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**Editors: Ayda Yurekli & Joy de Beyer**

**Tool 5. Tobacco Control**

# Understand and Evaluate the Impact of Tobacco Control Policies on Employment

**Ping Zhang**

## DRAFT

USERS : PLEASE PROVIDE FEEDBACK AND COMMENTS TO
Joy de Beyer ( jdebeyer@worldbank.org) and
Ayda Yurekli (ayurekli@worldbank.org)
World Bank, MSN G7-702
1818 H Street NW
Washington DC, 20433
USA

**Fax : (202) 522-3234**

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# I. Introduction

## Purpose of this Tool

A reduction in tobacco use can lead to a smaller tobacco industry, which in turn can affect, in both desirable and undesirable ways, the total number and distribution of employment in a nation or a region. For this reason, the public health community should examine the employment aspect of tobacco control measures when considering an effort to reduce tobacco use. The purpose of this examination is three-fold:

- Provide the information needed by policy makers who are hesitant to make tobacco control efforts.
- Provide a counterpoint to that of the tobacco industry.
- Formulate a more effective policy that takes into account those who are negatively affected by tobacco control.

### Provide Information to Policy Makers

Despite the obvious threat of tobacco to human health, many governments, particularly in low-and middle-income countries, have not taken significant action to reduce tobacco's toll, partly due to concerns about the undesirable consequences on employment (World Bank, 1999). Governments in those countries fear that tobacco control measures create unemployment, an undesirable factor since job creation is an important element of any country's development and poverty alleviation strategies. Policies that lead to job loss are often discounted regardless of their benefits.

The fear of the possibly negative impact on employment by a tobacco control policy is due to a lack of information. The employment impact of such a policy has only been studied in a few countries, mostly in developed countries. In theory, reduced tobacco use *does not* lead to a loss in the total number of jobs since money not spent on tobacco is used on other goods and services, thus creating additional jobs to offset the job loss in tobacco-related sectors. Empirical evidence based on previous studies shows that

tobacco control measures have little impact—or even a positive impact—on employment, except in a handful of agrarian countries heavily dependent on tobacco farming (World Bank, 1999). Examining the employment impact of reducing tobacco use provides the information needed for those policy makers concerned about imposing a negative employment impact due to a tobacco control policy.

## Balance Both Tobacco Industry and Academic Arguments

For many years, to combat tobacco control legislation, the tobacco industry and its representatives sponsored many studies to document the employment contribution of tobacco consumption at both national and regional levels**.** Those studies show that the tobacco industry created a large number of jobs, for example, 30 million jobs in tobacco farming alone worldwide (Agro-Economic Services Ltd. and Tabacosmos Ltd., 1987). The tobacco industry argues that tobacco control measures will, therefore, result in a mass loss of jobs across the world. Thus, a country considering tobacco control must make the choice between health and employment.

These industry-sponsored studies, however, use unrealistic assumptions, and overestimate the number of jobs associated with the tobacco industry and the possible negative impact of tobacco control measures on employment. Conducting an objective study can point out the validity of the results from the industry-sponsored studies and, subsequently, the arguments made by the tobacco industry.

To counter the arguments made by the tobacco industry and provide information needed by the public policy makers, university and government researchers have also conducted a number of studies. Conducting an objective study can help validate the results and conclusions obtained in these academic studies.

## Develop an Effective Policy

Tobacco control measures are designed to reduce consumer demand for tobacco products. This shift in demand can lead to reduced spending on tobacco products and increased spending on other goods and services. Thus a job loss in the industry directly related to tobacco can be countered with a job gain in other industries, based on consumer spending. Therefore, tobacco control measures should only have a negative impact on those jobs related to the tobacco industry.

Opposition from those who are negatively affected by tobacco control measures can be an obstacle for implementing such measures. The extent of this opposition is positively related to the degree of the negative effect. Identifying and quantifying those who are significantly affected not only helps in mapping a strategy to

address the political pressure they create against tobacco control policies, but it can also help to assess the short-term impact of tobacco control policies.

# Who Should Use this Tool

This tool is intended for researchers, public health practitioners, and policymakers of tobacco control. This tool provides basic information on various arguments and concerns related to employment and the consequences thereof as a result of a reduction in tobacco consumption. More importantly, this is a practical tool offering concise, step-by-step instructions on counting the number of jobs directly associated with the tobacco industry, and measuring the impact of a reduction in tobacco consumption on employment.

No prior background knowledge is required of readers using this tool to understand various employment issues associated with tobacco control. However, moderate to extensive knowledge of the background and empirical studies of tobacco employment is necessary for readers using this tool as a guide to conduct analyses.

# How to Use this Tool

This tool provides guidance in conducting analyses on two important issues related to the employment aspect of tobacco control:

- Estimating the number of jobs directly related to the tobacco industry.
- Estimating the impact of reducing tobacco use on employment.

All readers should become familiar with the **Key Information** chapter, which contains definitions and requirements for effectively using this tool, and the **Conclusion** chapter, which summarizes key aspects of this tool.

For those unfamiliar with employment in the tobacco sector, the **Previous Studies of Tobacco Industry Employment** chapter is an excellent review of the literature.

The **How to Measure Tobacco Industry Employment** chapter begins a step-by-step outline of ways to best identify and measure tobacco industry employment. This chapter is enhanced and followed by the **Tobacco Control Policies and Industry Employment** chapter, which discusses various policy and political implications that one must consider when conducting analyses of the data.

Finally, the **Additional References** chapter contains an extensive list of resources and other reference material with which all readers should review or become familiar.

# II. Key Information

## Definitions

### Tobacco Industry

The phrase *tobacco industry* is used in different contexts to mean different things. To some people, the tobacco industry is the equivalent of a tobacco product or the tobacco product manufacturing sector. To others, it includes all the economic activities related, both directly and indirectly, to tobacco as a final consumer good. Since all economic activities in an economy are interrelated to some degree, in this case it is important to specify the degree of linkage when defining the tobacco industry.

This tool defines tobacco industry as a distinguished group of economic activities directly involved in the production, distribution, and retailing of tobacco leaf and tobacco products. It covers several economic sectors, including: the agriculture sector for tobacco leaf production, marketing, and processing; the manufacture sector for producing tobacco products; and the wholesale and retail sectors for distributing tobacco products to consumers.

### Sector

Often the words *sector* and *industry* are used interchangeably, since they both represent a distinguished group of economic activities in an economy. This tool sees a distinction between the two words and uses them separately: a sector resides within and is a subset of the tobacco industry. That is, the tobacco industry can be divided into several sectors: core sectors include the agricultural, manufacturing, and wholesale and retail efforts that are directly related to tobacco; whereas the supply sectors are those that provide inputs to/for the core sectors, and may include other manufacturing efforts (for fertilizer, for instance), transportation, and so on. However, when counting employment related to the tobacco industry, only core sectors are considered.

