In the economics literature, most analysis of risk and its consequences in developing countries is based on a handful of data sets, with most stylized facts entering into textbooks based on data from the three villages in south India covered by ICRISAT. It is not realistic to expect this level of detail for many developing economies.

Although more work is needed on detailed panel data sets, household surveys, including cross-sectional surveys, could be used to derive some measures of and insights into vulnerability and the strategies used by households to reduce it. Most panel data studies suggest that vulnerability to shocks is closely linked to human and physical capital assets (Baulch and Hoddinott 2000; Deaton 1997; Jalan and Ravallion 2000). These factors are similar to those identified as determining long-term poverty, although the extent to which they matter is usually different. Households with limited landholdings, few assets that can be liquidated, and limited education are typically most affected by the consequences of income risk. Their more limited ability to deal with risk is reflected in a lower mean level of consumption (due to consumption risk-averting actions, such as income skewing) or higher consumption fluctuations. Most cross-sectional household surveys contain information on physical and human capital, although in recent years some of the instruments promoted for monitoring welfare changes appear to have included fewer of these measures.

The total value of assets alone may not provide sufficient information on the ability to use self-insurance. It may not be possible to liquidate some assets. Other assets

may lose their value during a crisis due to covariate risk. For these reasons, current asset values may not be a good indicator of the ability of an asset to buffer consumption. At the least, information is needed on how well asset and food markets function in times of crisis.

Information on physical and human capital may not be sufficient for another reason. Households may be unable to enter into profitable diversification because of physical and human capital constraints or the lack of opportunity to use their capital. Well-functioning markets, facilitated by infrastructure and demand for the products the poor produced, are just as important. Individuals, for example, may possess the physical capital or skills needed to enter into handicrafts or trade as part of a coping strategy, but they may live in areas that are too remote for them to pursue these activities profitably.

Entry constraints and incentives to skew income toward low-risk activities imply that indexes measuring the degree of diversification (number of activities, share of off-farm income) are unlikely to be good measures of vulnerability. There is, for example, no reason why a household specializing in a low-risk activity faces higher risk than a household having a diversified portfolio of two very risky correlated activities. Furthermore, it is important to look at the income portfolio in conjunction with other risk-coping strategies, including self-insurance and informal insurance. Indeed, one important lesson from the literature surveyed is that the degree of diversification is endogenous to the other strategies used, including self-insurance, irrespective of constraints on diversification

In short, data on physical and human capital, combined with information on the functioning of and opportunities in product, labor, and asset markets, could provide a good basis for identifying vulnerable households. Standard household surveys, including cross-sectional surveys, may include much of the relevant information at the household level.

Data on household involvement in informal insurance systems are also necessary to analyze vulnerability to poverty. The lack of such information is an important shortcoming of most standard household surveys. Understanding vulnerability and designing programs to address these problems require information on the networks households can fall back on. Household surveys could include questions about households' association with other households and whether these associations include any insurance elements. Observing transfers and other linkages is one way of identifying these networks; direct questioning about opportunities for help in times of crisis is another (see De Weerd 2002; Dercon and Krishnan 2000b; Goldstein and others 2002). Simple enumeration of networks may be useful, but care has to be taken not to interpret any linkage or network as proof of the existence of informal insurance mechanisms. Insurance and support networks form part of social capital, but all social capital cannot be assumed to serve insurance purposes.

A full description of the opportunities available to households to cope with shocks also requires information on formal safety nets. All formal safety net programs (including, for example, safety nets provided as part of a social security policy and public employment schemes) need to be taken into account in monitoring vulnerability or designing policy. In addition to the amount of support offered, the timeliness, targeting, and overall impact on household vulnerability need to be considered. Taking these factors into account may reveal that these programs have less impact than they appear to have (Barrett and others 2002; Dercon and Krishnan 2002).

The different forms of capital and the opportunities to use them to reduce consumption risk can be identified by studying how households respond to shocks. It is useful, for example, to ask households how they handled idiosyncratic and common shocks in recent years. Questions could cover the impact of the shocks, whether the household adjusted its income-generating activities, how it used its assets, and whether it could rely on other people for support during the crisis. Households could also be surveyed about how they would respond if particular shocks hit them now. Though qualitative in nature, these direct questions, combined with information on assets, could provide rich information on strategies to cope with risk and could inform policy design (for examples, see De Weerd 2002; Goldstein and others 2002; Udry 1994).

The Effect of Policy on Risk Coping by Poor Households

Economic reform programs are bound to affect the opportunities and the ability of households to cope with risk—and not necessarily in a positive way. Although more economic opportunities or better-functioning asset and product markets are likely to strengthen households' strategies, they may also expose households to other risks. For example, market liberalization could spread local price risk over larger geographical areas, but shocks in other areas would then be reflected in local prices as well.

Even new safety net programs may have unwanted impacts, as a result of imperfect targeting or the crowding out of households not covered by the program. Policy design should require study of the informal links and insurance mechanisms that exist between the targeted group and other vulnerable groups that depend on informal arrangements. In general, if policies cannot be assumed to be exogenous to household behavior and networks, detailed analysis of the shocks experienced by households and the way households cope with income risk should be performed to inform policy. Such work is rarely conducted, however.

Households' ability to cope with risk by using assets and informal insurance can be gauged using both quantitative approaches, such as household surveys, and qualitative approaches, such as participatory assessment (see Moser 1998). The emphasis in both approaches is on monitoring different forms of capital (human, physical, and social) and households' ability to use that capital when necessary. Both types of

methodology view households as managers of complex portfolios of assets and suggest that policy should seek to improve their opportunities to use their assets.

I do not believe, as some researchers have proposed, that only qualitative methods should be used to study vulnerability and risk-coping strategies. Integrating qualitative data collection into quantitative household surveys is likely to yield less contradictory evidence than that provided by studies adopting one approach or the other. National household surveys are likely to be needed to measure the scale of vulnerability and its regional spread and diversity as well as to inform decisions about policies and priorities. The local nature of qualitative studies is likely to provide a more detailed understanding of vulnerability, but the results of such studies are difficult to aggregate and compare across areas.

Conclusion

In this article I examine the different strategies households use to cope with risk. I focus on income-based strategies, the use of assets as self-insurance, and informal insurance arrangements and show that households are constrained in using these strategies. Income-based strategies are limited because of entry constraints into profitable activities, forcing the poor to pursue low-return, low-risk activities. Self-insurance is limited by diminished access to assets and the poor functioning of asset markets when a crisis hits. Informal insurance arrangements are affected by sustainability constraints and often exclude the poor. Such arrangements, moreover, cannot handle economywide shocks

Economic policies could help protect the poor against risk. Macroeconomic stability and better-functioning asset markets would increase the usefulness of self-insurance. Better access to alternative economic activities and increased income-earning opportunities could strengthen income-based strategies. Public safety nets could be a useful alternative, although initiatives to develop such programs should take into account their effect on existing risk-coping strategies. Strengthening self-insurance—through group-based savings, for example—is an alternative that remains insufficiently explored. More empirical research is needed to assess the functioning of informal risk-sharing arrangements and the effect policy interventions may have on them.

Obtaining estimates of the vulnerability to poverty rather than of current poverty is very important and requires panel data. Cross-sectional surveys could also yield useful insights. In particular, they could provide information on the underlying determinants of risk-reducing strategies—physical, human, and social capital. They could also provide information on the risks faced by households and the opportunities they have for dealing with those risks, currently and during past crises. Qualitative studies alone could provide useful insights, but incorporating qualitative research into large quantitative household surveys is likely to yield a deeper understanding of changes in welfare and vulnerability and to better inform policy design.

Notes

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1. The *World Development Report 2000/2001* (World Bank 2001) uses a different classification, distinguishing among risk-reduction, risk-mitigation, and risk-coping strategies. The classification used here follows the economics literature and focuses on welfare outcomes, such as consumption. It distinguishes risk strategies based on whether or not they take income as given.

2. In the basic model, income is also independently identically distributed. This assumption is relaxed in other simulations.

3. This type of risk in returns to assets is not limited to commodity-based assets. The risk of bank failure and a run to withdraw deposits during an economic crisis means that seemingly safe assets are also risky, with covariate returns with incomes.

4. Morduch finds a significant effect on plot diversification but not on a crop diversification index, which may well be linked with some of the points made here.

5. This may happen even if everyone is covered by the safety net, as Attanasio and Rios-Rull (2000) show. Because insurance of some part of the total risk faced by households improves the households' autarky position, it is possible that more than one-to-one crowding out occurs and total welfare is reduced by the safety net. Self-targeted schemes may not necessarily solve the problem because they also affect the individuals' outside options. Of course, the lower the payments in the scheme, the less they will affect the enforceability constraints. This is equivalent to providing less insurance.

6. Indeed, in some traditional societies, this type of group behavior is common. In western Tanzania a community food stock, run by the village head, provides protection for the village when a large-scale crisis occurred (Dercon 1998).

7. Conning and Kevane (2002a, 2002b) discuss some of these problems, including high delegated monitoring costs, norm behavior, and local power relations.

8. This is a problem for nonmonetary dimensions of poverty as well. Alternative welfare measures, such as nutrition, food expenditure, expenditure on specific commodities (such as health or education), and even health or school enrollment, would suffer from the same problem. For evidence on the effect of risk on education and nutrition, see Dercon and Krishnan (2000a), Foster (1995), Jacoby and Skoufias (1997), and Jalan and Ravallion (1998).

9. Risk need not be the only reason for fluctuations in poverty: if credit and asset markets are imperfect, even predictable fluctuations in income may cause fluctuations in consumption and poverty. An example is seasonality.

10. More precisely, given that Jalan and Ravallion (2000) use the squared poverty gap (P_2), the nonpoor in any given year will contribute to poverty in other years.

References

- Albarran, P., and O. Attanasio. 2002. "Do Public Transfers Crowd Out Private Transfers? Evidence from a Randomized Experiment in Mexico." WIDER Discussion Paper DP2002/06. Insurance against Poverty Programme, World Institute for Development Economics Research, Helsinki.
- Alderman, H. 1998. "Saving and Economic Shocks in Rural Pakistan." *Journal of Development Economics* 51(2):343–66.

- Alderman, H., and C. Paxson. 1994. "Do the Poor Insure? A Synthesis of the Literature on Risk and Consumption in Developing Countries." In D. Bacha, ed., *Economics in a Changing World*. Vol. 4: *Development, Trade and the Environment*. London: Macmillan.
- Alwang, J., P. Siegel, and S. Jorgensen. 2001. "Vulnerability: A View from Different Disciplines." SP Discussion paper. World Bank, Social Protection Unit, Human Development Network. Washington, D.C.
- Amin, S., A. Roi, and G. Topa. 1999. "Does Microcredit Reach the Poor and Vulnerable? Evidence from Northern Bangladesh." CID Working Paper No. 28. Harvard University, Cambridge, Mass.
- Attanasio, O., and J. Rios-Rull. 2000. "Consumption Smoothing in Island Economies: Can Public Insurance Reduce Welfare?" *European Economic Review* 44(7):1259–79.
- Barrett, C.B., D. Clay, and S. Holden. 2002. "Food-for-Work Programs as Safety Nets." WIDER Discussion Paper DP2002/25. Insurance against Poverty Programme, World Institute for Development Economics Research, Helsinki.
- Baulch, B., and J. Hoddinott. 2000. "Economic Mobility and Poverty Dynamics in Developing Countries." *Journal of Development Studies* 36(6):1–24.
- Behrman, J. 1988. "Intrahousehold Allocation of Nutrients in Rural India: Are Boys Favored? Do Parents Exhibit Inequality Aversion?" *Oxford Economic Papers* 40(1):32–54.
- Behrman, J., and A. Deolalikar. 1990. "The Intrahousehold Demand for Nutrients in Rural South India: Individual Estimates, Fixed Effects, and Permanent Income." *Journal of Human Resources* 25(4):665–96.
- Bell, C. 1988. "Credit Markets, Contracts, and Interlinked Transactions." In H. Chenery and T. N. Srinivasan, eds., *Handbook of Development Economics*. Vol. 1. Amsterdam: North Holland.
- Besley, T. 1994. "Savings, Credit, and Insurance." In J. Behrman and T. N. Srinivasan, eds., *Handbook of Development Economics*. Vol. 3A. Amsterdam: North Holland.
- . 1995. "Nonmarket Institutions for Credit and Risk Sharing in Low-Income Countries." *Journal of Economic Perspectives* 9(3):115–27.
- Bevan, D., P. Collier, and J. W. Gunning. 1991. *Peasants and Governments*. Oxford: Oxford University Press.
- Binswanger, H., and J. McIntire. 1987. "Behavioral and Material Determinants of Production Relations in Land-Abundant Tropical Agriculture." *Economic Development and Cultural Change* 36(1):73–99.
- Bliss, C., and N. Stern. 1982. *Palanpur: The Economy of an Indian Village*. Oxford: Oxford University Press.
- Chaudhuri, S., and C. Paxson. 1994. "Consumption Smoothing and Income Seasonality in Rural India." Discussion Paper 173. Princeton University, Research Program in Development Studies, Princeton, N.J.
- Chaudhuri, S., J. Jalan, and A. Suryahadi. 2001. "Assessing Household Vulnerability to Poverty: A Methodology and Estimates for Indonesia." Columbia University, Department of Economics, New York.
- Christiaensen, L., and R. Boisvert. 2000. "On Measuring Households' Food Vulnerability: Case Evidence from Northern Mali." Working Paper 2000–05, Cornell University, Department of Agricultural, Resource, and Managerial Economics, Ithaca, N.Y.
- Coate, S., and M. Ravallion. 1993. "Reciprocity without Commitment: Characterization and Performance of Informal Insurance Arrangements." *Journal of Development Economics* 40(1):1–24.
- Conning, J., and M. Kevane. 2002a. "Community-Based Targeting Mechanisms for Social Safety Nets." *World Development* 30(3):375–94.
- . 2002b. "Why Isn't There More Financial Intermediation in Developing Countries?" WIDER Discussion Paper DP2002/28. World Institute for Development Economics Research, Insurance against Poverty Programme, Helsinki.
- Cox, D., and E. Jimenez. 1992. "Social Security and Private Transfers in Developing Countries: The Case of Peru." *World Bank Economic Review* 6(1):115–69.

- Czukas, K., M. Fafchamps, and C. Udry. 1998. "Drought and Saving in West Africa: Are Livestock a Buffer Stock?" *Journal of Development Economics* 55(2):273–305.
- Davies, S. 1996. *Adaptable Livelihoods*. London: Macmillan.
- Deaton, A. 1991. "Savings and Liquidity Constraints." *Econometrica* 59(5):1221–48.
- . 1992. "Household Saving in LDCs: Credit Markets, Insurance, and Welfare." *Scandinavian Journal of Economics* 94(2):253–73.
- . 1997. *The Analysis of Household Surveys: A Microeconomic Approach*. Baltimore, Md.: Johns Hopkins University Press.
- Dercon, S. 1996. "Risk, Crop Choice, and Savings: Evidence from Tanzania." *Economic Development and Cultural Change* 44(3):385–514.
- . 1998. "Wealth, Risk, and Activity Choice: Cattle in Western Tanzania." *Journal of Development Economics* 55(1):1–42.
- . 2000. "Income Risk, Coping Strategies and Safety Nets." Working Paper WPS/2000.26. Oxford University, Centre for the Study of African Economies, Oxford.
- . 2002. *The Impact of Economic Reforms on Rural Households in Ethiopia: A Study from 1989–1995*. Washington, D.C.: World Bank.
- Dercon, S., and P. Krishnan. 1996. "Income Portfolios in Rural Ethiopia and Tanzania: Choices and Constraints." *Journal of Development Studies* 32(6):850–75.
- . 2000a. "In Sickness and in Health: Risk-Sharing within Households in Ethiopia." *Journal of Political Economy* 108(4):688–727.
- . 2000b. "Vulnerability, Seasonality, and Poverty in Ethiopia." *Journal of Development Studies* 36(6):25–53.
- . 2002. "Informal Insurance, Public Transfers and Consumption Smoothing." Oxford University, Department of Economics, Oxford.
- De Waal, A. 1987. *Famines That Kill: Darfur Sudan 1984–85*. Oxford: Clarendon.
- De Weerd, J. 2002. "Risk Sharing and Endogenous Group Formation." WIDER Discussion Paper DP2002/57. World Institute for Development Economics Research, Insurance against Poverty Programme, Helsinki.
- Eswaran, M., and A. Kotwal. 1989. "Credit as Insurance in Agrarian Economies." *Journal of Development Economics* 31(1):37–53.
- Fafchamps, M. 1999. "Rural Poverty, Risk, and Development." FAO Economic and Social Development Paper No.144. Food and Agricultural Organization, Rome.
- . 2002. "Inequality and Risk." WIDER Discussion Paper DP2002/07. World Institute for Development Economics Research, Insurance against Poverty Programme, Helsinki.
- Fafchamps, M. and S. Lund. Forthcoming. "Risk-Sharing Networks in Rural Philippines." *Journal of Development Economics*.
- Foster, A. D. 1995. "Prices, Credit Markets, and Child Growth in Low-Income Rural Areas." *Economic Journal* 105(430):551–70.
- Frankenberg, E. 1999. "The Real Costs of Indonesia's Economic Crisis." Working paper. RAND, Santa Monica, Calif.
- Gaiha, R., and A. Deolalikar. 1993. "Persistent, Expected and Innate Poverty: Estimates for Semi-Arid Rural South India 1975–1984." *Cambridge Journal of Economics* 17(4):409–21.
- Gertler, P., and J. Gruber. 2002. "Insuring Consumption against Illness." *American Economic Review* 92(1):51–70.
- Grimard, F. 1997. "Household Consumption Smoothing through Ethnic Ties: Evidence from Côte d'Ivoire." *Journal of Development Economics* 53(2):391–422.

- Goldstein, M., A. de Janvry, and E. Sadoulet. 2002. "You Can't Always Get What You Want: Inclusion and Exclusion in Mutual Insurance Networks in Southern Ghana." WIDER Discussion Paper DP2002/25. World Institute for Development Economics Research, Insurance against Poverty Programme, Helsinki.
- Hayashi, F., J. Altonji, and L. Kotlikoff. 1996. "Risk-Sharing between and within Families." *Econometrica* 64(2):261-94.
- Hoff, K. 1996. "Informal Insurance Schemes: An Equilibrium Analysis." World Bank, Development Research Group, Washington, D.C.
- Jacoby, H., and E. Skoufias. 1997. "Risk, Financial Markets, and Human Capital in a Developing Country." *Review of Economic Studies* 64(3):311-35.
- Jalan, J., and M. Ravallion. 2000. "Is Transient Poverty Different? Evidence from Rural China." *Journal of Development Studies* 36(6):82-99.
- . 2001. "Behavioral Responses to Risk in Rural China." *Journal of Development Economics* 66(1):23-49.
- Kamanou, G., and J. Morduch. 2002. "Measuring Vulnerability to Poverty." WIDER Discussion Paper DP2002/58. World Institute for Development Economics Research, Insurance against Poverty Programme, Helsinki.
- Kinsey, B., K. Burger, and J. W. Gunning. 1998. "Coping with Drought in Zimbabwe: Survey Evidence on Responses of Rural Households to Risk." *World Development* 26(1):89-110.
- Kochar, A. 1995. "Explaining Household Vulnerability to Idiosyncratic Income Shocks." *AEA Papers and Proceedings, American Economic Review* 85(2):159-63.
- Ligon, E. 2002. "Targeting and Informal Insurance." WIDER Discussion Paper DP2002/8. World Institute for Development Economics Research, Insurance against Poverty Programme, Helsinki.
- Ligon, E., J. Thomas, and T. Worrall. 2002. "Informal Insurance with Limited Commitment: Theory and Evidence from Village Economies." *Review of Economic Studies* 69(1):209-44.
- Lim, Y., and R. Townsend. 1994. "Currency, Transaction Patterns, and Consumption Smoothing: Theory, and Measurement in ICRISAT Villages." University of Chicago, Department of Economics.
- Lustig, N., ed. 2001. *Shielding the Poor. Social Protection in the Developing World*. Washington, D.C.: Brookings Institution Press.
- Morduch, J. 1990. "Risk, Production, and Saving: Theory and Evidence from Indian Households." Harvard University, Department of Economics, Cambridge, Mass.
- . 1995. "Income Smoothing and Consumption Smoothing." *Journal of Economic Perspectives* 9(3):103-14.
- . 1999. "Between the State and the Market: Can Informal Insurance Patch the Safety Net?" *World Bank Research Observer* 14(2):187-207.
- . 2002. "Consumption Smoothing across Space: Tests for Village-Level Responses to Risk." WIDER Discussion Paper DP2002/55. World Institute for Development Economics Research, Insurance against Poverty Programme, Helsinki.
- Moser, C. 1998. "The Asset Vulnerability Framework: Reassessing Urban Poverty Reduction Strategies." *World Development* 6(1):1-19.
- Paxson, C. 1993. "Consumption and Income Seasonality in Thailand." *Journal of Political Economy* 101(1):39-72.
- Platteau, J.-P. 1997. "Mutual Insurance as an Elusive Concept in Traditional Rural Communities." *Journal of Development Studies* 6(33):764-96.
- Pritchett, L., A. Suryahadi, and S. Sumarto. 2000. "Quantifying Vulnerability to Poverty: A Proposed Measure, Applied to Indonesia." Policy Research Working Paper 2437. World Bank, Washington, D.C.

- Rahmato, D. 1991. *Famine and Survival Strategies, A Case Study from Northeast Ethiopia*. Uppsala: Nordiska Afrikainstitutet.
- Ravallion, M. 1988. "Expected Poverty under Risk-Induced Welfare Variability." *Economic Journal* 98(393):1173–83.
- Reardon, T. 1997. "Using Evidence of Household Income Diversification to Inform Study of the Rural Nonfarm Labor Market in Africa." *World Development* 25(5):735–47.
- Reardon, T., C. Delgado, and P. Matlon. 1988. "Coping with Household-Level Food Insecurity in Drought-Affected Areas of Burkina Faso." *World Development* 16(9):1148–70.
- Reardon, T., A. A. Fall, V. Kelly, C. Delgado, P. Matlon, J. Hopkins, and O. Badiane. 1994. "Is Income Diversification Agriculture-Led in the West African Semi-Arid Tropics?" In A. Atsain, S. Wangwe, and A. G. Drabek, eds., *Economic Policy Experience in Africa: What Have We Learned*. Nairobi: African Economic Research Consortium.
- Rose, E. 1999. "Consumption Smoothing and Excess Female Mortality in Rural India." *Review of Economics and Statistics* 81(1):41–49.
- Rosenzweig, M. 1988. "Risk, Implicit Contracts, and the Family in Rural Areas of Low-Income Countries." *Economic Journal* 98(393):1148–70.
- Rosenzweig, M., and H. Binswanger. 1993. "Wealth, Weather Risk, and the Composition, and Profitability of Agricultural Investments." *Economic Journal* 103(416):56–78.
- Rosenzweig, M., and K. Wolpin. 1993. "Credit Market Constraints, Consumption Smoothing, and the Accumulation of Durable Production Assets in Low-Income Countries: Investment in Bullocks in India." *Journal of Political Economy* 101(2):223–44.
- Sen, A. 1981. *Poverty and Famines*. Oxford: Clarendon.
- Thomas, D., K. Beegle, E. Frankenberg, B. S. Ikoki, J. Strauss, and G. Teruel. 2001. "Education in a Crisis." Working paper. RAND and UCLA, Santa Monica, Calif.
- Townsend, R. M. 1994. "Risk and Insurance in Village India." *Econometrica* 62(3):539–91.
- . 1995. "Consumption Insurance: An Evaluation of Risk-Bearing Systems in Low-Income Economies." *Journal of Economic Perspectives* 9(3):83–102.
- Udry, C. 1991. "Credit Markets in Northern Nigeria: Credit as Insurance in a Rural Economy." *World Bank Economic Review* 4(3):251–71.
- . 1994. "Risk and Insurance in a Rural Credit Market: An Empirical Investigation of Northern Nigeria." *Review of Economic Studies* 61(3):495–526.
- World Bank. 2001. *World Development Report 2000/2001: Attacking Poverty*. Washington, D.C.

The Gender Implications of Public Sector Downsizing: The Reform Program of Vietnam

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Using data from Vietnam, this article describes several types of analysis that could be conducted before launching a major downsizing operation to identify possible gender effects. It draws several conclusions about Vietnam's downsizing reforms. First, although women's prospects of obtaining salaried jobs following displacement from state-owned enterprise worsened as a result of recent reforms, they are likely to improve in the near future. Second, reforms are associated with a sharp decline in the gender gap in earnings, both in and outside the state sector. Third, overstaffing is greatest in sectors in which most employees are men, such as construction, mining, and transportation; it is much less prevalent in sectors in which women dominate the work force, such as footwear, textiles, and garments. Fourth, training and assistance programs currently in place to help redundant workers reveal no evidence of strong gender bias. Fifth, severance packages based on a multiple of earnings are more favorable to men, whereas lump-sum packages favor women.

A comprehensive economic reform program is likely to affect men and women differently. Some of the effects may be indirect. Moving from central planning to a market economy may change the labor market payoffs to education, for example, which could affect men and women differently given different levels of educational attainment. Trade liberalization may change the composition of labor demand and hence the gender structure of employment.

Other effects are much more direct, especially when the reform program includes massive public sector downsizing. The burden of job separations may not be borne evenly by male and female workers. The welfare impact of these separations could also differ by gender.

It is increasingly accepted that policymaking has to pay attention to social impacts, including those on gender. The conceptual framework and the information

needed to predict the gender impact of reform programs in general and public sector downsizing in particular are often lacking, however.

Gender issues have been the focus of much research in industrial countries. Much less is known about gender issues in developing and transition economies. At the risk of simplifying, the scant literature on the gender implications of economic reforms, especially of public sector downsizing, can be summarized by four hypotheses. Empirical support for each of these hypotheses varies, but in no case is it strong.

The first hypothesis suggests that reforms aimed at shifting the economy from central planning and self-reliance to market orientation and exposure to international markets should improve women's prospects for salaried employment. Women should benefit because capital-intensive heavy industries are more likely to employ men, whereas labor-intensive light industries are more likely to employ women. Heavy industries are favored by state-led development strategies as symbols of national pride and self-reliance. Capital-intensive industries are also promoted by import-substitution policies, which shift the allocation of resources away from a developing economy's comparative advantage, namely, unskilled labor. In contrast, export-oriented growth relies on light, labor-intensive industries. Support for the hypothesis that economic reforms are associated with a feminization of employment is provided mainly by the East and South Asian experiences (World Bank 2001).

The second hypothesis posits that economic reforms may affect the gender gap in labor earnings, although the sign of this effect is ambiguous a priori. A frequent outcome of the transition to a more market-oriented economy has been the decompression of labor earnings in general and wages in particular. This decompression results from increases in the market returns to various skills and productivity characteristics. If women have less education than men, the gender gap in labor earnings could increase. This phenomenon has been observed in the Russian Federation and Ukraine (Rodgers 1999). But economic reforms also reduce the scope for employers to discriminate against women. Faced with increased competition, employers have a stronger incentive to hire lower-priced female labor, which should reduce the gender gap in earnings. The experience of Mexico during a recent period of trade liberalization is consistent with this hypothesis (Artecona and Cunningham 2001).

The third hypothesis is that women may suffer a larger drop in total compensation as a result of downsizing. The gender gap in labor earnings tends to be smaller in the public sector, implying a larger loss (in relative terms) for displaced female workers. The gender gap in private-sector earnings has been documented by several studies of developing economies (Psacharopoulos and Tzannatos 1992; Appleton and others 1999). Other studies have tried to estimate the drop in earnings of men and women following public sector downsizing (Mason 1997; Rama 1999). Downsizing of the public sector may also hurt women more than men because the public sector usually offers benefits that are highly valued by women, such as maternity leave, more flexible working hours, and child care facilities. These benefits are less

common in the private sector. They are generally not offered in the informal sector, where many displaced workers end up. The loss in total compensation experienced by women is thus potentially larger than the more easily measurable loss in earnings.

The fourth hypothesis suggests that women are more likely than men to withdraw from the labor force after downsizing. Women's earnings fall markedly, and many displaced women have no earnings at all. However, labor force withdrawal is sometimes voluntary. A tracer study of displaced Central Bank employees in Ecuador found that the earnings loss was significantly larger for women than for men (Rama and MacIsaac 1999). The study also included questions on subjective well-being, taking into account the compensation received, the increase in leisure time associated with withdrawal from the labor force, and other adjustments in the life of the household following job separation. Taking these factors into account, the net change in well-being was not significantly different for men and women.

Although these hypotheses provide interesting insights on the expected gender impacts of economic reforms, especially of public sector downsizing, they are not detailed enough to inform economic policy in a particular country at a particular time. Depending on the magnitude of the gender impact on employment, earnings, and well-being, special policy measures may be needed, such as programs targeting women who lose jobs as a result of downsizing. Policy adjustments may also need to be made to aspects of the economic reform program that appear to be gender-neutral but actually have different impacts on men and women.

This article describes some of the types of analysis that could be conducted before launching a public sector downsizing program to assess gender impact. These analyses seek to predict how trends in salaried employment by gender will be affected by the reform program, quantify the potential changes in the gender gap in labor earnings, evaluate job losses by gender, and assess whether programs to assist and compensate redundant workers affect the well-being of men and women differently. Some of these analyses rely on little more than educated conjectures; others require rigorous quantitative work. Despite their weaknesses, they may provide a useful picture of the effects of public sector downsizing.

When the article was written, the Vietnamese government was about to launch a massive reform program that will involve the liquidation, divestiture, or restructure of up to 5,740 state-owned enterprises over a decade. About 1.68 million workers (roughly 5 percent of the labor force) worked in state-owned enterprises, and about 450,000 of them were expected to lose their jobs (Belser and Rama 2001); many others were expected to take early retirement. The research for this article was originally conducted as input for this reform program, which could in principle have disproportionately affected women.

The specific findings reported herein may not hold in other countries, where public sector downsizing could have different gender implications. The article should be viewed as a template with which policymakers can assess gender implications before

introducing a policy. Household- and enterprise-level data similar to those used here are widely available in other developing and transition economies. The use of this template could thus be generalized, even if its specific results should not be.

The article can also be seen as an illustration of a broader trend toward the ex ante evaluation of economic programs or policies. Most evaluations are implemented after a program or policy has been in effect for a while, using tracer surveys of affected households or enterprises. Although ex post evaluations are potentially more accurate, evaluating a program after it is in place often means that major mistakes or biases are corrected only several years down the road, if at all. A natural complement to ex post evaluations is the ex ante simulation, using microeconomic data, of the potential impact of the programs or policies under consideration.

Impact of Reform on Salaried Employment

The effects of previous reforms in Vietnam should shed light on the possible effects of its current reform program. In 1986 the Sixth National Congress of the Communist Party adopted the Doi Moi, or renovation process. Since then several reform policies have been implemented and the country has been moving steadily from a centrally planned to a market-oriented economy.

In 1991 the pace of reform was dramatically accelerated by the disintegration of the Soviet Union, which entailed the loss of Vietnam's main trading partner and aid provider. The result was a collapse in economic growth and high inflation, which peaked at about 450 percent a year. Confronted with this situation, the government launched a massive restructuring of loss-making state-owned enterprises, leading to the displacement of about a third of the public enterprise work force.

Studies of the condition of women in Vietnam can help analyze the gender impact of these reforms (see the overview by Long and others 2000 and the comprehensive bibliography by Pham 2000). Those studies do not always allow the effects of economic reforms to be disentangled from those of other, more permanent factors affecting gender relations. Even so, they prove interesting when combined with data on employment from the 1992–93 and 1997–98 rounds of the Vietnam Living Standards Survey.

A striking fact that emerges from the Vietnam Living Standards Survey data is the slow growth of salaried employment among women relative to men. This fact is at odds with the first hypothesis about the gender implications of economic reforms, according to which women should face better employment prospects than men do. This employment pattern is not due to a decline in female participation rates, as observed in many countries in Eastern Europe and the former Soviet Union. Labor force participation rates are very high for women in Vietnam, and they increased during the 1990s (table 1). At the end of the decade, the percentage of women of working age who were employed was almost the same as the percent-

Table 1. Economic Activities of Working-Age Population in Vietnam, by Gender, 1992–93 and 1997–98 (percent)

Status	1992–93			1997–98		
	Female	Male	Total	Female	Male	Total
Active	83.86	87.85	85.74	85.44	86.92	86.14
Employed	80.91	84.49	82.59	83.73	84.79	84.23
Unemployed	2.95	3.37	3.15	1.71	2.13	1.91
Not active	16.14	12.15	14.26	14.56	13.08	13.86
Attending school	2.12	3.71	2.87	6.27	8.58	7.37
Housekeeping	3.97	0.22	2.20	3.71	0.23	2.05
Other	10.06	8.21	9.19	4.58	4.28	4.43

Note: Working-age population includes everyone between ages of 15 and 64.

Source: Bales (2000).

age of men. Moreover, women were less likely than men to be unemployed. Still, the number of women in wage employment expanded at a much slower pace than the number of men, growing 10.1 percent between 1992–93 and 1997–98, compared to 25.6 percent for men.

A natural candidate to explain this trend is the massive downsizing program of the early 1990s. The total number of employees in the state sector was reduced from 3.86 million in 1985 (about 15 percent of the labor force) to 2.92 million in 1992 (9 percent). Because public sector jobs account for a larger share of wage employment among women than among men, even a gender-neutral downsizing would lead to a larger drop in wage employment (in relative terms) for women than for men. This downsizing was not gender-neutral: about 70 percent of the displaced workers were female. In 1990–91 alone some 553,000 female workers at state-owned enterprises, representing 19.7 percent of all female wage employment in 1992–93, were laid off (Beresford 1994).

Over time, however, downsizing in Vietnam is likely to improve women's prospects of obtaining salaried employment. In 1998 state-owned enterprises represented 46.2 percent of industrial GDP but just 24.2 percent of industrial employment. In contrast, private manufacturing firms were clearly labor-intensive and export-oriented (Belser 2000). Vietnam's economic reform program should lead to a gradual contraction of the public sector and a rapid expansion of the private manufacturing sector. Belser estimates that given Vietnam's endowment of natural and human resources, manufacturing exports could triple over a five-year period, generating on average about 300,000 direct jobs a year. Jobs in exporting firms often come with the benefits associated with participation in the formal sector of the economy.

A majority of the jobs to be created as a result of the reform program could be held by women. A survey of 1,294 enterprises carried out by the Ministry of Labor, Inva-

lids and Social Affairs (1998) provides valuable insights in this respect. The sample included 408 state-owned enterprises, 761 private firms, and 125 enterprises with foreign investment capital. The sample was not intended to be representative, and all of the enterprises in it were presumably formal. An interesting finding of this survey is that the highest proportion of female workers is found in private firms (55.6 percent), followed by enterprises with foreign investment capital (48.8 percent). The lowest proportion of women, 39.7 percent, is found in state-owned enterprises. This ranking is observed despite a government policy that encourages state-owned enterprises to employ as many female workers as possible (International Labour Office [ILO] 1998). If the ranking holds over time, an expansion of private firms and enterprises with foreign investment capital and a contraction of the state sector should lead to better employment opportunities for women.

Impact on Labor Earnings

Mincerian equations, or earnings functions, are useful tools with which to assess the impact of economic reforms on the gender gap in labor earnings. These functions, usually estimated using individual records from household surveys, link (the log of) labor earnings to individual characteristics, such as educational attainment, work experience, or region of residence. Earnings functions can be estimated separately for men and women, decomposing the gender gap into two effects: differences in endowments (for example, educational attainment) and differences in the returns to those endowments. An intuitively simpler way to assess the gender gap is to estimate the earnings function by pooling workers of both sexes but including a gender dummy among the explanatory variables. The coefficient multiplying this variable indicates whether two workers of different genders with the same average educational attainment, experience, and so forth have different earnings.

Coefficients of these simple earnings functions were estimated at two points during the reform process, using individual records for salaried workers of both genders obtained from the 1992–93 and 1997–98 rounds of the Vietnam Living Standards Survey (table 2). Many factors may have changed between these two periods. Differences in the skill composition of the labor force, the terms of trade faced by the country, the world interest rate, or even weather conditions could account for some of the change in the coefficients. But the effects of these exogenous differences are probably dwarfed by those of the economic reforms launched under the Doi Moi.

The earnings functions reported in table 2 do not correct for potential self-selection biases. Women who hold salaried jobs could be different in some systematic way from other women. They could, for example, be more talented. More talented workers are also likely to have higher educational attainment. Earnings functions could attribute to educational attainment what is in reality due to talent, thus biasing upward the

Table 2. Determinants of Wage Earnings in Vietnam, 1992–93 and 1997–98

Explanatory variable	Dependent variable: Log of total earnings in main occupation			
	1992–93		1997–98	
	State-owned enterprises	Private firms	State-owned enterprises	Private firms
Female (yes = 1)	-0.3399*** (-5.222)	-0.4919*** (-10.329)	-0.2047*** (-4.810)	-.3025*** (-8.096)
Education (in years)	0.0272*** (2.737)	0.0234*** (2.755)	0.0363*** (3.575)	0.0398*** (6.031)
Work experience (in years)	0.0017 (0.146)	0.0229*** (2.846)	0.0001 (0.387)	0.0175*** (3.097)
Work experience squared	0.0003 (0.922)	-0.0005*** (-3.498)	0.0001 (0.387)	-0.0005*** (-4.976)
Married (yes = 1)	0.0938 (0.962)	-0.0955 (1.257)	0.1847*** (3.196)	0.0990** (2.135)
Household head (yes = 1)	-0.0320 (-0.419)	0.0548 (0.843)	0.0474 (0.777)	-0.0043 (-0.093)
Ethnic and religion dummies	Yes	Yes	Yes	Yes
Urban dummies	Yes	Yes	Yes	Yes
Regional dummies	Yes	Yes	Yes	Yes
Community characteristics	Yes	Yes	Yes	Yes
R ²	0.376	0.217	0.370	0.284
F-test	330.76	14.90	20.57	17.53
Number of observations	340	1342	566	1921

*Significant at the 10 percent level.

**Significant at the 5 percent level.

***Significant at the 1 percent level.

Note: Values in parentheses are *t*-statistics.

Source: Author's calculations based on individual records of wage earners in the Vietnam Living Standards Surveys.

corresponding coefficient. And the coefficients on other individual characteristics could be biased as well. If the self-selection bias is stable over time, however, the comparison between the coefficients obtained for 1992–93 and 1997–98 should still be informative regarding the changes caused by economic reforms.

Moreover, careful analysis of the data reveals no evidence of self-selection bias. The econometric techniques used to assess this bias rely on assumptions about the self-selection mechanism at work. They are likely to be effective only if one or several variables exist that affect the selection into salaried work but not labor earnings. Some household characteristics could play this role. For instance, having children to care for might affect the decision to work (either for a salary or independently), but it should not affect the earnings of those who do work. Re-estimating the 1992–93 and 1997–98 earnings functions using the Heckman selectivity correction with the number of

children as an additional explanatory variable does not produce results that differ much from those reported in table 2.