### Activity

An activity is defined as a distinguished group of related actions for producing goods or providing services. For example, within the agricultural sector of the tobacco industry, there are three activities that include leaf production, leaf marketing, and leaf processing. Within the manufacturing sector of the tobacco industry, one activity is the manufacturing process for cigarettes or other tobacco products. Within the wholesaling and retailing sector, two activities are wholesaling and retailing of cigarettes and other tobacco products.

## Assumptions and Requirements

This tool assumes economic activities associated with tobacco industry play a significant role in the employment of a nation or a region, thus requiring very close and careful examination of the impact of reducing tobacco consumption on national or regional employment.

To count employment directly associated with each sector of the tobacco industry, access to national employment statistics by sector is necessary. In the absence of this detailed statistical data, however, analysis can proceed by estimating the employment indirectly using very stylized assumptions and facts, such as the amount of tobacco leaf produced and hours of labor required to produce a unit of tobacco. To conduct an impact analysis of the reduction in tobacco consumption from tobacco control measures such as a tobacco product tax increase, the input-output table of the national or regional economy and data on how consumers spend money that is freed due to lowered tobacco consumption are required.

With basic knowledge about economic and statistical analysis, the reader can use this tool to perform an analysis on the number of jobs directly related to tobacco. However, knowledge of advanced economic and statistical analysis, particularly the input-output analysis, is required in order to conduct an impact analysis of tobacco control on employment. Collaboration with someone who is experienced in input-output analysis is advisable. Access to a spreadsheet program like Microsoft Excel or Lotus 123 is highly recommended.

# III. Previous Studies of Tobacco Industry Employment

Studies on tobacco industry employment can be grouped into two categories: studies sponsored by the tobacco industry and its representatives, and studies sponsored by other third parties—mainly academia and government researchers. These two groups of studies are different due to their purposes, the questions they seek to answer, and the assumptions they use. Certain aspects of the their methodologies are also different, as are the timeframes—the industry-sponsored studies emphasize short-term impacts on employment, whereas the academic-sponsored studies address long-term effects on employment.

## Tobacco Industry-Sponsored Studies

In general, tobacco industry-sponsored studies address two concerns:

- the gross contribution by the tobacco industry to a nation's or region's overall employment, and
- the impact of tobacco control measures, and most specifically an increase in tobacco product excise taxes, on employment.

The gross number of jobs associated with the tobacco industry is estimated using either macroeconomic model or direct counting approaches. The macroeconomic model approach uses the econometric model of a national economy, which contains equations describing the quantitative relationships between different sectors, to simulate the number of jobs generated by consumer expenditure on tobacco products. The alternative use of tobacco expenditure (i.e., where to spend the money if not spend on tobacco products) is *not* considered in this approach. The direct counting approach counts the jobs related to tobacco sector by sector (i.e., tobacco leaf production, processing and marketing, tobacco product manufacturing, and tobacco product wholesaling and retailing), either directly by using available statistical data or indirectly by calculation (e.g., the number

of jobs associated with tobacco farming can be calculated as the number of acres of tobacco planted multiplied by the number of people needed for growing one acre of tobacco).

In the industry-sponsored studies, the estimated number of jobs includes those both directly and indirectly related to the tobacco industry. Specifically, estimated employment comes from three sources:

- The core sector includes activities related to tobacco farming, leaf marketing and processing, tobacco product manufacturing, and distribution and retailing of tobacco products.
- The supplier sector consists of all industries that produce and distribute goods and services in support of the core sector (i.e., raw goods, electricity, machinery, and financial and legal services). For example, since a tobacco farmer uses fertilizer, a portion of the employment in the agricultural chemical industry that produces fertilizer is counted as tobacco-related employment.
- The expenditure-induced employment is a result of what is traditionally known as "ripple" or multiplier impacts. Through the core and supplier sectors, the tobacco industry creates jobs and pays wages to employees. These wages are spent on consumer goods, which in turn create jobs and wages in other industries. For example, an employee of a tobacco product manufacturer purchasing a new car impacts employment in places where the loan is financed, the steel is produced, the petroleum is refined, and the car is assembled.

In addition to the number of jobs associated with the tobacco industry, these studies also estimate the tax revenues generated by tobacco from both the direct taxes on tobacco and tobacco products and the income taxes generated from tobacco-related employment. Please refer to **Tool 4. Design and Administration** for an in-depth discussion of the effect of tobacco policy on taxes.

Tobacco industry-sponsored studies show that the tobacco industry contributes a significant number of jobs to a national or regional economy, but that most of these jobs are a result of consumer spending from the employee and their families in the core and supplier sectors (see Table 5.1). These studies also conclude that eliminating or reducing tobacco use has a significant negative impact on employment. Yet as discussed below, only a small number of people in the estimated tobacco-related employment are negatively affected by tobacco control policies. Most of them, particularly within the expenditure-induced employment category, do not experience any negative effect of tobacco control policies due to their own weak relationship with tobacco leaf production and tobacco product manufacturing.

**Table 5.1. Estimated Tobacco-Related Employment from Tobacco Industry-Sponsored Studies**

| Study | Model and Assumptions | Estimated Tobacco Related Employment | | | | |
|---|---|---|---|---|---|---|
| | | Year | Total | Direct Jobs: Core Sector | Indirect Jobs: Supply Sector | Expenditure-Induced Jobs |
| US: Tobacco Merchant Association (1995) | Econometric model at Wharton Econometric Forecasting Assoc. | 1994 | 3,000,000 | 730,000† | 730,000† | 2,270,000 |
| US: Price Waterhouse (1992) | Direct counting | 1990 | 2,282,507 | 426,407 | 254,994 | 1,601,156 |
| Zimbabwe: Maravanyika (1998) | Direct counting | 1993 | 153,404 | 11,971 | 8,120 | 25,567‡ |
| EC, Portugal, and Spain: PEIDA (1985) | Unknown | 1982 | 694,200†† | 107,450†† | 801,650†† | N/A |
| Worldwide: Agro-Economic Services Ltd and Tabacosmos Ltd (1987) | Direct counting | 1987 | 47,000,000 | 47,000,000 | N/A | N/A |

† Core and supplier sectors combined.
‡ Multiplier effect: 0.2 multiplied by the job number.
†† Full-time equivalent.
Source: Complied by the author.

The impact of a tobacco product tax increase on employment in the industry-sponsored studies is usually estimated in two steps.

1. The reduction in tobacco sales as a result of the tobacco product tax increase is estimated by multiplying the percentage increase in tobacco product prices to an assumed price elasticity of demand for tobacco products.
2. This reduction in sales is applied to the same model used to estimate the gross employment contribution of the tobacco industry.

These industry-sponsored studies overestimate the number of job losses resulting from a tobacco product tax increase. Higher tobacco product taxes lead to higher tax revenues for the government. This higher tax leads to additional government revenue, and new jobs are generated while the government spends this extra revenue. All of the industry-sponsored studies ignore these additional jobs when estimating the employment impact of a tobacco product tax increase.