According to the second hypothesis emerging from the literature, an increase in the returns to education should be expected. In Vietnam this increase is observable in both state-owned enterprises and the private sector, as shown by the coefficients multiplying the education variable in table 2. Although returns to education appear to be substantially lower than in other countries, they almost doubled over a five-year period. In the private sector the contribution of each additional year of education to earnings increased from 2.34 percent to 3.98 percent between 1992–93 and 1997–98. Because women have lower levels of education than men, this decompression of earnings must have reduced their earnings relative to men. This effect is probably small, however, because the difference in average levels of education between men and women is only about one year. The earnings decompression could then be associated with an increase in the earnings gender gap of less than two percentage points.

In contrast, the 1990s witnessed a substantial decline in the gap in earnings between men and women, as measured by the coefficient multiplying the gender dummy variable. As expected, the gender gap in earnings is larger in the private sector than it is in the public sector (table 2). But the gap declined dramatically in both sectors. Other things equal, in 1992–93 female workers in the private sector earned 38.9 percent less ($[\exp(-0.4919)-1] * 100$) than male workers. By 1997–98 the gap had shrank to 26.1 percent ($[\exp(-0.3025)-1] * 100$). The trend is similar in state-owned enterprises, with the gap falling from 28.8 to 18.5 percent. This second effect more than offsets the effect of increased returns to education. The reforms launched under the Doi Moi have thus reduced the gender gap in earnings, a trend that can be expected to continue with the new wave of reforms.

The comparisons in table 2 refer to wage earners only, as data on the earnings of the self-employed were not available. Few of the women who lost their jobs in state-owned enterprises are likely to have found salaried jobs, and many ended up doing unpaid work. The figures in table 3 were constructed by Rodgers (1999), using data from the 1992–93 round of the Vietnam Living Standards Survey. That survey contains detailed information on employment at the time of the survey, over the previous 12 months, and 12 to 24 months before the survey. Many workers at state-owned enterprises lost their jobs before the survey was administered; the recall questions on employment history, however, cover at least some of the retrenchment period.

During the first 12 months after a job change, many more women than men withdrew from the labor force (table 3). To a large extent, this withdrawal appears to be voluntary, as unemployment rates are low for all groups. Only 1.3 percent of the women who left jobs in the public sector reported having sought work subsequently. At first glance, this result is consistent with the fourth hypothesis on the gender impact of economic reforms in developing economies. It is possible that displaced women

Table 3. Activity Following Public Sector Retrenchment in Vietnam, 1991
(percent)

Previous job	Gender	Activity at time of survey			
		Unpaid work	Paid work	Seeking work	Out of labor force
<i>Up to 12 months after job switch</i>					
In public sector	Female	47.5	8.8	1.3	42.5
	Male	52.8	11.3	0.0	35.8
In other sector	Female	21.5	10.4	2.4	65.7
	Male	23.1	27.5	3.4	46.0
<i>More than 12 months after job switch</i>					
In public sector	Female	74.0	14.3	1.3	10.4
	Male	70.0	22.4	0.4	7.2
In other sector	Female	71.3	18.1	0.3	10.3
	Male	63.9	27.3	0.7	8.1

Source: Adapted from Rodgers (1999).

took the opportunity to spend more time with their families, supporting household consumption with the separation package they received. This is just a conjecture, however; the Vietnam Living Standards Survey does not include enough information with which to support or reject it.

Whatever the reason for the labor force withdrawal, it was temporary. After 12 months, the levels of men and women out of the labor force declined substantially, returning to the shares observed for the population at large (table 1). Based on the experience of the early 1990s, it is thus unlikely that the latest downsizing reforms will have a lasting effect on the labor force participation rate of women.

The decline in the share of workers out of the labor force observed after 12 months is largely associated with an increase in unpaid work (table 2). Unpaid work is the main activity of most of those who changed jobs, whether the jobs they left were in the public sector or not. The share of unpaid work is roughly twice as large 12 months after a job change than within the first 12 months. Paid work remains more prevalent among men than among women, even after 12 months, regardless of whether the previous job was in the public sector.

Impact of Reform on Job Losses

Vietnam's public sector downsizing in the early 1990s disproportionately affected women. Will this be the case in the early twenty-first century? According to Hyun and others (2000), the gender division of labor in these industries would remain largely unchanged if they were privatized. There are some grounds to share this con-

clusion. Individual records from a sample from the 1997–98 round of the Vietnam Living Standards Survey show that the average characteristics of men and women employed in state-owned enterprises are similar (table 4). The sample contains 451 people whose main source of employment was a state-owned enterprise. Although the sample was not drawn proportionally, there is no reason to believe that its sampling fractions were correlated with the individual characteristics of workers at state-owned enterprise. Therefore, the figures reported in table 4 are nonweighted averages across those 451 people.

Female workers differ from male workers at state-owned enterprise workers in two main respects. First, and not surprisingly, women earn less than men. The annual basic salary is more than 1 million dong (US\$67) lower for women than for men. When bonuses, allowances, and payments in kind are taken into account, the gap climbs to roughly 2 million dong (\$133). It widens by an extra half-million dong (\$33) when extra earnings in secondary and tertiary occupations are considered as well. Given the similarity of average age, education, and seniority, this difference confirms the existence of a gender gap in labor earnings, as suggested by the regressions in table 2. Second, men are more likely than women to be married.

These two differences could have opposite effects on the probability of being declared redundant. Other things equal, female workers are less expensive than male workers. From a purely economic perspective, it could therefore be in the enterprise's interest to cut male employment first. The interest could even be stronger for the new private owners, who might be more profit-oriented than public-sector managers. Alternatively, males workers may be less likely to be laid off because employers, recognizing that men are more likely than women to have dependents, may be more reluctant to fire them; from a social perspective state-owned enter-

Table 4. Characteristics of Workers in State-Owned Enterprises in Vietnam, 1997–98

<i>Variable</i>	<i>Female</i>	<i>Male</i>	<i>All</i>
Age (years)	35.0	37.0	36.0
Married (percent)	58.5	71.7	66.1
Household size	5.3	5.1	5.2
Education (years)	11.0	11.2	11.1
Vocational training (years)	0.7	0.8	0.8
Seniority in state-owned enterprise (years)	10.7	9.5	10.0
Basic annual salary in state-owned enterprise (thousands of dongs)	7,311	8,652	8,078
Total annual earnings in state-owned enterprise (thousands of dongs)	8,544	10,456	9,638
Total annual earnings in all jobs (thousands of dongs)	10,000	12,568	11,469
Percentage of total of workers	42.8	57.2	100.0

Note: Refers to workers whose main occupation was in a state-owned enterprise at the time of the 1997–98 Vietnam Living Standards Survey. Earnings figures are adjusted to December 1999 prices.

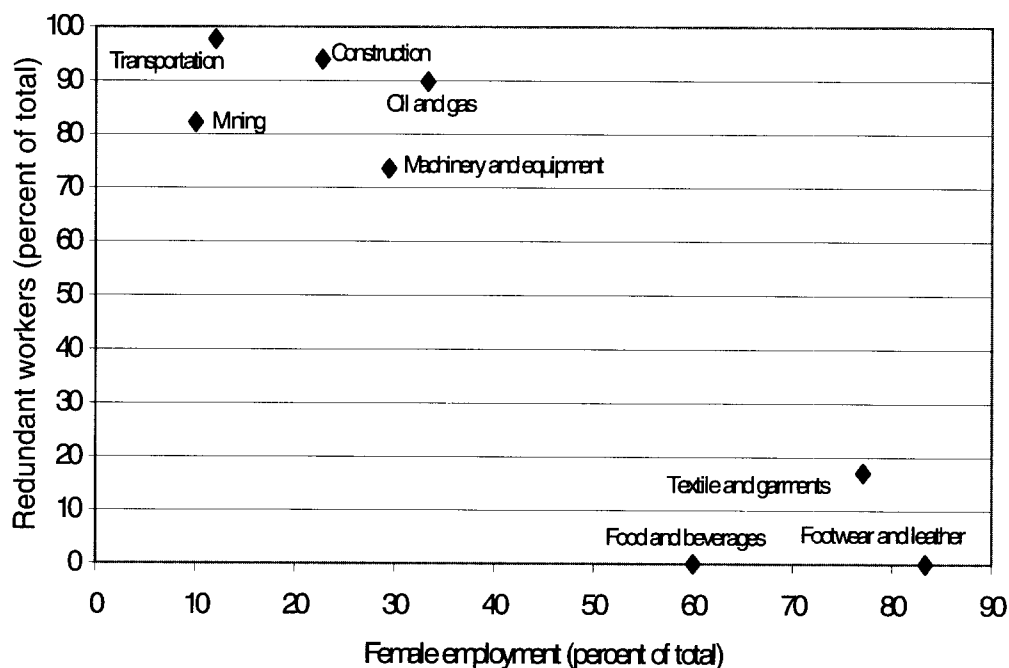
Source: Author's calculations based on the 1997–98 Vietnam Living Standards Survey.

prises (and even the new private owners) may therefore prefer to lay off women first. It is difficult to tell a priori whether the economic or the social considerations will dominate.

It is not possible to analyze the link between labor redundancy and gender at a disaggregated level, unfortunately, because there are no matched data for enterprises and individuals in Vietnam. In particular, none of the enterprise databases provides a breakdown of employment by gender. However, data for enterprises and individuals can be matched at the sector level. The female share of employment by sector of activity is estimated based on the 451 people in the 1997–98 round of the Vietnam Living Standards Survey whose main employer was a state-owned enterprise. The source of the data is thus the same as in table 4. The female share of employment was in turn matched to sectoral indicators of labor redundancy, estimated using enterprise-level data.

Figure 1 plots the female share of employment in state-owned enterprises against the fraction of workers who are potentially redundant, by sector of activity. The fraction of potentially redundant workers was estimated by Belser and Rama (2001), comparing employment levels across enterprises with different degrees of state ownership. Belser and Rama control for sector of activity, region, and the age of the enter-

Figure 1. Female Employment and Labor Redundancy in Vietnam, by Sector



Source: Author's calculations based on Downsizing Options Simulation Exercise (dose) for Vietnam and Belser and Rama (2001).

prise, among other variables. They then measure the drop in employment that would occur if all state-owned enterprises were to operate as privately owned enterprises. The calculation rests on a forecast of the employment level of each enterprise if the state's share of its capital were to fall to zero. This forecast is compared to the observed employment level. In practice, the number of job separations will be smaller than suggested by this comparison, as some enterprises are bound to remain (at least partially) in state hands, others will be divested or restructured only gradually, and some labor redundancies will be handled through natural attrition. Still, the indicator in the vertical axis of figure 1 should be highly correlated with the (smaller) fraction of workers who could be declared redundant.

Overstaffing is not prevalent in sectors in which female employment is dominant (figure 1). State-owned enterprises in footwear and leather, food and beverages, and textile and garments are not substantially (or at all) overstaffed compared with their private sector counterparts (Belser and Rama 2001). These are the sectors of activity in which female employment is more prevalent.

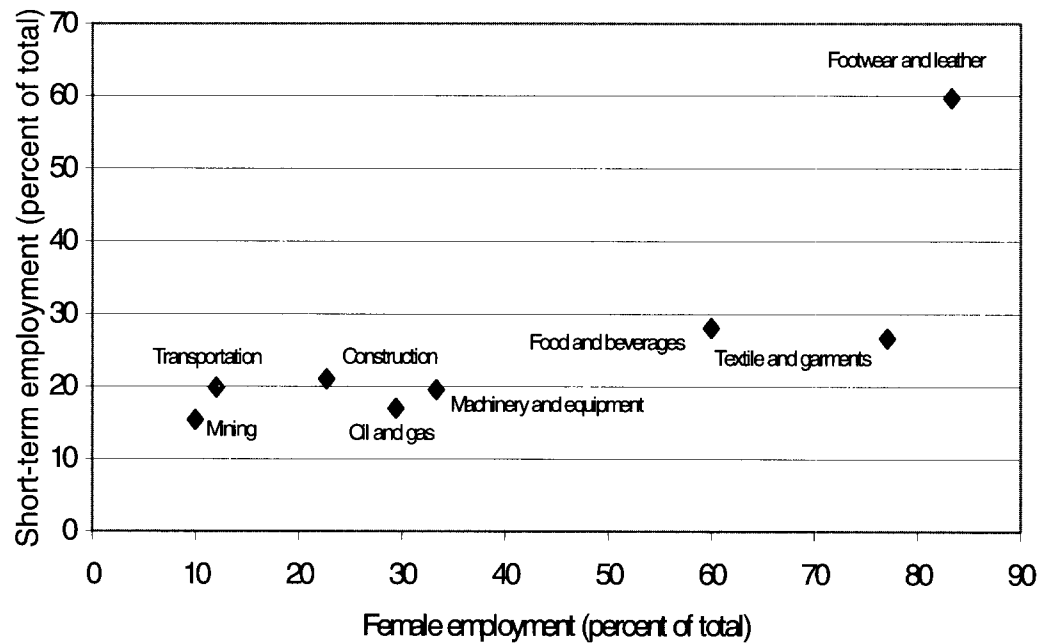
In contrast, the vast majority of workers in state-owned enterprises in transportation, construction, oil and gas, mining, and machinery and equipment are potentially redundant. Male employment is dominant in these sectors. Overall, there is a strongly negative association between female employment and potential labor redundancy. The correlation coefficient between these two variables is -0.92 .

The nature of the labor contracts used in different sectors of activity also suggests that female workers are in higher demand than male workers. Figure 2 plots by sector of activity the female share of employment against the fraction of state-owned enterprises workers who are employed on short-term or temporary contracts. Short-term and temporary contracts usually indicate precarious employment conditions. State-owned enterprises or their new owners could discontinue these contracts on short notice by simply not renewing them. From the point of view of the enterprise, then, a short-term or temporary contract can be seen as an indication that an employ is productive. It follows that most of the truly redundant workers must be employed on either long-term or open-ended contracts.

Short-term and temporary contracts are prevalent in the footwear and leather sector, where more than 80 percent of the workers are female (figure 2). At the other extreme, less than a quarter of all workers are on short-term or temporary contracts in the mining, transportation, construction, oil and gas, and machinery and equipment sectors, in which male employment is dominant. Other sectors, such as food and beverages and textile and garments, occupy an intermediate position. The data suggest a positive association between female employment and short-term and temporary contracts with a correlation coefficient of 0.78.

This positive association has two different implications. On one hand, it suggests that the gender gap is larger than revealed by earnings. Women not only earn less

Figure 2. Female Employment and Temporary Contracts in Vietnam, by Sector



Source: Author's calculations based on Downsizing Options Simulation Exercise (DOSE) for Vietnam and Belser and Rama (2001).

than men with similar skills, they also face more economic insecurity. To the extent that short-term or temporary contracts entail fewer nonwage benefits, the earnings gap also probably underestimates the gap in total compensation. In contrast, the positive association implies that women may suffer less from public sector downsizing than men. Truly redundant workers, employed on either long-term or open-ended contracts, are more likely to be male than female.

It is important to stress that the correlations revealed in figures 1 and 2 do not arise by construction. In estimating the fraction of state-owned enterprise workers who are potentially redundant, Belser and Rama do not use information on the female share of employment (which is not available at the enterprise level) or on the fraction of workers who are on short-term or temporary contracts. The variables in the horizontal and vertical axes of figures 1 and 2 are generated independently. In figure 1 they even come from different sources, as the estimates by Belser and Rama (2001) rely on an enterprise database, which reports no gender breakdown, whereas the female share of employment comes from 1997–98 round of the Vietnam Living Standards Survey, which is a household survey.

Gender Biases in Assistance Programs

Are government assistance programs aimed at helping displaced workers biased against women? Workers whose short-term or temporary contracts are not renewed at expiration receive no cash compensation, training, or any other form of assistance. This lack of assistance may not be gender-neutral, however. The third hypothesis emerging from the literature is that women are likely to experience a larger drop in earnings than men in the event of job displacement. Providing the same amount of support (including no support at all) to displaced men and women therefore means that women accept a larger loss in earnings. If large numbers of workers hired on short-term or temporary contracts were to be displaced in Vietnam, women could suffer disproportionately.

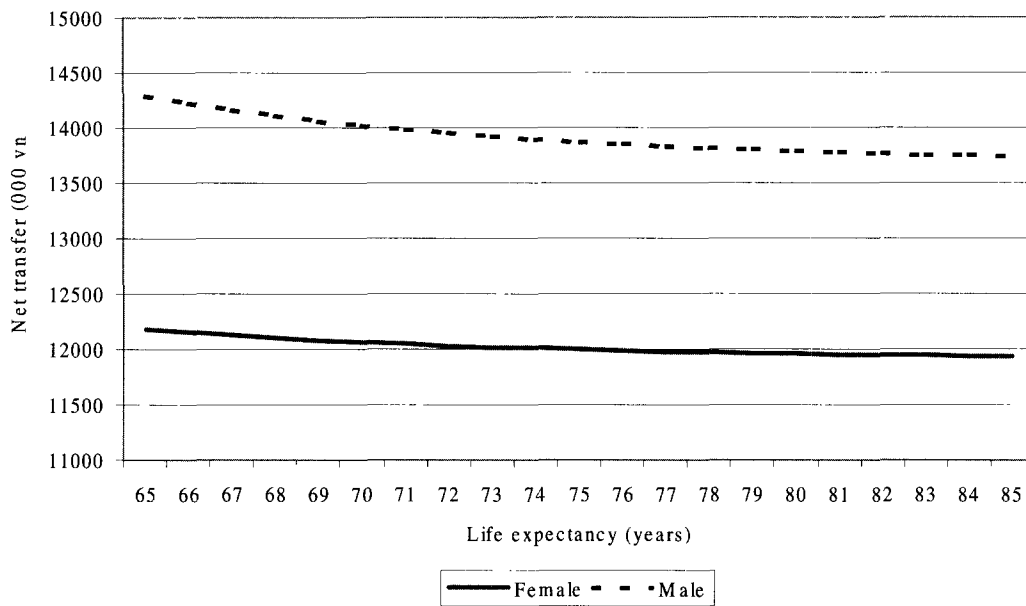
For workers on long-term or permanent contracts, a key component of the assistance strategy considered by the government of Vietnam is early retirement. In 1998 the government decreed that workers can receive old-age pensions up to five years before the normal retirement age of 60 years for men and 55 years for women. The old-age pension is reduced by 1 percent for each year below the normal retirement age. The reduction in retirement age is the same for both sexes, so that on the surface the program does not discriminate against women. The case has been made, however, that women in Vietnam are penalized by their lower retirement age. Being forced to retire, the argument goes, prevents women from reaching the upper echelons of the enterprises and agencies for which they work.

To try to determine whether women are discriminated against, the Vietnam Women's Union (1998) surveyed 302 people, equally divided by gender, in Haiphong. Most of the respondents worked in administrative and production units of state-owned enterprises and government agencies; the rest were retirees. This sample is not representative, and the interpretation of some of the responses is difficult. Even so, some of the survey's results are interesting (for a more detailed analysis, see Rama 2001).

According to the survey, women are more inclined than men to claim that early retirement adversely affects their status. From a social point of view, the early retirement program could thus be detrimental to women. However, this perception is voiced by less than half of the interviewees. Only two assertions receive a majority of supporters among women. One is that early retirement leads to a lower pension, which is so by design. The other is that early retirement benefits women more than men. From an economic point of view, then, the early retirement program could be favorable to women. Whether the adverse social implications are offset by the economic implications probably depends on the characteristics of individual workers.

Although the subjective evaluation of early retirement is unobservable, the implicit transfer of resources created by the program can be quantified. Figure 3 displays the average transfer for all the state-owned enterprise workers who would have been

Figure 3. Estimated Net Transfer of Resources from Early Retirement in Vietnam



Source: Author's calculations based on Downsizing Options Simulation Exercise (DOSE) for Vietnam.

eligible for early retirement in the sample of the 1997–98 round of the Vietnam Living Standards Survey had the early retirement decree been in force at that time. To estimate the average transfer, it is necessary to compute both the full pension at the normal retirement age and the reduced pension at early retirement for all eligible workers, taking into account their earnings and work histories. The average transfer is the outcome of two effects of different sign. On one hand, workers who retire early receive a pension until they reach the legal retirement age, up to a maximum of five years. On the other hand, they receive a lower pension over all the years between their legal retirement age and their death. The net transfers reported in figure 3 are the present value of these two flows of opposite sign, discounted at an annual rate of 10 percent (in real terms), under different assumptions regarding life expectancy.

Computations were carried out using the Downsizing Options Simulation Exercise (DOSE), an Excel-based application that incorporates the lessons from a broader research project on public sector downsizing (see Rama 1999). The DOSE is a small-scale version model of the public sector agencies or enterprises to be restructured, constructed using all the information available about their workers. For Vietnam the DOSE is made up of the 451 state-owned enterprise workers included in the 1997–98 Vietnam Living Standards Survey sample. The DOSE takes into account their individual characteristics as well as the characteristics of their public sector jobs. Using this

information it predicts, worker by worker, the consequences of different early retirement programs. Reported figures are averages over all the workers eligible for early retirement.

Based on the results in figure 3, the early retirement program entails a net transfer of roughly 14 million dong (\$933) for the average eligible male worker and 12 million dong (\$800) for the average eligible female worker. The ratio between these two figures is very close to the ratio between the average earnings of male and female workers in state-owned enterprises, suggesting that the early retirement program could be considered gender-neutral. However, this conclusion does not hold if the size of the monetary transfer, rather than its relationship to earnings, is considered. From that perspective, the early retirement program is more advantageous for male workers.

Another component of the assistance strategy considered by the government is training. A variety of training programs already exists in Vietnam. Their use may be intensified if displaced workers are given a training allowance or a training voucher. Between 1999 and 2002 a training allowance was under consideration as part of a broader severance package (discussed in the next section). Although the ability of training programs to improve the skills of trainees remains unclear, such programs in Vietnam do not appear to be biased against women.

The Vietnam Women's Union operates vocational training centers for such skills as computer operation, English language, garment manufacture, knitting, lace-making, embroidery, handicrafts, beauty treatment, and domestic skills. Some of these training programs may simply reflect gender stereotypes; others appear to be geared toward the needs of the labor market. Many of these training centers received initial funding from international agencies or from the national level of the Vietnam Women's Union, but they are largely self-supporting. Trainees are required to pay a fee, usually ranging from \$10 to \$30 a month. These vocational training centers could play a key role in helping female workers who are displaced from their state-owned enterprises.

Gender Biases in Severance Packages

Cash compensation for job loss is usually one of the most important components of assistance for redundant workers. Compensation of this sort takes the form of a severance package, generally based on individual characteristics, such as salary and seniority.

Although compensation formulas do not explicitly discriminate by gender, they may treat men and women differently. Because women earn less than men, they may receive less compensation. Moreover, the present value of the loss in earnings and benefits from displacement could be larger for women. Compensation formulas should therefore be scrutinized to assess whether they implicitly discriminate by gender.

At present, separation packages in Vietnam are determined by the 1995 Labor Code, which grants displaced workers half a month of salary per year of service. Because this formula was deemed insufficiently generous to handle mass layoffs, the government set up a special fund to pay for potentially more expensive severance packages. Under the special compensation formula, workers displaced from state-owned enterprises receive two months' salary per year of service, plus a training allowance equal to six months' salary plus 5 million dong (\$333). This formula resulted from protracted policy debates.

It is interesting to assess the gender implications of compensation packages that have been used in a variety of countries and contexts. Most packages can be seen as a combination of three basic formulas (see the survey by Kikeri 1997). The first is based on earnings. In this case, the amount of compensation S_i received by worker i is a multiple of his or her total salary in the state-owned enterprise, W_i :

$$S_i = AW_i \quad (1)$$

As parameter A increases, the amount of compensation becomes more generous. Parameter A can be measured in months of total salary.

The second formula involves current earnings and the number of years of service in the state-owned enterprise, Y_i . The amount of compensation received by worker i is

$$S_i = BW_i Y_i \quad (2)$$

The generosity of this package hinges on parameter B , which can be measured in months of total salary per year of service.

The third formula is a lump-sum payment, which does not take into account any individual characteristic of the worker:

$$S_i = C \quad (3)$$

In this case, parameter C directly indicates the amount of compensation received by the worker. Parameter C can be measured in (thousands of) dong.

Because not all workers have the same earnings and the same number of years of service, the three formulas would compensate them differently. For instance, workers whose earnings are higher than average would receive a more generous severance package under the first formula than they would under the third one.

Different workers also have different outside alternatives. Those with good job opportunities or who want to withdraw from the labor force may need only a small amount of compensation to be enticed to leave their job. Those who would like to continue working but are relatively unemployable may require much larger amounts. Each of the three packages may thus look acceptable to some workers and unacceptable to others.

Is this acceptability systematically different for men and for women? One way to address this issue is to compare each of the three severance packages to the present

value of the loss from job displacement for each of the 451 workers included in the DOSE simulation. The present value of job loss is calculated using a methodology initially proposed by Fiszbein (1994) and subsequently developed by Assaad (1999) and Chong and Rama (2001). This methodology relies on an estimation of the alternative earnings of each worker, given his or her individual characteristics. In practical terms, the DOSE relies on an earnings function similar to the one in the last column of table 2.

Comparing these alternative earnings with actual earnings suggests that a majority of workers laid off from state-owned enterprises would be worse off as a result of displacement. There is, however, a nonnegligible group of workers who apparently could earn more (in some cases, much more) outside the public sector. The fact that these workers did not voluntarily leave the state sector suggests that they attach a high value to noncash benefits associated with their jobs (health coverage, old-age pension, low work effort).

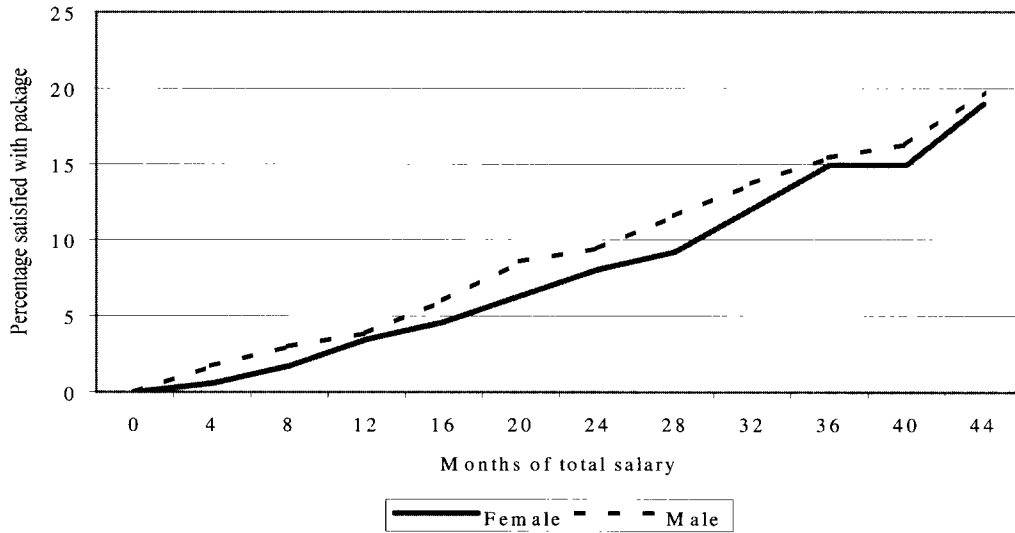
Some of the potential earnings gains generated by the model are too large to be credible, implying that they are likely due to measurement error. The approach developed by Chong and Rama (2001) assumes that the top 10 percent of expected changes in earnings from job displacement are too high to be realistic and eliminates them from the sample. Once these unrealistic cases have been removed, the highest predicted change in earnings is used as an indicator of the cash value of the benefits associated with public sector employment. This cash equivalent is added to the actual earnings in the state-owned enterprise to create an indicator of total compensation, including non-cash benefits. The present value of the loss from displacement is calculated as the difference between total compensation in the state-owned enterprise and alternative earnings, discounted over all the years until the worker reaches normal retirement age.

Using this method, the benefits associated with a job in a state-owned enterprise are estimated to be worth 56 percent of the total salary for male workers and 60 percent for female workers. Discarding only the top 8 percent of values yields a larger gender gap, with employment in a state-owned enterprise worth 65 percent of total salary for men and 75 percent for women. The higher figures for female workers are consistent with the fact that some of the benefits available in state-owned enterprises but not necessarily in other enterprises (such as maternity leave) are valued more by women.

Figures 4, 5, and 6 report the acceptance rates of each of the three compensation formulas for different values of parameters *A*, *B*, and *C*. The acceptance rate is the fraction of workers for whom the severance package would exceed the present value of the estimated loss in earnings and benefits from job displacement. Parameters *A*, *B*, and *C* were chosen so that the highest acceptance rate is close to 20 percent for all three packages. However, the average compensation per worker needed to attain the same acceptance rate is different in all three cases. Overall, the severance package that combines salary and years of service tends to be the most expensive.

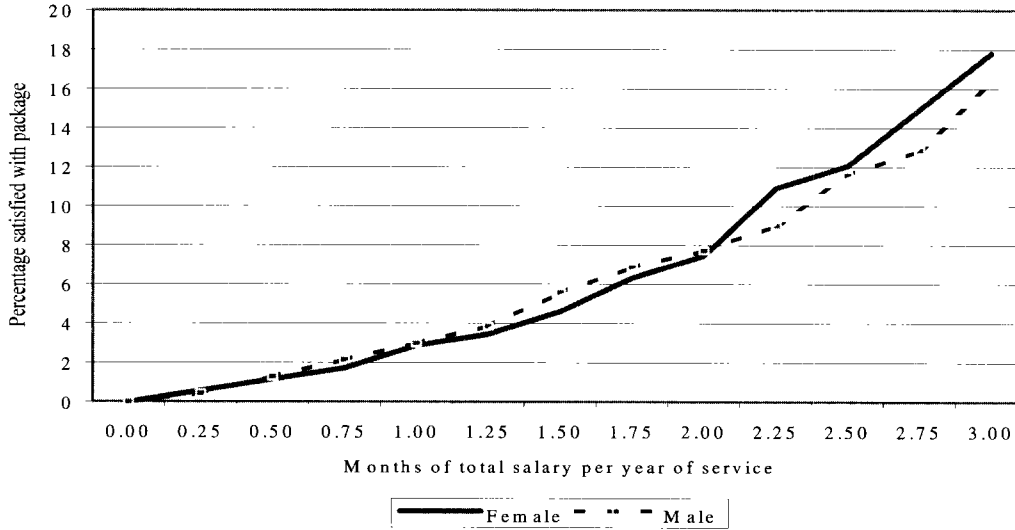
From a gender perspective, the formula based on earnings displays consistently higher acceptance rates for male workers (figure 4). The formula based on a lump-

Figure 4. Percentage of Workers Willing to Accept Severance Package Based on Earnings, by Size of Package



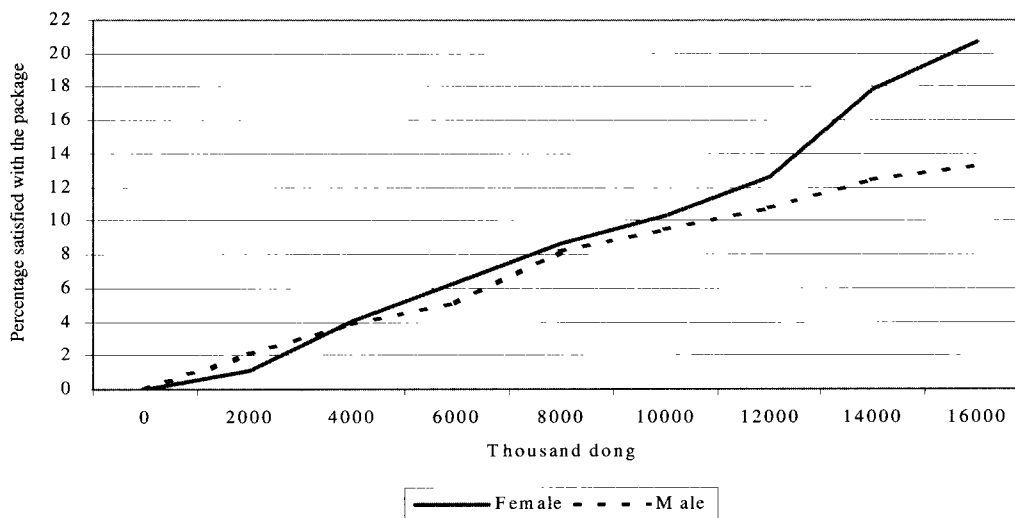
Source: Author calculations based on Downsizing Options Simulation Exercise (DOSE) for Vietnam.

Figure 5. Percentage of Workers Willing to Accept Separation Package Based on Seniority, by Size of Package



Source: Author calculations based on Downsizing Options Simulation Exercise (DOSE) for Vietnam.

Figure 6. Percentage of Workers Willing to Accept Lump-Sum Severance Package, by Size of Package



Source: Author calculations based on Downsizing Options Simulation Exercise (DOSE) for Vietnam.

sum payment is more attractive to female workers, increasingly so as it becomes more generous (figure 6). The formula combining earnings and seniority occupies an intermediate position, as revealed by the multiple intersections of the solid and the broken lines (figure 5). These figures suggest that a severance package involving a large lump-sum component is less likely to penalize women. This is the rationale for the formula chosen by the government of Vietnam, which involves a large training allowance, payable in cash.

Conclusions

This article proposes a conceptual framework and identifies the kind of information needed to carry out an ex ante evaluation of the effects of an economic policy with potentially important gender implications. It draws specific conclusions about the reform program implemented by the government of Vietnam for reducing the number of employees at state-owned enterprises.

Vietnam's reform program does not appear likely to hurt women disproportionately, as did the massive downsizing of the early 1990s. In fact, labor redundancy in Vietnam in the twenty-first century appears to have become more of a male problem.

Employment in state-owned enterprises has been shaped by a decade of increased exposure to market competition. In sectors of activity in which Vietnam has a comparative advantage—especially in light industries, such as footwear, leather, textile, and garments—female employment is dominant and overstaffing is not prevalent. In the sectors of activity that had been favored by central planning, such as transportation and mining, only a small fraction of workers are female. In these sectors overstaffing is most prevalent.

The nature of the contracts used in different sectors reflects the relatively high demand for female workers. Short-term and temporary contracts are more common in those sectors where female employment is dominant, whereas long-term and open-ended contracts characterize the sectors in which male employment is dominant.

The assistance programs currently in place to help redundant workers are not strongly biased against women. Measured as a multiple of labor earnings, the net transfer of resources from the current early retirement program is similar for men and women. It is higher for men when measured in value terms, but this does not necessarily mean that women are penalized. The claim that early retirement is detrimental to female workers because it prevents them from reaching the upper echelons of their enterprise is not supported by the only survey available on the issue. Although a large fraction of female respondents agree that early retirement diminishes the social status of women, an absolute majority of them say that it is economically beneficial. Vocational training programs are also geared appropriately toward female workers.

Whether severance packages treat women fairly depends on the compensation formula used. Simulations indicate that the acceptance rate for some standard packages could differ systematically for men and women. Severance packages based on a multiple of current earnings would be preferred by men, whereas packages based on a lump-sum payment would be preferred by women. Packages defined in months of salary per year of service occupy an intermediate position, but they would be more expensive from the government's perspective. These simulations suggest that including a large lump-sum component in the formula of the severance package is key to ensuring that displaced female workers are not penalized relative to displaced male workers.

Making displacement voluntary would also safeguard against gender discrimination. In Vietnam redundant workers who qualify for early retirement can decide whether they want to take it or not. Given the government's willingness to cushion the social impact of its reforms, displacement of many workers who are not eligible for early retirement will be made voluntary as well. Given a generous compensation package, the number of workers willing to resign could be large enough to deal with most of the labor redundancy problem. It is possible that men would benefit more from voluntary severance than women. Making the program voluntary, however, ensures

that on average the well-being of redundant female state-owned enterprise workers is not reduced.

Vietnam's reform program may also improve the well-being of women who do not lose their jobs as a result of public sector downsizing. During the 1990s the reform program was associated with a substantial reduction in the unexplained gap in earnings between men and women in both state-owned enterprises and the private sector. Moreover, a reduction in the size of the state sector should be associated with an expansion of employment in the private sector. Data on large establishments reveals that the highest proportion of female workers can be found in the private sector and the lowest in state-owned enterprises. Vietnam's reform program could thus increase the opportunities for women to become salaried workers.

Note

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References

- Appleton, Simon, John Hoddinott, and Pramila Krishnan. 1999. "The Gender Wage Gap in Three African Countries." *Economic Development and Cultural Change* 47:289–312.
- Artecona, Raquel, and Wendy Cunningham. 2001. "Effects of Trade Liberalization on the Gender Wage Gap in Mexico." Background paper for the Policy Research Report *Engendering Development*. World Bank, Washington, D.C.
- Assaad, Ragui. 1999. "Matching Severance Payments with Worker Losses in the Egyptian Public Sector." *World Bank Economic Review* 13(1):117–54.
- Bales, Sarah. 2000. "Vietnam's Labor Situation and Trends: Analysis Based on 1992–93 and 1997–98 Vietnam Living Standards Survey Data." Background paper to the *Vietnam Development Report 2000*. World Bank, Washington, D.C.
- Belser, Patrick. 2000. "Vietnam: On the Road to Labor-Intensive Growth?" Policy Research Working Paper 2389. World Bank, Washington, D.C.
- Belser, Patrick, and Martín Rama. 2001. "State Ownership and Labor Redundancy: Estimates Based on Enterprise-Level Data from Vietnam." Policy Research Working Paper 2599. World Bank, Washington, D.C.
- Beresford, Melanie. 1994. "Impact of Macroeconomic Reform on Women in Vietnam." UNIFEM Project VIE/93/W02, Hanoi.
- Chong, Alberto, and Martín Rama. 2001. "Do Compensation Packages Need to Be That Generous? Simulations for Government Employees in Guinea-Bissau." In Shantayanan Devarajan, F. Halsey Rogers, and Lyn Squire, eds., *World Bank Economists' Forum*. Washington, D.C.: World Bank.

- Fiszbein, Ariel. 1994. "An Opportunity Cost Approach to Redundancy Compensation: An Application to Sri Lanka." *Estudios de Economía* 21:115–26.
- Hyun, Mia, Tran Thi Van Anh, and Tran Thi Que. 2000. "Mainstreaming Gender in the National Socio-Economic Development Strategy to 2010." NCFAW-UNDP Project VIE/96/011. Hanoi.
- ILO. 1998. *Quyền lao động nữ Vietnam trong thời kỳ đổi mới* (Rights of Vietnamese Female Labourers in the Renovation Process). Training material prepared for regional project INT/94/M09/NET. International Labour Office, Hanoi.
- Kikeri, Sunita. 1997. "Privatization and Labor: What Happens to Workers When Governments Divest?" World Bank Technical Paper 396. World Bank, Washington, D.C.
- Long, Lynellyn D., Le Ngoc Hung, Allison Truit, Le Thi Phuong Mai, and Dang Nguyen Anh. 2000. "Changing Gender Relations in Vietnam's Post Doi Moi Era." Policy Research Report on Gender and Development, Working Paper 14. World Bank, Washington, D.C.
- Mason, Andrew D. 1997. "Gender Issues in the China Labor Market." Working Paper, World Bank, Washington, D.C.
- Ministry of Labor Invalids and Social Affairs. 1998. *Female Labor Force in Industry in Vietnam in Period of Renovation*. Hanoi: Institute for Labor and Social Policy.
- Pham, Thi Hue. 2000. "Bibliography on Women and Gender in Vietnam, 1993–1999." Hanoi: Center for Family and Women Studies.
- Psacharopoulos, George, and Zafiris Tzannatos, eds. 1992. *Women's Employment and Pay in Latin America: Overview and Methodology*. Washington, D.C.: World Bank.
- Rama, Martín. 1999. "Public Sector Downsizing: An Introduction." *World Bank Economic Review* 13(1):1–22.
- . 2001. "The Gender Implications of Public Sector Downsizing: The Reform Program of Vietnam." Policy Research Working Paper 2573. World Bank, Washington, D.C.
- Rama, Martín, and Donna MacIsaac. 1999. "Earnings and Welfare after Downsizing: Central Bank Employees in Ecuador." *World Bank Economic Review* 13(1):89–116.
- Rodgers, Yana van der Meulen. 1999. "Protecting Women and Promoting Equality in the Labor Market: Theory and Evidence." Policy Research Report on Gender and Development, Working Paper 6. World Bank, Washington, D.C.
- Vietnam Women's Union. 1998. "Viewpoint of Men and Women on Social Insurance: Equality in Pensionable Age, Maternity Leave, and Leave for Child Tending." Vietnam Women's Union Research Department, Hanoi.
- World Bank. 2001. *Engendering Development through Equality in Rights, Resources, and Voice*. New York: Oxford University Press for the World Bank.



Trade, Foreign Direct Investment, and International Technology Transfer: A Survey

Kamal Saggi

What role does trade play in international technology transfer? Do technologies introduced by multinational firms diffuse to local firms? What kinds of policies have proved successful in encouraging technology absorption from abroad and why? Using these questions as motivation, this article surveys the recent trade literature on international technology transfer, paying particular attention to the role of foreign direct investment. The literature argues that trade necessarily encourages growth only if knowledge spillovers are international in scope. Empirical evidence on the scope of knowledge spillovers (national versus international) is ambiguous. Several recent empirical plant-level studies have questioned earlier studies that argued that foreign direct investment has a positive impact on the productivity of local firms. Yet at the aggregate level, evidence supports the view that foreign direct investment has a positive effect on economic growth in the host country.

Economic growth results from accumulation of factors of production or from improvements in technology or both. To encourage the generation of new knowledge, industrial countries have elaborate systems of intellectual property rights (IPRS) in place and conduct the majority of the world's research and development (R&D). Technologies resulting from R&D spread throughout the world via a multitude of channels. On a fundamental level, international trade in technology differs from other indirect channels of international technology transfer, such as trade in goods and international movement of factors of production. This article critically surveys the literature that explores the roles of trade and foreign direct investment (FDI) as channels of international technology transfer. With respect to FDI, a distinction is made between wholly owned subsidiaries of multinational firms and international joint ventures. Furthermore, the role of FDI is contrasted with that of arm's-length channels of technology transfer, such as licensing.

Although the literature has done a decent job of outlining the various channels through which international technology transfer occurs, not enough is known, both

in theory and practice, about the relative importance of each of these channels. There is a limited understanding of the role that policy can play in facilitating international technology transfer. For example, the literature continues to debate whether increased openness to trade encourages economic growth. Although Dollar (1992) and Sachs and Werner (1995) find support for the view that open economies grow faster, Rodriguez and Rodrik (1999) are quite skeptical about this conclusion.

As a practical matter, few economists advocate the imposition of trade restrictions. In fact, the general feeling seems to be that traditional analyses may very well understate the true cost of protectionism because most utilize static models and do not capture the dynamic costs of trade protection. Underlying this view is the notion that, somehow, trade, FDI, and interaction among countries in various other forms all play roles not only in improving the global allocation of resources but also in transmitting technology globally. How exactly this transmission occurs is not fully understood, making international technology transfer an active area of research.

Dynamic trade models shed light on the complex relation between technology and trade. These models frequently lead to ambiguous welfare conclusions. The literature (both theoretical and empirical) does not provide a blanket endorsement of trade as an engine for growth because introducing dynamics in an interesting fashion often requires multiple departures from the neoclassical model of perfect markets. Imperfect competition and externalities are central to the new dynamic models of trade, and such distortions can easily lead to perverse results. Of course, the argument cuts both ways. Introducing such elements in the traditional static model also furnishes additional arguments in support of free trade. Nevertheless, it is difficult to make the unconditional case for free trade purely on the basis of logic. For example, see Krugman (1987) for a pragmatic argument for free trade even in the presence of market failures.

It is also not the case that anything can happen if a closed economy opens up to free trade. In fact, the theoretical literature suggests that the scope of knowledge spillovers is a crucial determinant of whether trade necessarily encourages growth (Grossman and Helpman 1995). However, the empirical evidence has been mixed: some studies discover that knowledge spillovers have a limited geographical scope, whereas others find the opposite. The ambiguous nature of this empirical evidence immediately raises the following question: What factors determine the scope of knowledge spillovers? Clearly the scope of knowledge spillovers must be determined in part by the interaction between innovators (potential suppliers of technology) and those firms and entrepreneurs that seek access to newer technologies through imitation, technology licensing, and other forms of collaboration with innovators. In other words, a fair bit of technology transfer may indeed be endogenous.

In a discussion of the special properties of knowledge as an economic good, Romer (1990) makes the important point that knowledge is a nonrival good: it can be used simultaneously by two different agents. However, this does not mean that knowledge

can be transferred across agents at zero cost. If technology transfer entailed no costs, the room for fruitful policy intervention with respect to assimilation of foreign technology would be quite limited because any technology transfer that would yield even a minutely positive return to any agent would take place automatically. Pack (1992) provides an overview of what can be reasonably expected in terms of technology transfer to developing economies, given that the potential for transfers is large.

The nonrival nature of knowledge only implies that if two agents are willing to pay the cost of adopting a new technology, they can do so without interfering with each other's decisions. Much empirical evidence indicates that international technology transfer carries significant resource costs (Mansfield and Romeo 1980; Ramachandran 1993; Teece 1977). In his survey of 29 technology transfer projects, Teece (1977) found that on average such costs were approximately 20 percent of the total costs of the project, and in some cases, they were as high as 60 percent.

The fact that international technology transfer occurs through a multitude of channels makes it difficult to arrive at an aggregate measure of the activity and accurately assess its contribution to economic growth. Most research, theoretical as well as empirical, tends to focus on one or two channels of technology transfer. Of these, trade and FDI have received the most attention. If one could somehow rank the different channels of technology transfer in terms of their relative importance, empirical analysis could then proceed by ignoring the relatively unimportant channels. However, given that multiple options exist in theory, the dominance of any one channel in the data would itself require explanation. Indeed, the emergence and expansion of multinational firms, given the existence of alternative arrangements for transacting in technology, has been viewed as a phenomenon that requires explanation. Furthermore, the various channels of technology transfer, though independent to a certain degree, are linked to each other in important ways. For example, the extent to which inward FDI contributes to technology transfer (in addition to international trade) may very well be a function of a country's trade policy. An important challenge for both theoretical and empirical research is to isolate the marginal contribution of inward FDI to technology transfer and its relation to a country's trade and investment policies. I discuss the relevant research in this survey to the extent the literature has addressed these questions.

Once a technology has been introduced into a country (by a multinational firm, say), how does it subsequently diffuse throughout the rest of the economy? The presence of trade barriers across countries as well as international differences in market conditions and policy environments imply that technology diffusion within a country should be considerably easier than international transfer of technology. For example, the mobility of labor is severely constrained only at the international level (exceptions include contact with consultants and the return of foreign-educated nationals). Thus labor turnover across firms may be crucial for driving technology diffusion within a country and may not play any role in international technology transfer. This

article discusses the role of technology licensing, imitation, and FDI in the process of international technology transfer and its subsequent diffusion in the host country.

One goal of this article is to help identify the role policy plays in facilitating international technology transfer. The range of relevant policies is clearly quite large. To limit the scope of the discussion, I address the role of trade, FDI, and IPR policies. Given the central questions of interest, I discuss the literature on FDI and IPRs in greater detail than that on trade policy.

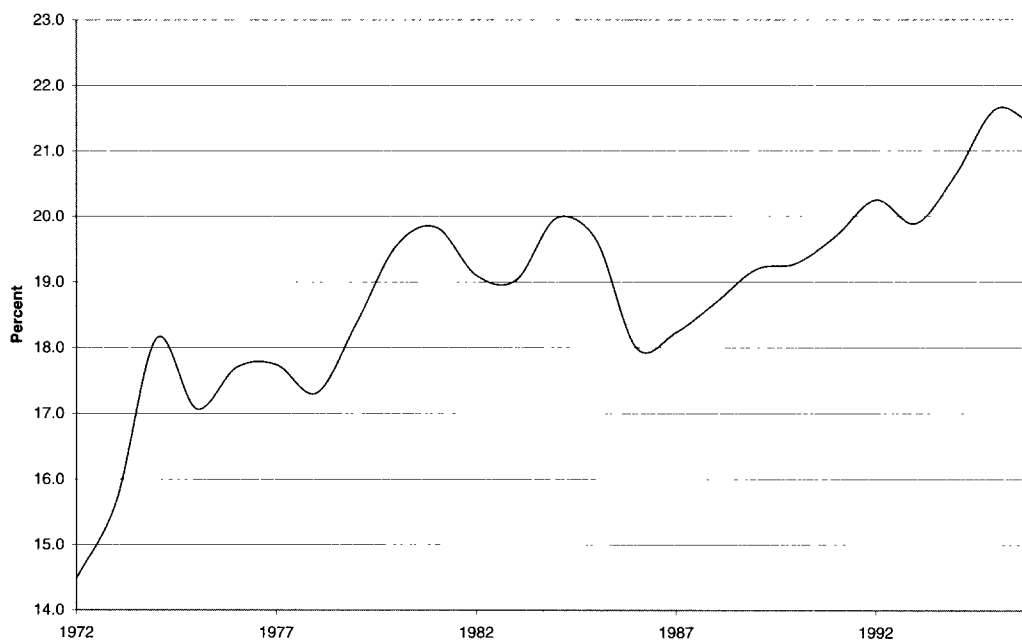
Blomström and Kokko (1998) review the theory and evidence regarding spillovers from multinational firms. Unlike the present article, their survey is concerned exclusively with spillovers from FDI and does not deal with trade and the effects of policy on international technology transfer. Furthermore, they do not emphasize the endogeneity of international technology transfer. Blomström and Kokko focus on the internal diffusion of technologies introduced by multinational firms. By contrast, this article emphasizes the interaction between domestic diffusion and incentives for international technology transfer. Furthermore, at least in the context of tradable goods, a relevant issue (not addressed by the Blomström and Kokko survey) is that a complete definition of spillovers from FDI ought to account for technology diffusion that would result in the absence of FDI but in the presence of international trade.

Knowledge Spillovers through Trade

Figure 1 plots worldwide exports of goods and services as a percentage of gross domestic product (GDP) for 1970–96. During this period, the percentage of exports increased from approximately 14.1 to 21.4. An interesting consideration is whether this increase in world trade yielded primarily static efficiency gains or dynamic gains by facilitating international technology transfer. An extensive literature studies the dynamic effects of trade. Much of the relevant work emphasizes two intertwined aspects of the relationship between trade and technology: that trade alters the allocation of resources in an economy and plays a role in transmitting knowledge internationally.

Much of the literature on trade and international transmission of technology derives from closed-economy growth models. For this article, endogenous growth models are those in which economic growth results from the intentional actions of individuals who seek to profit from their investments in technological innovation. In traditional growth theory, capital accumulation is the major determinant of economic growth; a natural conclusion of this research was that unless the return to capital accumulation could stay bounded away from zero, growth would peter out or cease in the long run. A natural implication of this finding is that over time, poor countries eventually converge to the per capita income levels of the countries. However, the evidence on convergence is weak; although some areas—such as the Re-

Figure 1. Worldwide Exports over GDP, 1972–96



Source: World Bank (1999).

public of Korea; Taiwan, China; and Hong Kong, China—have achieved enviable rates of growth for sustained periods, most developing economies do not seem to be on a path of convergence toward rich countries (Pritchett 1997).

Standard neoclassical growth models assume costless technology transfer by positing a common production function across countries. The fact that chosen production techniques differ across countries is not evidence against the neoclassical view; when faced with different factor prices (due to differences in factor endowments), firms typically adopt different production techniques in different countries. Thus, the issue is whether all firms can access the global pool of technologies at the same cost. Parente and Prescott (1994) emphasize barriers to technology adoption as a key determinant of differences in per capita income across countries. In their model, although any firm can access the underlying stock of knowledge in the world economy, the cost of such access differs across countries due to differences in legal, regulatory, political, and social factors. Thus in their view, some countries make it inherently costlier for their firms to adopt modern technologies and thereby retard the development of the entire economy. In fact, Parente and Prescott (1994) go on to suggest that trade may affect growth by lowering the barriers to technology adoption.

In contrast to neoclassical models that stress capital accumulation, the new growth theory emphasizes technological change and the accumulation of human capital

(Lucas 1988). For the purposes of this survey, the literature on R&D-based growth models is clearly more relevant, and I restrict attention to this strand of growth theory. Romer (1990), Grossman and Helpman (1991), Aghion and Howitt (1990), and Segerstrom and others (1990) are among the pioneers of R&D-based models of economic growth. These models provide a coherent framework for the Schumpeterian notion of creative destruction. Although they differ from each other in important ways, the models all share the idea that entrepreneurs conduct R&D to gain temporary monopoly power made possible by patents and other IPRs.

Grossman and Helpman (1991) provide a unifying framework for two widely used strands of R&D-based endogenous growth models: the varieties model, which builds on foundations laid by Dixit and Stiglitz (1977), Ethier (1982), and Romer (1990), and the quality ladders model developed by Aghion and Howitt (1990), Segerstrom and others (1990), and Grossman and Helpman (1991). In a closed economy, growth is sustained in the varieties model through the assumption that the creation of new products expands the knowledge stock, which then lowers the cost of innovation. As more products are invented, both the costs of inventing new products and the profits of subsequent innovators are lower because of increased competition (no products disappear from the market in this model). By contrast, the quality ladders model assumes that consumers are willing to pay a premium for higher-quality products. As a result, firms always have an incentive to improve the quality of products. The important assumption that sustains growth in this model is that every successful innovation allows all firms to study the attributes of the newly invented product and then improve on it. Patent rights restrict a firm from producing a product invented by some other firm but not from using the knowledge (created due to R&D) that is embodied in that product. Thus, as soon as a product is created, the knowledge needed for its production becomes available to all; such knowledge spillovers ensure that anyone can try to invent a higher-quality version of the same product.

Although R&D-based endogenous growth theory is quite appealing theoretically, empirical evidence does not provide a strong endorsement (Pack 1994). In fact, Jones (1995a, 1995b) explicitly tests the empirical implications of R&D-based growth models and finds that the data reject these implications. However, rejecting a particular model of R&D-based economic growth does not imply that R&D is not an important determinant of growth. In fact, a reasonable conclusion may be that although R&D is crucial for the generation of new ideas (and economic growth), early variants of R&D-based growth models do not adequately capture the relationship between R&D and growth. The newer strand of growth theory has not abandoned R&D as a determinant of growth; instead, it has focused on creating models that do not have the "scale effects" that Jones demonstrates are not supported by the data. Roughly speaking, scale effects imply that large economies grow faster than small economies (see Dinopoulos and Thompson 1999 for a discussion of scale effects in endogenous growth models).

R&D-based models of growth argue that new products result from new ideas; therefore, trade in goods could help transmit knowledge internationally. This is the central insight of many open economy growth models. Of course, trade in ideas can take place without trade in goods. Rivera-Batiz and Romer (1991) analyze two different models (the lab equipment model and the knowledge-driven model) of endogenous growth to highlight the role of trade in goods versus trade in ideas. The general conclusion of their analysis is that trade in either goods or ideas can increase the global rate of growth if such trade allows a greater exploitation of increasing returns to scale (in the production of goods or ideas) by expanding market size.

Multicountry models of endogenous growth have two strands: those that study trade between identical countries and those that have a Northern Hemisphere–Southern Hemisphere structure. Although knowledge spillovers are central to both, technology transfer in the sense emphasized here is a central feature only of North–South models. Prominent early works include Krugman (1979), Rivera-Batiz and Romer (1991), and Grossman and Helpman (1991). The literature is now rather large and a complete discussion requires a survey of its own (see Grossman and Helpman 1995). North–South models that emphasize the product-cycle nature of trade have been particularly useful for understanding international technology transfer and merit some further discussion.

Product-cycle models assume that new products are invented in the North and, due to the lower relative Southern wage (endogenous in the model), Southern firms can successfully undercut Northern producers by succeeding in imitating Northern products. A typical good is initially produced in the North until either further innovation (in the quality ladders model) or successful Southern imitation (in both the varieties model and the quality ladders model) makes profitable production in the North infeasible. Consequently, either production ceases (due to innovation) or shifts to the South (due to imitation). Thus, prior to imitation, all products are exported by the North, whereas postimitation they are imported, thereby completing the cycle. These models capture technology-driven trade and have been generalized to consider technology transfer more explicitly. Neither FDI nor licensing (choices available to innovators for producing in the South) was considered in the early variants of these models.

What do R&D-based models of growth imply about the effect of trade on growth? An important conclusion of this line of research is that much importance hinges on whether knowledge spillovers are national or international in nature (Grossman and Helpman 1995). If the spillovers are international, these models endorse the view that trade is an engine of growth. However, when the spillovers are national, perverse possibilities can arise. Note that this perspective is more relevant for North–North models of trade because international knowledge spillovers (of one form or another) are assumed in North–South product-cycle models of trade, where the South is modeled as a pure imitator. In North–South models, the more interesting question is how Southern imitation affects incentives for innovation in the North.

What factors can help account for the explosive growth of economies like Hong Kong, Korea, and Taiwan? Some economists argue that the accumulation of resources has driven economic growth in these countries (Young 1995). Others argue that improvement in productivity (driven partly through trade) has played a large role (Nelson and Pack 1999). However, even if capital accumulation were the driving force, why did it take place at such a high rate? What kept the returns to capital accumulation so high? Perhaps technology transfer (again, partly through trade) kept the marginal product of capital from falling and kept investment rates high (Nelson and Pack 1999).

What does the empirical evidence say about the scope of knowledge spillovers? Should research focus primarily on determining their geographical scope? The frequent agglomeration of R&D-intensive industries (such as in Silicon Valley) suggests that spillovers may be primarily local. However, several studies find that R&D activity in a country is not strongly correlated with productivity growth, suggesting that the benefits of R&D in one country spill over substantially to other countries. Eaton and Kortum (1996) find that more than 50 percent of the growth in some Organisation for Economic Co-operation and Development (OECD) countries derives from innovation in the United States, Germany, and Japan. Yet Eaton and Kortum also report that distance inhibits the flow of ideas between countries, whereas trade enhances it.

In their micro-level study of the semiconductor industry, Irwin and Klenow (1994) find that learning (resulting from production) spills over as much across national borders as it does between firms in the same country. Similarly, Coe and Helpman (1995) and Coe and others (1997) argue that international R&D spillovers are substantial and that trade is an important channel of such spillovers. Using estimates of international R&D spillovers from these two studies, Bayoumi and others (1999) simulate the impact of changes in R&D and in exposure to trade on productivity, capital, output, and consumption in a multicountry model (the International Monetary Fund [IMF]'s MULTIMOD model). Their simulations indicate that R&D can affect output not only directly but also indirectly by stimulating capital investment. Incidentally, this finding is also of interest for the debate regarding the Asian growth miracle.

Keller (1998) casts some doubt on the latter finding by generating results similar to those of Coe and Helpman (1995) for randomly generated trade weights. However, a recent paper by Coe and Hoffmaister (1999) argues that Keller's weights are not actually random. When alternative weights are used, estimated international R&D spillovers are nonexistent for the case of random weights.

In principle, trade in both consumption and capital goods can contribute to technology transfer, and the empirical studies discussed typically utilize a country's imports of all goods while attempting to measure knowledge spillovers through trade. For example, when Korea imports a manufactured consumption good, such as an automobile, local firms can absorb some technological know-how by simply study-

ing the design and the engine of the imported automobile. Attempts at reverse-engineering may be important, but they probably contribute less to technology transfer than does trade in capital goods (such as machinery and equipment) that are used in the production of other consumption goods. Xu and Wang (1999) argue that trade in capital goods is more relevant than total trade for measuring knowledge spillovers because capital goods have higher technological content than consumption goods. Xu and Wang measure trade in capital goods by exports of machinery and transport equipment (SITC 7). They show that although the volume of such trade helps explain cross-country differences in total factor productivity (TFP), trade in all other goods does not. This result fits well with the finding by De Long and Summers (1991) that investment in machinery and equipment has a strong association with growth.

Capital goods trade is a prominent part of world trade, and its importance has increased over time. Table 1 reports worldwide exports of capital goods (as measured by trade in machinery and transport equipment) as a percentage of total exports. In 1975, approximately 23 percent of total trade in the world was trade in capital goods; this ratio was over 30 percent in 1996. During 1975–96, worldwide exports of machinery and transport equipment as a percentage of GDP increased from about 4.2 to approximately 7.0. In 1996, roughly 30 percent of capital goods exports were destined for developing economies. Although the developing economy share of imports of capital goods has increased over time, this increase has not been substantial (from 28.9 percent in 1980 to 30.8 percent in 1996). Within the OECD countries, there is significant cross-country variation in the magnitude of imports of capital goods. In 1983–90, more than 50 percent of U.S. imports from other OECD countries was made up of capital goods; this ratio was only 25 percent for Japan (Xu and Wang 1999). Such variation in the data suggests that using total trade to measure the degree of knowledge spillovers across countries might lead to erroneous conclusions.

Table 1. Global Exports of Capital Goods as a Percentage of Total Exports

<i>Year</i>	<i>Percent</i>	<i>Year</i>	<i>Percent</i>
1975	23.5	1986	27.9
1976	23.8	1987	28.3
1977	24.1	1988	28.5
1978	25.0	1989	28.0
1979	22.7	1990	28.4
1980	21.5	1991	28.6
1981	22.2	1992	27.8
1982	23.3	1993	28.8
1983	23.9	1994	30.2
1984	24.6	1995	30.6
1985	25.8	1996	30.7

Source: United Nations (1983–98).

Most theoretical models assume knowledge spillovers from R&D to be national or international in scope and then compare the predictions of the two scenarios. Following this line of argument, the goal of the empirical economist is simply to determine which assumption is appropriate. Yet this approach sits rather uncomfortably with the central tenets of the literature on trade and growth. A major theme of this literature is that technological change occurs due to intentional and costly investments undertaken by firms that seek to profit from monopoly power that results from successful innovation. If this is the case, arbitrage in knowledge, which is basically what the spread of know-how across countries amounts to, cannot be totally exogenous to economic activity. Those agents that invest heavily in creating new technologies face strong incentives to control the spread of their hard-earned successes. If such control were not possible, they would have little incentive to make those investments in the first place. For the theory of trade and innovation to be internally consistent almost requires that inventors partially control the rate at which their technologies spread internationally. Therefore it is misleading to focus on the geographical scope of knowledge spillovers without giving innovators some role in that process.

In addition to the incentives of innovators, other factors determine the scope of knowledge spillovers, including incentives facing potential buyers and imitators of technologies. The literature in this area has not paid adequate attention to the choices that both potential suppliers and buyers of technology face. However, the literature seeks to explain the emergence of multinational firms that play a central role in international technology transfer.

Explaining FDI: Location and Mode of Production

There are two distinct questions that a firm seeking to serve foreign markets must address. First, is it better to produce the good in the home country and export to foreign markets, or is production abroad more profitable? Second, for production abroad, how should technology be transferred overseas? Firms can choose from a variety of arrangements that differ in their relative use of markets and organizations. One extreme arrangement transfers technology to wholly owned subsidiaries; the other extreme transfers technology to unrelated parties through licensing.

Exports versus Production Abroad

When serving a foreign market, a firm can choose from a menu of options. The literature mainly focuses on the choice between exports and FDI, assuming that exports and FDI are substitutes for one another. However, empirical work usually uncovers a complementary relationship between exports and foreign affiliate sales. For example, Lipsey and Weiss (1981) find that sales of foreign affiliates are positively cor-

related with exports at the industry level. Firm-level studies, such as Lipsey and Weiss (1984), Grubert and Mutti (1991), and Blomström and others (1988) also uncover a complementary relationship between trade and FDI.

Does the evidence imply that most theoretical models are flawed? Perhaps not. Blonigen (1999) suggests that a reasonable interpretation of the evidence shows that such studies find net complementarity: aggregation bias in the data simply buries the substitution effects emphasized in theoretical models. Blonigen's major contribution lies in using product-level data because theory implies the substitution effect at this level. Blonigen uses data on Japanese production and exports to the United States for two types of products: automobile parts and automobiles. His study is particularly useful in the context of Japanese multinational firms located in the United States that import relatively large amounts of parts from Japan and seem quite unwilling to substitute between U.S. and Japanese parts.

Only a study of the type done by Blonigen (1999) can really sort out the complementary nature of trade between intermediate goods and affiliate sales on the one hand and the substitutability of exports of final goods and FDI on the other. Not surprisingly, Blonigen's results conform nicely to the theory: exports of intermediate goods and sales of affiliates are complements, whereas exports and sales of final goods are substitutes. The only unresolved issue is why aggregate studies find a net complementary relationship. The explanation probably lies in a fact that Ethier (1982) emphasizes: most intraindustry trade between industrial countries involves exchange of intermediate goods. The literature on intraindustry trade as derived from Dixit and Stiglitz's (1977) model may overemphasize the role of product differentiation and consumer emphasis on variety. As Ethier (1982) notes, actual trade is in intermediate goods needed for production. Thus, if such trade is indeed pervasive, there should be a strong complementary relationship between exports and FDI at the aggregate level.

The theoretical models have also argued that strategic considerations influence the choice between exports and FDI (see Horstmann and Markusen [1992] and Motta and Norman [1996]). The presence of trade barriers creates a tariff-jumping motive for FDI. Bhagwati and others (1987, 1992) argue that the mere threat of future trade restrictions may lead to anticipatory investment (called *quid pro quo* investment) by foreign firms. However, the preceding research emphasizes the interdependence of decisionmaking between multinational firms. For example, when two firms are exporting to a foreign market, a switch from exports to FDI by one creates an incentive for FDI on the part of the other firm, which finds itself at a competitive disadvantage (Lin and Saggi 1999 call this the competitive incentive for FDI). An old tradition in the management literature describes the interdependence between the decisionmaking of large multinationals as *follow-the-leader* behavior.

As far as the static choice between exports and production abroad, the theoretical models seem reasonably well developed. However, firms face a dynamic problem, not

just a one-time choice between exports and FDI. Firms may (and indeed do) switch between the two activities over time. Unfortunately, there is scarce literature that explores the dynamics of optimal entry strategies into foreign markets. Roberts and Tybout (1997) highlight the role of sunk costs in determining the dynamic behavior of exporters. Using data for Colombian manufacturing plants, Roberts and Tybout show that prior exporting experience is an important determinant of the current tendency to export as well as the profitability of exporting. Their findings show that sunk costs are indeed relevant for export behavior and that learning is subject to strong depreciation. The entry costs of a plant that has never exported do not differ significantly from those of plants that have not exported for more than two years.

Although Roberts and Tybout (1997) do not consider other modes of serving foreign markets, their insight can be utilized in a more general context. Suppose firms also have the option of FDI. Building on the Roberts and Tybout approach, the choice between exports and FDI is a choice between two different technologies, where exports entail a higher marginal cost and a lower fixed (sunk) cost than FDI. Under uncertainty, if firms do face such a cost structure, an interesting dynamic relation between exports and FDI may emerge.

Saggi (1998) builds a two-period model to examine a firm's choice between exports and FDI in the face of demand uncertainty. First-period exports yield information about demand in the foreign market. As a result, first-period exports have an option value. That is, if a significant portion of the fixed cost of FDI is sunk, it is optimal for a firm to export in the first period and to choose FDI if and only if demand abroad is large enough.

Clearly, the preceding argument is not specific to demand uncertainty and can be generalized with respect to other types of uncertainty about which sales through exports can yield information. Similarly, exports and initial FDI may be strongly complementary because firms are not likely to shift the entire production process to a new location immediately. If initial investment is profitable, local sourcing may reduce the need for imported intermediates. Over time, such substitution effects may become stronger, and the complementarity between exports and FDI may become weaker (assuming local suppliers are indeed competitive or local production is consistent with comparative advantage considerations).

Of course, generalizing the preceding argument to the case of multiple firms also creates the possibility of information externalities among investors; that is, the experience of one firm may impart lessons to others. Such externalities may be particularly relevant for FDI in many developing and formerly closed economies (China and much of Eastern Europe) that have only recently opened their markets to foreign investors. Firms from industrial countries have little prior experience in operating in these new environments. This lack of experience coupled with the complexity surrounding the FDI decision implies that firms seeking to invest in these markets can

learn valuable lessons from the successes and failures of others. FDI involves hiring foreign labor, setting up a new plant, meeting foreign regulations, and developing new marketing plans; these decisions require adequate information. In this context, decisions made by rival firms can lower a firm's fixed cost by helping avoid mistakes. For example, Lin and Saggi (1999) use a duopoly model in which the first firm to switch from exporting to FDI confers a positive externality on the subsequent investor by lowering its fixed cost of FDI.

In their survey of Japanese firms planning investments in Asia, Kinoshita and Mody (1997) find that both private and public information play important roles in determining investment decisions. They argue that information regarding many operational conditions (such as the functioning of labor markets, literacy, the productivity of the labor force, and timely availability and quality of inputs) may not be available publicly. Such information is either gathered through direct experience or through the experience of others. Indeed, Kinoshita and Mody's empirical analysis finds that a firm's current investment is strongly affected by its own past behavior as well as by the investments of its rivals.

Although the degree of fixed/sunk costs may play a role in determining the choice between licensing, joint ventures, and FDI, other considerations are probably more important. A new foreign plant is the primary contributing factor behind higher fixed/sunk costs of FDI relative to exports. This factor is unlikely to be of first-order importance in determining the choice between different entry modes that are distinguished primarily by the extent of foreign ownership.

Mode of Operation: Licensing, Joint Venture, or FDI?

A major question in the theory of the multinational firm is when and why firms choose to internalize technology transfer, thereby forgoing the option of utilizing market based alternatives such as technology licensing. Markusen (1995) and Caves (1996) discuss the relevant economics literature regarding internalization. A vast literature in the field of international business deals with some of the questions posed. By and large, this literature involves empirical tests of the ownership, location, and internalization paradigm developed by Dunning (1988). To limit the scope of this survey, I discuss this literature only to the extent that it offers new insights with respect to the economics of multinational firms (see Caves 1996 for a relatively recent survey of this literature). I focus on the central conclusions of this line of research, particularly those that relate to technology transfer.

Markusen and Maskus (1999) suggest that the literature that attempts to link the emergence of multinational firms with firm- and country-level characteristics can be understood as emerging from a common underlying model—the knowledge capital model. Research that deals directly with technology transfer includes Horstmann and

Markusen (1987, 1996) and Ethier and Markusen (1991). Markusen (1998) argues that the knowledge capital model rests on the fact that knowledge has a public good property, that is, it can be utilized in multiple locations simultaneously. Thus any innovation can then be fruitfully applied at multiple plants dispersed all over the world, giving rise to horizontal multinational firms. Markusen and Maskus (1999) show that there is indeed strong empirical support for this horizontal model of multinationals.

How does the knowledge capital model explain internalization? Once again, the public good nature of knowledge occupies a central role. If licensees (or local partners under a joint venture) can get access to the multinational's proprietary knowledge, the value of its knowledge based assets can be dissipated either because of increased competition (Ethier and Markusen 1991; Markusen 2000; Saggi 1996, 1999) or because the local partner has inadequate incentives to protect the multinational's reputation (Horstmann and Markusen 1987). The incentive to prevent the dissipation of knowledge-based assets is reflected in the fact that multinationals transfer technologies of new vintage through direct investment and license or transfer their older technologies through joint ventures (see Mansfield and Romeo 1980). Alternatively, it may be easier to trade older technologies through the market; potential buyers are likely to be better informed about well-established technologies compared with new ones.

In an empirical paper, Smarzynska (1999a) focuses on intraindustry differences in R&D intensity as a determinant of the mode of entry chosen by firms investing in Eastern European countries. Like past work, this study finds that a firm's R&D expenditure is negatively related to the probability of a joint venture and positively related to direct entry. Furthermore, a firm's R&D expenditure relative to the rest of the industry is positively correlated with the probability of greenfield entry in high-technology sectors. In low-technology sectors, higher relative R&D expenditure by a firm actually increases the likelihood of a joint venture rather than a greenfield entry. Thus, a firm's R&D expenditure relative to other firms in the industry and the aggregate R&D expenditure of the industry relative to other industries may interact in subtle ways to influence the choice between alternative entry modes. Smarzynska (1999a) argues that protecting technology is of greater concern in high-tech industries, thereby encouraging technological leaders to adopt direct entry. However it is also possible that in industries characterized by a fast pace of technological change, any technology leakage will hurt a firm for only a short period of time. Furthermore, the formation of joint ventures may be easier in relatively mature host industries because they can more easily find suitable local partners. Thus Smarzynska's results call for a careful interpretation but raise some interesting possibilities and questions.

Foreign firms may not be the only ones that have valuable information that is subject to the risk of dissipation. Horstmann and Markusen (1996) argue that a potential licensee in the host country may have better information about local demand and could use this information to extract rents from the licensor. Such agency costs can also be utilized to explain the dynamics of optimal entry modes. In his stud-

ies of British multinationals, Nicholas (1982, 1983) finds that 88 percent of the firms sold their products through a contract with a local agent before converting to directly owned sales or production branches. Furthermore, the decision to terminate the licensing arrangement was based on a desire to avoid agency costs. Once the multinational had acquired the information it needed through its alliance with the local partner, continuing the agency relationship was no longer attractive. Similarly, in their survey of Japanese multinationals in Australia, Nicholas and others (1994) find that 60 percent of the firms used a local agent before making a direct investment and 69 percent exported to Australia before making a direct investment of any sort. Such temporary licensing could be viewed as a method of information acquisition on the part of the foreign firm, as opposed to the local firm seeking superior production technology.

In Horstmann and Markusen's (1996) model, when the multinational firm's fixed costs of investment are high relative to the agent's and there is risk of large losses due to low demand, the multinational opts for an initial licensing contract that becomes permanent *ex post* in case of low demand. Their analysis can be applied to examine the choice between a joint venture and a wholly owned subsidiary, except that cost uncertainty may be more relevant than demand uncertainty for this scenario. For example, if the productivity of foreign labor is in doubt, forming a joint venture may present a low (fixed) cost option. If labor productivity turns out to be high, an acquisition of the foreign partner may be optimal *ex post*, resulting in the establishment of a wholly owned subsidiary.

However, dynamic issues remain underexplored in the literature. Although the comparative statics of the models provide some partial intuition about forces that are important for dynamic choice, such an approach is a poor substitute for explicit dynamic modeling. Several central questions deserve further research. For example, what determines the sequencing pattern of different activities? Do firms first form joint ventures and then proceed with direct investment? If so, why? To what extent do the dynamic choices of foreign firms result from their efforts at restricting diffusion of their own technology while at the same time maximizing the acquisition of valuable information from local firms? Do host country welfare and the rate of technology diffusion depend on the sequencing pattern?

FDI, Technology Transfer, and Spillovers

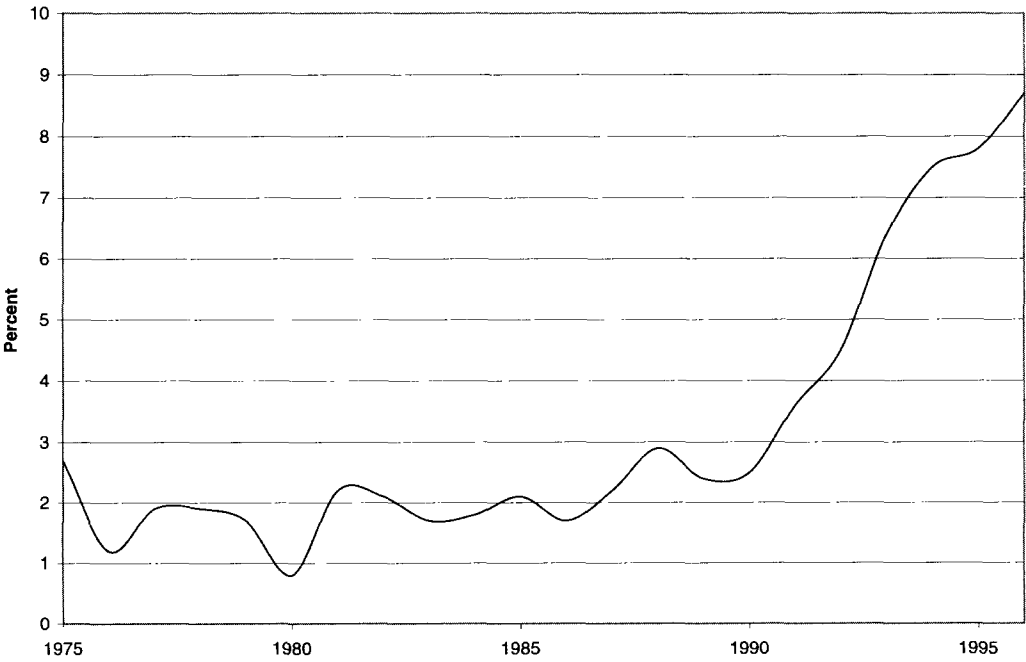
Although the increase in world trade has received significant attention, the role FDI has played in the explosion of world trade is not often appreciated. Today, intrafirm trade, that is, trade between subsidiaries and headquarters of multinational firms, may account for one-third of total world trade. The importance of FDI can also be gauged from the fact that sales of subsidiaries of multinational firms now exceed

worldwide exports of goods and services. In 1998, the total estimated value of foreign affiliate sales was US\$11 trillion, whereas the value of worldwide exports was \$7 trillion (U.N. Conference on Trade and Development [UNCTAD] 1999). Thus, FDI is the dominant channel through which firms serve customers in foreign markets.

Historically much of the flows of FDI occurred between industrial countries (much like most intraindustry trade). For example, during 1987–92, industrial countries attracted \$137 billion of FDI inflows a year on average; developing economies attracted only \$35 billion, or slightly more than 20 percent of global FDI inflows. Yet developing economies have become increasingly important host countries for FDI, especially because of the large-scale liberalization undertaken by formerly closed economies, such as China. During 1996 and 1997, over 40 percent of global FDI flows went to developing economies (UNCTAD 1999).

Figure 2 plots net FDI inflows as a percentage of gross domestic investment for low- and middle-income countries (those countries with per capita income below \$9,655) for 1975–96. During this period, FDI became an increasingly important source of capital for such countries. On average, FDI inflows now constitute approximately 10 percent of their annual gross domestic investment.

Figure 2. Net Inflows of FDI over Gross Domestic Investment, Low- and Middle-Income Countries, 1975–96



Source: World Bank (1999).

The recent surge in capital flows to developing economies, of which FDI has been a significant part, is also reflected in the fact that approximately 30 percent of the total stock of FDI is in developing economies (table 2). FDI is of relatively greater importance to developing economies because of their smaller size. In 1997, the total inward stock of FDI as a percentage of GDP was almost 17 percent in developing countries, compared with less than 12 percent in industrial countries (table 2).