# Criticism of the Tobacco Industry-Sponsored Studies

The gross number of tobacco-related employment, as estimated by the tobacco industry, is not always interpreted correctly by many people, including the press. This figure only reflects the number of jobs related to the tobacco industry. It cannot be interpreted, as the tobacco industry and its representative imply, as the number of people who would be unemployed if the tobacco industry is substantially diminished. There are two reasons for this.

## Can the Economy Adjust?

Interpreting the gross number of jobs related to the tobacco industry as the number of jobs lost assumes that an economy is incapable of adjusting to changes in consumer demand. This is an unrealistic assumption. In a dynamic economy, there are always some industries that face decline while others enjoy growth, either absolutely or relatively. For example, the agricultural sector can account for a smaller portion of the economy while the service sector experiences growth as a country becomes more industrialized. The economy survives such a change because of its ability to adjust.

In a dynamic economy, resources—including human resources—are constantly shifting from one sector to another through changes in prices or other adjustment mechanisms. Thus, with reasonably full employment and a reasonably well functioning price system, a shift in demand away from tobacco products means that the economy reallocates production factors—including people—from the tobacco industry to other industries. Those who can no longer be employed in tobacco-related jobs due to a smaller tobacco industry move to other sectors where jobs are available, although some people may need training to gain the necessary skills for a new job.

## Are Opportunity Costs of Resources Zero?

Interpreting the gross number of jobs related to the tobacco industry as the number of jobs lost assumes that the opportunity cost of resources used in the production of tobacco is zero. This assumption is hardly justified. For example, it is difficult to imagine that agricultural resources, such as land and capital, currently used in tobacco leaf production cannot be used for other agricultural purposes, and that tobacco farmers cannot produce other crops or engage in other economic activities if tobacco leaf production ceases. This same logic holds for the resources used in tobacco product manufacturing, wholesaling, and retailing. Without the tobacco industry, the expenditures, incomes, and resources devoted to tobacco production and distribution are simply shifted elsewhere in the economy. Reallocation spending generates alternative business opportunities in other sectors of an economy, along with the

associated employment and income that counteract the loss in the tobacco sectors. Likewise, additional tax revenues generated from raising tobacco product taxes do not disappear from the economy, but are redirected into other uses by the government, creating employment and other benefits in those sectors.

Besides this incorrect interpretation, the tobacco industry-sponsored studies overestimate the number of jobs related to the tobacco industry. Many of these are part-time jobs. For example, many tobacco farmers grow several crops and/or hold non-farming jobs. There are few farms that grow only tobacco. In developing countries, tobacco is often grown along side or in rotation with food crops. In the United States, flue-cured tobacco farms are also likely to grow soybean, corn, cotton, and wheat, while beef cattle are common on many small burley tobacco farms (Jacobs *et al*, 2000). In addition, many who work in tobacco leaf production are seasonal workers. So the failure to convert these part-time jobs into an adjusted full-time employment base inflates the "true" number of jobs associated with tobacco farming.

Further, the tobacco industry-sponsored studies underestimate the tobacco industry's contribution by ignoring the employment impact in several sectors, including the provision of health care services for those made ill by tobacco, the need for more cleaning of clothes soiled by tobacco smoke, greater consumption of air-filtration systems, and so on (Warner and Fulton, 1994). While some of these impacts can be modest in magnitude, others are not. For example, medical expenditures attributed to smoking are estimated to be greater than consumer spending on tobacco products. Including this and other activities in calculating the employment contribution could disprove the arguments and findings of the tobacco industry-sponsored studies.

# Academic Studies

Studies by university and government researchers estimate the contribution of the tobacco industry to net employment. Net employment is the change in employment in a nation or a region after considering the redistribution of the same resources to alternative uses (see Table 5.2). If the consumer spending on tobacco products is reduced as a result of tobacco control measures such as smoking restriction regulations, the money released from tobacco purchases is spent on other goods and services. The increase in savings or spending in other goods and service creates new jobs in the economy. Thus, unlike the tobacco industry-sponsored studies that estimate the gross number of tobacco-related jobs, academic studies examine the employment impact of shifting consumer spending from tobacco products to other goods and services for a nation or a region.

**Table 5.2. Estimated Net Changes in Country Employment Resulting from Reduced Smoking**

| Study | Model and Assumptions | Conclusions |
|---|---|---|
| Scotland: McNicoll and Boyle (1992) | Static Input-Output Model<br>▪ Domestic consumption expenditure eliminated<br>▪ Expenditure allocated by average expenditure pattern<br>▪ No change in government spending | Net gain of 7,869 jobs in 1989 |
| Michigan State: Warner and Fulton (1994) | Dynamic Regional Economic Model<br>▪ Domestic consumption expenditure eliminated, and the rate of consumption decline during 1992–2005 doubled.<br>▪ Expenditure allocated by average expenditure pattern<br>▪ Government spending reduced, or kept the same level by increasing other taxes | Net gain of 5,600 jobs in 1992 and 1,500 by 2005; or 300 jobs in 1992 and 880 by 2005 with consumption decline |
| US: Warner *et al* (1996) | Dynamic Regional Economic Model<br>▪ Domestic consumption expenditure eliminated, and the rate of consumption decline during 1993–2009 doubled.<br>▪ Expenditure allocated by average expenditure pattern<br>▪ Government spending reduced, or kept the same level by increasing other taxes | Net gain of 47 jobs in 1993 and 133,000 by 2000; or 78 jobs in 1992 and 19,719 by 2000 with consumption decline |
| UK: Buck *et al* (1995) | Static Input-Output Model<br>▪ 40 percent decline in tobacco product expenditure<br>▪ Expenditure allocated by recent stopper, non-smoker, former smoker, and average expenditure pattern<br>▪ Government spending reduced, or kept the same level by increasing other taxes | Net gain of 15,542 jobs, or 115,688 full-time equivalent jobs, in 1990 with recent stopper expenditure, and the same government spending |
| Canada: Irvine and Sims (1997) | Static Input-Output Model<br>▪ 20 percent decline in tobacco product expenditure<br>▪ Expenditure allocated by average expenditure pattern.<br>▪ Government spending reduced | Net loss of 6,129 jobs in 1995 |
| South Africa: Van der Merwe (1998a) | Static Input-Output Model<br>▪ Domestic consumption expenditure eliminated and the rate of consumption decline in 1995 doubled<br>▪ Expenditure allocated by recent stopper and average expenditure pattern<br>▪ Government spending reduced, or kept the same level by increasing other taxes | Net gain of 50,236 jobs in 1995 with tobacco elimination, recent stopper expenditure, and the same government spending |
| Zimbabwe: Van der Merwe (1998b) | Static Input-Output Model<br>▪ Domestic consumption expenditure and tobacco production in 1980 eliminated<br>▪ Average input-output pattern and all tobacco production shifted to alternatives in agriculture<br>▪ No change in government spending by increasing other taxes | Net loss of 87,798 jobs in 1980 and 47,463 jobs when all output goes to alternative agriculture |
| Bangladesh: Van der Merwe (1998c) | Static Input-Output Model<br>▪ Domestic consumption expenditure and all tobacco production for tobacco products and *bidis* in 1994 eliminated<br>▪ Average input-output pattern and all tobacco production shifted to alternatives in agriculture<br>▪ No change in government spending by increasing other taxes | Net gain of 1,098,919 jobs in 1994 |

Source: Jacobs *et al*, 2000

Most of the studies by academic and government researchers assume that money not spent on tobacco is spent on other goods and services according to consumers' existing (average) expenditure patterns, although one study (Buck *et al*, 1995) did test different consumer spending patterns, such as those of former smokers and recent quitters. To simulate the change in employment from a reduction or elimination of tobacco consumption, the amount of expenditure released from tobacco spending is distributed according to an assumed expenditure pattern and then applied to either a static input-output or a dynamic regional econometric model (these models are discussed in the following section). Both models contain the interdependencies or relationships between industry sectors or subsectors in the economy and can be used to simulate the impact of an external policy change on outputs and employment of each sector of the economy. The static approach usually compares two alternative situations in a give year, one with and one without (or with reduced) tobacco expenditure taking place. The dynamic model allows one to simulate trade flows and feedback effects. The dynamic model is technically superior, but much more complicated than the static approach.

The academic studies conclude that tobacco control efforts have no, or even a small positive, effect on the total output and employment of the national economy, except in a very few countries that are heavily dependent on tobacco production (see Table 5.2). A reduction in smoking does lead to job losses in those sectors immediately associated with tobacco product production, such as tobacco manufacturing and farming, or in tobacco dependent regions. But these losses are generally outweighed by increases in employment in all other industries or in non-tobacco dependent regions. For any country or region, the estimated net change of employment depends on specific assumptions used in the studies and the structure of the economy.

# Criticism of the Academic Studies

The academic studies assume there are minimal costs associated with the transition from the current tobacco economy to a smaller or tobacco free economy. However, there is always a cost associated with the economic dislocation during the transition from tobacco-related to other economic activities.

Labor and land currently used for tobacco leaf production are sometimes considerably more productive in tobacco than in other uses, as tobacco grows well on land where most other crops grow poorly. The skills and experience specific to tobacco growing may also not be readily transferable to other crops. The equipment, technology, and labor skills used for tobacco product production are sophisticated and represent the effort of many year's research and development that consume a considerable amount of resources. But this equipment, technology, and production skill may have a limited

use when they are released from tobacco product manufacturing as a result of a smaller tobacco economy. In an extreme case, this equipment and technology are so specific to tobacco product production that they would have no alternative use. To state this problem differently, there is always a cost associated with making an alternative use of the resource freed from tobacco-related activities. Ignoring this transition cost considerably overestimates the positive impact on outputs and employment of a national economy as a result of the smaller tobacco economy.

# IV. How to Measure Tobacco Industry Employment

## Count Only Direct Tobacco Industry Employment

A reduction in tobacco use does not affect everyone whose job is related to tobacco in an equal manner. The degree of a negative effect depends on the dependence of an individual on tobacco income, any available alternative opportunities, and the level of difficulty in transferring to the next best opportunity.

- Individuals whose jobs are linked to tobacco through the spending of employees in the core and supplier sectors of the tobacco industry, as defined in the industry-sponsored studies, are affected little by a reduction in tobacco sales. These expenditure-induced jobs are weakly related to the tobacco industry and do not depend on the existence of the tobacco industry. For example, it is difficult to argue that the employees who work in the bank that offers auto loans depend entirely on the spending of employees in tobacco industry on automobiles. Further, increases in spending on other goods and services as a result of reduced consumer spending on tobacco products generate comparable employment in these sectors.
- Employees who work in the supplier sectors of the core tobacco industry, as defined in the industry-sponsored studies, also do not experience much negative effect from a reduction in tobacco consumption. At an aggregate level, suppliers of the tobacco core sectors derive only a small portion of their total revenues from sales to the tobacco industry. Further, the goods and services produced by the supplier sectors are not uniquely used by the core sector of the tobacco industry; these suppliers can find new customers for their goods and services without much difficulty. For example, tobacco products are heavily advertised products. A fall in demand for tobacco product advertising does not

lead to a smaller advertising industry, since an advertising agency can find new products to advertise if the demand for its service from tobacco advertising falls. In fact, there is evidence that the recent ban on billboard advertising of tobacco products in the United States produced a positive rather than negative impact on the revenues of the billboard advertising industry.

- Those most susceptible to a negative impact of a reduction in tobacco consumption are those who work in tobacco farming, leaf marketing and processing, and tobacco product manufacturing. Employees who work in these sectors derive a large percentage of their incomes from producing or marketing tobacco leaf or tobacco products. Also, the number of alternate opportunities for many of them, particularly tobacco farmers, is limited and poor. Further, some of them (again mainly tobacco farmers) are invested in tobacco production for a long time in the form of either skills or equipment. Their costs to leave tobacco farming and/or production for other employment opportunities are high. Finally, some (such as older farmers) lack the necessary skills and financial resources to make a career change, even if they are willing. However, despite these hard realities, this negative impact would in fact be moderate, since reduction in tobacco consumption does not occur overnight but gradually over time. The subsequent gradual phase-out of tobacco farming can be managed and/or funded to effectively minimize the direct impact to individual farmers.
- Two additional groups of people who can be negatively affected by a reduction in smoking are those who distribute and retail tobacco products. These people do not experience much negative effect from a reduction in tobacco consumption, for much the same reasons given to the suppliers of the core sectors of the tobacco industry. Other than a small number of tobacco-only retailers, most tobacco distributors and retailers derive only a small portion of their revenues from tobacco sales. In addition, the resources they use for tobacco products are not unique and can be shifted to non-tobacco alternatives to generate comparable revenue.

# Classify Tobacco Industry Employment

Direct tobacco employment is defined as employment directly related to the production, distribution, and retailing of tobacco leaf and tobacco products. These activities range from land preparation for tobacco leaf production to selling tobacco products to the end

consumer at a retail outlet. Based on the physical flow of the tobacco product, direct tobacco employment falls into four groups:[1]

- tobacco farming
- leaf marketing and processing
- tobacco product manufacturing
- tobacco product wholesaling and retailing

Coincidentally, this classification is consistent with the organization of the tobacco industry in most countries.