For the purposes of this article, the role of FDI as a channel for transferring goods and services internationally is of secondary concern. Instead, the main issue is the role of FDI as a channel of technology transfer. It is difficult to find fully convincing evidence of the dominance of FDI as a channel of international technology transfer (among those channels that directly involve the owner of the technology being transferred). However, several facts hint in that direction. For example, in 1995 over 80 percent of global royalty payments for international transfers of technology were made from subsidiaries to their parent firms (UNCTAD 1997). In general, technology payments and receipts have risen steadily since the mid-1980s, reflecting the importance of technology for international production.

Table 3 reports data for Germany, Japan, and the United States. For example, from 1985 to 1997, Germany's receipts of royalties and license fees increased from approximately \$0.5 billion to more than \$2 billion. For the United States, the increase was even sharper, from \$6 billion to more than \$33 billion. The data also indicate the importance of FDI for international trade in technology. During 1985–97, between two-thirds and nine-tenths of technology flows were intrafirm in nature. Furthermore, as is evident from table 3, the intrafirm share of technology flows has increased over time. Of course, royalty payments only record the explicit sale of technology and do not capture the full magnitude of technology transfer through FDI relative to technology transfer via imitation, trade in goods, and other channels.

Yet another confirmation of the strong role FDI plays in transmitting technology internationally comes from the interindustry distribution of FDI. It is well known that multinational firms are concentrated in industries that exhibit a high ratio of R&D relative to sales and a large share of technical and professional workers (Markusen

Table 2. FDI Inward Stock, 1987–98

<i>FDI inward stock</i>	<i>1980</i>	<i>1985</i>	<i>1990</i>	<i>1995</i>	<i>1997</i>
<i>Billions of dollars</i>					
World	506	783	1769	2790	3437
Percent in industrial countries	73.8	69.7	78.9	71.1	67.3
<i>Percentage of GDP</i>					
World	5.0	6.9	8.7	9.9	11.7
Industrial countries	4.8	6.1	8.4	9.0	10.5
Developing economies	5.9	9.8	10.5	14.1	16.6

Source: UNCTAD (2000).

Table 3. Receipts of Royalties and License Fees, 1985–97
(millions of dollars)

Year	Germany			United States		
	Total	Intrafirm		Total	Intrafirm	
		German parent firms only	Foreign affiliates in Germany		U.S. parent firms only	Foreign affiliates in the United States
1985	546	464	83	6,680	—	—
1986	780	597	122	8,114	5,994	180
1987	997	698	146	10,183	7,668	229
1988	1,081	883	124	12,147	9,238	263
1989	1,122	899	106	13,818	10,612	349
1990	1,547	1,210	235	16,635	12,867	383
1991	1,515	—	345	17,819	13,523	583
1992	1,680	—	472	20,841	14,925	733
1993	1,596	—	498	21,694	14,936	752
1994	1,720	—	489	26,712	19,250	1,025
1995	2,174	1,486	642	30,289	21,399	1,460
1996	2,315	1,667	653	32,823	22,781	1,929
1997	2,282	1,659	509	33,676	23,457	2,058

— Not available.

Source: UNCTAD (1999).

1995). In fact, it is commonly argued that multinationals rely heavily on intangible assets, such as superior technology, for successfully competing with local firms that are better acquainted with the host country environment.

By encouraging FDI, developing economies hope not only to import more efficient foreign technologies but also to generate technological spillovers for local firms. Not surprisingly, a large body of literature tries to determine whether host countries enjoy spillovers from FDI. It is important to be clear about the meaning of the word *spillover*. A distinction can be made between pecuniary externalities (that result from the effects of FDI on market structure) and other pure externalities (such as the facilitation of technology adoption) that may accompany FDI. A strict definition of spillovers would count only the latter, and this is the definition employed here. In other words, if FDI spurs innovation in the domestic industry by increasing competition, I do not view that as a spillover from FDI because this effect works its way through the price mechanism. However, it is difficult to isolate empirically the pure externalities from FDI from its other effects that work through the market. Furthermore, policy ought to be based on the aggregate effect of FDI on welfare, not just on the extent of positive externalities from FDI.

The central difficulty is that spillovers, as defined here, do not leave a paper trail; they are externalities that the market fails to take into account. Nevertheless, sev-

eral studies have attempted the difficult task of quantifying spillovers. But what are the potential channels through which such they may arise? A more difficult question is whether it is even reasonable to even expect spillovers to occur from FDI. Multinationals have much to gain from preventing the diffusion of their technologies to local firms (except when technologies diffuse vertically to potential suppliers of inputs or buyers of goods and services sold by multinationals).

Potential Channels of Spillovers

At a general level, the literature suggests the following potential channels of spillovers:

- *Demonstration effects.* Local firms may adopt technologies introduced by multinational firms through imitation or reverse engineering.
- *Labor turnover.* Workers trained or previously employed by the multinational may transfer important information to local firms by switching employers or may contribute to technology diffusion by starting their own firms.
- *Vertical linkages.* Multinationals may transfer technology to firms that are potential suppliers of intermediate goods or buyers of their own products.

Demonstration effects. In its simplest form, the demonstration effect argument states that exposure to the superior technology of multinational firms may lead local firms to update their own production methods. The argument derives from the assumption that it may simply be too costly for local firms to acquire the necessary information for adopting new technologies if they are not first introduced in the local economy by multinationals (and hence demonstrated to succeed in the local environment). Incidentally, the demonstration effect argument relates well to the point made by Parente and Prescott (1994) that trade may lower costs of technology adoption.

Clearly, geographical proximity is a vital part of the demonstration effect argument. As noted earlier, empirical evidence on the geographical scope of R&D spillovers is mixed. However, studies that reach optimistic conclusions with respect to the international nature of R&D spillovers typically involve data from industrial countries and therefore require qualification. Geographical proximity may indeed be crucial for developing economies that are not as well integrated into the world economy and that have fewer alternative channels for absorbing technologies.

The main insight of the demonstration effect argument is that FDI may expand the set of technologies available to local firms. If so, this is a potential positive externality. However, a mere expansion in choices need not imply faster technology adoption, especially if domestic incentives for adoption are also altered due to the impact of FDI on market structure. FDI may expand choices, but it also generally increases competition. The industrial organization literature on market structure and inno-

vation does not provide an unambiguous answer to this question. A rough conclusion is that a monopolist has a stronger incentive to invest in R&D that yields innovations that complement existing technology, whereas competitive firms have a stronger incentive to invest in R&D that yields innovations that replace existing technology. The net effect on the incentives for adopting new technologies may indeed be ambiguous.

Suppose FDI does lower the cost of technology adoption and lead to faster adoption of new technologies by local firms. Does that imply that relative to trade (that is, a scenario in which foreign firms export to the domestic or world market), inward FDI necessarily generates spillovers for the local economy? A point to keep in mind is that technology diffusion may strengthen the competitors of the foreign firms. Foreseeing the consequences of such diffusion, foreign firms may alter the very terms of their original technology transfer. For example, a foreign firm may choose to transfer technologies of lower quality when there is a risk of leakage to local firms. It is conceivable, however, that due to their larger size and other advantages they enjoy in the product market, multinationals can alter the market outcome in their favor despite technology leakage. Thus, a multinational would not have to resort to such strategies.

For example, Das (1987) presents a model in which native firms may learn from the subsidiary of a multinational firm that acts as a dominant firm facing a local competitive fringe in the product market. Wang and Blomström (1992) present a related model. In their duopoly model with differentiated goods, a multinational transfers technology to its subsidiary so that the local firm can learn from the new technologies introduced. Learning occurs both through costless technology spillovers as in the contagion effects that Findlay (1978) first emphasized, as well as through the local firm's costly investments. The most interesting implication of Wang and Blomström's model is that technology transfer through FDI is positively related to the level of the local firm's investment in learning. This result suggests that multinationals respond to local competition by introducing newer technologies faster.

Assuming the rate of increase in efficiency of the local firms to be positively related to the scale of operation of the multinational firm's subsidiary, Das (1987) investigates the optimal time paths of the multinational's output and price. She shows that despite technology leakage, the multinational may find it profitable to transfer technology. Huizinga (1995) models a multinational's incentive for technology transfer where it faces risk of competition caused by expropriation by the government of the host country. The main result is that the multinational responds by lowering the quality of technology transfer even when such transfers are costless.

Because the demonstration effect argument is largely an industry-level argument, relating industry-level variation in R&D expenditures by local firms to the extent of FDI is one method of checking whether local adoption efforts are encouraged through FDI. Of course, such an exercise would have to control for the effect of FDI on market

structure, and this seems rather difficult. To the best of my knowledge, a convincing empirical exercise of this type has not been performed. Instead, the existing literature has focused on the effects of FDI on TFP in local firms.

Labor turnover. Although researchers have extensively studied direct imitation and reverse engineering as channels of interfirm technology diffusion, they have tended to neglect the role of labor turnover. Labor turnover differs from the other channels because knowledge embodied in the labor force moves across firms only through the physical movement of workers. The relative importance of labor turnover is difficult to establish because it would require tracking individuals who have worked for multinationals, interviewing them regarding their future job choices, and then determining their impact on the productivity of new employers. Few empirical studies attempt to measure the magnitude of labor turnover from multinationals to local firms. To the best of my knowledge, there are no empirical studies that attempt to measure the role such turnover plays in improving productivity in local firms.

The available evidence on labor turnover itself is mixed. For example, although Gershenberg's (1987) study of Kenyan industries finds limited evidence of labor turnover from multinationals to local Kenyan firms, several other studies document substantial labor turnover from multinationals to local firms. UNCTAD (1992) discusses the case of the garment industry in Bangladesh (see also Rhee 1990). Korea's Daewoo supplied Desh (the first Bangladeshi firm to manufacture and export garments) with technology and credit. Thus, Desh was not a multinational firm in the strict sense; rather, it was a domestic firm that benefited substantially from its connection with Daewoo. Eventually, 115 of the 130 initial workers left Desh to set up their own firms or to join other newly established garment companies. The remarkable speed with which the former Desh workers transmitted their know-how to other factories clearly demonstrates the role labor turnover can play in technology diffusion.

Pack (1997) discusses evidence documenting the role of labor turnover in disseminating the technologies of multinationals to local firms. For example, in the mid-1980s, almost 50 percent of all engineers and approximately 63 percent of all skilled workers that left multinationals left to join local Taiwanese firms. By contrast, Gershenberg's (1987) study of Kenyan industry reports smaller figures: of the 91 job shifts studied, only 16 percent involved turnover from multinationals to local firms.

To synthesize these empirical findings, the cross-country variation in labor turnover rates itself requires an explanation. One possible generalization is that in areas such as Korea and Taiwan, local competitors are less disadvantaged relative to their counterparts in many African economies, thereby making labor turnover possible. Thus the ability of local firms to absorb technologies introduced by multinationals may be a key determinant of whether labor turnover occurs as a means of technology diffusion in equilibrium. Furthermore, the local investment climate may be such

that workers looking to leave multinationals in search of new opportunities (or other local entrepreneurs) find it unprofitable to start their own companies, implying that the only alternative opportunity is to join existing local firms. The presence of weak local competitors probably goes hand in hand with the lack of entrepreneurial efforts because both may result from the underlying structure of the economic environment.

Glass and Saggi (forthcoming) argue that because superior technology is one of the key intangible assets that permit multinationals to successfully compete with local firms, multinationals may attempt to limit technology diffusion by offering higher wages to their workers relative to local firms. Thus, the wage premiums paid by a multinational can provide a rough estimate of the value it places on the knowledge it transfers to its workers. The more interesting point is that such a premium may either exceed or fall short of the benefit the local economy would enjoy if the multinational were to allow its workers to leave. Note that if the multinational must raise wages to restrict technology diffusion to local firms, the wage premium might not be related to the social value of the knowledge embodied in the workers. Thus, technology diffusion is not necessarily optimal for the local economy. Policies designed to encourage technology transfer do not always increase the welfare of the recipient country.

Local competition policy may also affect labor turnover. For example, Bulgaria's competition law does not permit an individual to join the management of a competing firm operating in the same line of business as the person's original employer for the first three years after leaving an enterprise (Hoekman and Djankov 1997). Of course, in many industrial countries, trade secrets laws protect firms against the loss of valuable information to their rival firms. But it is difficult to see how such laws could protect against the kind of basic technology diffusion that results from labor turnover from multinationals in developing economies.

Labor turnover rates may vary at the industry level as well. Casual observation suggests that industries with a fast pace of technological change (such as the computer industry in Silicon Valley) are characterized by very high turnover rates relative to more mature industries. Therefore, cross-country variation in labor turnover from multinationals could simply stem from the global composition of FDI: developing economies are unlikely to host FDI in sectors subject to rapid technological change.

Vertical linkages. For quite some time, analysts have recognized that multinationals may benefit the host economy through the backward and forward linkages they generate. However, merely documenting extensive linkages between multinationals and local suppliers or buyers is insufficient for arguing that net benefits accrue to the local economy as a result of FDI. Rodriguez Clare (1996) develops a formal model of linkages and shows that multinationals improve welfare only if they generate linkages over and beyond those generated by the local firms they displace. Yet the question of relevance here is whether the generation of linkages is expected to result in technology diffusion. Although analytical modeling of such issues is scarce, there is

limited empirical evidence in support of the view that multinationals are involved in vertical technology transfers (Lall 1980).

Mexico's experience with FDI is illustrative of how such a process works. In Mexico, extensive backward linkages resulted from FDI in the automobile industry. Within five years of investments by major auto manufacturers there were 300 domestic producers of parts and accessories, of which 110 had annual sales of more than \$1 million (Moran 1998). Foreign producers also transferred industry best practices, zero defect procedures, and production audits to domestic suppliers, thereby improving their productivity and the quality of their products. As a result of increased competition and efficiency, Mexican exports in the automobile industry boomed. Thus, although direct competitors of multinational firms may not realize technological benefits (as evidenced by Aitken and others 1996), suppliers of intermediate goods are likely to benefit substantially.

Even more interesting is the possibility that such vertical transfers when accompanied by spillovers may lead to interaction between upstream and downstream multinational firms that encourages industrial development. Markusen and Venables (1999) develop a model that abstracts from technology spillovers but focuses on the pecuniary externalities that accompany vertical linkages and result in industrial development. Pack and Saggi (2001) emphasize that downstream buyers in industrial country markets benefit from technology diffusion among potential suppliers in developing economies because such diffusion increases competition among suppliers. In their model, by increasing demand in the downstream market, competition caused by technology diffusion in the developing market may induce entry into marketing, thereby increasing competition in the downstream market. Their analysis implies that fully integrated multinational firms may be more averse to technology diffusion than are firms involved in international arm's-length arrangements. Although they do not model FDI, it is not hard to see how their model can be applied to understand the consequences of technology diffusion under FDI rather than exporting.

Empirical Evidence on Spillovers

Early efforts in search of spillovers from FDI proceeded by relating the interindustry variation in productivity to the extent of FDI (Blomström 1986; Blomström and Persson 1983; Caves 1974; Globerman 1979). These studies largely find that sectors with a higher level of foreign involvement (as measured by the share of the labor force in the industry employed by foreign firms or the extent of foreign ownership) tend to have higher productivity, higher productivity growth, or both. The fact that these studies involve data from different countries (Australia for the Caves study, Canada for Globerman, and Mexico for Blomström) lends a strong degree of robustness to this positive correlation between the level of foreign involvement and local productivity at the sector level.

Of course, correlation is not causation and, as noted by Aitken and Harrison (1999), this literature may overstate the positive impact of FDI on local productivity. Investment may have been attracted to the more productive sectors of the economy instead of being the cause of the high productivity in such sectors. In other words, the studies ignore an important self-selection problem. Both trade and FDI help ensure an efficient allocation of global resources by encouraging investment in those sectors in which an economy enjoys comparative advantage. In this sense, Aitken and Harrison's point is almost necessarily implied by traditional trade theory. However, if trade protection encourages investment in sectors in which a host economy does not enjoy comparative advantage, trade protection may be welfare-reducing. This possibility was relevant for countries that sought to industrialize by following a strategy of import substitution.

Nevertheless, only plant-level studies can control for the self-selection problem that may plague industry-level studies. Taking the argument a step further, the self-selection problem may also arise in plant-level studies: the more productive plants may be the ones that attract foreign investment. For example, Clerides and others (1998) find support in favor of the self-selection hypothesis in the context of exporting. They find that the more productive firms self select into exporting. However, if plant-level studies fail to find a significant relationship between foreign involvement and productivity, the self-selection problem might not be important. It might be important if foreign firms seek out plants with low productivity and bring them up to par with more efficient local plants. In this case, there might be no significant productivity differential between foreign and local firms. This argument seems far-fetched, but it could make sense. Suppose local plants with very low productivity are relatively undervalued by local agents because the skills (technology and modern management) needed to make them competitive are in short supply locally. In this scenario, such plants would be attractive to foreign investors who can, through their technology, generate productivity improvements that simply cannot be achieved by local agents.

What do empirical plant-level studies find with respect to spillovers from FDI? Haddad and Harrison's (1993) study was the first to employ a comprehensive data set at the level of the individual firm over several years. The data came from an annual survey of all manufacturing firms in Morocco. An important result was that foreign firms exhibited higher levels of TFP, but their rate of TFP growth was lower than that for domestic firms. As the authors note, at first glance, such a finding suggests that perhaps there was some sort of convergence between domestic and foreign firms. However, this was not the case. Although there was a level effect of foreign investment on the TFP of domestic firms, such an effect was missing for the growth rate of the TFP of domestic firms. In addition, when sectors were divided into high and low tech, the effect of FDI at the sector level was found to be more positive in low-tech sec-

tors. The authors interpret this result as indicative of the lack of absorptive capacity on the part of local firms in the high-tech sector, where they may be further behind multinationals and unable to absorb foreign technology.

Aitken and others (1996) undertake a somewhat different approach to measuring spillovers from FDI. The idea behind their study is that technology spillovers should increase the marginal product of labor, and this increased productivity should show up in the wages for workers. The study employs data from manufacturing firms in Venezuela, Mexico, and the United States. For both Mexico and Venezuela, a higher share of foreign employment is associated with higher overall wages for both skilled and unskilled workers. Furthermore, royalty payments to foreign firms from local firms are highly correlated with wages. Most important, the study finds no positive impact of FDI on the wages of workers employed by domestic firms. In fact, the authors report a small negative effect for domestic firms, whereas the overall effect for the entire industry is positive. These findings differ from those for the United States, where a larger share of foreign firms in employment is associated with both a higher average wage as well as higher wages in domestic establishments.

Putting the Aitken and others (1996) findings into the context of previous work, it is clear that wage spillovers (from foreign to domestic firms) are associated with higher productivity in domestic plants. Conversely, the absence of wage spillovers appears to accompany the existence of productivity differentials between domestic and foreign firms. Why might this be so? Any serious explanation of this association requires studying the interaction of the market for labor and goods. Glass and Saggi (1999b) develop a model to capture this interaction (their findings are discussed in the section on labor turnover).

The most recent study on the issue of spillovers from FDI is Aitken and Harrison (1999). This study uses annual census data on more than 4,000 Venezuelan firms. Because each plant was observed over a period of time, the self-selection problem of previous sector-level studies (that is, FDI goes to the more productive sectors) could be avoided. The authors find a positive relationship between foreign equity participation and plant performance, implying that foreign participation does indeed benefit plants that receive such participation. However, this own-plant effect is robust for only small plants, that is, those plants that employ fewer than 50 employees. For larger plants, foreign participation results in no significant improvement in productivity relative to domestic plants.

More interestingly, productivity in domestic plants *declines* when foreign investment increases. In other words, the authors find evidence of negative spillovers from FDI and suggest that they could result from a market stealing effect. That is, foreign competition may have forced domestic firms to lower output and thereby forgo economies of scale. Note that if loss in output is large enough, local plants may have lower productivity despite enjoying some sort of technology spillovers. Nevertheless, on

balance, Aitken and Harrison (1999) find that the effect of FDI on the productivity of the entire industry is weakly positive. They also note that similar results are obtained for Indonesia, except that the positive effect on its own plants is stronger, whereas the negative effect on domestic plants is weaker, suggesting a stronger overall positive effect.

Djankov and Hoekman (2000) also find a negative spillover effect of FDI on purely domestic firms in industry in the Czech Republic. Interestingly, however, when joint ventures are excluded from the sample and attention is restricted to the impact of majority-owned foreign affiliates (that is, FDI) on all other firms in an industry (including joint ventures), the negative effect loses statistical significance. The authors report that survey questionnaires reveal that joint-venture firms invest significantly more in new technologies than do purely domestic firms. The authors suggest that purely domestic firms might lack the ability to absorb the technologies introduced by foreign firms (due to their lower R&D efforts).

Overall, several studies have cast doubt on the view that FDI generates positive spillovers for local firms. But such findings need not imply that host countries have nothing significant to gain (or must lose) from FDI. The point is that the reallocation of resources that accompanies the entry of foreign firms may not be immediate. Domestic firms should be expected to suffer from an increase in competition; in fact, part of the benefit of inward FDI is that it can help weed out relatively inefficient domestic firms. Resources released in this process will be put to better use by foreign firms with superior technologies, efficient new entrants (domestic and foreign), or some other sectors of the economy. Existing studies of spillovers may not cover a long enough period to be able to accurately determine how FDI affects turnover rates (entry and exit). Furthermore, their design limits such horizontal studies because they cannot clarify linkages and spillovers that may result from FDI in industries other than the one in which FDI occurs.

Spillovers from FDI: A Recapitulation

A challenge facing the optimistic view regarding technology spillovers from FDI is to explain how such spillovers can ever be in the interest of the multinational firms. Clearly, under most circumstances, multinationals would rather limit diffusion in the local economy. In fact, the heart of the theory that seeks to explain the emergence of multinationals is that such firms are able to successfully compete with local firms precisely because they possess superior technologies, management, and marketing. Why, then, would multinationals not take actions to ensure that such advantages do not diffuse to local competitors?

Part of the answer must lie in the fact that such actions are costly and may even entail externalities between multinationals. Suppose a costly action (such as litigation in local courts to enforce protection of IPRs) can indeed help limit the loss of

knowledge capital for a multinational. A difficulty arises if all potential multinationals benefit from the curtailment of technology diffusion, whereas the costs fall on only the one who takes legal action. Thus the public good nature of such actions suggests that developing economies hosting multinationals may expect the rivalry among such firms to result in some degree of technology diffusion. Of course, the preceding argument also overstates the case a bit: some loss of knowledge will result despite all precautions. Nevertheless, it is beyond dispute that multinationals can take actions to limit diffusion, and while they are making their decisions regarding where to set up subsidiaries, the expected costs of technology diffusion will enter their calculus of profit maximization.

That being said, the entry of multinationals may indeed benefit host countries even if it fails to result in spillovers for local firms. First, the preceding discussion suggests that spillovers to local firms that directly compete with the multinationals would be the most elusive of benefits that host countries may expect to enjoy from FDI. Second, local agents other than domestic competitors of multinationals (for example, local workers) may enjoy positive externalities from FDI. If so, the total effect of FDI on local welfare may be positive despite the lack of technology spillovers.

Third, spillovers may be of an entirely different nature: local firms may enjoy positive externalities from foreign firms that make it easier for them to export. Such externalities may come about because better infrastructure (transportation, storage facilities, and ports) emerges in regions with a high concentration of foreign exporters. Aitken and others (1997) provide direct evidence on this issue. They conducted a detailed study of 2,104 manufacturing plants in Mexico. In their sample, 28 percent of the firms had foreign ownership and 46 percent of the foreign plants exported. Their major finding is that the probability of a Mexican-owned plant exporting is positively correlated with its proximity to foreign-owned exporting plants. Such spillovers may result from informational externalities and are more likely to lower fixed costs rather than marginal costs of production.

FDI and Growth

Regardless of the channel through which technology spillovers occur, the fact that FDI often involves capital inflows along with technology transfer implies that one would expect a positive impact of FDI on growth in the host country. Yet there are several important caveats to this assertion. First, a positive correlation between the extent of FDI and economic growth in cross-country regressions may simply reflect the fact that countries that are expected to grow faster attract FDI because it yields higher returns there. Thus the causation could run from growth to FDI and estimation of a simultaneous equation system may be needed to resolve the issue. Second, multinationals often raise the required capital in the host country, and in such a scenario capital inflows associated with FDI may not be substantial. An optimistic view

of FDI would then look to technology transfer and/or spillovers as the mechanism through which FDI may affect growth. Indeed, Romer (1993) argues that FDI can have a positive effect on growth in developing economies by helping them bridge the idea gap with respect to industrial countries.

Glass and Saggi (1999) examine the question of spillovers from FDI in a product-cycle model. In their North–South model, the demonstration/proximity argument is formalized as follows. Southern firms are assumed to be able to imitate multinationals located in the South at a lower cost than firms located in the North. However, multinational firms are also stronger competitors than firms that produce only in the North because multinationals produce in the same low-wage location as potential imitators. The model delivers the surprising result that a faster flow of FDI increases the aggregate rate of technology transfer to the South only if local firms lack the ability to imitate firms located in the North (that is, if geographical proximity is a prerequisite for imitation). If firms in the North can be imitated, FDI does not alter aggregate technology transfer because imitation focusing on firms located in the North slows down with a hastening of imitation targeting multinationals.

Although the internalization question is a central one in the theory of FDI, almost all theories of FDI and licensing have been developed in either static or partial equilibrium models. A few dynamic general equilibrium models explore the effect of FDI on growth, but these models have ignored the possibility of licensing. Glass and Saggi (2002b) develop a model of FDI that captures the internalization decision and its implications for both the rate and magnitude of innovation. They also examine how policy interventions (taxes or subsidies to FDI) that alter the incentive to internalize production within the firm affect economic growth. They find that the ability of firms to switch modes from licensing to FDI in response to policy changes is vital for ensuring that a subsidy to FDI leads to faster economic growth.

In a comprehensive paper, Borensztein and others (1998) utilize data on FDI flows from industrial countries to 69 developing economies to test the effect of FDI on growth in a cross-country regression framework. Their findings are as follows. First, FDI contributes *more* to domestic growth than domestic investment, suggesting that it is indeed a vehicle of technology transfer. Second, FDI is more productive than domestic investment only when the host country has a minimum threshold stock of human capital. The latter finding is especially interesting because it clarifies when exactly FDI should be expected to effect growth.

Using cross-section data from 46 developing economies, Balasubramanyam and others (1996) also investigate the effect of FDI on growth in developing economies. They report two main findings. First, the growth-enhancing effects of FDI are stronger in countries that pursue a policy of export promotion rather than import substitution, suggesting that the trade policy regime is an important determinant of the effects of FDI. Second, they find that, in countries with export-promoting trade regimes, FDI has a stronger effect on growth than domestic investment. Both find-

ings relate well to the results of Borensztein and others (1998). The second finding may be viewed as a confirmation of the hypothesis that FDI results in technology transfer.

The findings of Borensztein and others (1998) relate well to Keller (1996), who argues that mere access to foreign technologies may not increase the growth rates of developing economies. In his model, if a country's absorptive capacity (stock of human capital) remains unchanged, a switch to an outward orientation does not lead to a higher growth rate. Using a model quite different from Keller's, Glass and Saggi (1998) focus on the issue of the quality of technology transferred through FDI. They argue that investment in imitation by host country firms generates the necessary knowledge (or skill) foundation for FDI, and thus factors that promote imitation can promote a higher-quality mix of FDI. Keller's (1996) model stresses that a country's stock of human capital effectively constrains its ability to take advantage of foreign technologies; Glass and Saggi (1998) emphasize that indigenous technological capability in an industry effectively constrains a country's ability to host foreign technology. Thus, they take a more micro-level view of the constraints on technology transfer relative to Keller (1996), although both studies make similar points. For example, a country may have a fair amount of human capital in the aggregate but may lack the technological sophistication to be able to host high-quality FDI in any particular industry.

Xu (2000) provides yet another confirmation of the argument that, in the absence of adequate human capital, technology transfer from FDI may fail to increase productivity growth in the host country. Using data on outward FDI from the United States to 40 countries, Xu finds that technology transfer from FDI contributes to productivity growth in more developed countries but not in less developed economies because the latter lack adequate human capital. Incidentally, as Xu notes, FDI may contribute to productivity growth due to reasons other than technology transfer. Thus a statistically significant coefficient on some measure of FDI in a productivity growth equation does not necessarily imply that technology transfer is the mechanism through which FDI contributes to productivity growth.

Xu (2000) measures the technology transfer intensity of multinational firms affiliates by their spending on royalties and license fees as a share of their gross output and estimates that, of the total effect of trade (through R&D spillovers) and FDI (through technology transfer) on productivity growth in industrial countries, 41 percent is due to technology transfer. These results for industrial countries confirm the findings of Barrell and Pain (1997), who find that FDI has a positive impact on technological change in Germany and the United Kingdom. Xu and Wang (2000) find that although capital goods trade serves as a channel of technology transfer among industrial countries, bilateral flows of FDI do not. However, Xu and Wang (2000) raise questions regarding these results because of the poor quality of the FDI data.

The Role of Policy

What does the literature say about the role policy plays in the process of international technology transfer? There is a large range of policies; this section focuses on policies on trade, FDI, and protection of IPRS.

Trade Policy

Although the literature on trade policy is voluminous, it does not pay significant attention to the interaction between protection and technology transfer. In fact, most models treat the process of technology transfer in a rather rudimentary way, focusing instead on other aspects of the problem. Here I discuss a few prominent examples of this line of research.

Miyagiwa and Ohno (1995) examine a domestic firm's incentives for technology adoption when a foreign rival has already adopted a superior technology. They assume that the cost of adoption decreases over time, and they examine how the nature (tariff versus quota) and the duration (temporary versus permanent) of trade protection influence the domestic firm's incentives for technology adoption. Their most interesting result is that temporary protection (that is, protection that is removed on successful adoption by the domestic firm) actually delays the date of technology adoption. In a related paper, Miyagiwa and Ohno (1999) show that if temporary protection is credible, it may indeed increase R&D relative to free trade. However, if the domestic firm expects that protection will be removed early should innovation occur before the preannounced terminal date of protection, the firm will invest less in R&D under protection relative to free trade. Similarly, as first emphasized by Matsuyama (1990), if the domestic firm expects protection to be extended in case of no innovation by the terminal date, its investment incentives are marred by protection.

The literature also investigates the effect of trade protection in R&D-based models of endogenous growth (see Grossman and Helpman 1991, 1995). As expected from models in which increasing returns, imperfect competition, and externalities play a central role, the results depend on the details of a particular model and require careful interpretation. To the extent that one can draw a general conclusion from such a complex body of literature, it would be that the literature does not provide an unconditional argument against trade protection. The conclusions hinge dramatically on the scope of knowledge spillovers: international knowledge spillovers strongly tilt the balance in favor of free trade, whereas national spillovers create a role for policy intervention that can combat path dependence resulting from a historical accident. For example, if productivity improvements depend only on a country's own R&D, a case can be made for policies that ensure that industries in which such improvements occur at a rapid rate are not all located elsewhere.

Dinopoulos and Segerstrom (1999) develop a specific-factor variant of the quality ladders model of endogenous growth without scale effects. They examine the consequences of contingent protection, that is, tariffs imposed on imports whenever domestic firms lose their technological leadership to foreign firms who successfully innovate over them. Their approach is interesting because protection in the real world is usually not marginal (for example, antidumping duties may be levied on foreign firms with the explicit goal of providing sufficient relief to domestic industry). Somewhat interestingly, Dinopoulos and Segerstrom find that tariffs that allow domestic firms to capture the domestic market are positively related to the global rate of technological change in the short run.

Grossman and Helpman (1991) also analyze the effects of tariff protection in a two-country quality ladders model. Unlike Dinopoulos and Segerstrom, Grossman and Helpman analyze only tariffs that are too small to allow domestic firms to capture the market. Both models assume Bertrand competition on the product market, so that a low-quality firm can monopolize the market only if a tariff of sufficient magnitude is imposed on higher-quality imports. A small tariff can extract rents from foreign firms but fails to protect domestic firms that have been innovated over by foreign firms. It should be noted that Dinopoulos and Segerstrom's (1999) analysis assumes that both countries adopt symmetric policies.

FDI Policy

There is no simple way of describing the policy environment that faces multinationals in developing economies. In countries that historically emphasized import substituting industrialization—such as most of Africa, Latin America, and Southeast Asia—FDI was either completely prohibited or multinational firms had to operate under severe restrictions. In fact, even where technology acquisition was a major policy objective, multinationals were rarely permitted to operate wholly owned subsidiaries; Japan, Korea, and Taiwan all imposed restrictions on FDI at various points in time. In other words, “outward-oriented” economies were not particularly keen on allowing multinational firms into their markets. Japan's Ministry of International Trade and Investment (MITI) played an active role in the country's acquisition of foreign technology. MITI limited competition between potential Japanese buyers, did not allow inward FDI until 1970, never greatly liberalized FDI, and even sometimes insisted that foreign firms share their technology with local firms as a precondition for doing business in Japan. Ozawa (1974) provides a rich description of the role imported technology and local R&D (aimed at facilitating absorption of foreign technology) played in Japan's economic development.

In contrast to the restrictive stance toward FDI, licensing of foreign technology was aggressively encouraged (Layton 1982). Korea's experience has been quite similar to that of Japan. For example, annual inflows of licensed technology increased steadily during the 1970s and 1980s. FDI inflows into Korea, which were always relatively

low, stagnated during 1978–83, but annual inflows of licensed technology (as measured by royalty payments) increased steadily during the 1970s and 1980s (Sakong 1993). This slowdown of FDI into Korea was partially a result of restrictive FDI policies instituted by the Korean government during that period (see Hobday 1995 for further details on Korea's experience).

What is the rationale behind policies that discourage FDI? Pack and Saggi (1997) argue that by prohibiting FDI and placing other restrictions on the conduct of multinationals, government policies in many countries may have effectively weakened the bargaining position of foreign firms. They note that in Japan, MITI restricted many local firms from participating as potential buyers exactly for this reason.

Sometimes policy has also favored licensing and joint ventures relative to wholly owned subsidiaries of multinationals. For example, the Chinese government has been particularly interventionist in technology transactions and has encouraged FDI in the form of joint ventures. Although wholly owned subsidiaries are not prohibited, the policy environment favors joint ventures over such enterprises. Of course, an immediate reason for this might be that all such policies simply reflect protectionism. Large public firms or hitherto protected private firms may not be able to compete with multinationals and may secure protection through the political process. However, is it also possible that joint ventures (as well as technology licensing) lead to more local involvement and therefore greater technology spillovers to local agents.

Saggi (1999) develops a two-period model in which a foreign firm chooses between FDI and technology licensing. The key assumption is that licensing results in greater transfer of know-how to the local firm than does FDI, under which the local firm must compete with the subsidiary of the multinational firm. The main result is that the local firm would have the strongest incentive for innovation if the foreign firm were to follow initial licensing by direct investment. However, in equilibrium, the foreign firm never adopts such a course of action.

Using plant-level data for 1991 for all Indonesian establishments with more than 20 employees, Blomström and Sjöholm (1999) shed light on two important questions. First, do establishments with minority and majority ownership (that is, joint ventures versus wholly owned subsidiaries) differ in terms of their (labor) productivity levels? Second, does the degree of technology spillovers vary with the extent of foreign ownership? The second question is crucial for the purposes of the present study. Blomström and Sjöholm obtain several interesting results. First, as in many other previous studies, they find that labor productivity is higher in establishments with foreign equity than in purely domestic firms. Second, the extent of total foreign production is positively associated with the productivity of domestic firms, suggesting some sort of spillovers from FDI. Third, the degree of foreign ownership affects neither the productivity of firms that get foreign equity nor the extent of spillovers to the domestic sector.

These findings are puzzling. Clearly, the degree of foreign participation does matter in that plants with no foreign investment are less productive. Perhaps the results

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suggest some sort of threshold effects in which beyond a certain degree of foreign ownership additional foreign equity affects neither the productivity of those that receive the investment nor the degree of spillovers to local firms. The authors do not report the minimum level of foreign equity (for those plants that do get foreign equity) in their sample. It is important to keep in mind that the study only measures labor productivity and treats some important endogenous variables as exogenous. Overall, it seems fair to say that the question remains open. Several earlier studies document that technologies transferred to wholly owned subsidiaries are of a newer vintage than licensed technologies or those transferred to joint ventures (Kabiraj and Marjit 1993; Mansfield and Romeo 1980; Saggi 1996).

Djankov and Hoekman (1999) also uncover an interesting role for joint ventures and suggest that such enterprises may have greater ability to absorb foreign technologies than do purely domestic firms. Hoekman and Saggi (2000) suggest that although the motivation behind policies that discriminate between licensing, joint ventures, and establishment of wholly owned subsidiaries is not easy to decipher, a plausible interpretation may be that such policies seek to maximize technology transfer to local firms while limiting the rent erosion that results from the entry of multinational firms.

Another policy issue is that many Southeast Asian countries still do not allow free entry of multinational firms and often express preferences with regard to the type of FDI; that is, entry by Pepsi or Coke is viewed differently than entry by General Motors or Texas Instruments. Unfortunately, the literature provides little insight for understanding such policies. Other than the standard argument that certain industries are able to secure greater protection for themselves, perhaps it may also be the case that spillovers to the local economy are higher under certain types of FDI. For example, it might be that domestic content protection policies involve more local firms and therefore generate greater spillovers. However, there is no formal model or empirical evidence to support this position. In addition, this argument is closely related to the idea of industrial targeting in general, and the pitfalls of the government's ability to correctly identify high-spillover industries are well known.

Despite the subtle policy interventions outlined, when measured by a broad yardstick, overall government policy has become more liberal across the world. For example, as of 1997, there were 1,513 bilateral investment treaties among countries, compared with 400 seven years earlier (UNCTAD 1998). Economic reform in many formerly communist countries has added to the list of countries vying for FDI. Coupled with this rise in treaties, both industrial and developing economies have a proliferation of fiscal and financial incentives to lure in FDI. Such overly optimistic policies carry dangers of their own and may reduce welfare in host countries. Although a case for such policies can indeed be made on the basis of positive externalities from FDI, there is no convincing evidence on this front.

Barry and Bradley (1997) describe Ireland's experience with FDI. Both favorable policies (reduced taxes and trade barriers, and investment grants) as well as strong

fundamentals (such as infrastructure and an educated labor force) seem to have played a role in attracting FDI to Ireland. The strong performance of the Irish economy since the mid-1980s is attributable to both strong fundamentals as well as significant FDI inflows.

An alternative case for the use of FDI incentives can be made on the basis of the oligopolistic nature of the markets within which FDI occurs. For example, consider Mexico's recent experience with FDI in its automobile industry. Initial investments by U.S. car manufacturers in Mexico were followed by investments not only by Japanese and European car manufacturers but also by firms that made automobile parts and components. As a result, competition in the automobile industry increased at multiple stages of production, thereby improving efficiency. Such a pattern of FDI behavior (that is, investment by one firm followed by investment by others) reflects strategic considerations involved in FDI decisions. Because multinational firms compete in concentrated markets, they are responsive to each other's decisions. An important implication of this interdependence between competing multinationals is that a host country may be able to unleash a sequence of investments by successfully inducing FDI from one or two major firms.