In general, tobacco farming includes all aspects of tobacco works on the farm, from initial land preparation to the delivery of cured tobacco at the place where the leaf buyer takes physical charge of it. Tobacco leaf marketing and processing contains all activities after tobacco departs the farm but prior to the aging process. Major activities include leaf auctioning and warehousing (a central place for leaf trade and temporary leaf storage), and leaf processing (the name given to a series of treatments to separate the midrib or stems of each leaf from Lamina, thresh the tobacco, and dry it with uniform moisture content for storage and aging). Tobacco product manufacturing includes all aspects of tobacco product and other tobacco production, from the process of reordering, blending, and cutting the leaf to the delivery of packed tobacco products, cigars, and so on to a wholesaler. Wholesaling and retailing include all of the activities from transporting the tobacco product to a warehouse to selling the tobacco product to the end consumer.

As discussed above, a clear distinction between the production and distribution stages may not be obvious, and the specific organization of the tobacco industry can be different between countries. To properly count the jobs directly related to the tobacco industry in a country or region, it is necessary to understand the structure and organization of that tobacco industry.

First, know which specific tobacco stage is relevant to a nation or region. Since not all stages are performed in a country, only count employment in the relevant stage. Additionally, in many developing countries, tobacco leaf marketing is not yet a distinct economic activity, thus no one is employed in the activity related to marketing tobacco leaf. Also, some countries export a large proportion of the raw tobacco or tobacco products they produce, so count employment related to leaf or tobacco product exports as being directly related to tobacco.

[1] Note that it can be argued that employment associated with the distribution and retailing of tobacco products should not be counted as direct tobacco employment, since most of them also deal with other non- tobacco products. This is a valid argument, yet they are included here for the purpose of developing a conservative estimate of the number of people affected by a reduction in tobacco sales.

Second, define the specific activities included in each segment of the tobacco industry based on the organization of the tobacco industry to avoid missing or double counts. For example, in some countries, leaf stock and processing are part of the tobacco product manufacturing industry, so employment associated with these activities is counted as a part of the employment for tobacco product manufacturing. Elsewhere, leaf processing is a distinct economic activity performed by independent processors, so jobs related to leaf processing are counted separately from manufacturing jobs.

# Estimate Employment of the Tobacco Industry

Vary the method used to count each component of direct tobacco employment depending on the kinds of data available. Data on employment associated with some activities can be directly obtained from government statistical resources, while data associated with other activities must be estimated. The type and quality of data available vary greatly, even within a country, though in general, developed countries have better data than developing countries.

## Tobacco Farming Employment

Information on the number of jobs related to tobacco farming is normally not available directly from government statistical resources. Thus, estimate and derive this information from other relevant resources by following one or both of two methods.

The procedure involved in the two methods is similar: first estimate the total hours of labor used, then convert this number into a full-time employee base. The difference between the two methods lies in the way in which the number of hours of labor used is estimated. In the first method, the number of hours is calculated as the product of the amount of tobacco produced and hours of labor required per production unit. In the second method, the total number of hours of labor is the product of acres of tobacco planted and hours of labor required per acre. See Box 5.1 for examples of using the two methods. Refer to Table 5.3 for the estimated results of the number of jobs associated with tobacco farming for many countries.

Possible data sources for tobacco production and acreage of tobacco include national agricultural statistics of individual countries, the Food and Agricultural Organization of the United Nation (FAO, 1999) and the Department of Agriculture of the United States (USDA, 1999). Data on labor requirements for a unit of tobacco production or for an acre of tobacco planted may be available from production cost surveys published by government agencies such as a Department of Agriculture, a Statistical Agency, or academic publications. For example, in the United States, the U.S. Department of Agriculture publishes production cost data on major crops including tobacco based on an agricultural census; while in China, the Ministry of Agriculture periodically publishes production cost

**Box 5.1. Estimating the Number of Jobs Associated with Tobacco Farming**

**Method 1**[†]

1. Estimate the total amount of labor used in tobacco production:

   Total number of hours of labor used = Number of labor hours required per 100 pounds of tobacco × pounds of tobacco produced in hundreds = 8 × 16,260,000 =130,080,000 hours

2. Convert the labor hours used into the number of full-time jobs:

   The number of full-time employees = Total number of hours of labor used ÷ Hours worked per full-time employee = 130.08 million hours ÷ 2,000 hours = 65,040

**Method 2**[†]

1. Estimate the total amount of labor used in tobacco production:

   Total number of hours of labor used = Number of labor hours required per acre of tobacco × acre of tobacco planted = 187 × 733,000 =137,071,000 hours

2. Convert the labor hours used into the number of full-time jobs:

   The number of full-time employees = Total number of hours of labor used ÷ Hours worked per full-time employee =137.07 million hours ÷ 2,000 hours = 68,535.

These two methods can yield different results due to errors in data collection. Both methods can be used to calculate the jobs associated with each type of tobacco production if labor required for a unit production across tobacco types are significantly different.

[†] Based on U.S. data.

data on major crops. If secondary data is not available, a survey of experts knowledgeable about agricultural production costs can be used.

In many countries, information on the number of tobacco farms is available in governmental agricultural statistics. However, the number of tobacco farmers is not equal to the number of jobs related to tobacco farming for several reasons.

There may be more than one person working on a tobacco farm.

Although tobacco may be the major source of income, it is very likely that tobacco farmers also grow other crops or engage in other economic activities.

The number of tobacco farms may not include those where the amount of tobacco harvested falls below a certain crop percentage or threshold, depending on how a tobacco farm is defined in the statistical data.

## Leaf Marketing and Processing Employment

Employees associated with leaf marketing and processing are those who perform all activities between the instances when leaf tobacco has left the farm to when tobacco leaves are threshed for the aging

**Table 5.3. Employment in Tobacco Growing in Selected Countries, 1983**

| Country | Number Employed in Growing Tobacco (thousands) | FTE† Employed in Growing Tobacco (thousands) | Percent of the Total Employment in Agriculture |
|---|---|---|---|
| China | 15,998 | 6,152 | 1.6 |
| India | 3,500 | 1,108 | 0.8 |
| Indonesia | 1,466 | 454 | 1.4 |
| Thailand | 1,362 | 213 | 1.3 |
| USSR | 673 | 310 | 1.2 |
| USA | 604 | 184 | 5.2 |
| Brazil | 600 | 289 | 2.0 |
| Turkey | 560 | 313 | 3.3 |
| Philippines | 488 | 301 | 1.1 |
| Bangladesh | 409 | 205 | 1.5 |
| Greece | 406 | 163 | 15.3 |
| Mexico | 351 | 117 | 2.2 |
| Burma | 350 | 114 | 1.2 |
| Italy | 330 | 48 | 1.9 |
| Colombia | 302 | 101 | 23.2 |
| Korea Rep | 282 | 30 | 0.7 |
| Japan | 279 | 20 | 0.4 |
| Bulgaria | 240 | 206 | 22.4 |
| Nigeria | 217 | 42 | 0.1 |
| Pakistan | 205 | 86 | 0.6 |
| Tanzania | 178 | 47 | 0.7 |
| Malawi | 157 | 93 | 46.6 |
| Sri Lanka | 150 | 50 | 15.0 |
| Argentina | 105 | 44 | 1.2 |
| Malaysia | 100 | 39 | 1.3 |
| Venezuela | 95 | 23 | 3.1 |
| Romania | 94 | 61 | 2.0 |
| Spain | 94 | 47 | 2.4 |
| Zimbabwe | 92 | 39 | 14.6 |
| Canada | 67 | 20 | 1.9 |
| South Africa | 66 | 66 | 1.8 |
| Poland | 58 | 21 | 0.4 |
| Iraq | 57 | 29 | 2.7 |
| Syria | 54 | 10 | 1.5 |
| France | 51 | 17 | 1.0 |
| Jordan | 32 | 13 | 11.5 |
| Guatemala | 24 | 7 | 2.2 |
| Ethiopia | 23 | 6 | 0.1 |
| Zaire | 21 | 13 | 0.1 |
| Cuba | 20 | 17 | 3.1 |
| Taiwan | 20 | 7 | 0.5 |