Protection of IPRS

Common sense suggests that if any policy variable should affect international technology transfer, it ought to be the host country's IPR regime. The theoretical literature has often investigated the effect of IPR enforcement on technology transfer and FDI in several endogenous growth models. Other approaches also exist. For example, in a strategic partial equilibrium model, Vishwasrao (1995) argues that the lack of adequate enforcement of technology transfer agreements may encourage FDI relative to licensing. In her screening model, depending on the type of licensee, licensing may or may not lead to imitation. The tradeoff between FDI and licensing is that FDI avoids the risk of imitation at the expense of higher production costs.

To limit the scope of the discussion, I omit models in which technology transfer does not play a central role. Several of the articles are linked through their use of the two models used intensively by Grossman and Helpman (1991). Before turning to these, I discuss Taylor's (1994) work because it differs from the other studies in that it employs a model of endogenous technological change with Ricardian features.

In a two-country model, Taylor examines two scenarios: one in which IPR enforcement is symmetric across the two countries (it applies to innovators regardless of country of origin) and one in which it is asymmetric (it protects only domestic innovators). Although Taylor conducts the analysis under the assumption of costless technology transfer and equal productivity in R&D in the two countries, his results hold even when these assumptions are dropped, making it possible to apply them to a North-South setting. A subtle qualification must be made: symmetric versus asym-

metric treatment implies both countries adopting one policy as opposed to another. Taylor's model does not analyze incentives for unilateral adoption of a symmetric policy. His major result is that asymmetric protection of IPR distorts the pattern of world trade and lowers the global rate of growth.

Interpreting the exogenous rate of imitation as a proxy for the level of IPR enforcement in the south, Helpman (1993) shows that a decline in the intensity of imitation promotes FDI (with exogenous innovation). Krugman (1979) addresses the issue as well, although his model has a greater degree of exogeneity than does Helpman's. The major contribution of Helpman's work lies in providing the first detailed welfare analysis of IPR enforcement in the South (as measured by an exogenous decline in the rate of imitation) in a dynamic general equilibrium growth model. He shows that a strengthening of IPR protection is not in the interest of the South, and that a weak enforcement of IPR protection in the South may even benefit the North, provided the rate of imitation is not too fast. Lai (1998) extends the Helpman model to allow for FDI and shows that innovation is promoted along with FDI if the South strengthens its IPR protection. The common weakness of both models is that stronger IPR enforcement is modeled as an exogenous decline in the rate of imitation. Nevertheless, Helpman's model is a *tour de force* in that it clearly specifies the alternative channels through which a strengthening of Southern IPR protection affects Northern and Southern welfare.

Yang and Maskus (2001) study the effects of Southern IPR enforcement on the rate of innovation in the North as well as on the extent of technology licensing undertaken by Northern firms. A key assumption in their model is that increased IPR enforcement increases the licensor's share of rents and reduces the costs of enforcing licensing contracts, thereby making licensing more attractive. Consequently, both innovation and licensing increase with stronger IPR protection in the South.

Glass and Saggi (2002a) provide an analysis of Southern IPR protection in a comprehensive product-cycle model of trade and FDI. In their model, Southern imitation targets both multinationals producing in the South and purely Northern firms producing in the North. They treat stronger IPR protection as an increase in imitation cost stemming perhaps from stricter uniqueness requirements in the South. In their model, FDI actually *decreases* with a strengthening of Southern IPR protection because an increase in the cost of imitation crowds out FDI through tighter Southern resource scarcity. Although products like books, videos, and CDs receive a lot of press about conflicts over IPR protection, imitating most products is not so simple (see Pack and Westphal 1986). Empirical evidence indicates that imitation is indeed a costly activity for a wide range of high-tech goods, such as chemicals, drugs, electronics, and machinery. For example, Mansfield and others (1981) find that the costs of imitation average 65 percent of the costs of innovation (and very few products are below 20 percent).

Less efficient imitation absorbs more resources, although the rate of imitation declines with a strengthening of Southern IPR protection. In addition, the contraction

in FDI tightens resource scarcity in the North: increased production leaves fewer resources for innovation, so the rate of innovation falls. It is worth emphasizing that if strengthening Southern IPR protection increases the cost of imitation, targeting both firms producing in the North as well as multinationals producing in the South, Northern incentives for FDI (at the firm level) are basically unaffected.

It should be clear from the discussion so far that the theoretical literature does not give an unambiguous prediction regarding the effects of stronger Southern IPR protection on the extent of FDI and the rate of growth. Does empirical evidence help resolve the issue? The literature largely has not explored the interaction between optimal policies in the two regions (for a recent exception, see Lai and Qiu 1999).

Consider the effect of Southern IPR enforcement on FDI. Surveys of U.S. multinational firms frequently find that such firms are more willing to invest in countries with stronger IPR protection (see Lee and Mansfield 1996). How does the researcher reconcile the ambiguous predictions of the theoretical models with this empirical finding? There are two ways out. First, increased IPR enforcement can be asymmetrical in that firms investing in a country may expect to have a greater influence in local courts relative to those that simply export. Second, imitation of firms located in the North may not be an option for local firms in some developing economies, as is assumed by some theoretical models. In such a scenario, any increase in IPR enforcement by the South will benefit multinational firms, thereby encouraging them to engage in FDI.

As Ferrantino (1993) notes, all of the preceding models suffer from a fundamental problem: either FDI or licensing is the only channel through which Northern firms are allowed to produce in the South. A more complete treatment of FDI requires that Northern firms be given the option of transacting in technology through the market. What are the consequences of strengthening IPR protection in the South if Northern firms can choose between licensing and FDI? Does FDI increase with IPR enforcement, or does such a change in policy encourage licensing by lowering the risk of opportunism in market transactions? The latter scenario is equally likely, and studies that ignore the possibility of licensing (or joint ventures for that matter) are likely to overstate the effect of IPR enforcement on inward FDI. In fact, a more subtle analysis may be needed. Increased IPR enforcement by the South may indeed make it a more attractive location for production (thereby increasing FDI relative to exports). However, the technologies transferred for that purpose might flow through licensing rather than FDI, so that the net effect on technology transfer through FDI is ambiguous. Of course, aggregate technology transfer to the South may increase, although general equilibrium effects may also require qualifications of this conclusion (Glass and Saggi 2002a).

Using data for 1982 on U.S. exports and sales of overseas affiliates of U.S. firms, Ferrantino (1993) presents a detailed cross-country study that attempts to identify the determinants of both exports and sales of multinational affiliates of U.S. firms, as suggested by the gravity model. His analysis reveals many insights, but perhaps the most interesting finding is that the U.S. firms export more to their affiliates in coun-

tries that have weak IPR regimes. Ferrantino (1993) suggests that this result may reflect attempts by the U.S. firms to limit technology leakage to their rivals abroad by confining production within the United States. This interpretation fits well with a central theme of this survey: multinational firms will adjust their strategies to optimize against policies and market conditions they face in various host countries, casting doubt on the conclusions of empirical (or theoretical) work that treats FDI as given.

Empirical evidence indicates that the level of IPR protection in a country also affects the composition of FDI in two different ways (Lee and Mansfield 1996; Smarzynska 1999b). First, in industries for which IPRs are crucial (pharmaceuticals, for example), firms may refrain from investing in countries with weak IPR protection. Second, regardless of the industry in question, multinationals are less likely to set up manufacturing and R&D facilities in countries with weak IPR regimes and more likely to set up sales and marketing ventures because the latter run no risk of technology leakage.

These studies present useful findings but are unable to address perhaps the most central question of all: does a country's IPR regime affect its economic growth? Although there are several theoretical analyses of this question, empirical studies are scarce. One such study is Gould and Gruben (1996), who use cross-country data on patent protection, trade regime, and economic fundamentals. They find that IPR protection, as measured by the degree of patent protection, is an important determinant of economic growth. Somewhat more interestingly, they find that the effect of IPR protection is stronger for relatively open economies than it is for relatively closed economies. In other words, a strengthening of IPR protection is more conducive for growth when it is accompanied by a liberal trade policy.

A possible interpretation of this finding is that by increasing foreign competition trade liberalization not only curtails monopoly power granted by IPRs but also ensures that such monopoly power is obtained only if the innovation is truly global. If firms in other countries can export freely to the domestic market and have better products or technologies, a domestic patent is useless in granting monopoly power. Furthermore, note that trade liberalization alone can improve productivity. Using data from Mexican manufacturing firms, Tybout and Westbrook (1995) find that trade liberalization is associated with higher rates of productivity growth. The results of Gould and Gruben (1996) show that IPR enforcement matters over and above trade orientation and that both have mutually reinforcing effects.

Finally, what does the empirical literature tell us about the effect of IPR protection on trade? Theory informs us that asymmetric IPR protection across countries can distort the pattern of world trade; empirical evidence supports this result. Using bilateral trade data for manufactured goods from 22 exporting countries to 71 importing countries, Maskus and Penubarti (1995) find that within the group of large developing economies, the importing country's strength of IPR protection (as measured by patent rights) exerts a significantly positive effect on bilateral manufacturing imports in many product categories. In other words, in such countries, weak IPR

protection is indeed a barrier to the manufacturing exports of most OECD countries. Maskus (2000) provides an up-to-date discussion of the empirical evidence on the effects of IPR protection on trade and FDI. Smith (1999) updates the study by Maskus and Penubarti (1995), using data on exports of U.S. states to 96 countries. She makes the interesting point that because countries with strong IPR protection also have sophisticated technological capabilities that facilitate local imitation of foreign technologies, within industrial countries there is an ambiguous relationship between strength of IPR protection and the volume of trade.

Conclusions

This article has covered a rather large terrain. This section highlights the eight main points.

First, the role of trade in encouraging growth hinges critically on the geographical scope (national versus international) of knowledge spillovers. As Grossman and Helpman (1995) note, knowledge spillovers are neither exclusively national nor international; they are probably both to some extent. However, spillovers are more likely to be national in scope for developing economies than for industrial ones. Consequently, whether R&D and high-technology production are carried out in close geographical proximity to such countries may indeed matter for their development.

Second, little is known about the relative role of trade and FDI (with licensing and joint ventures as special cases) as mechanisms of technology transfer. Given that foreign firms opt to produce in a developing economy, FDI seems to be the preferred route and is therefore a prominent channel of technology transfer.

Third, the existence of several channels of international technology transfer raises two important quantitative questions that merit further research. First, is it possible to arrive at an aggregate measure of international technology transfer and its contribution to economic growth in developing economies? Second, can one isolate the role of each channel? For example, how much does FDI contribute to growth in addition to trade? The marginal contribution of FDI has important policy implications and can only be settled through careful empirical studies.

Fourth, a well-developed paradigm (called the OLI paradigm, for ownership, location, and internalization) seeks to explain the emergence of multinational firms, given the existence of viable alternatives such as exports, licensing, and joint ventures. The OLI framework is useful for explaining a one-time choice between alternative modes of serving foreign markets but is virtually silent regarding the dynamics of entry strategies. Future research needs to explicitly consider the dynamic decision problem facing multinational firms.

Fifth, local policy often causes foreign firms to opt for licensing or joint ventures over FDI. There is little or no empirical evidence to support the idea that licensing or

joint ventures are more likely than FDI to lead to increased learning. To be fair, few careful studies have attempted this difficult task. The jury may still be out on this issue.

Sixth, policies designed to lure in FDI have proliferated in recent years, but it is difficult to base the case in favor of these policies on the notion of positive spillovers from FDI to domestic firms. Several recent plant-level studies have failed to find positive spillovers from FDI to their direct competitors. However, these studies require careful interpretation because they treat FDI as exogenous. In addition, FDI spillovers may be vertical in nature rather than horizontal (as is assumed in such studies). Furthermore, all such studies find that the subsidiaries of multinationals are more productive than domestic firms. Thus, regardless of the evidence on the spillover issue, FDI does result in a more effective use of resources in host countries.

Seventh, several studies (both theoretical and empirical) indicate that absorptive capacity in the host country is crucial for obtaining significant benefits from FDI. Without adequate human capital or investments in R&D, spillovers from FDI may simply be infeasible. Thus, liberalization of trade and FDI policies needs to be complemented by appropriate policy measures with respect to education, R&D, and human capital accumulation if developing economies are to take full advantage of increased trade and FDI.

Eighth, empirical evidence supports the argument that IPRs are trade related and that asymmetric IPR protection across countries distorts the pattern of world trade. Furthermore, a country's IPR policy may alter the composition of FDI at both the industry and firm levels. In industries in which IPRs are crucial, firms may refrain from FDI if IPR protection is weak in the host country, or they may not invest in manufacturing and R&D activities. Last, IPR policy may also lead foreign firms to choose FDI over other arm's-length modes of technology transfer, such as licensing.

Note

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References

- Aghion, Philippe, and Peter Howitt. 1990. "A Model of Growth through Creative Destruction." *Econometrica* 60:323–51.
- Aitken, Brian, and Ann E. Harrison. 1999. "Do Domestic Firms Benefit from Direct Foreign Investment?" *American Economic Review* 89(3):605–18.
- Aitken, Brian, Gordon H. Hanson, and Ann E. Harrison. 1997. "Spillovers, Foreign Investment, and Export Behavior." *Journal of International Economics* 43:103–32.

- Aitken, Brian, Ann E. Harrison, and Robert E. Lipsey. 1996. "Wages and Foreign Ownership: A Comparative Study of Mexico, Venezuela, and the United States." *Journal of International Economics* 40:345–71.
- Balasubramanyam, Venkataraman N., Mohammed A. Salisu, and David Sapsford. 1996. "Foreign Direct Investment and Growth in EP and IS Countries." *Economic Journal* 106:92–105.
- Barrell, Ray, and Nigel Pain. 1997. "Foreign Direct Investment, Technological Change, and Economic Growth within Europe." *Economic Journal* 107:1770–86.
- Barry, Frank, and John Bradley. 1997. "FDI and Trade: The Irish Host Country Experience." *Economic Journal* 107:1798–811.
- Bayoumi, Tamim, David T. Coe, and Elhanan Helpman. 1999. "R&D Spillovers and Global Growth." *Journal of International Economics* 47:399–428.
- Bhagwati, Jagdish N., Richard A. Brecher, Elias Dinopoulos, and T. N. Srinivasan. 1987. "Quid Pro Quo Foreign Investment and Welfare: A Political-Economy-Theoretic Model." *Journal of Development Economics* 27:127–38.
- Bhagwati, Jagdish N., Elias Dinopoulos, and Kar-Yiu Wong. 1992. "Quid Pro Quo Foreign Investment." *American Economic Review* 82:186–90.
- Blomström, Magnus. 1986. "Foreign Investment and Productive Efficiency: The Case of Mexico." *Journal of Industrial Economics* 15:97–110.
- Blomström, Magnus, and Hakan Persson. 1983. "Foreign Investment and Spillover Efficiency in an Underdeveloped Economy: Evidence from the Mexican Manufacturing Industry." *World Development* 11(6):493–501.
- Blomström, Magnus, and Ari Kokko. 1998. "Multinational Corporations and Spillovers." *Journal of Economic Surveys* 12:247–77.
- Blomström, Magnus, and Fredrik Sjöholm. 1999. "Technology Transfer and Spillovers: Does Local Participation with Multinationals Matter?" *European Economic Review* 43:915–23.
- Blomström, Magnus, Robert E. Lipsey, and Ksenia Kulchycky. 1988. "U.S. and Swedish Direct Investment and Exports." In R. E. Baldwin, ed., *Trade Policy and Empirical Analysis*. Chicago: University of Chicago Press.
- Blonigen, Bruce A. 1999. "In Search of Substitution between Foreign Production and Exports." *Journal of International Economics* 53(1):81–104.
- Borensztein, E., J. De Gregorio, and J.-W. Lee. 1998. "How Does Foreign Direct Investment Affect Economic Growth?" *Journal of International Economics* 45:115–35.
- Caves, Richard E. 1974. "Multinational Firms, Competition, and Productivity in Host-Country Industries." *Economica* 41(May):176–93.
- . 1996. *Multinational Enterprise and Economic Analysis*. Cambridge: Cambridge University Press.
- Clerides, S. K., Saul Lach, and James R. Tybout. 1998. "Is Learning by Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico, and Morocco." *Quarterly Journal of Economics* 113:903–48.
- Coe, David T., and Elhanan Helpman. 1995. "International R&D Spillovers." *European Economic Review* 39:859–87.
- Coe, David T., Elhanan Helpman, and Alexander W. Hoffmaister. 1997. "North-South R&D Spillovers." *Economic Journal* 107:13–149.
- Coe, David T., and Alexander W. Hoffmaister. 1999. "Are There International R&D Spillovers among Randomly Matched Trade Partners? A Response to Keller." IMF Working Paper No. WP/99/18. International Monetary Fund, Washington, D.C.
- Das, Sanghmitra. 1987. "Externalities and Technology Transfer through Multinational Corporations: A Theoretical Analysis." *Journal of International Economics* 22:171–82.

- De Long, Bradford J., and Lawrence H. Summers. 1991. "Equipment Investment and Economic Growth." *Quarterly Journal of Economics* 106:445–502.
- Dinopoulos, Elias, and Paul Segerstrom. 1999. "The Dynamic Effects of Contingent Tariffs." *Journal of International Economics* 47:191–222
- Dinopoulos, Elias, and Peter Thompson. 1999. "Scale Effects in Schumpeterian Models of Economic Growth." *Journal of Evolutionary Economics* 9:157–85.
- Dixit, Avinash K., and Joseph E. Stiglitz. 1977. "Monopolistic Competition and Optimum Product Diversity." *American Economic Review* 67:297–308.
- Djankov, Simeon, and Bernard Hoekman. 2000. "Foreign Investment and Productivity Growth in Czech Enterprises." *World Bank Economic Review* 14(1):49–64.
- Dollar, David. 1992. "Outward Oriented Developing Economies Really Do Grow More Rapidly: Evidence from 95 LDCs, 1976–85." *Economic Development and Cultural Change* 523–44.
- Dunning, John H. 1988. "The Eclectic Paradigm of International Production: A Restatement and Some Possible Extensions." *Journal of International Business Studies* 19(1):1–31.
- Eaton, Jonathan, and Samuel Kortum. 1996. "Trade in Ideas: Patenting and Productivity in the OECD." *Journal of International Economics* 40:251–78.
- Ethier, Wilfred J. 1982. "National and International Returns to Scale in the Modern Theory of International Trade." *American Economic Review* 72:389–405.
- Ethier, Wilfred J., and James R. Markusen. 1991. "Multinational Firms, Technology Diffusion and Trade." *Journal of International Economics* 41:1–28.
- Ferrantino, Michael J. 1993. "The Effect of Intellectual Property Rights on International Trade and Investment." *Weltwirtschaftliches Archive* 129:300–331.
- Findlay, Ronald. 1978. "Relative Backwardness, Direct Foreign Investment, and the Transfer of Technology: A Simple Dynamic Model." *Quarterly Journal of Economics* 62:1–16.
- Gershenson, Irving. 1987. "The Training and Spread of Managerial Know-how: A Comparative Analysis of Multinational and Other Firms in Kenya." *World Development* 15:931–39.
- Glass, Amy J., and Kamal Saggi. 1998. "International Technology Transfer and the Technology Gap." *Journal of Development Economics* 55:369–98.
- . 1999. "Foreign Direct Investment and the Nature of R&D." *Canadian Journal of Economics* 32:92–117.
- . 2002a. "Intellectual Property Rights and Foreign Direct Investment." *Journal of International Economics* 56:387–410.
- . 2002b. "Licensing versus Direct Investment: Implications for Economic Growth." *Journal of International Economics* 56:131–53.
- . Forthcoming. "Multinational Firms and Technology Transfer." *Scandinavian Journal of Economics*.
- Globerman. 1979. "Foreign Direct Investment and 'Spillover' Efficiency Benefits in Canadian Manufacturing Industries." *Canadian Journal of Economics* 12(February):42–56.
- Gould, David M., and William C. Gruben. 1996. "The Role of Intellectual Property Rights in Economic Growth." *Journal of Development Economics* 48:323–50.
- Grossman, Gene M., and Elhanan Helpman. 1991. *Innovation and Growth in the Global Economy*. Cambridge, Mass.: MIT Press.
- . 1995. "Technology and Trade." In Gene Grossman and Kenneth Rogoff, eds., *Handbook of International Economics*, Vol. 3. Amsterdam: Elsevier Science.
- Grubert, Harry, and John Mutti. 1991. "Taxes, Tariffs, and Transfer Pricing in Multinational Corporate Decision Making." *Review of Economics and Statistics* 73:285–93.

- Haddad, Mona, and Ann Harrison. 1993. "Are there Positive Spillovers from Direct Foreign Investment? Evidence from Panel Data for Morocco." *Journal of Development Economics* 42:51–74.
- Helpman, Elhanan. 1993. "Innovation, Imitation, and Intellectual Property Rights." *Econometrica* 61:1247–80.
- Hobday, Michael. 1995. *Innovation in East Asia: The Challenge to Japan*. Cheltenham: Edward Elgar.
- Hoekman, Bernard, and Simeon Djankov. 1997. "Competition Law in Post-Central Planning Bulgaria." Mimeo, World Bank, Washington, D.C.
- Hoekman, Bernard, and Kamal Saggi. 2000. "Multilateral Disciplines for Investment-Related Policies?" In Paolo Guerrieri and Hans-Eckart Scharrer, eds., *Global Governance, Regionalism, and the International Economy*. Baden-Baden: Nomos-Verlagsgesellschaft.
- Horstmann, Ignatius J., and J. R. Markusen. 1987. "Strategic Investments and the Development of Multinationals." *International Economic Review* 28:109–21.
- . 1992. "Endogenous Market Structures in International Trade (Natura Facit Seltum)." *Journal of International Economics* 32:109–29.
- . 1996. "Exploring New Markets: Direct Investment, Contractual Relations and the Multinational Enterprise." *International Economic Review* 37:1–20.
- Huizinga, Harry. 1995. "Taxation and the Transfer of Technology by Multinational Firms." *Canadian Journal of Economics* 28:648–55.
- Irwin, Douglas A., and P. J. Klenow. 1994. "Learning by Doing Spillovers in the Semiconductor Industry." *Journal of Political Economy* 102:1200–1227.
- Jones, Charles. 1995a. "Time Series Tests of Endogenous Growth Models." *Quarterly Journal of Economics* 110:495–525.
- . 1995b. "R&D-Based Models of Economic Growth." *Journal of Political Economy* 103:759–84.
- Kabiraj, Tarun, and Sugata Marjit. 1993. "International Technology Transfer under Potential Threat of Entry." *Journal of Development Economics* 42:75–88.
- Keller, Wolfgang. 1996. "Absorptive Capacity: On the Creation and Acquisition of Technology in Development." *Journal of Development Economics* 49:199–227.
- . 1998. "Are International R&D Spillovers Trade-Related? Analyzing Spillovers among Randomly Matched Trade Partners." *European Economic Review* 42:1469–81.
- Kinoshita, Yuko, and Ashoka Mody. 1997. "Private and Public Information for Foreign Investment Decision." World Bank Policy Research Working Paper No. 1733. World Bank, Washington, D.C.
- Krugman, Paul R. 1979. "A Model of Innovation, Technology Transfer, and the World Distribution of Income." *Journal of Political Economy* 87:253–66.
- . 1987. "Is Free Trade Passe?" *Journal of Economic Perspectives* 1:131–44.
- Lai, Edwin L. C. 1998. "International Intellectual Property Rights Protection and the Rate of Product Innovation." *Journal of Development Economics* 55:131–51.
- Lai, Edwin L. C., and Larry D. Qiu. 1999. "Northern Intellectual Property Rights Standard for the South?" Mimeo, City University of Hong Kong and Hong Kong University of Science and Technology.
- Lall, Sanjaya. 1980. "Vertical Inter-Firm Linkages in LDCs: An Empirical Study." *Oxford Bulletin of Economics and Statistics* 42:203–6.
- Layton, Duane W. 1982. "Japan and the Introduction of Foreign Technology: A Blueprint for Lesser Developed Countries?" *Stanford Journal of International Law* 18:171–212.
- Lee, Jeong Y., and Edwin Mansfield. 1996. "Intellectual Property Protection and U.S. Foreign Direct Investment." *Review of Economics and Statistics* 78:181–86.
- Lin, Ping, and Kamal Saggi. 1999. "Incentives for FDI under Imitation." *Canadian Journal of Economics*, 32:1275–98.

- Lipsey, Robert E., and Merle Yahr Weiss. 1981. "Foreign Production and Exports in Manufacturing Industries." *Review of Economics and Statistics* 63:488-94.
- . 1984. "Foreign Production and Exports of Individual Firms." *Review of Economics and Statistics* 66:304-7.
- Lucas, Robert E. Jr. 1988. "On the Mechanics of Economic Development." *Journal of Monetary Economics* 22:3-42.
- Mansfield, Edwin, and Anthony Romeo. 1980. "Technology Transfer to Overseas Subsidiaries by U.S. Based Firms." *Quarterly Journal of Economics* 95:737-49.
- Mansfield, Edwin, Mark Schwartz, and Samuel Wagner. 1981. "Imitation Costs and Patents: An Empirical Study." *Economic Journal* 91:907-18.
- Markusen, James R. 1995. "The Boundaries of Multinational Enterprises and the Theory of International Trade." *Journal of Economic Perspectives* 9:169-89.
- . 1998. "Multilateral Rules on Foreign Direct Investment: The Developing Countries' Stake." Mimeo. University of Colorado at Boulder, Boulder, Colo.
- . 2000. "Contracts, Intellectual Property Rights, and Multinational Investment in Developing Countries." *Journal of International Economics* 53(1):189-204.
- Markusen, James R., and Keith E. Maskus. 1999. "Discriminating Among Alternative Theories of the Multinational Enterprise." NBER Working Paper No. 7164. National Bureau of Economic Research, Washington, D.C.
- Markusen, James R., and Anthony Venables. 1999. "Foreign Direct Investment as a Catalyst for Industrial Development." *European Economic Review* 43:335-56.
- Maskus, Keith E. 2000. *Intellectual Property Rights in the Global Economy*. Washington, D.C.: Institute of International Economics.
- Maskus, Keith E., and Mohan Penubarti. 1995. "How Trade-related Are Intellectual Property Rights?" *Journal of International Economics* 39:227-48.
- Matsuyama, Kiminori. 1990. "Perfect Equilibrium in a Trade Liberalization Game." *American Economic Review* 80:480-92.
- Miyagiwa, Kaz, and Yuka Ohno. 1995. "Closing the Technology Gap under Protection." *American Economic Review* 85:755-70.
- . 1999. "Credibility of Protection and Incentives to Innovate." *International Economic Review* 40:143-64.
- Moran, Theodore. 1998. *Foreign Direct Investment and Development*. Washington D.C.: Institute for International Economics.
- Motta, Massimo, and George Norman. 1996. "Does Economic Integration Cause Foreign Direct Investment?" *International Economic Review* 37(4):757-84.
- Nelson, Richard R., and Howard Pack. 1999. "The Asian Miracle and Modern Growth Theory." *Economic Journal* 109(July):416-36.
- Nicholas, Stephen. 1982. "British Multinational Investment before 1939." *Journal of European Economic History* 11:605-30.
- . 1983. "Agency Costs, Institutional Modes, and the Transition to Foreign Direct Investment by British Manufacturing Multinationals before 1939." *Journal of Economic History* 43:675-86.
- Nicholas, Stephen, W. Purcell, D. Merritt, and A. Whitewell. 1994. "Foreign Direct Investment in Australia in the 1990s." Mimeo, University of Melbourne.
- Ozawa, Terutomo. 1974. *Japan's Technological Challenge to the West, 1950-1974: Motivation and Accomplishment*. Cambridge, Mass.: MIT Press.

- Pack, Howard. 1992. "Technology Gaps between Industrial and Developing Countries: Are There Dividends for Late-comers?" In *Proceedings of the World Bank Annual Conference on Development Economics, Supplement to the World Bank Economic Review and World Bank Research Observer*. Washington, D.C.: World Bank, pp. 283–302.
- . 1994. "Endogenous Growth Theory: Intellectual Appeal and Empirical Shortcomings." *Journal of Economic Perspectives* 8(1):55–72.
- . 1997. "The Role of Exports in Asian Development." In Nancy Birdsall and Frederick Jaspersen, eds., *Pathways to Growth: Comparing East Asia and Latin America*. Washington, D.C.: Inter-American Development Bank.
- Pack, Howard, and Kamal Saggi. 1997. "Inflows of Foreign Technology and Indigenous Technological Development." *Review of Development Economics* 1:81–98.
- . 2001. "Vertical Technology Transfer via International Outsourcing." *Journal of Development Economics* 65: 389–415.
- Pack, Howard, and Larry E. Westphal. 1986. "Industrial Strategy and Technological Change: Theory versus Reality." *Journal of Development Economics* 22:87–128.
- Parente, Stephen L., and Edward C. Prescott. 1994. "Barriers to Technology Adoption and Development." *Journal of Political Economy* 102:298–321.
- Pritchett, Lant. 1997. "Divergence, Big Time." *Journal of Economic Perspectives* 11(3):3–17.
- Ramachandran, Vijaya. 1993. "Technology Transfer, Firm Ownership, and Investment in Human Capital." *Review of Economics and Statistics* 75:664–70.
- Rhee, Yung Whee. 1990. "The Catalyst Model of Development: Lessons from Bangladesh's Success with Garment Exports." *World Development* 18:333–46.
- Rivera-Batiz, Louis A., and Paul Romer. 1991. "Economic Integration and Endogenous Growth." *Quarterly Journal of Economics* 106:531–56.
- Roberts, Mark, and James Tybout. 1997. "The Decision to Export in Columbia: An Empirical Model of Entry with Sunk Costs." *American Economic Review* 87:545–64.
- Rodriguez, Francisco, and Dani Rodrik. 1999. "Trade Policy and Economic Growth: A Skeptic's Guide to the Cross-country Evidence." NBER Working Paper no. 7081. National Bureau of Economic Research, Boston, Mass.
- Rodriguez-Clare, Andrés. 1996. "Multinationals, Linkages, and Economic Development." *American Economic Review* 86(4):852–74.
- Romer, Paul. 1990. "Endogenous Technological Change." *Journal of Political Economy* 98:S71–S102.
- . 1993. "Idea Gaps and Object Gaps in Economic Development." *Journal of Monetary Economics* 32:543–73.
- Sachs, Jeffrey, and Andrew Werner. 1995. "Economic Reform and the Process of Global Integration." *Brookings Papers on Economic Activity* 1:1–118.
- Saggi, Kamal. 1996. "Entry into a Foreign Market: Foreign Direct Investment versus Licensing." *Review of International Economics* 4:99–104.
- . 1998. "Optimal Timing of FDI under Demand Uncertainty." In Jean-Louis Mucchielli, Peter J. Buckley, and Victor V. Cordell, eds., *Globalization and Regionalization: Strategies, Policies, and Economic Environments*. Binghamton, N.Y.: Haworth Press.
- . 1999. "Foreign Direct Investment, Licensing, and Incentives for Innovation." *Review of International Economics* 7:699–714.
- Sakong, Il. 1993. *Korea in the World Economy*. Washington, D.C.: Institute for International Economics.
- Segerstrom, Paul S., T. C. A. Anant, and Elias Dinopoulos. 1990. "A Schumpeterian Model of the Product Life Cycle." *American Economic Review* 80:1077–91.

- Smarzynska, Beata K. 1999a. "Technological Leadership and the Choice of Entry Mode by Foreign Investors: Evidence from Transition Economies." Mimeo, World Bank, Washington, D.C.
- . 1999b. "Composition of Foreign Direct Investment and Protection of Intellectual Property Rights in Transition Economies." Mimeo, World Bank, Washington, D.C.
- Smith, Pamela. 1999. "Are Weak Patent Rights a Barrier to U.S. Exports?" *Journal of International Economics* 48:151–77.
- Taylor, M. Scott. 1994. "TRIPS, Trade and Growth." *International Economic Review* 35:361–81.
- Teece, David J. 1977. "Technology Transfer by Multinational Firms: The Resource Cost of Transferring Technological Know-how." *Economic Journal* 87:242–61.
- Tybout, James, and M. Daniel Westbrook. 1995. "Trade Liberalization and Dimensions of Efficiency Change in Mexican Manufacturing Industries." *Journal of International Economics* 39:53–78.
- UNCTAD. 1992. *World Investment Report: Transnational Corporations as Engines of Growth*. New York: United Nations.
- . 1997. *World Investment Report: Transnational Corporations, Market Structure, and Competition Policy*. New York: United Nations.
- . 1998. *World Investment Report: Trends and Determinants*. New York: United Nations.
- . 1999. *World Investment Report: Foreign Direct Investment and the Challenge of Development*. New York: United Nations.
- . 2000. *World Investment Report: Foreign Direct Investment and the Challenge of Development*. New York: United Nations.
- United Nations. 1983–98. *International Trade Statistics Yearbook*. New York: United Nations.
- Vishwasrao, Sharmila. 1995. "Intellectual Property Rights and the Mode of Technology Transfer." *Journal of Development Economics* 44:381–402.
- Wang, Jian-Ye, and Magnus Blomström. 1992. "Foreign Investment and Technology Transfer." *European Economic Review* 36:137–55.
- World Bank. 1999. *World Development Indicators*. Washington, D.C.: World Bank.
- Xu, Bin. 2000. "Multinational Enterprises, Technology Diffusion, and Host Country Productivity Growth." *Journal of Development Economics* 62:477–93.
- Xu, Bin, and Jianmao Wang. 1999. "Capital Goods Trade and R&D Spillovers in the OECD." *Canadian Journal of Economics* 32:1258–74.
- . 2000. "Trade, FDI, and International Technology Diffusion." *Journal of Economic Integration* 15(4):585–601.
- Yang, Guifang, and Keith Maskus. 2001. "Intellectual Property Rights, Licensing, and Innovation in an Endogenous Product-Cycle Model." *Journal of International Economics* 53(1):169–88.
- Young, Alwyn. 1995. "The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience." *Quarterly Journal of Economics* 110(3):641–80.



Deregulating the Transfer of Agricultural Technology: Lessons from Bangladesh, India, Turkey, and Zimbabwe

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Many transition and developing economies have reduced direct public involvement in the production and trade of seed and other agricultural inputs. This trend creates opportunities for farmers to realize improved access to inputs, including technology from international private research. Unfortunately, input regulations often derail these opportunities by blocking private entry and the introduction of private technology. This study looks at the experience in Bangladesh, India, Turkey, and Zimbabwe to see whether regulations make a difference in agriculture and input industries in developing economies. In all countries, companies and farmers responded to regulatory reforms by introducing and adopting more new technology and by expanding the production, trade, and use of inputs. The increased use of private technology has brought higher yields and incomes, allowing farmers and consumers to reach higher levels of welfare. These results challenge governments to open their regulatory systems to allow market entry and the introduction of private technology through seeds and other inputs.

For many years, discussions about technical change in agriculture in developing economies have focused on public research and extension. However, a number of studies have shown that private input companies can also be important channels for the introduction of technology in the agricultural sector in these countries. Pray and Echeverria (1988) find that maize yields in 50 countries responded to private research and seed imports. Narrod and Pray (1995) show the relation between livestock productivity and the introduction of private technology. And Evenson and others (1999) present evidence for India that private research contributes to total factor productivity growth in agriculture.

This article looks at regulatory barriers that restrain private technology transfer and the changes that follow when governments reduce some of those barriers. The study was motivated by findings of widespread regulatory barriers to private intro-

duction of input-embodied technologies (Gisselquist 1994). The first section introduces the hypothesis that guides this study. The second section describes regulatory reforms and impacts on input industries in Bangladesh, India, Turkey, and Zimbabwe. The third section looks at downstream impacts on agricultural production and incomes. The fourth section concludes with recommendations for governments, donors, and the Consultative Group on International Agricultural Research (CGIAR) to improve farmers' access to the world's flow of new (often private) agricultural technology.

Hypothesis: Regulations Make a Difference

All countries regulate inputs, and regulatory designs and practices vary widely across countries. However, to our knowledge, only two studies have dealt directly with the costs and benefits of regulating technology transfer in agriculture. Both studies deal with seeds: for wheat in Canada (Ulrich and others 1987) and for cotton in California (Constantine and others 1994). These studies show large losses in the form of forgone gains when governments do not allow farmers to adopt new input-embodied technologies. We have found no studies dealing with the costs and benefits of input regulations in developing economies. In other words, the empirical basis for debates about how best to regulate inputs in developing economies is extremely weak.

To estimate the costs and benefits of closed versus open systems (that is, open to the introduction of private technology) in developing areas, we looked for countries that had recently eased barriers to the introduction of private technology. We found five countries with significant shifts in input controls. Using data from four countries—Bangladesh, India, Turkey, and Zimbabwe—we tested the following hypothesis: Regulatory reforms reducing obstacles to the introduction of new agricultural technology stimulate technology transfer and have a significant net positive impact on productivity and incomes. (The fifth country, Chile, was cut from the study due to funding constraints.)

Most industrial market economies allow private companies to introduce new technology for most industries—including computers, computer programs, and electronic consumer goods—without government preview and approval as long as there are no major problems with externalities or public health. These same general principles guide agricultural input regulations. Organisation for Economic Co-operation and Development (OECD) countries generally allow companies to introduce new technology for seeds, fertilizers and farm machinery. Although performance tests may be a formality in some countries, they are seldom obstacles. However, for classes of inputs with significant externalities or public health impacts—such as pesticides and livestock medicines—most OECD governments balance data on performance against risks in deciding whether to allow a new technology.

By contrast, regulators in many transition and developing economies, motivated by widespread distrust of private companies and misunderstanding of market processes, often suppress market entry and competition. This leaves farmers heavily dependent on public research for new technology and on regulators to monitor and enforce input quality. Many agricultural experts recommend that governments of poor countries should control the private introduction of new input-embodied technology based on government assessments of the performance of the technology, even when externalities are not a factor. For example, one expert, raising the specter of “a disastrous effect on food supplies . . . from the extensive use of a poor-yielding variety,” urged governments to protect farmers “against exploitation by those who might try to market an unsatisfactory variety simply to recoup breeding costs” (Kelly 1989, p. 43). One of the expert reviewers for this research project worried about “the moral hazard problem that arises with asymmetric information between consumers (farmers) and producers (private input suppliers),” noting that farmers in developing economies “do not have access to the wide range of written and broadcast information available to farmers in developed countries.”

Fears that farmers might lose from uncontrolled private introduction of new technology continue to influence the design of input regulations. However, we have not been able to find any studies that investigate those fears empirically. During this project, we looked for instances of farmer loss from inappropriate technology.

Government controls on private technology impose two costs: the direct costs that governments and companies incur in regulatory processes and forgone gains that farmers and consumers lose when regulators block or delay the sale of productive inputs. Even a very efficient agency takes some time to evaluate input performance and to decide whether to permit a new technology. Too often, regulators take a long time and make many bad decisions, imposing significant costs in the form of forgone gains. In some cases, processes to test and assess new technologies are not much more than a cover to protect public or private monopolies or oligopolies.

Whether governments are closed or open to new private companies and technology, essentially all governments share some common practices in regulating inputs. For example, most (if not all) governments regulate truth in labeling, list allowed pesticides based on risk and efficacy data, and supervise seed imports to block seedborne pests and diseases (see table 1). The question about whether governments allow private technology introduction is not about deregulating inputs—that is out of the question—but rather about focusing input regulations on externalities and public health. Arguably, focusing in this way allows more effective protection against externalities.