† Full-time equivalent

Source: Agro-Economic Services Ltd and Tabacosmos Ltd (1987).

process. Major economic activities within this range include auctioning and warehousing, and stemming and redrying.

*Before counting jobs associated with leaf marketing and processing, determine the relevance of this activity to the country or region in question.*

The relevance of these activities to a specific country depends on the organization of the tobacco industry within that country. In many countries, tobacco farmers sell their leaves directly to manufacturers or merchant traders under private arrangements; thus, tobacco leaf auctioning and warehousing is not a separate economic activity. That is, there are no separate jobs associated with tobacco leaf auctioning and warehousing. In addition, in many developing countries, the function of stemming and redrying of tobacco leaves is a part of the tobacco product manufacturing industry. So for those countries, jobs associated with stemming and redrying are counted as a part of the employment associated with manufacturing, and should not be counted again to avoid double counting.

Consequently, counting jobs associated with leaf marketing and processing is an irrelevant issue because these jobs either do not exist or have been counted as manufacturing jobs.

In a number of countries, the functions of auctioning and warehousing, and stemming and redrying are performed by separate entities. For example, in the United States, Zimbabwe, Canada, and Malawi, most of the leaf tobacco is sold through auctioning rather than direct contracting to manufacturers or trade merchants; and in the United States, stemming and redrying are carried out by a separate entity other than the manufacturers of tobacco products. For these countries, the number of jobs associated with leaf marketing and processing must be estimated.

To estimate jobs associated with each of the relevant activities, first check the availability of this information from published governmental statistics data. In some countries, data on both the number of establishments and jobs associated with auctioning and warehousing, and stemming and redrying can be obtained from publications of the Bureau of Census (e.g., refer to the Census of Wholesale Trade for auctioning and warehousing, and the Census of Manufacturers for stemming and redrying). In countries where this type of information may not be available directly from the governmental statistics, estimate employment information indirectly from other relevant sources.

Estimate jobs associated with auctioning and warehousing by multiplying the volume, in pounds, of tobacco leaf sold in the auction warehouse by employment per auction sales volume (estimate data on the volume of tobacco sold based on government statistical data). If all tobacco leaves produced in a country are marketed through auctioning, the auction volume is the same as the tobacco production; otherwise, the auction volume is equal to the production minus the volume not sold through auctions. Data on employment per auction sales volume is normally not available from governmental statistical data. Therefore, estimate this information by surveying either an expert or an actual tobacco warehouse. The

survey should contain questions about the annual volume of tobacco the auction warehouse handles, the number of full-time employees and how many days they work each year, the number of part-time employees and how many hours a day and days a year they work. Since tobacco auctions are typically seasonal, first estimate the total number of hours of labor used, then convert those hours into a full-time employee base. See Box 5.2 for an example of estimating jobs associated with tobacco auctioning and warehousing.

Estimate jobs associated with stemming and redrying in a similar way as the jobs associated with auctioning and warehousing. First, estimate the total units of tobacco leaves processed, which should be equal to the leaf consumption if all tobacco leaves imported are in unprocessed form. Leaf consumption data is available from government statistics. Then, estimate the hours of labor required for processing a unit by surveying a typical processing plant. Finally, calculate the total number of jobs associated with stemming and redrying by multiplying the units of tobacco leaves processed by the hours of labor per unit, divided by hours of labor per full-time employee per year.

## Tobacco Product Manufacturing Employment

Counting jobs associated with manufacturing tobacco products is relatively straightforward, since this information is available from governmental statistical data, by sector or industry, in most of the countries that make tobacco products and other tobacco products. For example, information on the number of tobacco establishments and jobs in the United States is available from the Bureau of Census, Census of Manufacturers (U.S. Department of Commerce, 1987a); and compiled data for many countries is provided by international organizations, such as the United Nations International Development

**Box 5.2. Counting Jobs Associated with Tobacco Auctioning and Warehousing**

1. Estimate the volume sold through auctioning:

   Volume sold through auctioning = Total tobacco production – Tobacco marketed through private contract = 1,626 million – 626 million = 1,000 million pounds

2. Estimate hours of labor per sale volume from the survey data:

   Volume of tobacco leaf handled per year for a warehouse = 1,000,000 pounds

   Total number of hours of labor used = (Number of full-time employees × Hours worked per day × Days worked) + (Number of part-time employees × Hours worked per day × Days worked) = (5 × 8 × 120) + (10 × 4 × 30) =6,000 hours.

   Hours of labor needed for handling every 100 pounds of tobacco = (6,000 × 100) ÷ 1,000,000 = 0.6 hours.

3. Estimate the jobs associated with tobacco auctioning and warehousing:

   Total number of jobs = Volume of auctioning × Hours of labor per sale volume ÷ Hours worked per full-time employee = ((1,000 millions × 0.6) ÷ 100) ÷ 2,000 =3,000.

Origination Database (UNIDO, 1999). Table 5.4 shows the number of jobs in tobacco manufacturing in major production countries in 1990.

To avoid double counting or miscounting, it is necessary to fully understanding which economic activities are included in the estimation of the number of jobs associated with tobacco product manufacturing. For example, in some countries, governmental statistical data may include jobs associated with tobacco stemming and redrying; while in other countries, governmental statistical data may include jobs associated with tobacco product wholesaling (especially if the manufacture has its own regional depot and transport facilities for the bulk distribution of finished products).

## Tobacco Product Wholesale and Retail Employment

Count or don't count jobs associated with tobacco product wholesaling depending on how the function of tobacco product wholesaling is arranged in a country. In many developing countries, tobacco product manufacturers perform the function of wholesaling. Thus it is not necessary to count these jobs since they are already included under tobacco product manufacturing. In other countries, such as the United States, wholesaling is done by separate entities responsible for tobacco products from the instances they leave the manufacturer to delivery to a retailer. In this case, count jobs associated with tobacco product wholesaling separately.

Counting jobs associated with wholesaling depends on the kind of information available in governmental statistical data. In countries where the government publishes wholesaling information by commodity group, the number of jobs associated with tobacco product wholesaling can be obtained from resources like the Census of Wholesale Trade from the Bureau of Census (U.S. Department of Commerce, 1987b). In other countries where employment information on tobacco product wholesaling is unavailable, the number of jobs must be estimated.

One way to estimate jobs is to multiply the total wholesale jobs in a country by the tobacco share. Maravanyika (1998) uses this method to estimate jobs in Zimbabwe. In 1992 there were 120 registered wholesalers employing 1,800 people, and tobacco products represented 5 percent of wholesalers' total turnover. Thus, the estimated jobs associated with tobacco wholesaling are 90 jobs ($1{,}800 \times 0.05 = 90$).

Obtain information on the total number of jobs associated with the wholesaling industry from government published statistics on employment by industry, which should be available in most countries. However, the share of tobacco products in total wholesale turnover must be estimated by either surveying industry experts or the wholesale establishments. Surveys should address the total

**Table 5.4. Employment in Tobacco Manufacturing in Selected Countries, 1990**

| Country | Employment in Tobacco Manufacturing (thousands) | Percent of Total Manufacturing Employment |
|---|---|---|
| China | 265,000 | N/A |
| Indonesia | 241,126 | 5.32 |
| United States | 41,000 | 0.19 |
| Russia | 33,000 | N/A |
| Turkey | 32,142 | 1.56 |
| Bangladesh | 27,155 | 1.6 |
| Egypt | 17,513 | 1.24 |
| Italy | 15,845 | 0.39 |
| Bulgaria | 15,300 | N/A |
| Philippines | 13,941 | 0.88 |
| United Kingdom | 13,000 | 0.25 |
| Japan | 12,000 | 0.09 |
| Thailand | 10,500 | 0.55 |
| Iran | 10,500 | 1.28 |
| Poland | 10,000 | 0.25 |
| Pakistan | 9,400 | 0.60 |
| Spain | 8,607 | 0.32 |
| Korea Rep | 7,200 | 0.17 |
| Netherlands | 7,000 | 0.61 |
| Romania | 6,200 | 0.18 |
| Zimbabwe | 5,414 | N/A |
| Mexico | 5,240 | 0.14 |
| France | 5,100 | 0.12 |
| Canada | 5,000 | 0.23 |
| Hungary | 5,000 | 0.43 |

Source: UNIDO (1998)

turnover value of an establishment and the value of the tobacco products in a give period (such as one year).

Tobacco products are distributed to final consumers through a wide range of distribution outlets, including food stores, drug stores, department stores, and gas stations that also sell other, non-tobacco products. As a result, information on jobs associated with tobacco product retailing is generally not available from governmental statistical data, so it is necessary to estimate the number of jobs associated with tobacco product retailing indirectly, as follows. The

total number of jobs associated with tobacco product retailing is equal to the sum of jobs associated with each retail outlet. The number of jobs in each outlet is calculated as the product of the number of full-time jobs in that outlet by the employment share of tobacco products. The tobacco product share of total retail sales or total net earnings is used to approximate the employment share of tobacco.

Information on jobs by major distribution outlets is normally available from government statistical data. For instance, in the United States, this information is found in the Employment and Earning publication of the Bureau of Labor Statistics, U.S. Department of Labor. Information on the tobacco share of total sales or total net earning in each outlet may not available in most countries, however. While the Census of Retail Trade, Merchandise Line Sales, U.S. Bureau of Census provides this information in the United States, in other countries a survey may be required to estimate this information. Include all of the outlets that carry tobacco products in the survey population. The survey should address the total sale value or net earning of a store, and the sale value or net earning for tobacco products. Where even this information is lacking, simplify the estimation by multiplying the total number of jobs in the retail sector by the share of tobacco in retail sales. For instance, in applying this simple method, Maravanyika (1998) estimates that the jobs associated with retailing in Zimbabwe total 8,030 (16% of the 50,190 retail jobs).

Table 5.5 shows an example of estimated jobs associated with tobacco product retailing, and Table 5.6 shows jobs associated with

**Table 5.5. Estimating Jobs Associated with Tobacco Product Retail**

| Outlet | Gross Number of Employees | Percent of Time Devoted to the Job | Number of Full-time Employees | Proportion of Outlet Carrying Tobacco | Tobacco's Share of Sales | Tobacco Employment |
|---|---|---|---|---|---|---|
| | a | b | c = a × b | d | e | f = c × d × e |
| Grocery stores | 3,000,000 | 75% | 2,250,000 | 60% | 4% | 54,000 |
| Merchandising machine operators | 68,000 | 75% | 51,000 | 65% | 13% | 4,310 |
| Drug stores | 639,000 | 75% | 475,250 | 65% | 4% | 12,357 |
| Gas stations | 670,000 | 75% | 502,500 | 80% | 4% | 16,080 |
| Tobacco store and stands | 5,500 | 100% | 5,500 | 100% | 80% | 4,400 |
| General merchandising stores | 2,800,000 | 75% | 2,1000,000 | 50% | 4% | 42,000 |
| Total | — | — | — | | — | 133,147 |

wholesaling and retailing in selected countries in 1983 as estimated by Agro-Economic Services Ltd. and Tabacosmos Ltd. (1987).

**Table 5.6. Employment in the Distribution of Tobacco Products in Selected Countries, 1983**

| Country | Number Employed in Wholesale and Retail (thousands) | FTE† Employed in Wholesale and Retail (thousands) | Percent of theTtotal Employment in Wholesale and Retail |
|---|---|---|---|
| China | 1,070 | 1,070 | 0.9 |
| Indonesia | 1,055 | 155 | 1.8 |
| Pakistan | 1025 | 77 | 2.6 |
| India | 900 | 428 | N/A |
| United Kingdom | 683 | 87 | 2.8 |
| Japan | 525 | 35 | 0.5 |
| Former USSR | 512 | 174 | 1.9 |
| Former Germany Fed Rep | 474 | 43 | 1.1 |
| Brazil | 352 | 120 | 2.4 |
| Philippines | 273 | 52 | 2.4 |
| USA | 228 | 76 | 0.4 |
| Argentina | 216 | 8 | 1.2 |
| Mexico | 198 | 26 | 1.0 |
| Italy | 177 | 24 | 0.7 |
| Thailand | 159 | 18 | 0.8 |
| Bangladesh | 158 | 34 | 44.0 |
| Poland | 148 | 24 | 1.8 |
| France | 141 | 18 | 0.9 |
| Portugal | 117 | 3 | 1.2 |
| Colombia | 108 | 30 | 4.0 |
| Burma | 107 | 30 | 2.2 |
| South Africa | 103 | 27 | 2.8 |
| Egypt | 100 | 39 | 3.8 |
| Venezuela | 100 | 7 | 0.7 |
| Nigeria | 97 | 17 | 32.0 |
| Greece | 93 | 6 | 1.7 |
| Czechoslovakia | 82 | 6 | 0.7 |
| Turkey | 67 | 34 | 6.6 |
| Korea Rep | 65 | 14 | 0.4 |
| Malaysia | 63 | 27 | 14.1 |
| Algeria | 55 | 10 | 3.0 |
| Former Yugoslavia | 55 | 12 | 1.4 |
| Guatemala | 55 | 1 | 2.4 |
| Kenya | 55 | 4 | 8.4 |
| Iraq | 53 | 10 | 7.4 |
| Ethiopia | 50 | 2 | 0.1 |

† Full-time equivalent

Source: Agro-Economic Services Ltd and Tabacosmos Ltd (1987).