General economic and regulatory reforms in Bangladesh, India, Turkey, and Zimbabwe have reduced but not eliminated barriers to technology transfer for seeds and other inputs. Reforms in Turkey date from the early 1980s, in Bangladesh and India

Table 1. Common Regulatory Practices with Respect to Efficacy and Performance

<i>Input</i>	<i>Regulatory practices</i>	<i>Comments</i>
Seeds	<p>Three systems are common in the world:</p> <ol style="list-style-type: none"> 1. Voluntary variety registration. Companies can sell seeds that government has not tested and listed, although governments may test and recommend varieties. 2. Compulsory variety registration for specified crops, with multicountry lists. This is the pattern in the E.U. For specified crops, E.U. governments do not allow the sale of seed except for varieties that have passed performance tests. However, each government automatically accepts varieties tested and listed by any other E.U. government. 3. Compulsory variety registration for specified crops, with single-country variety lists. Many developing economies maintain their own national lists of allowed varieties based on in-country performance tests. 	<p>Voluntary registration facilitates private introduction of new cultivars. Voluntary variety registration also allows the sale of seed for unregistered land races, traditional varieties, and public varieties from world trade.</p>
Pesticides	<p>Virtually all governments list allowed products (formulations with brand names) based on risk and performance; some accept risk data from other countries; and most require in-country performance tests. The United States registers new biopesticides without performance tests.</p>	<p>Options to facilitate private technology transfer include accepting efficacy data from other countries and waiving efficacy data for biopesticides and low-risk products.</p>
Livestock medicines	<p>Most countries list allowed products (formulations and brands) based on risk and efficacy; many countries accept data on risk and efficacy from prior tests in other countries.</p>	
Fertilizers and livestock feeds	<p>Some countries list allowed products based on expert decisions about optimum nutrient compositions; other countries allow dealers to sell any composition but insist on truth in labeling.</p>	<p>Allowing markets to determine compositions facilitates private technology transfer.</p>
Agricultural machinery	<p>Some countries list allowed makes and models based on official performance tests; other countries allow sales of new makes and models without any tests.</p>	<p>Allowing markets to determine models favors private technology transfer.</p>

from the late 1980s, and in Zimbabwe from the early 1990s. In all four countries, regulatory changes closely followed or coincided with more general economic reforms that established market access to foreign exchange, removed nontariff barriers for broad classes of imported goods, and improved the environment for domestic and foreign private investment. In some cases (for example, agricultural machinery in Zimbabwe), general economic reforms have been sufficient by themselves to allow private technology transfer and competitive markets.

The Impact of Regulatory Reforms on Input Industries

Input companies compete at least in part by offering farmers a menu of interesting technologies and by continually adding new technologies to that menu. The costs and returns of identifying and introducing new technologies determine the rate at which a company will do so. The research effort required to introduce new technologies varies from field testing imported technologies to in-country development of new cultivars, chemicals, and farm machinery.

There are three major cost factors. The first is the cost of available technology. For agriculture as well as other activities, technology that is useful in one country comes from a worldwide process of public and private research. The supply of technology available for spill-in (that is, adoption of the technology, with or without adaptation) into any one country depends on its distance from other countries (due to differences in climate, tastes, wage rates, and other factors that affect the acceptability of imported technologies). A company may access technology through various channels, including imports of inputs or capital goods, licensing agreements and exchange of information among researchers. Public research within a country can also increase the flow of technology for private firms to develop for the market.

The second major cost factor is research efficiency. A company's ability to take advantage of available technology to identify or develop new technology for a particular market depends on several factors, including research efficiency. Research efficiency depends in turn on the skills available in the company as well as the labor market and the existence of supporting institutions, including public universities and research institutes and private seed and fertilizer associations. Countries with high research efficiencies tend to access and apply available spill-ins more quickly and also develop more new technology for domestic as well as foreign markets. Multinationals operating in multiple countries locate research activities in countries with high research efficiencies.

The third major risk factor is regulatory barriers. From a company's point of view, regulatory barriers impose significant costs, including direct expenditures to pass regulatory hurdles and forgone income due to delayed sales.

There are two major return factors. The first is market size. Expected sales and profits for an input with new technology depend on population, average income, and other factors that determine market size. In low-income countries, a large share of agricultural gross domestic product (GDP) comes from food staples. As incomes rise, consumers want higher-value foods, so that markets for vegetable seeds, baby chicks, and livestock feed premixes tend to grow over time at rates that significantly exceed overall GDP growth.

The second major return factor is appropriability. A company's profits from selling inputs embodying new technology depend also on the share of total social benefits the company is able to collect. One factor that influences appropriability is the

nature of the technology. With hybrids, for example, companies can protect ownership of technology by physical control of parent lines, as in India (see later discussion). Another factor that influences appropriability is the existence of legal channels to register and enforce intellectual property rights (IPRs), including patents and plant variety protection (PVP) or plant breeders' rights.

Seed Reforms and Seed Industries

For seeds, the regulatory reforms in Bangladesh, India, Turkey, and Zimbabwe repeat some common themes but are far from identical (see table 2). Prior to the reforms under review, both Bangladesh and Turkey had compulsory variety registration (that is, for a new variety, seed sales are not allowed until the government has approved the variety). Bangladesh reduced barriers to new varieties by making variety registration voluntary for all but five major crops (rice, wheat, jute, potatoes, and sugarcane). Turkey reduced barriers to private varieties by cutting required performance tests to one year, allowing companies to submit data from their own tests, and establishing a practice of readily approving almost all varieties proposed for registration. India and Zimbabwe had voluntary variety registration for several decades. India continues this policy. Zimbabwe has imposed compulsory variety registration for 11 major crops since 1993, about the same time that general economic reforms created the possibility (threat) of market entry and real competition in seed markets.

Relaxation of seed import controls has played a major role in improving technology transfer in India and Turkey. Since 1988, India has allowed imports of commercial seed, parent seed, and germ plasm for vegetables, coarse grains, and oilseeds. However, for many other crops (for example, wheat, rice, and potatoes), the country continues to block private imports—including germ plasm for breeding—based on nonphytosanitary factors, including performance. Turkey's reforms since the early 1980s have gone much further, allowing even commercial seed imports (albeit with some difficulties) for essentially all crops. In Bangladesh, import controls are no obstacle to new varieties; seeds of new varieties for five crops cannot be imported, but the obstacle comes from variety controls rather than import controls. Zimbabwe blocks seed imports for major crops, which can slow the introduction of new varieties.

Improving the access of private companies to public lines has been an issue. Since 1986, India has set procedures for seed companies to buy breeders' seeds from public research institutes. By contrast, Zimbabwe continued agreements into the mid-1990s that gave one private company exclusive rights to lines from public breeding for major crops.

In India, relaxation of investment controls has had an important impact on private investment in seeds. The 1969 Industrial Policy Act restricted Indian firms with more than Rs 1 billion in total assets (about \$130 million in 1969) to a list of core industries that did not include seeds; since 1979 the government has also restricted

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firms with more than 40 percent foreign equity to core industries. In 1986, the government made seeds and biotech core industries, and in 1991 general reforms eased controls on foreign investment. In 1991, the government relaxed restrictions on technology transfer and foreign investment for the entire economy.

All members of the World Trade Organization have agreed to introduce IPRs for varieties and genes, but developing economies were given 10 years—until 2004—to comply. Whether to comply is not the issue because both public and private researchers look to make money from owning new technology. Zimbabwe's PVP law dates from 1973 and Turkey's from 1994, but neither country is a member of the major treaty organization that sets PVP standards, which suggests some difficulty with design or implementation. India's ongoing attempts to draft a PVP law continue to generate political controversy. New laws and regulations are also required to regulate and protect IPRs for genetically modified organisms.

Bangladesh. Prior to the 1990 seed reforms, private seed companies in Bangladesh focused almost exclusively on vegetable seeds. Government lists of allowed cultivars absolutely blocked all varieties for some crops and severely limited farmer choice for many others. For example, listed varieties included only two open-pollinated varieties of maize and no hybrids, only two soybean varieties, and no sunflower hybrids. The lists protected lucrative markets for companies with listed varieties for popular produce (for example, seedless watermelon and cauliflower). The government dominated seed production and trade for field crops.

Since 1990, nongovernmental organizations (NGOs) and other companies have entered seed trade and introduced a large number of new varieties for vegetables and some field crops. New varieties allow off-season production and introduction of new vegetables, including sweet corn. New papaya varieties have improved quality and cut cost to consumers. Two large NGOs, Grameen Krishi Foundation and Bangladesh Rural Advancement Committee, promoted hybrid maize through contract growers. In 1994/95, Bangladesh imported 65 tons of hybrid maize seed (enough for 3,300 hectares). Companies have also tested hybrid sunflower, canola, and sorghum.

Import and distribution of vegetable seed continues to dominate the private seed industry. Among field crops, jute and potato seed are financially important, but private seed production and trade for these crops are held back by compulsory variety registration. Private companies and NGOs screen imported varieties and lines for vegetables and a number of field crops for suitability to local conditions. In addition, in the mid-1990s, a new joint venture began planning to breed vegetables in Bangladesh.

Despite large public research programs, the pace and quality of government variety releases for the five crops with compulsory variety registration—rice, wheat, jute, potatoes, and sugarcane—leaves opportunities for additional gains from private introductions. However, the government has resisted introducing private varieties. Well over half of the jute area is planted in Indian public varieties for which seeds are ille-

Table 2. Seed Reforms and Impacts on Technology Transfer and Seed Industries

<i>Country</i>	<i>Reforms</i>	<i>Post-reform regulations</i>	<i>Impact on technology transfer</i>	<i>Impact on seed production and trade</i>
Bangladesh	In 1990, the government ended compulsory variety registration for all but five crops (rice, wheat, jute, potatoes, and sugarcane).	<ul style="list-style-type: none"> • No barriers to new varieties for most crops • High barriers remain for nongovernment varieties of rice, wheat, jute, sugarcane, and potatoes 	<ul style="list-style-type: none"> • Many new vegetable varieties introduced • Hybrid maize and sunflower introduced 	<ul style="list-style-type: none"> • More competition in vegetable seed • Modest increase in trade of field crop seeds • Limited market entry by foreign companies (only one Thai-Bangladesh joint venture)
India	<p>In 1986, the government included seed and biotech companies as core industries, allowing large companies to enter.</p> <p>In 1986, the government established procedures for public research agencies to sell breeder seed to companies.</p> <p>In 1988, the government eased barriers to seed and germ plasm imports for vegetables, coarse grains, and oilseeds.</p> <p>In 1991, the government eased barriers to technology purchase and foreign investment for the entire economy.</p>	<ul style="list-style-type: none"> • Low to no barriers to new private varieties for vegetables, coarse cereals, and oilseeds • Import barriers for seeds and breeding material block introduction of new private varieties for other crops 	<ul style="list-style-type: none"> • Huge increase in rate of introduction for vegetable, cotton, coarse grain and oilseed hybrids (e.g., more than 100 new cotton hybrids introduced in 1996); for these crops, technology nears or sets world best standards 	<ul style="list-style-type: none"> • Significant market entry by large Indian and foreign firms and by new Indian firms • Private seed companies take larger share of seed trade • Moderate growth in volume of private seed trade, but large growth in value

Turkey	<p>In 1983, the government ended seed price controls.</p> <p>In 1983, the government cut performance tests to one year, allowed companies to do their own tests and established a pattern to accept most private varieties.</p>	<ul style="list-style-type: none"> • Low barriers to new private varieties for all crops 	<ul style="list-style-type: none"> • Large increase in rate of introduction of new varieties; for example, starting in 1982 to 1987, sunflower hybrids increased from 3 to around 30 and soybean varieties increased from 2 to more than 40 	<ul style="list-style-type: none"> • Significant market entry by foreign and domestic firms; number of private seed companies increased from fewer than 5 before the reforms to about 80 by 1990, including several subsidiaries, some joint ventures and many international licensees • Private companies took over major shares of the seed market; public sales continue to dominate some crops (e.g., wheat)
Zimbabwe	<p>Around 1990, the general economic reforms improved the environment for private companies.</p> <p>In 1993 (policy reversal), the government made variety registration and seed certification compulsory for 11 major crops, but accepted most varieties without tests.</p>	<ul style="list-style-type: none"> • Low barriers to new varieties from established companies • Market entry difficult for small local companies • Maize open-pollinated varieties not allowed 	<ul style="list-style-type: none"> • Large increase in rate of introduction of new varieties for maize; less impact on other crops 	<ul style="list-style-type: none"> • Some market entry by large foreign firms, limited entry by domestic firms • Seed Coop's hybrid maize monopoly eroded starting in the mid-1990s

gal because the government of Bangladesh has not registered the varieties. Similarly, farmers in border areas plant unregistered, short-duration Indian rice varieties. The introduction of Indian varieties could be more efficient through legal (private) seed trade.

India. The Indian seed industry has developed within a large national market. Three national seed associations have a total of more than 300 members, a large share of which are seed producers, and many smaller seed companies are not members. In the public sector, agriculture is a state (versus federal) subject, so that state universities and research organizations contribute to public breeding and state seed corporations compete in national markets. Over the past several decades, Indian public breeders have developed and released thousands of varieties, although only a small share has been commercially significant.

The government has relaxed controls on foreign and domestic investment and technology contracts and Indian public research and foreign sources have improved access to germ plasm. These developments have led large local firms and joint ventures already in India to move into seeds and some foreign seed companies to establish new joint ventures or subsidiaries. Reforms also stimulated new entry by small and medium local companies.

Reforms have significantly accelerated the introduction of technology. However, because companies introduce most of their new hybrids and varieties without variety registration, it is not possible to give comprehensive figures on the number of cultivars introduced over time. Industry sources report that more than 100 new cotton hybrids were introduced in 1996 alone. Most of these were private hybrids developed from public parent lines, much as the U.S. hybrid maize industry began with public lines. Public lines—many from the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)—are also important for sorghum and millet hybrids. Maize and sunflower hybrids have gained from imported parent lines. Major improvements in quality have brought large changes in market share. In sunflower hybrids, for example, the share for one firm dropped from over 80 percent in 1990 to less than 20 percent by 1996. Despite lack of PVP, at least one multinational has introduced its best maize germ plasm for low latitudes into the Indian market, relying on physical control of hybrid parent lines to protect ownership. In 1997, several companies reported plans to screen 100–800 new tomato hybrids in the coming year. When asked who has the largest market share in tomatoes, a seed executive answered, “It depends on who has the best new hybrid that year.”

In the mid-1990s, industry representatives estimated that since 1984–85 the private sector had been responsible for about 50–60 percent of the value of seed sales. Other recent estimates show private seed gaining significantly larger market shares in some crops and states. For example, from 1985–89 to 1990–95, the area under private hybrids in Karnataka grew from 33 to 61 percent for maize and from 24 to

54 percent for sunflower hybrids. In Andhra Pradesh, the area under private hybrids increased from 10 to 33 percent for pearl millet and from 9 to 29 percent for sorghum (Pray and Ramaswami 1998). Most private seed company revenues come from hybrids, whereas public companies dominate markets for relatively low-value nonhybrids. However, private companies also produce and sell nonhybrid seed (for example, wheat), and public companies have been important in cotton and sorghum hybrids.

Turkey. Among the four countries studied here, market entry has been most dramatic in Turkey, where the number of private companies increased from fewer than 5 in 1982 (before reforms) to more than 80 in the early 1990s. New entrants include subsidiaries and joint ventures of major multinationals, but most are wholly locally owned companies, often with (multiple) licensing contracts with foreign companies.

New companies have introduced new cultivars, screening material from breeding in other countries. Relaxation of variety controls has been a major factor in market entry and has led to a large increase in the rate of introduction of cultivars. In sunflowers, for example, the number of cultivars increased from 3 to about 30 during 1982–87. Among field crops, maize and sunflower hybrids are by far the most important seeds for private companies. However, as of 1993, private companies have also introduced new varieties and produced several thousand tons of seed for sugarbeet hybrids as well as nonhybrids of potatoes and soybeans, and about 10,000 tons of nonhybrid wheat seed. Reforms have brought much faster technology introduction for nonhybrids and hybrids. For example, the aggregate number of approved soybean varieties increased from 2 to more than 40 during 1982–87, and the government approved an average of 5 new wheat varieties each year during 1984–94, compared with a cumulative total of 21 varieties approved through 1982. As of the mid-1990s, farmers planted private maize hybrids on about 170,000 hectares (a third of maize area) and private sunflower hybrids on about 450,000 hectares (90 percent of sunflower area), all from cultivars introduced after and because of the reforms. For many other crops and vegetables, the shift to post-reform private cultivars has been at least as dramatic as for maize.

Almost all private research is limited to screening imported lines. However, some companies with international connections (including license partners) work with foreign breeders to develop material for Turkey. For example, one company reported sending materials from Turkey for breeding in the United States. Budgets and staff for public agricultural research fell when Turkey liberalized trade in inputs. Although the flow of introduction of technology has increased with liberalization, even more may have been possible with continued strong public research.

Zimbabwe. Throughout the early 1990s, Seed Coop held a near monopoly in hybrid maize seed—Zimbabwe’s major seed market—and there was little competition for other seeds. Three major foreign companies—Pannar, Pioneer, and Cargill—began

hybrid maize research or seed sales before 1990; two other foreign companies—Pacific Seeds and DeKalb—entered after 1990 with local partners. Other local and foreign companies have entered niches in the seed industry (especially production for export).

In 1990, farmers had access to about a dozen maize hybrids, most of them relatively old ones from public breeding, and Seed Coop had an estimated 98 percent of the market. Reforms brought a large increase in private breeding, which got under way in at least four companies (primarily for hybrid maize but also including other crops), compared with little or no private breeding through the mid-1980s. In 1997, farmers had access to almost 30 hybrids from four companies, and the share for Seed Coop (now Seed Company) had fallen to about 80 percent.

Since 1993, new regulations—compulsory variety registration and seed certification—have obstructed market entry for small local companies and blocked the introduction of some specific technology. For example, a local NGO has been organizing small farmers to produce sorghum seed. Sorghum seeds must be certified, which involves laboratory testing. However, there are only two laboratories in the country approved for tests, one in the government, which is overcommitted and underfunded, and the other in Seed Company. Seed Company tests, processes, and packages the seed, after which it is too expensive for Zimbabwe's small farmers and goes instead for export. In addition, some available technology continues to be explicitly barred. Compulsory variety registration for maize gives the government a legal instrument to ban the sale of nonhybrid maize seed, forcing farmers to buy more expensive hybrid seed. Hence, although suitable nonhybrid varieties are readily available, the seed is illegal.

The impact of seed reforms on private research. Regulatory and other reforms cut costs to introduce new cultivars. Other things equal, this leads to more private breeding. However, the impact of regulatory reforms on private research depends also on other factors that influence returns to research investments, such as available technology, research efficiency, market size and appropriability.

Multinationals, which account for a major share of breeding investments, carry out breeding activities in some countries, but sell their products in many other countries as well. For most crops, the areas of applicability for new cultivars cross political boundaries, so that a purely national breeding strategy is inefficient. For example, Bangladesh is so close to India that companies could breed in either one for both, but India has a much larger market (with 900 million people) and higher research efficiency. Similarly, Turkey is agroclimatically close to Western Europe and the Great Plains in the United States, regions with large markets and high research efficiency, so that companies breed elsewhere for Turkey. Because the African highlands—from Ethiopia through Zimbabwe—are distant from other maize markets, companies that want to compete must breed there. All private hybrid maize breeding for highland

Africa is done in Zimbabwe, which offers the highest research efficiency and a medium-size market (10 million people for whom maize is the major staple).

Ownership of hybrids does not depend on PVP legislation; companies can keep physical control of parent lines, selling only the hybrid or crossed seed. Therefore, for many years companies have been able to realize high returns to research on such crops as maize for which hybrid seed is possible. Because hybrid maize accounts for a major share of world seed sales and profits, companies invest heavily in maize research. In the four companies in this study, private maize breeding is important in India and Zimbabwe, whereas companies active in Turkey and Bangladesh limit in-country research to testing lines bred elsewhere. For other crops and vegetables, India is the only one of the four countries with significant private breeding. Since 1994, the one private breeding program in Turkey has taken advantage of the presence of the orobanche parasite to breed resistance into sunflower hybrids intended for international markets.

India, with its large population, presents one of the largest potential seed markets in the world, rivaling the E.U., U.S., and Chinese markets. Breeding efficiency is also high, with high skills, strong scientific support, and low wages. Reforms in the late 1980s relaxed restrictions on joint ventures, technical collaborations, entry by large firms, and imports of commercial and research seeds. Analysis of data from a 1987 ICRISAT survey and another 1995 ICRISAT survey (done as a part of this study) suggests that private research has responded positively to these changes. Between 1987 and 1995, private research expenditures increased from US\$1.2 million to US\$4.7 million, the number of doctoral scientists increased from 31 to 111, the number of master's of science degrees increased from 45 to 140, and the area of experimental stations increased from 400 to 1,200 hectares.

Some of the total increase in Indian private research spending is in a handful of large local firms and foreign subsidiaries or joint ventures that could not enter before the reforms. Another share is in new, small companies that entered after the reforms but could have entered at any time. Allowing imports of research seed was one factor that made small research programs viable. The 1995 survey also found a large increase in research expenditures by incumbent firms, often linked to new foreign collaborations, suggesting that policy change had a crucial role to play here as well. Although new spending by incumbent firms was more important than new entry in accounting for the overall increase in private research, the effect of entry must not be underestimated. It was probably the post-reform threat of entry by technologically superior foreign companies that led the incumbent firms to seek collaborations.

Parastatal seed companies. Bangladesh, India, and Turkey began reforms with seed parastatals; Zimbabwe began with a private monopoly. In all four countries, the overall pattern of reform—insofar as it has followed any pattern—has been to reduce barriers to entry for new companies and technology, with little or no attempt (at least

initially) to privatize or reduce the operations of seed parastatals. In crops where technology introduction has been most rapid—primarily high-value seeds, including vegetables and hybrids—private companies have been able to enter and expand market shares against parastatals (which continue to operate) and Zimbabwe's pre-reform monopoly. Private companies also sell some nonhybrid seeds in all four countries.

Fertilizer Reforms and Industries

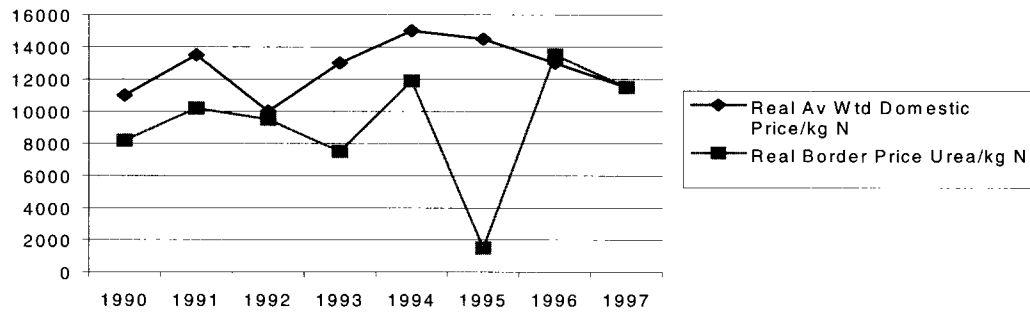
Bangladesh, Turkey, and Zimbabwe have ended fertilizer price controls and relaxed import controls, reducing barriers to company and product entry (see table 3). Turkey and Zimbabwe have maintained controls on fertilizer compositions allowed for domestic trade, and Bangladesh has introduced them. These controls are based on the argument that on their own farmers might not choose products that meet soil deficiencies (Zimbabwe) or might be fooled by cheaper products that have less impact on soil fertility, such as low-analysis products (Bangladesh). Nevertheless, governments have allowed private companies to introduce some new compositions.

All three countries produce much of their own fertilizer. Turkey's industry includes public and private companies; Bangladesh has several public plants and one new private urea plant; and Zimbabwe's fertilizer production is all public. Fertilizer reforms left production patterns intact—at least for the short term—but removed barriers to private trade starting in 1990 in Bangladesh, 1986 in Turkey (with more liberalization in 1994), and 1995 in Zimbabwe. Reforms allowing private imports brought company entry, new products and lower margins.

In Bangladesh, expansion of private trade brought a shift from triple super phosphate (TSP, with 46 percent phosphoric acid) to single super phosphate (SSP, with 18 percent phosphoric acid and 12 percent sulfur) along with a large increase in gypsum (18 percent sulfur). The sulfur content of fertilizer sales grew steadily from 14,000 tons (1.5 percent of all nutrients) in 1989/90, the last year before reform, to 89,000 tons (7 percent of nutrients) in 1995/96. This shift makes sense in light of the widespread sulfur deficiency, and suggests that pre-reform products—with production and imports controlled by the government—did not address soil deficiencies. Aggregate fertilizer sales have continued to grow after reform at least as fast as they did before reform, despite three years of low rice prices (1992/93, 1993/94, and 1996/97).

Omnia, a major South African fertilizer company, entered Zimbabwe with new compositions in 1995. Existing companies responded with their own new compositions. Omnia offers soil tests and made-to-order bulk blending for large customers. In Turkey, reforms in 1986 established oligopolistic competition, which brought more products into the market, but left presubsidy prices far above border prices. Since 1994, further import liberalization has brought real competition, so that domestic presubsidy fertilizer prices fell to border-parity levels (see figure 1 for nitrogen fertilizers; results for phosphorous are nearly identical).

Figure 1. Unsubsidized Nitrogen Prices in Turkey, 1990–97
(constant lira)



Source: State Institute of Statistics, Turkey; International Fertilizer Developer Center, Muscle Shoals, Ala.

Agricultural Machinery Reforms and Industries

In Bangladesh, Turkey, and Zimbabwe, pre-reform controls blocked new technology and competing makes of agricultural machinery (see table 4). For example, the government of Bangladesh maintained a list of specific models of diesel engines that were tested and approved (standardized) for minor irrigation and a similar list of approved models of power tillers. Machinery not on the list could not be imported for agriculture. The government did away with these lists in early 1989, allowing traders to import and sell any diesel engine for irrigation and also any power tiller. In Zimbabwe, administrative distribution of scarce foreign exchange through an association of established dealers allowed the association to control allowed makes and models and to limit competition as well. These controls crumbled around 1994 with general economic reforms that gave new dealers market access to foreign exchange and freedom to import and sell new makes and models. In Turkey, in about 1985, the government removed nontariff barriers and price controls on machinery trade.

Trade liberalization in Bangladesh and Zimbabwe brought market entry and a significant increase in the range of products and sales for engines and engine-powered machinery (such as tractors). In Bangladesh during 1988/89, dozens of traders began importing engines and power tillers from China. Compared with choices that the government had previously enforced, traders and farmers shifted to cheaper makes and a wider range of models, including especially smaller diesel engines. Competition also lowered trading margins. During 1988/89, investment costs for common minor irrigation installations (a diesel engine, 100-mm diameter pump, and well) and power tillers fell by about 50 percent. From the three years before reform to the three years after (1986–88 to 1989–91), sales increased by 400 percent in diesel engines and by more than 1,000 percent in power tillers. The public share of diesel engine imports and

Table 3. Fertilizer Reforms and Impacts on Technology and Fertilizer Industries

<i>Country</i>	<i>Reforms</i>	<i>Post-reform regulatory situation</i>	<i>Impact on technology transfer</i>	<i>Impact on fertilizer industry and trade</i>
Bangladesh	<p>In 1988–90, the government shifted most domestic fertilizer sales from factories and ports to private traders (most wholesale and retail trade was already in private hands).</p> <p>In 1990, the government allowed the import of private triple super phosphate and muriate of potash without permits.</p> <p>Around 1991, the government allowed private import of all other fertilizers without permits.</p> <p>In 1995 (policy reversal), the government assigned markets to each fertilizer dealer, banning sales outside assigned markets.</p> <p>Around 1996 (policy reversal), the government began to limit (list) fertilizer compositions allowed for sale.</p>	<ul style="list-style-type: none"> • In 1991–95, no barriers to new compositions and low barriers to market entry • Starting in 1995, moderate to major barriers to new products and market entry 	<ul style="list-style-type: none"> • Traders introduced new products (e.g., single super phosphate and micronutrients) to address soil deficiencies 	<ul style="list-style-type: none"> • In the early 1990s, private traders took over import trade; there was significant new entry in fertilizer wholesale trade (wholesale and retail trade already competitive)

<p>Turkey</p>	<p>In the early 1980s, the government established a workable foreign exchange market.</p> <p>In 1986, the government ended fertilizer price controls and allowed four private companies to import fertilizers; subsidies continued.</p> <p>In 1994, the government opened fertilizer imports to all large companies; subsidies continued.</p>	<ul style="list-style-type: none"> • Low barriers to new technology started in 1986 • Low barriers to market entry started in 1994 	<ul style="list-style-type: none"> • Competing oligopolists introduced new compounds in the mid-1980s 	<ul style="list-style-type: none"> • Starting in 1986, there was some increase in competition at all levels of fertilizer trade • Starting in 1994, internal prices (before subsidies) fell to border parity
<p>Zimbabwe</p>	<p>In 1994, the government established a workable foreign exchange market.</p> <p>In 1993–95, the government ended all fertilizer price controls.</p>	<ul style="list-style-type: none"> • Incomplete but workable reforms starting around 1995 • Moderate barriers to introduction of new technology • Moderate to major barriers to competition 	<ul style="list-style-type: none"> • Significant increase in number of compositions offered starting around 1995 	<ul style="list-style-type: none"> • Some market entry and significant competition starting in mid-1995

Table 4. Agricultural Machinery Reforms and Impacts on Technology and Machinery Trade

<i>Country</i>	<i>General and regulatory reforms</i>	<i>Post-reform regulatory situation</i>	<i>Impact on technology transfer</i>	<i>Impact on agricultural machinery industry and trade</i>
Bangladesh	<p>In 1985–87, the government established a workable foreign exchange market and ended many nontariff barriers (nontariff barriers continued for diesel engines for irrigation and power tillers).</p> <p>In 1988, the government eliminated import taxes on standardized (approved for agriculture) diesel engines and power tillers.</p> <p>In 1989, the government ended standardization, allowing import without taxes for all 3–20-hp diesel engines and all power tillers.</p>	<ul style="list-style-type: none">• No barriers to new makes and technology	<ul style="list-style-type: none">• Large increase in variety of diesel engines available, including wider range of horse-power and quality	<ul style="list-style-type: none">• Large increase in number of makes of diesel engines and power tillers available, bringing competition and much lower prices• Average annual diesel engine sales increased over 400 percent from three years before reform to three years after reform• Average annual power tiller sales increased about 10 times from three years before to three years after reform
Turkey	<p>In the early 1980s, the government established workable foreign exchange markets.</p> <p>In 1984, the government abolished price controls on agricultural machinery.</p> <p>In 1985, the government abolished rules for domestic content for agricultural machinery manufactured in Turkey.</p> <p>Around 1985, the government removed nontariff barriers on imports of tractors, harvesters, and other machinery.</p>	<ul style="list-style-type: none">• No barriers to new brands and technologies for all machinery	<ul style="list-style-type: none">• Accelerated introduction of new technology, including pneumatic seed drills, drip irrigation equipment, and dryers	<ul style="list-style-type: none">• Consolidation in the domestic tractor industry, possibly to meet stronger international competition• Competitive domestic producers for nonpowered equipment improved product lines
Zimbabwe	<p>Around 1994, the government established workable foreign exchange markets.</p>	<ul style="list-style-type: none">• No barriers to new brands and technologies for all machinery	<ul style="list-style-type: none">• Introduction of more makes, including cheaper options• Introduction of new technology, including better seeders	<ul style="list-style-type: none">• New companies and more competition in machinery import and trade brought lower prices for tractors and other imported equipment• Significant increase in tractor imports (from 1300/year in 1988–93 to 3000/year in 1994–96)

retail sales fell from over 90 percent in 1986–88 to almost none in 1992–94. Liberalization brought a large increase in private imports and sales, although formal credit was rarely available to farmers buying engines from private traders.

In Zimbabwe, the removal of trade barriers brought about a similar increase in the range of makes and models of tractors and other equipment. The number of tractors sold increased from an average of 1,300 per year in 1989–93 to 3,000 in 1994–96. Farmers also report an improvement in seeders and other equipment.

Pesticide Reforms and Industries

Consistent with standard international practice, Bangladesh, Turkey, and Zimbabwe maintain lists of allowed pesticide products, approving new entries based on information about pesticide risks and efficacy. All three countries accept all or most data on risks from tests in other countries but ask for local efficacy tests. The government of Turkey allows companies to do their own efficacy tests, and accepts results from one year of tests (at two sites). By contrast, Bangladesh and Zimbabwe require three years of tests; even then approvals are time-consuming and problematic. Turkey has significantly cut the cost and time required to introduce new pesticide technologies; Bangladesh and Zimbabwe have not. For competing brands of off-patent formulations that are already on the market, Zimbabwe requires three years of redundant efficacy tests, whereas Turkey approves competing products on the basis of chemical analysis alone. Zimbabwe's excessively expensive and slow approval for competing products—notably approving only one product for one company through early 1996—suggests that there is abuse of pesticide regulations to protect market shares for existing major companies. Across all three countries, procedures to approve new low- and zero-risk products remain as time-consuming and strict as for conventional medium and high-risk pesticides.

In Turkey, changes in pesticide regulations brought more active ingredients, competition, and sales. The average annual number of new active ingredients approved for sale increased from 9 in 1980–84 to 20 in 1985–92. The country deregistered some dangerous active ingredients over the same period. From 1980 to 1992, the number of active ingredients available in Turkey increased from 100 to 300, which compares with 700 in the United States in the mid-1990s and 200 in a number of middle-income countries in Latin America and Southeast Asia around 1990 (Gisselquist and Benbrook 1996). Turkey also has more products for each active ingredient. In the 1970s, the government approved an average of three new products for each new active ingredient; starting in 1980, this ratio jumped to nearly five, suggesting increased competition (although individual firms may offer multiple products with the same active ingredient).

In 1989, Bangladesh removed import limits on approved pesticides, allowing more competition among companies with registered products. Zimbabwe established mar-

ket access to foreign exchange, which similarly removed limits on imports for approved products and allowed more competition among established companies. However, in both countries, registration of new and competing products remains a barrier not only to the introduction of technology but also to market entry.

Impact on Productivity and Incomes

The hypothesis we set out to test is that regulatory reforms have a significant net positive impact on productivity and incomes. We establish a direct line of causation from reforms (for example, removal of compulsory variety registration), to changes in the rate of introduction of technology (for example, more private maize hybrids), to changes in input trade (for example, more sales of hybrid maize seeds), to changes in productivity and incomes (for example, higher maize yields and farm incomes). The crucial steps in this argument are the first two, in which regulatory reforms lead to the introduction of more new technology than would have occurred without reform, and this technology reaches farmers through inputs. If these points can be established, then we can be reasonably sure that the observed income gains from selected agricultural outputs would not have occurred in the absence of the regulatory reforms.

To quantify the impact on yields and incomes, we tailor the analysis to the available data so that our methodology varies by input and country. We could not quantify benefits in all markets; however, there were significant positive impacts for selected outputs and minor negative impacts across the agricultural sector. Our method of analysis does not focus on sector output. Therefore, we avoid questions about the relative impact of regulatory reforms compared with other reforms, such as extension and investments in rural roads.

The impact on overall welfare is an important consideration regarding regulatory reforms in the agricultural sector. Because the introduction of new technology is equivalent to an essentially costless expansion of the production possibility frontier, reforms that allow more productive technology have a positive impact on overall welfare. This is true regardless of whether other policies and conditions are ideal in the agricultural sector or other sectors. Regulatory reforms caused a switch from technologies essentially selected by governments to those selected by farmers; there were no real resource costs involved in the switch. Although market distortions may have affected the size and distribution of welfare gains, the introduction and adoption of the new technology was sufficient to enhance welfare qualitatively. In those cases for which we quantified the benefits, we did so using appropriate shadow prices—that is, border prices—so that measured benefits do not depend on uneconomic or distorted prices.

From a more dynamic viewpoint, we also found that regulatory reform often created pressures that worked against subsidies and other economic distortions. For

example, the private companies that entered seed markets in Bangladesh, India, and Turkey undermined parastatal seed sales and subsidies. Post-reform private trade in diesel engines and power tillers in Bangladesh replaced parastatal sales and subsidies and undermined donor and public support for enormously wasteful large-scale surface irrigation projects. An additional consideration is that better technology lowers production costs and thereby undermines the rationale for protection in the form of subsidies or trade barriers against imports. In these and other ways, regulatory reforms have encouraged fewer distortions and better policies.

Case Studies

Case studies from Bangladesh, India, Turkey, and Zimbabwe demonstrate that the reforms brought about improvements in productivity and incomes.

Irrigation in Bangladesh. Between 1988, the last year before the reforms, and 1996, farmers bought and installed 394,000 (net) new shallow tubewells and low lift pumps, an average of 50,000 per year. This compares with average annual increases of 20,000 in the four years before the reforms. Hence, the reforms brought an additional 30,000 new small pumps each year. Estimating that each pump irrigates 4.0 hectares, 30,000 additional pumps extend irrigation to an additional 120,000 hectares, or 1.2 percent of net cultivable area each year. In a regression of cereal production (tons) against irrigation (hectares) using 1972/73–1986/87 district data, the coefficient for standard small pumps is 10.8 (Gisselquist 1991). With this figure, 30,000 additional pumps each year boosts annual cereal production by 320,000 tons, equivalent to 2 percent of 1988 cereal production or 1.6 percent of the much higher 1996 cereal production. This comes on top of other gains from irrigation expansion that would have occurred without the reforms (that is, 20,000 new pumps each year) and increased use of fertilizers.

Based on these estimates, cereal production in 1996 was about 13 percent (1.6 percent compounded over eight years) above what it would have been without reform.¹ By 1996, higher post-reform irrigation expansion had increased net annual farm income from cereals alone by more than \$500 million. This is based on an estimated 2.6 million tons of additional rice at \$250 per ton—a conservative figure because the average import parity price exceeded \$300 per ton during 1991–97—and subtracting off-farm expenses estimated at 20 percent of the gross value of production. This estimate ignores additional farm income from other irrigated crops and fisheries.

Private hybrids in India. Our analysis covers cotton, maize, sunflowers, sorghum, and pearl millet. The empirical model for our partial productivity analysis is similar to the models of total factor productivity analysis in the literature (Evenson and others

1998). The independent variables in our analysis include a measure of the spread of high-yielding varieties expressed as a proportion of the crop area devoted to all varieties, a measure of the spread of private varieties, and other standard variables that affect yields. With this model, the impact of private hybrids on yields is positive and statistically significant in five of the nine crops and provinces analyzed and close to significant in a sixth case.

This evidence that private hybrids and research have had an impact on crop yields is particularly impressive because the region examined is in the semi-arid tropics, where private research is often not expected to have much impact. For maize and sunflowers, companies can draw on large private foreign research programs. In Maharashtra, private varieties and crop profitability have been the major factors explaining higher yields. In Karnataka, where the coefficient for private varieties is not significantly different from zero, the coefficient for public high-yielding varieties is large and could be picking up some of the impact of private varieties. Sunflower yields in Karnataka have been virtually stagnant despite an expansion in the share of area with private varieties. However, the sunflower area grew rapidly, which may explain the low increase in average yields because areas with lower marginal yields were brought into production. Maize yields increased only modestly in Karnataka.

Private maize hybrids in Turkey. We modeled maize yields in tons per hectare as a function of private hybrids, fertilizer, irrigation, rainfall, and trend. Using the model, we projected maize yields without private hybrids, then subtracted projected yields from actual yields to estimate yield and income gains (see Gisselquist and Pray 1999). The gap between actual and projected yields was greatest in 1990 at almost two tons per hectare. During 1990–92, the farm-level annual gross financial value of additional production was about \$130 million (\$255 per hectare over 515,000 hectares). Taking into account higher costs for hybrid seed and for harvesting and drying a larger crop and adjusting farm-level maize and fertilizer prices to international prices, the annual net economic benefit to the country from private maize hybrids in 1990–92 was \$74 million. This is equivalent to 23 percent of the gross value of maize production for the country.

Maize and tractors in Zimbabwe. We estimated the impact of reforms on maize yields in Zimbabwe from the share of area planted to post-reform hybrids and the average yield of new and old hybrids in multiyear field trials. This approach circumvents problems with year-to-year fluctuations in rainfall and other factors affecting national yields as well as inexact national production estimates, which can overwhelm the impact of even very large changes in yield due to new technology (Feyerham and others 1984).

In 1996, farmers planted 52 percent of maize area to post-1996 hybrids, for which the weighted average yield is 5.6 percent above the weighted average yield for pre-

1990 hybrids. Assuming that in the absence of reform all of the area would have been planted to the same pre-1990 hybrids, post-1990 hybrids are responsible for an almost 3 percent increase in national average maize yield and production. This figure compares with estimated annual increases in yield potential due to breeding of roughly 0.67 percent in industrial countries and well over 1 percent in selected developing economies with relatively new private breeding programs.

The reforms have had a large impact on Zimbabwe's stock of tractors. During 1987–89, Zimbabwe had a total of 20,400 tractors, only 3 percent more than in 1977–79 (World Resources Institute and others 1992:274). In the first three years after market access to foreign exchange, 1994–96, aggregate tractor imports were 9,200, equivalent to 45 percent of total tractors in Zimbabwe at the end of the 1980s. Assuming that half of the new tractors replaced older ones going out of service, farmers had more than 20 percent more tractors in 1996 due to the reforms. If these trends continue for another three to six years, the impact of more tractors may be evident in national and survey data on planted area, fertilizer use, timeliness of planting, and field-to-market transport costs. However, considering large fluctuations in agricultural activities due to erratic rainfall and other factors, we did not analyze the impact on planted area or aggregate production through 1996.

Costs of Reform

Disregarding the minor administrative costs of the redesign of regulations, we considered the costs of the regulatory reforms in three main areas: nonperforming technology, fraud, and externalities. We also looked at fears that local input industries might lose sales and that increased private technology flows might undermine funding for public research.

Nonperforming technology. For inputs and countries where changes in regulations brought a large increase in the introduction of technology, farmers shifted out of older technologies. This shift tended to be one-way and progressive, with the number of farmers adopting new technologies increasing over time. The pattern of these shifts suggests that farmers were not negatively surprised about the performance of the new technologies and that farmer adoption of inferior technology from the limited list of pre-reform options became less likely with reform.

This finding agrees with what could be predicted from the literature on markets with incomplete information. The theoretical analyses indicate, for example, that markets are more susceptible to misleading claims when the products being sold have “credence” characteristics, that is, qualities that are not apparent in normal usage (Lynch and others 1986). However, these risks are limited with frequently purchased experience goods, that is, goods whose quality is clear when they are used (Posner 1979). Other studies show that, under many conditions, sellers develop reputations

that improve market information and reliability for all parties (Allen 1984; Klein and Leffler 1981; Shapiro 1982).

Markets for seeds and other agricultural inputs (for example, livestock feed) clearly fit the model of a frequently purchased experience good, the quality of which can be cheaply ascertained. Given the high fixed costs of market entry (breeding, research, and building dealer networks), sellers must depend on reputations to generate repeat business. Farmers are quite capable of judging the attributes of a new variety from seeing it in others' fields (including company demonstrations). If necessary, farmers can test a variety in a small area before planting it on a large scale. Generally, information that farmers obtain this way is a more accurate predictor of their own future results than are data from a small number of government test plots. Of course, government testing may provide additional useful information and may justify government expenditure to develop and disseminate information. However, it does not justify government controls that force farmers to forgo new varieties while government officials collect data from multiyear trials.

Fraud. Some experts argue that in poor countries—where inadequate legal systems mean that farmers cannot sue—reforms that lead to market entry and more private input trade increase the risk of fraud. This argument overlooks the fact that increased competition gives farmers more opportunities to enforce quality through market choice. For example, without competition, seed parastatals are not afraid to lose sales if germination is below what is claimed; market entry changes this situation. In India, for example, it is generally recognized that seed quality improved during the 1990s as private companies with proprietary cultivars expanded their share of the market against public cultivars that were often produced and sold as commodities with little attention to brand name.

The only alleged case of large-scale fraud that we came across in the country studies occurred in Bangladesh. Government experts asserted that fertilizer traders cheated farmers by selling SSP in place of TSP, and that farmers did not fully appreciate differences in phosphoric acid content (18 percent versus 46 percent). Largely on the basis of this charge, in the mid-1990s, the government of Bangladesh introduced new regulations that imposed prior government approval on all fertilizer compositions allowed for trade. The government could have addressed the concern by enforcing truth in labeling for packaged fertilizers. (An alternative interpretation of the increase in SSP sales is that farmers were not fooled but rather appreciated the sulfur content of SSP and that government officials have been confused about the relative impacts of TSP and SSP on yields.)

Higher externalities. Just about anything that leads to agricultural growth—rural roads, regulatory reforms, or public research—will also lead to higher levels of commercial input use. Therefore, growth challenges the government to adjust regula-

tions to focus more effectively on externalities. Well-designed regulatory reforms not only allow more technology and input trade but also focus and strengthen controls that limit externalities. This has happened to some extent in Turkey, and less so in the other three countries. Overall, there has arguably been some increase in pesticide externalities due to insufficient efforts to shift farmers to safer pesticides and to control the use of more dangerous products.

In India, Bangladesh, and Turkey, seed reforms led to some increases in seed imports and hence possible phytosanitary problems. However, the share of planted seed that is imported is still far below common OECD practice in all four countries. Seed smuggling into Turkey fell with reforms, improving phytosanitary protection. However, none of the countries has yet implemented a consistent, science-based phytosanitary system. Overall, evidence suggests little or no shift either way in terms of phytosanitary threats from seed imports. However, governments could have done more to reduce such threats with more focused import controls.

Weaker local input industries. In general, reforms lead to increased company entry and technology, not only expanding input markets, but also taking market shares away from parastatals and some existing private companies. This can present a threat to people with a stake in the pre-reform situation, including government breeders, input parastatals, and existing private companies that are protected by regulations (for example, Seed Coop in Zimbabwe or the sole dealer for Sai Feng power tillers in Bangladesh before the reforms).

For most countries and inputs, we found that reform led to overall growth in the production and trade of inputs, with more links to international industries and technology. In some cases, new companies and technology helped national input industries to compete in world markets. For example, immediately after the reforms, Turkey imported hybrid maize and sunflower seeds; within several years, the country became a net exporter. By contrast, Turkey's fertilizer exports fell because the reforms reduced hidden export subsidies. However, it is important to keep concerns about impacts on input industries in context. Restraints on trade to protect an upstream activity, such as input production, can impose large losses on downstream activities, including agricultural production and processing industries.

Effect on public research. The impact of promarket reforms on public research budgets is another common concern. Before the reforms, regulations blocked private technology introduction, and the government dominated research. Reforms that allow the introduction of private technology stimulate private research (including screening imported technology for local applicability). For OECD countries with relatively much higher levels of private as well as public agricultural research, estimates of returns to public research are consistently high. This suggests that public research remains a good investment, even after reforms stimulate the introduction of more private technology.

Regulatory reforms present an opportunity to revitalize public-sector research. Arguably, a significant share of public research in many developing and transition economies currently has negative returns. In some cases, government scientists waste their time testing and regulating new private technologies or developing inferior technologies that farmers use only because they cannot choose more productive technologies that regulators do not allow. Reforms that bring more private companies and technology allow public research to shift effort into areas not covered by private companies. Such reforms create opportunities for public-private collaboration, create a competitive environment that makes it easier for public research managers to assess and manage staff and research programs, and increase returns to complementary public research (for example, greater use of high-yielding varieties increases returns to soil science research). Thus, the kinds of reforms discussed could lead to redirecting and increasing public research budgets. What actually happens depends directly on decisions within government, not on trade in private inputs.

Recommendations

These findings suggest some specific steps that developing economy governments and supporting institutions can take to more effectively support agricultural growth. First, governments should reduce regulatory barriers to the introduction of private technology. Governments should focus input regulations on fraud and externalities and allow markets to decide questions about performance. Table 5 summarizes some of the most common regulatory obstacles and suggested reforms for major inputs.

Reforms are especially important for products with small markets. Where the potential sales and profits to a private company are small, the high fixed costs incurred in overcoming regulatory hurdles deter the introduction of technology. Most African economies are small markets where high barriers to entry for local as well as foreign companies and varieties have essentially blocked development of private seed industries. These barriers have left farmers with short lists of improved varieties from national research institutes and poor access to seeds, often from monopoly parastatals. Even in large economies, low-risk biopesticides have only small niche markets because they are targeted to specific pests and crops. Forcing them through the same tests as high-risk poisons amounts to a bias in favor of high-risk products. The United States and some other OECD countries have taken steps to adjust regulatory processes to favor biopesticides. Governments in developing economies could consider similar changes.

Second, when donors design a project to support government agricultural research or extension in a developing economy, they should assess whether regulations present an obstacle to the introduction of private technology. If so, the donors should press governments to allow private technology. It makes little sense to pay for public research if government blocks the introduction of commercially available technology.

Table 5. Reforms toward Optimal Regulations: Focusing on Externalities and Fraud

<i>Input</i>	<i>Common excessive or inadequate regulations</i>	<i>Suggested reforms</i>
Seeds	<p>a. Case-by-case import permits based on government estimates of seed production and requirements as well as phytosanitary concerns.</p> <p>b. Case-by-case export permits based on government estimates of seed production and requirements.</p> <p>c. Compulsory variety registration: seed sale not allowed until government has approved the variety, often after several years of tests.</p> <p>d. Compulsory seed certification: seed sale not allowed unless government officials have visited and approved fields and tested seed.</p> <p>e. Government permission for new companies to enter the market is based on unreasonably strict objective criteria or arbitrary decision.</p>	<p>a. Focus import controls on realistic phytosanitary concerns.</p> <p>b. Do away with export permits.</p> <p>c. Make variety registration voluntary; test only as a service to farmers and companies.</p> <p>d. Make certification voluntary; do away with minimum standards or make them voluntary; enforce truth in labeling.</p> <p>e. Set low objective requirements for new companies, just as in other sectors (e.g., tax registration).</p>
Pesticides	<p>a. Efficacy tests required for all new formulations, including low- and zero-risk biopesticides.</p> <p>b. All pesticides—including low- and zero-risk products—subject to similar controls on sales, storage, transport, and use.</p> <p>c. Residue testing of food products in trade, but often focused on products for export to OECD countries with high standards.</p>	<p>a. Accept efficacy tests from comparable countries; reduce or eliminate efficacy tests for low- and zero-risk biopesticides.</p> <p>b. Adjust trade and use controls according to risk.</p> <p>c. Increase residue testing for food products intended for domestic markets.</p>
Fertilizers	Government approval required for new components and compositions.	Allow companies to sell any combination of nutrients, except for limits on heavy metals and other harmful items; enforce truth in labeling.
Livestock feeds	Government approval required for new nutrients and compositions.	Allow companies to introduce new components and compositions, except for limits on classes of components that threaten health externalities, such as nonvegetable proteins, hormones, and antibiotics; enforce truth in labeling; and increase testing for banned components in feeds and residues in livestock products.
Agricultural machinery	Government tests and approvals required for new makes and models.	Allow companies to introduce new machinery; test only as a service to companies and farmers.

Third, CGIAR should challenge the governments of developing economies to allow all resident companies and NGOs unrestricted access to CGIAR germ plasm and to multiply seed for sale without first having to gain approval from a government regulatory committee. Donors fund the CGIAR system to develop technology for farmers in developing economies. Unfortunately, much of that technology is illegal in many of the countries (where governments enforce compulsory variety registration and have at the same time registered only a small fraction of CGIAR lines). Returns to investments in CGIAR research could be much higher if technology could reach more farmers faster.

Notes

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1. Estimates of changes in cereal production based on changes in minor irrigation agree with Mitchell's (1997) estimate based on demand-side evidence that rice production grew 3.2 percent per year over 1991–97. During 1991–97, the population grew at 1.6 percent per year, income per capita increased 3 percent per year, and rice prices fell. Imports were minimal in 1991 and 1997. Similarly, field surveys by the Bangladesh Institute for Development Studies (Hossain and others 1996) for 1987 and 1994 show minor irrigation expanding from 20 to 37 percent of net cultivable area, average rice yields rising from 2.44 to 3.22 tons per hectare, and annual rice area increasing from 122 to 139 percent of net cultivated area (on average, 1.39 rice crops were planted each year on the same land in 1994). Official data show rice production growing less than 0.4 percent per year over FY91–97; however, the basis for the official data is weak.

References

- Allen, F. 1984. "Reputation and Product Quality." *Rand Journal of Economics* 15(3):311–27.
- Constantine, John, Julian Alston, and Vincent Smith. 1994. "Economic Impacts of the California One-Variety Cotton Law." *Journal of Political Economics* 102(5):951–74.
- Evenson, R. E., Carl Pray, and Mark Rosegrant. 1999. *Agricultural Research and Productivity Growth in India*. Washington, D.C.: International Food Policy Research Institute.
- Feyerham, A. M., G. M. Paulson, and J. L. Sebaugh. 1984. "Contribution of Genetic Improvement to Recent Wheat Yield Increases in the USA." *Agronomy Journal* 776:985–90.
- Gisselquist, David. 1991. *Development Potential of Minor Irrigation in Bangladesh*. Bangladesh: Agricultural Sector Team, Ministry of Agriculture, Government of Bangladesh.
- . 1994. "Import Barriers for Agricultural Inputs." UNDP–World Bank Trade Expansion Program Occasional Paper No. 10. World Bank, Washington, D.C.
- Gisselquist, David, and Charles Benbrook. 1996. "Technology Transfer, Competition, and Trade Liberalization for Low-Risk Pest Management." UNDP–World Bank Trade Expansion Program Occasional Paper No. 11. World Bank, Washington, D.C.

- Gisselquist, David, and Carl Pray. 1999. "Deregulating Technology Transfer in Agriculture: Impact of Turkey's 1980s Reforms." World Bank Policy Research Working Paper No. 2086. World Bank, Washington, D.C.
- Hossain, Mahabub, Hossain Zillur Rahman, and Binayak Sen. 1996. "Income Distribution and Poverty in Rural Bangladesh, 1987-94." Unpublished draft, Bangladesh Institute of Development Studies, Dhaka, Bangladesh.
- Kelly, A. Fenwick. 1989. *Seed Planning and Policy for Agricultural Production: the Roles of Government and Private Enterprise in Supply and Distribution*. London: Belhaven.
- Klein, B., and K. B. Lefler. 1981. "Non-Governmental Enforcement of Contracts: The Role of Market Forces in Guaranteeing Quality." *Journal of Political Economy* 89:615-41.
- Lynch, Michael, Ross Miller, Charles Plott, and Russell Porter. 1986. "Product Quality, Consumer Information and 'Lemons' in Experimental Markets." In P. M. Ippolito and D. T. Scheffman, eds., *Empirical Approaches to Consumer Protection Economics*. Washington, D.C.: Federal Trade Commission. pp. 251-306.
- Mitchell, Don. 1997. "Rice Production—What Can We Believe?" Unpublished manuscript, Development Prospects Group, World Bank, Washington, D.C.
- Narrod, Clare, and Carl Pray. 1995. "Animal Wastes and the Land/Water Interface." In Kenneth Steele, ed., *Technology Transfer in the Poultry Industry: Factors and Externalities Associated with Increased Production*. Boca Raton, Fla.: CRC Press.
- Posner, R. 1979. "The Federal Trade Commission's Mandated-Disclosure Program: A Critical Analysis." In H. Goldschmid, ed., *Business Disclosure: Government's Need to Know*. New York: McGraw Hill, pp. 331-76.
- Pray, Carl, and Ruben Echeverria. 1988. "Transferring Hybrid Maize Technology: The Role of the Private Sector." *Food Policy* (November).
- Pray, Carl, and Bharat Ramaswami. 2001. "Technology, IPRs, and Reform Options: A Case Study of the Indian Seed Industry with Implications for Other Input Industries." *International Food and Agricultural Marketing Review* 2(3/4):407-20.
- Shapiro, Carl. 1982. "Consumer Information, Product Quality, and Seller Reputation." *Bell Journal of Economics* 11:749-52.
- Ulrich, Alvin, William Furtan, and Andrew Schmitz. 1987. "The Cost of a Licensing System Regulation: An Example from Canadian Prairie Agriculture." *Journal of Political Economy* 95(1).
- World Resources Institute, UNEP, and UNDP. 1992. *World Resources 1992-93*. New York: Oxford University Press.

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How Research Can Assist Policy: The Case of Economic Reforms in Uganda

John Mackinnon • Ritva Reinikka

Research has had a powerful impact on policy in Uganda, affecting the climate of opinion, improving the quality of the policy debate, and helping focus public policy and intervention on poverty reduction. Uganda's successful use of knowledge and research to help set public policy priorities demonstrates that even a poor postconflict country can, in a relatively short period of time, create an effective information base and feedback mechanisms for decisionmaking.

Ugandan policymakers developed a reputation for being among the most committed economic reformers in Africa in the 1990s when they established macroeconomic stability, stimulated rapid economic growth, and granted considerable personal and political freedom following a long period of economic decline, conflict, and repressive government. Circumstances in Uganda were favorable for innovation in that the country has relatively abundant land resources and some reforms could generate returns very quickly. At the same time, the legacy of conflict and the AIDS epidemic present difficult long-term challenges.

During the 1990s Uganda introduced innovations in several policy areas. The Poverty Reduction Strategy Papers of the late 1990s, for example, owe their international popularity to the Poverty Eradication Action Plan (PEAP) developed earlier in Uganda (and to similar efforts in Bolivia and Mozambique).

The reform process in Uganda made use of various types of research, broadly defined as data, knowledge, statistical and other analyses, and dissemination. Some research outputs have been more important than others in influencing policy. The results of public expenditure tracking studies have had dramatic effects on policy, and other types of research have helped improve the climate of ideas influencing policymakers. Other research has had little influence, either because the need for reform was already recognized, the policy implications were intellectually or politically controversial, or the findings were inadequately disseminated.

Most of the research we examine here was officially sponsored and often donor-financed, including research conducted at the independent Economic Policy Research Centre in Kampala. Other domestic research activities were conducted outside governmental structures, including the work performed by the Centre for Basic Research, an independent, privately financed research institution working within a partially Marxian intellectual tradition. The government subcontracted the participatory poverty assessment to nongovernmental organizations (NGOs), which were (crucially) allowed to operate within the Ministry of Finance, Planning, and Economic Development, keeping them close to ongoing policy discussions in government.

In 1986 the National Resistance Movement government inherited a society in which improvements in institutions and service delivery would inevitably take a long time. Good opportunities existed, however, to reduce poverty in the short run by ending predatory taxation of exports, stabilizing the currency, and achieving peace after a long period of conflict (Collier and Reinikka 2001). Other reforms, however, such as land reform, raised potentially divisive political issues that needed to be addressed cautiously.

In this article we discuss the role of research in macroeconomic and structural reforms. After examining how analytic work guided policy on poverty and the distributional impact of growth in Uganda, we explore how data were used to shape sector policy, especially policy affecting public services, assets, and governance. We also show how the research–policy link was institutionalized in the PEAP.

Macroeconomic Reforms and the Reestablishment of National Accounting

Before the 1985–86 civil war, Uganda's economy had been in decline for 15 years, and much of its economic activity was in the black market; during the civil war the economy experienced hyperinflation. The most urgent macroeconomic problems facing the country in the mid-1980s were thus the need to control inflation and generate rapid economic growth.

Although a commitment to macroeconomic stability had been part of the adjustment programs with the International Monetary Fund (IMF) and the World Bank since 1987, lax budget implementation repeatedly resulted in larger than planned fiscal deficits. Borrowing from the central bank financed fiscal deficits, which led to an average annual inflation rate of nearly 200 percent and an acute fiscal crisis in 1992. Initially, little consensus was reached on the importance of price stability or how to achieve it

Informing the Debate on Devaluation

In the 1980s the prevailing wisdom in Uganda was that depreciation of the official exchange rate led to inflation, which in turn led to depreciation of the parallel mar-

ket rate, thus reestablishing the previously existing premium between the parallel and official rates (Henstridge and Kasekende 2001). This reasoning was also reflected in the academic literature, which recommended a constant crawl exchange rate regime (Kharas and Pinto 1989; Pinto 1988, 1989).

The Ugandan Ministry of Planning and Economic Development reached the opposite conclusion, determining that devaluation of the official rate would help the government implement a budget consistent with low inflation (because thanks to donor aid it was a net seller of foreign exchange) and therefore not lead to an offsetting depreciation of the parallel exchange rate. The Presidential Economic Council provided an important forum for economic policy debate, and the ministry's macroeconomic strategy document "The Way Forward I" eventually convinced decisionmakers to legalize the parallel market and devalue the official exchange rate (Republic of Uganda 1992b). This was an unexpectedly bold reform—critically informed by international and domestic analytic work—that went well beyond the conditionality agreement with the IMF.

The fact that devaluation has different impacts on different income groups fueled a Marxian critique on the grounds that devaluation would benefit groups that are neither poor nor productive (Mamdani 1989). This argument contributed to a lively public debate with senior civil servants.

Analysis of household survey data helped resolve many of the questions about liberalization as a poverty-reducing strategy. It showed that export crop farmers were as poor as the average Ugandan in 1992 and that they benefited from the early years of reform as much as any other group (although there is certainly some local monopsony in trade). The household data also revealed that following reform, smallholders increased their investment in housing improvements and agriculture. Research also helped convince policymakers to abandon the stabilization tax on coffee introduced following the 1994 boom in coffee prices, a tax that threatened the supply response of exports. The study by Bevan and others (1990), which showed that small farmers in Kenya were better able than politicians to save windfall income, caused a heated policy debate about its applicability to Uganda's circumstances and had an important effect on the decision to repeal the coffee tax two years later. The point at issue was not the findings of the research in Kenya but their applicability in a country with a less-developed financial system.

Creating a Consumer Price Index to Guide Short-Term Macroeconomic Management

The 1992 fiscal crisis helped solidify macroeconomic priorities. The new economic team put in place during the fiscal crisis had an explicit mandate from the president to match spending to resources. In a statement following the 1992 budget speech, President Museveni said, "There will be no inflation. Inflation is indiscipline" (quoted

in Henstridge and Kasekende 2001: 58). There was an increased willingness to make intrayear adjustments in implementing the budget to maintain macroeconomic stability. The monthly cash flow was used to track the fiscal stance and to make short-run fiscal adjustment in the face of shocks.

The main problem was no longer a lack of understanding about what causes inflation but the dearth of statistical information to guide short-term macroeconomic management. Priority was therefore given to creating a consumer price index, which required a household budget survey. The weights for consumption had to be significantly revised with the share of food expenditures increasing because of the impoverishment of the population in the period since the previous survey, conducted in the mid-1960s.

The new consumer price index was used as the direct target in managing the monthly cash flow for two reasons. First, prices were flexible and responded quickly to changes in the money supply. Second, there was a three-month lag in the compilation of monetary statistics, whereas the consumer price index was available at the end of each month. For these reasons changes in monetary conditions showed up in prices at about the same time they appeared in the statistics for broad money (Henstridge and Kasekende 2001). There was therefore no advantage to looking first at the intermediate monetary indicators. Looking directly at price data also sidestepped the difficulty of separating signal from noise in the monetary data, especially given the unpredictable short-run changes in money demand characteristics of a remonetizing economy like Uganda.

Reviving the National Accounts to Monitor Economic Growth

Reviving the national accounts to monitor economic growth performance was another early priority. Doing so involved conducting an enterprise census, improving trade statistics, and coming up with unconventional ways to estimate agricultural production in the absence of basic surveys. Meanwhile, the research department of the central bank focused on improving the balance of payments data to monitor private transfers. These transfers grew as members of the Asian community expelled by Idi Amin in 1972 returned to repossess their confiscated properties, bringing with them funds to renovate real estate and restart their businesses.

Economic Liberalization, Tax Reform, and the Response of Firms

Macroeconomic stabilization was accompanied by economic liberalization and structural reforms, including new trade, exchange rate, and tax policies.

Trade Liberalization

After an experiment with barter trade, Uganda abolished the coffee export tax and removed commodity board monopolies on coffee and cotton in the early 1990s (Akiyama 2000).¹ The speed with which this reform was adopted reflected the fact that many Ugandans suffered from restrictions on marketing their crops. Not only had prices been suppressed, farmers had often been paid in promissory notes rendered almost worthless by inflation. Smuggling (of Ugandan coffee through Kenya, for example) was widespread. Many Ugandan politicians farm and rear livestock, and the president publicly expressed sympathy for cross-border food traders. Although research (discussed later) did illustrate the distributional impact of trade restrictions, the decision to liberalize predated the research.

One major caveat is the extent to which men control cash crop incomes. Early in the reform process an NGO conducted a survey of women's needs. That study emphasized the extent to which men dominate the sale of cash crops (UNICEF/AFCODE 1988). Women in Arua were not enthusiastic about tobacco production, even though it is an important income source, because men controlled the income (Harmsworth 1991). More recent participatory work has suggested that malnutrition in the relatively affluent district of Bushenyi is caused by the commercialization of food crops (Republic of Uganda 1999b).

Although this research did not persuade the government to abandon its advocacy of cash crops, it brought attention to the need to consider corrective actions to ensure that women benefit from the opportunities created. One such action was gender training for agricultural extension officers. Land reform has also included some efforts to strengthen women's land rights (curtailing the right of men to sell land without the permission of the rest of the family). Universal primary education, introduced in 1997, is reducing the educational gender gap. The policy of export liberalization has therefore been accompanied by some corrective measures that should improve women's relative position. Notwithstanding these efforts, the interaction between gender and export promotion merits further investigation.

Liberalizing imports occurred more slowly than liberalizing exports. It also involved more debate and analysis. The main contribution of research was the theoretical understanding of the impact of import taxes in an economy like Uganda. Initially, the government failed to recognize the equivalence between export and import taxes or the fact that in a small, open economy, import taxes are ultimately borne by export producers. For this reason the switch from export taxation to import taxation during the early 1990s achieved less than expected in terms of export orientation and diversification (Collier and Reinikka 2001; World Bank 1996b). Once the equivalence between export and import taxes became well understood, nontariff barriers were gradually removed. During the late 1990s the government

implemented a major tariff reduction program, giving Uganda one of the lowest tariff structures in Africa.

Some country-specific research was important in establishing the needed direction of change. Research determined the impact of explicit and implicit tariff changes on enterprises and the effective protection provided them by the tariff system (Short 1995, 2000). These studies were used to advocate trade reforms and assess their impact. As noted, data from the first household survey demonstrated that coffee farmers, who benefited from the improved domestic terms of trade, were no better off in 1992 than the average Ugandan household. That finding suggested that trade liberalization would not necessarily be distributionally regressive.

Tax Policy

As macroeconomic distortions were gradually removed, it became increasingly clear that the tax exemptions under the 1991 investment code undermined the tax base and adversely affected competition. Subsequent tax reforms removed many of the code's exemptions and introduced a value-added tax and a new income tax law.

With the exception of work on tariffs, little research has been conducted on tax policy. Recently a few studies have examined the impact of the government's tax reforms on firms and their regional competitiveness and on the distributional impact on households, particularly poor households (Chen and others 2001). This work did not lead to any major policy changes, but it provided an ex post validation of the impact of the tax reforms. It also confirmed the view that increases in tax rates would not be conducive to growth and that future increases in revenue will have to come from expanding the tax base.

Too little attention has been paid to the most widely disliked tax in Uganda, the graduated personal tax. This tax, which has inspired a wave of popular protest songs, generates a large proportion of local revenue in Uganda. Although reform of the tax has been on the policy agenda for some time, little reform has actually taken place. The reform of local taxation deserves a higher profile in the design of future economic reform, and not just in Uganda. Participatory work on taxation has focused on local taxes because poor households are very directly aware of them (Muhumuza and Ehrart 2000). In contrast, survey-based work has tended to focus on central government. There is scope for these perspectives to learn from each other. Quantitative work needs to devote more attention to local taxation, which often includes some of the most distortionary and inequitable taxation in the whole system. Interpretation of participatory work needs to recognize the fact that taxes can have significant indirect impacts on the poor even when the poor are unaware of them. The indirect impact of import duties on cash crop producers is a good example.

Firms' Response to Reforms

In the early 1990s the Ugandan private sector and the World Bank began monitoring investor perceptions using surveys (World Bank 1994a, 1994b). In 1998 they jointly carried out the first quantitative enterprise survey to examine firms' investment and export response and the impact of inadequate infrastructure services and corruption on investment and growth. The survey revealed that despite major improvements in the policy environment, investment rates of Ugandan firms did not differ greatly from those of firms in other African countries, averaging slightly more than 10 percent a year with a median value of 1 percent. Profit rates, however, were lower in Uganda than elsewhere in Africa. These results suggest that Ugandan firms display more confidence in the economy than their counterparts in many other African countries and, for a given profit rate, invest more. At the same time, increased competition, thanks to economic liberalization, has put pressure on firms to cut costs. Many of these costs, however—such as the cost of infrastructure services—are set by the public sector and are not under firms' control. Thus firms have been unable to meet the challenge of increased competition by reducing costs, which has had adverse consequences on profits (Reinikka and Svensson 2001a).

The firm survey also reveals that the unreliable and inadequate supply of electricity was the leading constraint to all types of Ugandan firms, adversely affecting their investment rates. The supply of electric power appeared to have become less reliable in 1995–97, as demand increased. Given the poor quality of infrastructure services, investment in productive capacity often requires an additional investment in electric power generators. In 1997 Ugandan firms allocated a quarter of their total investment to generators (Reinikka and Svensson 2001a, forthcoming).

Publicizing the extent to which poor electricity services handicapped investment directly contributed to removing political obstacles to private participation in the power sector, helping break the parliamentary logjam on this issue. These findings also had a major impact on the subsequent formulation of the government's private sector and competitiveness strategy.

Coalition building between government and the private sector was generally difficult during the trade liberalization phase. Because most firms in Uganda produce for the domestic market, they naturally resisted the lowering of tariffs. Building coalitions with the private sector became somewhat easier when broader questions of constraints to growth and investment—particularly public-sector performance—were addressed (in the context of the 1998 firm survey, for instance).

Unfinished Business: Financial and Legal Reform

Private investment in Uganda, as in other African reformers, has proven too flighty a bird (to use Keynes's phrase) to be successfully captured. Measured investment rates

remain lower than the high rates of economic growth would suggest and cast some doubt on the sustainability of growth. Two major areas requiring attention are the financial and legal systems.

Reform of the financial and legal sectors confronts significant vested interests. In the financial sector there is the need to reclaim debts from large borrowers, some of whom are politically influential. Political pressure is often exerted to lower interest rates—rates that, although high, reflect the riskiness of lending in Uganda, as revealed in the high rate of bank failure and the large share of bad loans.

In the legal system, strengthened contract enforcement is needed, including the ability to foreclose. Surveys of entrepreneurs reveal that long delays and corruption in the legal system pose serious obstacles to investment (Republic of Uganda 1999a). Although these results are not surprising, the research is valuable because it underscores the need to ensure that the legal system treats investors, including foreign investors, equally. Only if the link with investment is clearly and vividly understood will policymakers take the steps needed to reform the legal system.

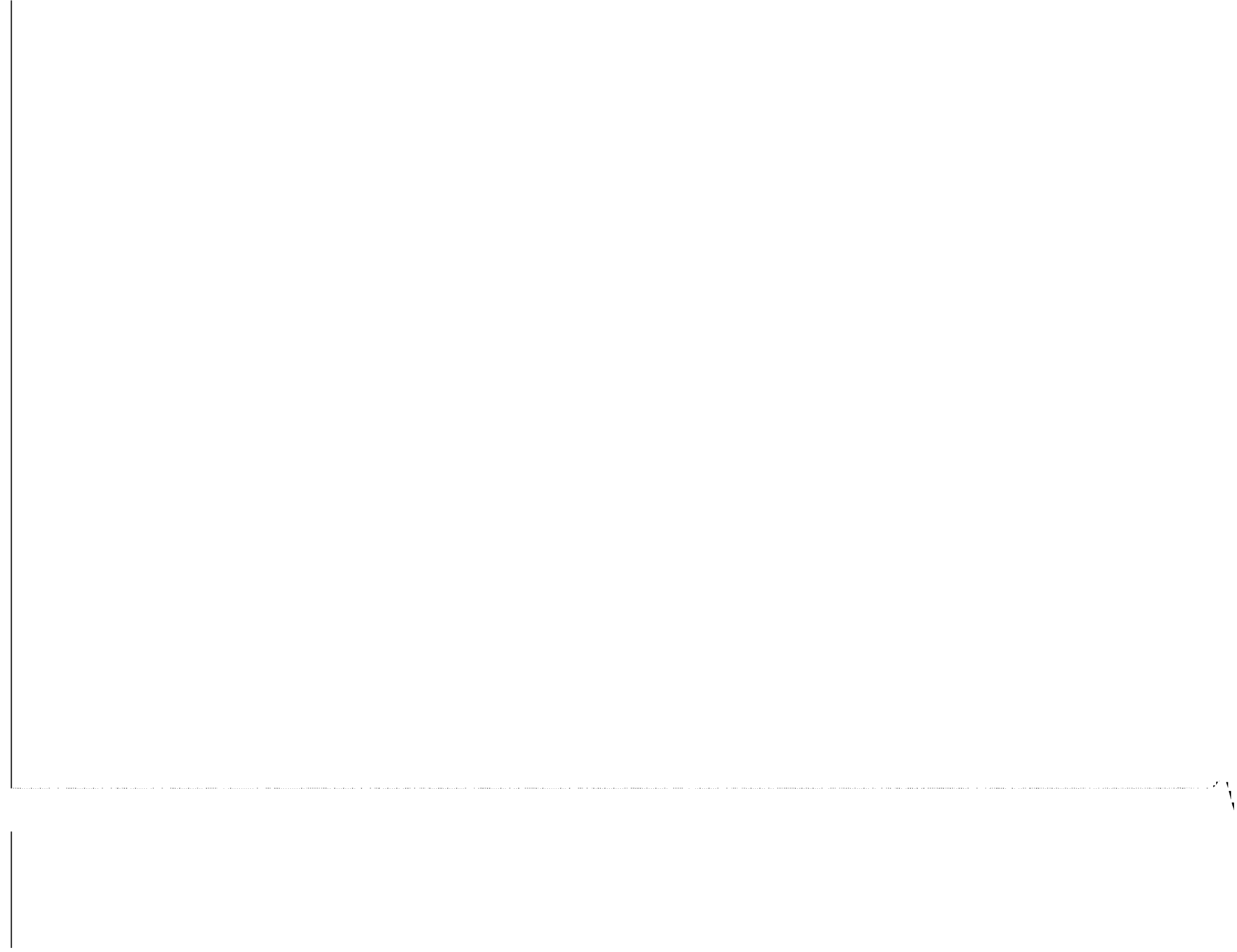
Poverty and the Distributional Impact of Growth

Little dialogue took place between the government and NGOs in the early 1990s. NGOs remained more skeptical than the government about the poverty-reducing benefits of prudent macroeconomic policy and saw more need to change direction. The data on poverty and inequality trends needed to resolve the differences between the two groups were completely lacking.

Household Surveys

Although time-series data on poverty trends were lacking, the 1992 integrated household survey provided the necessary data for obtaining a cross-sectional poverty profile, prepared in collaboration with the World Bank and the Ugandan Statistics Department (Appleton and Mackinnon 1995; Republic of Uganda 1992a; World Bank 1996b). The profile provided a useful snapshot, but it could not determine whether the country's economic policy had succeeded in reducing poverty. The 1989 household budget survey, conducted to obtain a new base for the consumer price index, used a different sampling method from the 1992 household survey, making comparison of consumption poverty between the two surveys impossible—something that became obvious only after several frustrating efforts (Appleton 1996, 2001a).

For a long time survey data collected after 1992 under the donor-supported Social Dimension for Adjustment project were unavailable for analysis because of the lack of statistical capacity to clean and archive the data for users. To meet the grow-



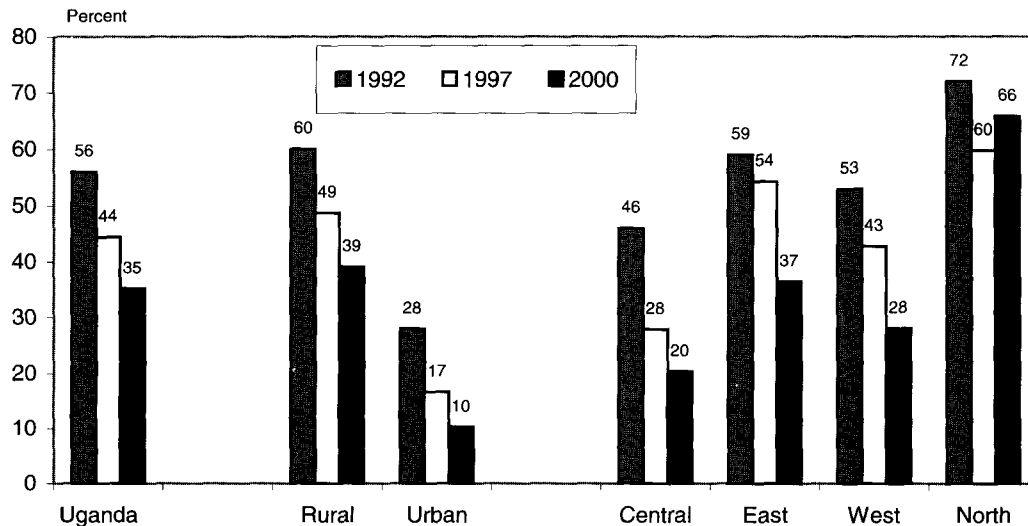
ing demand for data from household surveys, Ugandan statisticians, supported by external technical assistance, had to acquire these skills.

By 1999 five consecutive household surveys had become available covering the years 1992/93–1997/98. Each survey consists of a large sample of households (10,000 in 1992, 5,000 in other years) and communities (1,000 in 1992, 500 in other years) (Republic of Uganda 1994, 1996). These surveys offer relatively high-quality data for analyzing changes in poverty and inequality in response to economic reforms. A second baseline survey was carried out in 1999/2000.

The household survey data allow trends in poverty to be identified. Analysis of these data reveals that mean incomes did indeed rise significantly during the period, with a slight overall decline in inequality as measured by the Gini coefficient (Appleton 2001a, 2001b). This improvement reflects both the sharp increase in coffee prices in 1994, which was passed on to producers under the newly liberalized regime, and some change in economic structure, as the share of households in cash cropping increased. Decomposition analysis shows that almost half of the reduction in poverty came from improvement in the conditions of export crop farmers.

Using an absolute poverty line based on calorie needs (given the typical diet of the Ugandan poor and minimum nonfood requirements), the survey reveals that 56 percent of Ugandans were poor in 1992/93 and 44 percent were poor in 1997/98 (Appleton 2001a; Republic of Uganda 1997b) (figure 1). The 1999/2000 data indicate a further reduction in poverty to 35 percent in 1999 (Appleton 2001b; Okidi

Figure 1. Incidence of Consumption Poverty in Uganda, 1992–2000



Source: Appleton (2001b).

1999), and a decline in poverty was observed regardless of the poverty line used. These headcount indices illustrate the low base from which Uganda's recovery started and the persistence of mass poverty. But they also show a remarkable decline in poverty—by almost 40 percent—in only eight years, a decline explained largely by income growth rather than changes in income distribution.

Poverty declined in every region between 1992/93 and 1997/98; nationally, it also declined between every survey. The reduction in poverty was not uniform across all economic sectors or regions, however, nor was it the same each year. Households engaged in cash-crop farming, manufacturing, and trade fared particularly well. The incidence of poverty fell most in the central region and least in the northern region, where poverty has actually increased since 1997/98 (even though the most insecure regions in the north were excluded from the analysis).

An important lesson is the need for persistence in collecting household survey data. The robustness of poverty reduction did not become clear until 1997, a decade after reform began. The improvements enjoyed by non-cash-crop farmers were unclear even then, giving rise to the concern that the benefits might merely be a one-time effect of increased producer prices for coffee. The 1999/2000 data, which show that food crop farmers are doing very well, help put this concern to rest. On the down side, those data indicate an increase in inequality, which was not evident earlier.

The difficulty of comparing the earlier surveys provided ammunition to skeptics who questioned the usefulness of these data. Such skepticism is no longer a tenable position to hold in Uganda. Household surveys are likely to be useful for many purposes, and deficiencies in one dimension should not be used to dismiss the surveys entirely. The decision to continue conducting the surveys was an important one that has reaped considerable returns in terms of understanding poverty and ensuring support of economic policy (data that are inconclusive for time-series comparisons can be very informative for cross-section purposes).

Participatory Poverty Assessment

Another shortcoming in poverty data has been the lack of systematic qualitative information on poverty. Several small participatory studies have been conducted, but they have not affected the policy debate.

Only after the first PEAP was completed and the government had gained some capacity in and exposure to participatory methods was it able to address this constraint. It did so by carrying out a national participatory poverty assessment, in collaboration with donors and NGOs. The project is a three-phase process in which the perspectives of the poor are being brought into national and district policy formulation, planning, and implementation. The pilot phase in 1999 consulted people in 36 rural

and urban sites in 9 districts. The design and implementation of subsequent phases is currently under way.

During this exercise, local people described poverty as a lack of the means to satisfy basic material and social needs as well as a feeling of powerlessness (Republic of Uganda 2000c). Poverty was viewed as nonuniform, complex, multidimensional, cyclical, and seasonal and was described by more than 100 indicators. These findings considerably extend the concepts of poverty beyond private consumption without conflicting with the evidence from the quantitative household survey.

In terms of poverty trends, however, the data collected by participatory methods were clearly at odds with the quantitative household survey evidence. As the participatory assessment concludes, "Through analysis of long-term trends in poverty, many local people felt that poverty was worsening in their communities. . . . Local people reported more movement into poverty than out of it" (Republic of Uganda 1999b:10). The conflicting poverty trends observed by the two approaches led to a heated but valuable debate of the relative merits of the two approaches.

McGee (2000) offers several hypotheses about why the two approaches lead to different conclusions. First, the two surveys used a different reference period. Second, the participatory survey was not based on a representative sample. Third, increased incomes from cash crops may have come at the expense of reduced area cultivated for food, increasing local food prices, or directly reducing the availability of home-produced food. This phenomenon links closely with gender issues, because men generally control the income from cash crops. Fourth, the national statistical surveys do not adequately capture insecure areas. Where insecurity prevents the collection of data, the area affected is omitted from the sample for the relevant year and for any year to which it is compared. If increases in insecurity are correlated over time with increases in poverty, this procedure will tend to bias the comparison, because the areas omitted will be those in which conditions may have worsened rather than improved.²

We suggest that the strength of the participatory approach is not in monitoring short-run movements in poverty but in revealing fine-grained aspects of welfare— aspects that quantitative studies do not identify (although once identified they can often be studied quantitatively). For instance, the participatory surveys in Uganda shed light on the relative strengths and weaknesses of different legal institutions and different levels of law enforcement. They also identify the factors that deter people from using medical services (among which the unpredictability of costs was as important as the level of costs). The participatory poverty assessment suggested that the demand for public water and sanitation services was much higher than was previously assumed. As a result, government allocated a large part of the debt relief under the highly indebted poor countries (HIPC) initiative to this sector in the budget—another example of the Ugandan government's responsiveness to research findings.

Using Data to Shape Sector Policy

Research has been used to inform policy debate on sector policy and poverty in Uganda in five areas: prioritizing propoor spending, improving service delivery, increasing access to assets, increasing security, and improving governance.

Prioritizing Propoor Spending

The ideal method of prioritizing different types of public spending would be to compare rates of return or net present value corrected for income distributional effects, the extent of substitution between public and private sectors, a valuation of nonmonetary benefits, and an estimate of external effects (see Drèze and Stern 1990 for a formal presentation of cost-benefit analysis that integrates these concepts). In practice most estimates omit these corrections (partly because they are often difficult to make). As a result, estimated rates of return can be poor guides for policy. Tertiary education, for example, does very little to reduce poverty directly because it overwhelmingly benefits the nonpoor. Indirectly, tertiary education may have very significant benefits for poverty reduction if graduates help improve public services or generate employment, remit their incomes to poor households, or contribute to the communities from which they come. Estimates of these externalities are not available, however. Private returns to tertiary education can be measured, but they do not tell poverty analysts what they need to know. Moreover, the benefits produced by public services (lives saved by immunization and births prevented by contraception, for instance) are extremely diverse and hard to compare.

With these caveats in mind, research can provide valuable information on the private returns to public services, the roles of public and private sectors, the incidence of public expenditure, and the costs of providing the service.

In Uganda research has yielded several important findings on returns to different services. It has shown that the returns to primary education are positive (albeit not spectacularly high), with productivity and incomes rising 4–5 percent per year of education (Appleton 2001c; Appleton and Balihuta 1996; Appleton and Mackinnon 1995; Deininger 2001). Primary education appears to have similar proportional productive benefits in various income-generating activities (farming, nonfarming, and wage employment), and it creates externalities that are larger than the direct benefits (Appleton and Balihuta 1996). Education also has a major impact on health, with parents' knowledge about the causes of diarrhea and malaria having a significant independent impact on their children's survival (Mackinnon 1995). Research has also shown that agricultural extension has a positive impact on agricultural productivity, largely through increased use of fertilizer (Deininger and Okidi 2001).

The household survey data provide vital insights on the roles of the public and private sectors. They indicate, for example, that private education plays an important role, particularly at the secondary level. Private health care caters to a larger number of patients than do public providers. Use of private health services is strongly associated with income, suggesting that it is perceived as a superior service. Full understanding of the impact of public expenditure on welfare requires study of both the substitution between public and private sectors and the incidence of expenditures.

Where the justification for public expenditure is partly distributional, it is also important to examine the incidence of the benefits, which requires household survey data. The purpose of this kind of analysis needs to be made very clear, because it is easily confused with studies of the determinants of demand.

The World Bank (1996a) studied the incidence of benefits in the Ugandan health and education sectors, using data from the 1992 household survey and the government's fiscal accounts. It found that more than 20 percent of children in primary school were from the poorest quintile of households. Some interpreted this finding as indicating that spending on primary education was propoor and should therefore be supported. Others, who also favored subsidizing primary education, were skeptical of the finding on the grounds that it would imply that cost was not a problem for poorer households and that it would therefore tend to undermine the case for subsidy.

More recent work on the incidence of public expenditure has revealed some fine-grained results. Even where the broad patterns are unsurprising, the details can be unexpected. For instance, although the overall incidence of expenditure on secondary education 1997 was highly regressive (as expected), this did not apply to rural secondary schools, where a significant proportion of children came from poorer backgrounds. This finding is both surprising and potentially important for policy.

Until recently, information about the costs of delivering a package of basic services to the population was scanty and scattered. Although the medium-term expenditure framework provides costs for outputs, these costs are based on prevailing resource constraints and do not represent the costs of actually delivering a service to the intended target population. Recent pioneering work by the Ministry of Finance provides a global costing for the various aspirations in the sectoral plans that feed into the PEAP (Republic of Uganda 2000a). By revealing the substantial difference between aspirations and available resources, this work has stimulated thinking about how to bridge the gap.

There has been much confusion about the role of costing in developing a poverty strategy. The need for both resource-constrained and unconstrained estimates, followed by a substantial policy debate about how to reconcile them, has not been widely appreciated.

One danger in costing is that sectors may have an incentive to resist cost-saving mechanisms if they think adopting them will reduce their allocation or if they are

accustomed to thinking about first-best methods of delivery independent of cost. For instance, the acute shortage of teachers and classrooms could be addressed partly by using low-cost temporary structures or by double-shift teaching. These suggestions might have been considered more carefully if the sector had believed it faced a hard budget constraint. Costing thus represents a move in a bargaining game within the government and between government and its partners.

These analyses provide the basis for two kinds of allocative decisions in Uganda. The first and most fundamental is the need to reallocate expenditures toward areas that directly reduce poverty. The thinking behind the decision to focus on directly poverty-reducing programs was based on econometric evidence of benefits and of the often abysmal quality of services received by the poor, as well as on the political economy argument that the weak voice of the poor will lead to neglect of the services directly benefiting them unless corrective action is taken.

A second question concerns funding allocations within basic services: what should the allocations be and who should make them? The presidential election of 1996 led to a massive expansion of supply and expenditure in primary education, with enrollment skyrocketing virtually overnight. Though the increase in spending on education has been enormously popular, there is a serious question (not only in Uganda) about whether the sequence of reform has favored social sectors too much at the expense of basic productive services (such as agricultural extension), which are often far cheaper to provide and have a greater impact on incomes in the short run.

If the budget is optimal, all expenditure has equal marginal value. The approach to budgeting, however, has been to recognize that the budget did not start from an optimal state and that certain types of spending, including spending on basic services for the poor, have been neglected. These expenditures have been designated as priority areas, and the central commitment of government has been to ensure that they receive an increasing proportion of resources over time.

Measurement of these reallocations is complicated by the importance of donor-funded projects, which are often difficult to classify sectorally and of uneven effectiveness. To deal with this problem, Uganda adopted an innovative approach. First, it defined a set of public services that were believed to benefit the poor directly. The budget lines on these items were included in the Poverty Action Fund. Second, the share of the Poverty Action Fund in public expenditure, including spending financed by budget support and debt relief but excluding donor projects, was targeted. This proportion has risen dramatically, from 17 percent of total spending in 1997/98 to 24 percent in 1999/2000 and a projected 33 percent by 2002/03. Although some of this increase may come from converting project support into budget support, there is no doubt that the bulk of it represents a massive increase in the availability of resources for poverty-reducing services. Third, the set of services included in the Poverty Action Fund increases over time, but the share of the fund is recalculated backward to ensure that spurious increases are not created by redefinition.³

Improving Service Delivery

Research has helped improve the quality of service delivery in Uganda in two ways. First, no one fully understood the flows of expenditures through the system in the mid-1990s. This situation is not unusual in public sector service delivery in developing countries. What was unusual was the frankness with which the problem was acknowledged. There were also some apparent discrepancies between administrative and household-based primary school enrollment data in the early 1990s, with administrative data suggesting 70 percent gross enrollment and household-based data suggesting 90 percent. Most (but not all) of this difference could be explained by differences in definition and coverage.

To obtain reliable data on financing of primary schools and health clinics across the country, the government conducted a public expenditure tracking survey. The principal motivation for the tracking survey in education was the observation that although budgetary allocations for primary education almost tripled between 1991 and 1995, there was hardly any corresponding increase in officially reported enrollment (Reinikka 2001). The hypothesis was that actual service delivery (output) was much worse than budgetary allocations would imply because public funds (inputs) did not reach the intended facilities—because of competing priorities at various levels of government, corruption, or misuse of public funds. To test this hypothesis, researchers compared budget allocations and actual spending in two decentralized sectors, primary education and health care. Because government accounts were not generally available, a survey of 250 government schools and 100 public health clinics was carried out to collect spending data for 1991–95.⁴ Somewhat unexpectedly, local government (district) and health unit records were totally inadequate for effective surveying, whereas school records were relatively good.

The school survey confirmed the hypothesis that input flows suffered from serious problems of poor governance and lack of accountability. In 1995 only 22 percent of funding intended for nonsalary public spending actually reached schools, with district authorities retaining most of the nonsalary capitation (per student) grants meant for schools. Median school retention of the capitation grant was zero, with considerable variation across schools. Political economy and the bargaining power of schools mattered more than efficiency and equity considerations: larger schools and schools with wealthier parents received a larger share of the intended funds (per student), whereas schools with a higher share of unqualified teachers received less funding (Reinikka and Svensson 2001b).⁵

The survey also found that primary school enrollment rose 60 percent between 1991 and 1995. These figures are in stunning contrast to official figures, which reported stagnant enrollment rates over this period. The huge discrepancy suggests that official statistics cannot always be trusted. As a result, the government overhauled the method of collecting enrollment statistics.

The government's response to the survey findings, many of which were troubling, represented a triumph for the speedy effect of research on policy. Within weeks of the publication of the survey results, the cabinet decided to move ahead with a public information strategy (instead of administrative measures). The Ministry of Finance began publishing monthly transfers of public funds to districts in newspapers and broadcasting them on the radio. The Ministry of Education ordered that primary schools display information on transfers on public notice boards. The purpose of the campaign, which has been maintained since 1996, was to make information on transfers of funds more accessible to parents and to send a signal to local governments that the central government was now overseeing transfers. This information policy is currently being extended to other basic services, including health, agricultural extension, and water supply.

When the Ministry of Education replicated the school survey four years later, it found a dramatic improvement in the flow of funds (Republic of Uganda 2000b). In 1995, 70 percent of schools received no capitation grants, and on average, schools received only 22 percent of their total allocation. In 1999 more than 90 percent of schools received either a large part or all of their entitlement. For policy impact of research, this is exceptional.

The second major contribution of research is direct evidence on the quality or quantity of service provision. Three surveys were conducted within a short period on the performance of agricultural extension. All showed low rates of contact with farmers, with just 10–30 percent of farmers ever having seen an extension officer. A major reason for the poor performance was that many extension officers had no money for fuel to enable them to travel. The survey results also showed that farmers who did receive extension services valued the services. These findings contributed to a complete rethinking of agricultural service delivery, which is being restructured in a much more bottom-up fashion.

A major lesson of this experience is that negative findings about performance can be used to justify either more intense public effort or scrapping a service altogether. Only given a set of assumptions about what is feasible and desirable does a research finding have a policy implication.⁶

Increasing Access to Assets

It is sometimes argued that Uganda exhibits a high degree of equality of asset ownership and that differentials between households are due mainly to other factors, such as human capital and labor. This impression has been reinforced by the claim that Uganda is land abundant in aggregate. Household survey data qualify this picture. The land–labor ratio is generally higher among better-off families, suggesting that wealth in land is more important in generating differentials than wealth in labor (Appleton and Mackinnon 1995).

A richer picture is provided by the household surveys, in conjunction with two extensive studies of land issues conducted by the independent Centre for Basic Research and the Land Reform Centre at Makerere University in association with the University of Wisconsin (see references in Mackinnon and Reinikka 2000). Although the perspectives of the two major studies differ widely, their results share much. Both studies found considerable inequality in access to land, both across and within localities. This inequality reflects differential access to political influence under governments throughout Uganda's history (colonial, postcolonial, and current) rather than the operations of the land market. A significant part of the country is under a form of tenure known as *mailo*. Under this system, the colonial government effectively conferred tradable title on tenants while giving the traditional aristocratic owners nominal ownership status and some fixed rents. The ambiguity created by this form of tenure needs to be resolved because it does not translate easily into modern legal categories; how this is done has potentially large distributional implications. In addition, many people borrow or rent land under conditions that do not give them fully flexible use of it, preventing them, for example, from investing in tree crops. Land rights for women are very inadequate (perhaps non-existent) in some areas.

This extremely complex set of problems requires a policy response that is considerably subtler than advocacy of wholesale land redistribution or the view the authors have sometimes heard expressed, even by the shrewdest policymakers, that land shortage poses no problem or that no effective mechanisms are available to government to improve land distribution. What is needed is a set of institutions that guarantees that the poor cannot be expropriated in the process of formalizing land rights, either by a nontransparent allocation of the land they are already on or by granting large areas of land that could instead be used for smallholder development in future. The 1998 Land Act provides much of the necessary legal framework, strengthening women's land rights by requiring their consent before land is sold and establishing a set of permanent low-level land tribunals. This system is proving too costly to operate, however, and policy is now moving toward systematic demarcation. A heated debate on co-ownership of property by married couples is ongoing.

In economies in which wealth is unequally distributed, the use of public funds to redistribute assets can be justified in a perfectly orthodox neoclassical framework. Uganda's current practice of restocking cattle and coffee seedlings and providing land for the landless poor (through a legal provision for the Land Fund) are consistent with such a framework. Given the severity of the fiscal constraint, however, such policies will succeed only if they are carefully targeted and selective. Although Uganda's land policy or its restocking of cattle and coffee trees is not driven primarily by research findings, evidence from the household survey on changes in assets between 1992 and 1999 will help policymakers better understand the problems.

Increasing Security and Improving Governance

Security has become an increasingly important issue in the debate on poverty reduction in Uganda.⁷ Smallholders can do very little to invest in their future if they face major insecurity.

Lack of security in Uganda arises from two main causes: rebel movements operating from bases in neighboring countries and cattle rustling by pastoralists from the arid areas of Karamoja. The government is trying to reduce cattle rustling by disarming the Karamojong. The Karamojong need weapons, however, to defend themselves from incursions from Kenya by violent cattle-rustling tribes. Moreover, weapons are tradable assets for some very poor households, who may therefore be reluctant to hand them over.

The economic backwardness of a large part of Uganda cannot be understood without confronting major cultural and sociological problems. Seriously addressing poverty in the north will necessarily require transforming Karamojong culture by improving economic opportunities and providing adequate security for the border with Kenya. Adopting policy measures to help the Karamojong may be hampered, however, by the anger felt toward them by many people in the north who have lost property and lives to cattle rustling.

Research on the socioeconomic and cultural problems of Karamoja is needed. Most of the research that has been conducted on this region is sociological and political. Although this work provides many useful insights, more study is needed. It is generally agreed that the current government has been much more enlightened in its attitudes toward Karamoja than its predecessors. Full solution of the problem will require a better understanding, however. Achieving development in this context will be partly a matter of learning by doing.

Partly as a result of research findings, the effort to systematically and quantitatively document the characteristics and impact of corruption has begun. The first revision of the PEAP in 2000 places increased emphasis on governance. National household survey data showing that the judiciary and the police had the worst reputations of all major public services in Uganda may have been instrumental in moving the government to sharpen its focus on governance (Republic of Uganda 1998).

Svensson (2001, forthcoming) uses quantitative data from the 1998 enterprise survey to show that firms typically have to pay bribes when dealing with public officials whose actions directly affect their business operations, including exporting, importing, and using public infrastructure services. The demanded bribes are not fixed sums for given services but depend on the firm's ability to pay. The adverse effect of bribery on firm growth is more than three times greater than that of corporate taxation (Fisman and Svensson 2000).

Both security and corruption require a stronger regional focus in research and policy formulation. The problems of cattle rustling in Uganda cannot be addressed

in isolation from Kenya. The problem of corruption and governance cannot credibly be addressed without examining the conduct of military officers in the Democratic Republic of the Congo. Following a recent U.N. report on international military involvement in Congo, Uganda established a public judicial inquiry, led by a respected expatriate judge.

Institutionalizing the Research-Policy Link: The PEAP

Uganda was one of the first countries to formulate an economic strategy focused on eradicating poverty. In 1995 a taskforce was formed consisting of representatives of government, donors, and NGOs. An 18-month long participatory process culminated in the PEAP, Uganda's main policy document. That document was extensively revised in 2000. A summary of the revised PEAP served as Uganda's first Poverty Reduction Strategy Paper, which forms the basis for Uganda's relations with the donor community (Republic of Uganda 1997a, 2000a).

Formulation of the PEAP represented an effort by the executive branch of government to operationalize the commitment of Uganda's top political leadership to poverty reduction. Since adoption of the PEAP in 1997, it has reallocated significant public expenditure toward basic services.

Three features of the PEAP are noteworthy. First, research and data on Uganda were used extensively to refocus public policy and interventions on poverty reduction. Second, the government adopted a highly participatory approach, obtaining input from central and local governments, the donor community, NGOs, civil society, and academia. Third, the government quickly integrated the plan into its budget and medium-term expenditure framework.

The PEAP appears to have strongly influenced public thinking even outside the government. Its spirit was partially reflected in the proposals of several presidential candidates. The prominence of the plan suggests that there is sufficient consensus on many of the reforms that they will survive possible changes of government.

The PEAP is based on four goals: achieving macroeconomic stability, growth, and economic transformation; providing good governance and increasing security; directly improving the ability of the poor to increase their incomes; and directly improving the quality of life of the poor. Although many policies or actions contribute to more than one goal, this simple structure has been useful in communicating the essential thinking behind the PEAP. The PEAP is a document of the Ministry of Finance, Planning, and Economic Development. Uganda has thus mainstreamed poverty reduction into policy and public spending rather than create a separate structure for poverty reduction. Specific institutions nevertheless play an important part in the fight against poverty. The Poverty Action Fund, for example, was set up to provide a transparent way to ensure that HIPC receipts and other forms of budget support are

used to reduce poverty. NGOs are involved in monitoring the delivery of the fund's programs. Although the Poverty Action Fund programs form part of the budget, they receive higher budgetary priority, they are protected from within-year cuts, and their implementation at the local level is supported by conditional grants to local authorities.

The composition of Poverty Action Fund programs is not set in stone. Candidates for inclusion in the fund must satisfy certain criteria, however. Spending on hospitals and secondary schools is not currently included, for example, because the relevant agencies have not demonstrated that their programs are accessible to the poor or could be made accessible with extra funds.

Several institutions are mandated to monitor and analyze poverty. The Poverty-Monitoring and Analysis Unit, located in the Ministry of Finance, coordinates the national poverty monitoring strategy and publishes a regular poverty status report. That report has been frank about the need to extend the agenda (to improving security, for instance). The Bureau of Statistics collects and analyzes household survey data and other surveys relevant to poverty. The Economic Policy Research Centre, mandated to conduct research relevant to policy, has recently begun publishing an extensive working paper series. These and other institutions represent a significant mass of domestic capacity that is strengthening the quality of the debate on poverty reduction.

The thrust of budgetary reform is to prepare annual budgets through sectoral working groups. It is essential that these groups take poverty into account throughout their work. Economists in the planning units need to use the results of household surveys to analyze the incidence of their services and identify how they can be made more propoor. This is an ongoing process.

Conclusion

Research has had a powerful impact on policy in Uganda in several areas, including public expenditure accountability and energy sector reform. The climate of opinion has also been affected by research.

The impact of research has been particularly remarkable given that during the 1970s and 1980s Uganda's university departments and statistical offices were destroyed and many educated Ugandans fled the country. Rebuilding the information base occurred more rapidly than might have been expected thanks to the responsiveness of key policymakers. Uganda's experience suggests that if an effective information base can be created there in less than a decade, it can most likely be created anywhere.

Seven aspects of using research to set priorities for economic reform in Uganda are worth noting. First, open public debate is an essential part of the reform process. Although Uganda's political system prevents candidates from representing political

parties, public debate, including debate in the press, is open and lively, and elections at all levels can be vigorously contested, despite limitations on political party activity. Technicians in Uganda have been willing to engage in public debate to support their case. Public officials in Uganda are sometimes freer to express their personal views publicly than are officials in some Western democracies. Many civil society and private-sector groups typically lack the capacity to use empirical analysis, however (Devarajan and others 2001).

Second, in some cases country-specific research (such as a good poverty profile) can have high social utility, although its payoff to the researchers in terms of academic prestige may be limited. In the case of governance and security, a regional perspective is often needed.

Third, policy implications emerge only within a framework of assumptions and expectations about the best way for social institutions to function. Without such a framework, opposing conclusions can be drawn from the same piece of research. The finding that a public service was inadequate, for example, caused some Ugandans to call for increased spending on the service and others to call for its termination. The finding that tenancy is more widespread in the land market than had been previously believed has no policy implication in the absence of an analytical framework in which the efficiency and equity implications of this finding can be assessed.

Fourth, benefiting from interdisciplinary dialogue with researchers from outside mainstream economics, such as those studying the political economics of land distribution within a Marxian tradition and noneconomists conducting participatory work on the nature of poverty, is difficult because of differences in terminology and mutual misunderstanding. Overcoming these obstacles is essential to making good use of all sources of information. This dialogue improved during formulation of the PEAP.

Fifth, research usually has the greatest impact on policy when it is embedded in a social process. Many very good research papers have no impact because they are conceived outside of and never become part of such a process. In contrast, work that is discussed with policymakers throughout its development can have an impact very quickly. Moreover, this embeddedness can increase the quality of research. Academics who are in close contact with the policy process may risk being swayed by political factors or friendship with policymakers, but they are likely to develop a better understanding of the policy framework and to see more clearly which hypotheses will be most interesting as inputs into the policy debate. In our judgment, the benefits of embeddedness often outweigh the risks (although there may always be a need for some researchers to offer a thoroughly independent view).

Sixth, technical econometric and statistical investigation requires capacity building. This is not simply or even primarily a matter of training; it is a matter of incentives and quality control that ensure that people are motivated to put their training to good use. The powerful but skill-intensive techniques of econometrics and poverty measurement share one problem: a relatively small error can easily reverse the results

of the research. Ultimately, quality control should be performed domestically. In the meantime, ongoing international cooperation between Ugandan and foreign researchers in developing the research agenda and exchanging results can play an important role. Researchers also need incentives to analyze existing data rather than collect new data, a practice that can lead to a large number of underanalyzed data sets.

Finally, external agencies have played an important part in sponsoring research, and pressure from these agencies has often been very constructive. The World Bank, for example, has been direct in confronting vested interests in the interest of economic efficiency. Outside pressure appears to have been less effective in dealing with distributional issues, such as the distributional impact of local taxation, taxation of luxury consumption, and land policy, perhaps because the design of such policies inevitably depends on controversial conceptions of political justice. The World Bank has also been less focused on physical security as a major determinant of welfare, another issue that raises controversial political issues. Some bilateral donors have played more important roles in this regard. The important role that the World Bank has played in the donor community in Uganda (and in other low-income countries) may introduce some bias toward technocratic rather than political solutions to problems and away from examination of distributional and security issues. Awareness of these biases should strengthen the quality of the bank's interaction with governments and other donors and suggest areas in which other donors and domestic political society may want to take the lead.

The close involvement of external agencies may swamp the government's own capacity to set the agenda. This fear, however, relates more to policy than to research. The Ugandan government has been judiciously selective in the research it has used. Some senior officials have been exceptionally careful in their comments on research or policy documents that cross their desks. But once persuaded, they have been decisive in taking action to change policy. It is remarkable how the sequencing of reforms as well as policy research in Uganda appears optimal, if not *ex ante* at least *ex post*.

Notes

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1. The temporary stabilization tax represented a limited reversal of this policy.
2. The four districts excluded from the quantitative analysis because of security concerns included 6.9 percent of Uganda's population. The omission raises mean consumption by 1.8 percent in the 1992/93 household survey (Appleton 2001a).
3. Some observers have expressed concern that the Poverty Action Fund could undermine the budgetary process. This concern ignores three benefits of the fund. First, the monitoring of the fund's share of spending increases donor confidence that extra resources are really going into poverty reduc-

tion. Second, because the fund's share is targeted, sectoral ministries have an incentive to argue that their services are directly reducing poverty. This gives them an incentive to try to improve the incidence of benefits to the poor. The Poverty Action Fund thus creates an institutional incentive for sectors to address poverty reduction, something that should not be taken for granted. Third, civil society participation in the review meetings of the Poverty Action Fund has strengthened accountability and created wider public awareness of the purpose of public expenditure.

4. In 1997 there were about 10,000 primary schools in Uganda, about 15 percent of which were private.

5. Tracking teachers' salaries was complicated by the absence of disaggregated central government pay data. Relative to nonwage allocations, a larger share of salaries seems to reach schools, with considerable delays, however. The only systematic way of misappropriating salary funds was putting "ghosts" on the payroll. Previous actions by the government to clean up the teacher payroll suggest the magnitude of the leakage in salaries: almost 20 percent of all teachers on the payroll were removed as ghosts in 1993.

6. Participatory and sociological inquiries have shed light on subtler dimensions of quality, which would not easily be distinguished by econometric work. For instance, the quantitative evidence suggests that classrooms contribute much less than do textbooks to educational quality. What emerged from consultations, however, was that in very poor areas in which the schools had fallen down, textbooks might not survive long. To put this econometrically, the influence of classrooms may operate primarily through the impact on other explanatory variables and will therefore not be observed if these other variables are treated as exogenous.

7. According to the United Nations, 1.2 million Ugandans, or more than 5 percent of the population, are affected by emergency, including drought and conflict. Because the most insecure areas were omitted from the 1999/2000 household survey, the poverty impact is not fully known, but the effect on production and incomes must be enormous, given that more than 75 percent of people in some regions in the north have moved into camps.

References

- Akiyama, Takamasa. 2000. "Background, Process, and Results of Recent Coffee Market Liberalization." In Akiyama Takamasa, John Baffes, Donald F. Larson, and Panos Varangis, eds., *Commodity Market Reforms: Lessons of Two Decades*. Washington, D.C.: World Bank.
- Appleton, Simon. 1996. "Problems of Measuring Changes in Poverty Over Time: The Case of Uganda 1989-92." *Institute of Development Studies Bulletin* 27(1):43-55.
- . 2001a. "Changes in Poverty and Inequality." In Ritva Reinikka and Paul Collier, eds., *Uganda's Recovery: The Role of Farms, Firms, and Government*. Washington, D.C.: World Bank.
- . 2001b. "Poverty in Uganda, 1999/2000: Preliminary Estimates from the UNHS." School of Economics, University of Nottingham, United Kingdom.
- . 2001c. "What Can We Expect from Universal Primary Education?" In Ritva Reinikka and Paul Collier, eds., *Uganda's Recovery: The Role of Farms, Firms, and Government*. Washington, D.C.: World Bank.
- Appleton, Simon, and Arsene Balihuta. 1996. "Education and Agricultural Productivity: Evidence from Uganda." Working Paper 96-5. Centre for the Study of African Economies, Oxford University, Oxford.
- Appleton, Simon, and John Mackinnon. 1995. "Poverty in Uganda: Characteristics, Causes, and Constraints." Background paper for the Uganda Country Economic Memorandum. World Bank, Washington, D.C.
- Bevan, David, Paul Collier, and Jan-Willem Gunning. 1990. *Controlled Open Economies: A Neoclassical Approach to Structuralism*. Oxford: Clarendon.

- Chen, Duanjie, John Matovu, and Ritva Reinikka. 2001. "A Quest for Revenue and Tax Incidence." In Ritva Reinikka and Paul Collier, eds., *Uganda's Recovery: The Role of Farms, Firms, and Government*. Washington, D.C.: World Bank.
- Collier, Paul, and Ritva Reinikka. 2001. "Reconstruction and Liberalization: An Overview." In Ritva Reinikka and Paul Collier, eds., *Uganda's Recovery: The Role of Farms, Firms, and Government*. Washington, D.C.: World Bank.
- Deininger, Klaus. 2001. "Does the Cost of Schooling Affect Enrollment by the Poor? Universal Primary Education in Uganda." World Bank, Development Research Group, Washington, D.C.
- Deininger, Klaus, and John Okidi. 2001. "Rural Households: Incomes, Productivity, and Nonfarm Enterprises." In Ritva Reinikka and Paul Collier, eds., *Uganda's Recovery: The Role of Farms, Firms, and Government*. Washington, D.C.: World Bank.
- Devarajan, Shantayanan, David Dollar, and Torgny Holmgren, eds. 2001. *Aid and Reform in Africa*. Washington, D.C.: World Bank.
- Drèze, Jean, and Nicholas Stern. 1990. "Policy Reform, Shadow Prices, and Market Prices." *Journal of Public Economics* 42(1):1–45.
- Fisman, Raymond, and Jakob Svensson. 2000. "Are Corruption and Taxation Really Harmful to Growth? Firm-Level Evidence." Policy Research Working Paper 2485. World Bank, Development Research Group, Washington, D.C.
- Harmsworth, Josephine. 1991. "The Impact of the Tobacco Industry on Rural Development and Farming Systems in Arua, Uganda." In Margaret Haswell and Diana Hunt, eds., *Rural Households in Emerging Societies: Technology and Change in Sub-Saharan Africa*. Oxford: Berg.
- Henstridge, Mark, and Louis Kasekende. 2001. "Exchange Reforms, Stabilization, and Fiscal Management." In Ritva Reinikka and Paul Collier, eds., *Uganda's Recovery: The Role of Farms, Firms, and Government*. Washington, D.C.: World Bank.
- Kharas, Homi, and Brian Pinto. 1989. "Exchange Rate Rules, Black Market Premia, and Fiscal Deficits: The Bolivian Hyperinflation." *Review of Economic Studies* 56(3):435–47.
- Mackinnon, John. 1995. "Health as an Informational Good: The Determinants of Child Nutrition and Mortality During Political and Economic Recovery in Uganda." Working Paper 95-9. Oxford University, Centre for the Study of African Economies, Oxford.
- Mackinnon, John, and Ritva Reinikka. 2000. "Lessons from Uganda on Strategies to Fight Poverty." Policy Research Working Paper 2440. World Bank, Development Research Group, Washington, D.C.
- Mamdani, Mahmood. 1989. "Uganda: Contradictions of the IMF Programme and Perspective." Working Paper 5. Centre for Basic Research, Kampala.
- McGee, Rosemary. 2000. "Analysis of Participatory Poverty Assessment (PPA) and Household Survey Findings on Poverty Trends in Uganda." Institute of Development Studies, Sussex, United Kingdom and Department for International Development, United Kingdom.
- Muhumuza, Fred K., and Charles Ehrart. 2000. "Taxation and Economic Growth: Learning from the Poor." Uganda Participatory Poverty Assessment Process Policy Briefing Paper No. 1. Ministry of Finance, Planning, and Economic Development, Kampala.
- Okidi, John A. 1999. "Regional Growth Disparities and Household Economic Performance in Uganda." Research Series 17 (September). Economic Policy Research Centre, Kampala.
- Pinto, Brian. 1988. "Black Markets for Foreign Exchange, Real Exchange Rates, and Inflation: Overnight versus Gradual Reform." Policy Research Working Paper 84. World Bank, Development Research Group, Washington, D.C.
- . 1989. "Black Market Premia, Exchange Rate Unification, and Inflation in Sub-Saharan Africa." *World Bank Economic Review* 3(3):321–38.

- Reinikka, Ritva. 2001. "Recovery in Service Delivery: Evidence from Schools and Health Centers." In Ritva Reinikka and Paul Collier, eds., *Uganda's Recovery: The Role of Farms, Firms, and Government*. Washington, D.C.: World Bank.
- Reinikka, Ritva, and Jakob Svensson. 2001a. "Confronting Competition: Investment, Profit, and Risk." In Ritva Reinikka and Paul Collier, eds., *Uganda's Recovery: The Role of Farms, Firms, and Government*. Washington, D.C.: World Bank.
- . 2001b. "Explaining Leakage of Public Funds." Policy Research Working Paper 2709. World Bank, Washington, D.C.
- . Forthcoming. "Coping with Poor Public Capital." *Journal of Development Economics*.
- Republic of Uganda. 1992a. "Integrated Household Survey 1992." Ministry of Planning and Economic Development, Statistics Department, Entebbe.
- . 1992b. "The Way Forward I: Macroeconomic Strategy, 1990–1995." Ministry of Planning and Economic Development, Kampala.
- . 1994. "Social Dimension of Adjustment Monitoring Survey 1993." Ministry of Planning and Economic Development, Statistics Department, Entebbe.
- . 1996. "Uganda National Household Survey 1995–96." Ministry of Planning and Economic Development, Statistics Department, Entebbe.
- . 1997a. "Poverty Eradication Action Plan: A National Challenge for Uganda," Vol. I. Ministry of Planning, and Economic Development, Kampala.
- . 1997b. "Poverty Trends in Uganda, 1989–1995." Discussion Paper 1. Coordination of Poverty Eradication Project and Statistics Department, Ministry of Finance and Economic Planning, Kampala.
- . 1998. "National Integrity Survey." Inspector General of Government, Kampala.
- . 1999a. "Uganda Commercial Sector Justice Study." Ministry of Justice and Constitutional Affairs and Ministry of Finance, Planning, and Economic Development, Kampala.
- . 1999b. "Uganda Participatory Poverty Assessment: A Summary of Key Findings and Policy Messages." Ministry of Finance and Economic Planning, Kampala.
- . 2000a. "Revised Volume I of the Poverty Eradication Action Plan (PEAP)." Second draft (May). Ministry of Finance, Planning, and Economic Development, Kampala.
- . 2000b. "Tracking the Flow of and Accountability for UPE Funds." Report prepared for the Ministry of Education and Sports by International Development Consultants, Kampala.
- . 2000c. "Uganda Participatory Poverty Assessment." Ministry of Finance, Planning, and Economic Development, Kampala.
- Short, John. 1995. "Uganda: Assistance with Project Design Private Sector Development. Review of the Tax and Incentive Structure." Report prepared for the Eastern Africa Department, World Bank, Washington, D.C.
- . 2000. "Impact of Tariff Changes." Report prepared for the Ministry of Finance, Planning, and Economic Development and the World Bank.
- Svensson, Jakob. 2001. "The Cost of Doing Business: Firms' Experience with Corruption." In Ritva Reinikka and Paul Collier, eds., *Uganda's Recovery: The Role of Farms, Firms, and Government*. Washington, D.C.: World Bank.
- . Forthcoming. "Who Must Pay Bribes and How Much? Evidence from a Cross Section of Firms." *Quarterly Journal of Economics* 118(1).
- UNICEF/AFCODE (United Nations Children Fund/Action for Development). 1988. "Uganda: Women's Needs Assessment Survey." UNICEF, Kampala.
- World Bank. 1994a. "Eastern Africa: Survey of Foreign Investors: Volumes I–III." Results of the World

- Bank Enterprise Survey. Report prepared by Economisti Associati for the World Bank, Washington, D.C.
- . 1994b. "The Private Sector in Uganda: Results of the World Bank Enterprise Survey." World Bank, Eastern Africa Department, Washington, D.C.
- . 1996a. "Access to Education and Health Care in Uganda." *Macroeconomics 2*. Africa Region and Poverty and Social Policy Department, Washington, D.C.
- . 1996b. *Uganda: The Challenge of Growth and Poverty Reduction. A Country Study*. Washington, D.C.: World Bank.

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