# Place Tobacco Industry Employment in the Realm of National Employment

The absolute number of jobs associated with the tobacco industry has little bearing on its overall impact on a country's or region's employment. Rather, it is the ratio of those jobs to total employment that is of concern. Assess the relative importance of the tobacco industry on a country's or region's employment using four measurements:

1. the percentage of jobs associated with tobacco farming to total employment for agricultural production
2. the percentage of jobs associated with tobacco manufacturing to total employment in manufacturing
3. the percentage of jobs associated with wholesaling and retailing of tobacco products to total employment in wholesaling and retailing
4. the percentage of tobacco jobs to total national employment

Calculate these measures by dividing the number of jobs associated with tobacco in each sector by the total number of jobs in each sector, or by dividing the total number of jobs directly related to tobacco by the total national employment number (for selected countries, Tables 5.3, 5.4, and 5.6 show the percentage—or relevance—of tobacco jobs for each appropriate sector in the right-most column).

In many countries, information on employment by sector is available from government statistical data resources. For example, in the United States, this information is available from the Bureau of Labor Statistics, Department of Commerce; in the United Kingdom, this information is available from the Department of Employments; information is also available by industry and sector from international organizations such as the United Nations, the World Bank, and the International Monetary Fund.

# Consider Trends and Underlying Forces on Tobacco Industry Employment

*Examine the trends and causes of tobacco-related employment over time to determine whether or not the industry's arguments against tobacco control are valid.*

The estimated number of jobs associated with the tobacco industry at a given point of time provides important information on the size of the tobacco industry in terms of the number of people who can be affected if tobacco use is eliminated. These numbers, however, don't provide information on *how* the jobs associated with the tobacco industry change over time. Often, the tobacco industry argues that a reduction in tobacco sales will lead to a massive job loss, implying that tobacco control measures are the main driving force determining employment levels in the tobacco industry. It is important to examine

the change in tobacco-related employment over time and to identify the forces that drive this change to determine if the tobacco industry's argument is valid.

In many countries, employment associated with tobacco farming has declined over time due to improved productivity of tobacco leaf. For example, while U.S. tobacco leaf production decreased from 1,914 million pounds to 1,714 million pounds (a reduction of 10 percent) between 1954 and 1997, the number of tobacco farms decreased from 512,000 to 89,700 (a reduction of over 80 percent) during the same period (Capehart, 2000). Many factors contribute to this increased productivity. In the United States, for example, the two factors responsible for increased productivity are changes in the governmental policies on tobacco, and new and better technologies. Policies that allow the lease and transfer or even the sale of production quotas remove the obstacles of moving tobacco production from less efficient to more efficient farmers. Further, technological improvements, such as better seeds and crop management, increases the yield of production, while mechanization of the production process, such as adopting a mechanical harvester in flue-cured tobacco production, greatly reduces the labor requirement.

The change in the number of jobs associated with tobacco farming follow the same declining trend, since the number of workers per tobacco farm does not change much over time. In Canada, the number of tobacco farmers declined 37 percent from 1971 to 1981, even though the output and acreage of tobacco production surged. Since 1986, output and acreage have both increased, yet the number of farmers has dropped (Allen *et al*, 1993).

The numbers of jobs associated with tobacco product manufacturing is also declining as a result of productivity or quality improvement introduced by tobacco product manufacturers (Jacobs *et al*, 2000). A study in the United Kingdom (PEIDA, 1991) shows that much of the decline in employment related to tobacco product manufacture between 1980 and 1990 is due to productivity improvements. In the United States, tobacco product-manufacturing jobs fell from 68,700 to 49,100 (or 29 percent) between 1982 and 1992 despite the fact that U.S. tobacco product output actually increased during that period (Arthur Anderson Economic Consulting, 1993). An increase in tobacco product production output accompanied by a decrease in tobacco product manufacturing jobs has also been observed in Colombia, Spain, Malaysia, Pakistan, and the Philippines (Jacobs *et al*, 2000).

A reduction in tobacco use as a result of tobacco control policies will lead to a smaller tobacco industry and, thus, a smaller number of tobacco-related jobs. However, from a historical perspective, productivity increases due to technological advances in both tobacco farming and tobacco product manufacturing impose a much larger impact than tobacco control policies on the reduction of jobs associated with the tobacco industry.

# V. Tobacco Control Policies and Industry Employment

## Predicate the Impact on Employment

The impact of tobacco control policies on employment can be evaluated qualitatively based on the structure of country's or region's tobacco economy. Whether a country or region is a tobacco leaf producer, a tobacco product manufacturer, or both significantly determines how tobacco control policies affect national or regional employment (Jacobs *et al*, 2000). In general, the economic structure of leaf production and tobacco product manufacturing can be divided into five generic groups (Jacobs *et al*, 2000):

1. Areas that produce but do not consume tobacco are full exporters.
2. Areas that produce more tobacco than they consume are net exporters.
3. Areas that produce about as much as they consume are "self-contained" countries.
4. Areas that produce less than they consume are net importers.
5. Areas that do not produce tobacco but consume it are full importers.

Tobacco control policies aimed at reducing tobacco consumption affect employment differently in each of these cases. In general, as one moves from Group 5 to Group 1, the impact of tobacco control policy on employment becomes more complex due to increases in structural adjustment costs associated with moving to a smaller tobacco economy (Jacobs *et al*, 2000). For example, for a full importer, there are no losses of jobs associated with tobacco leaf production or tobacco product manufacturing when effective tobacco control policies are introduced; instead, the full employment impact falls on distribution of the tobacco products including importing,

wholesaling, and retailing. In general, jobs in countries that are net importers are less affected by tobacco control policies than those in net exporters. (Different structures of tobacco economies explain many of the results from the various studies depicted in Table 5.2.) While it is possible for a country or region to be categorized under Group 1, in practice this is very rare. Instead, countries and regions by and large fall into one of the last four groups.

A few major producers or exporters of tobacco, such as the United States, Canada, India, Brazil, Zimbabwe, Turkey, and Malawi, are categorized under Group 2. Given the large share of exports from the local production in these countries, tobacco-related employment is more responsive to the control policies affecting their export markets than to the domestic tobacco control policies. The net effect of domestic tobacco control policies on national employment is either positive or negative, depending on the number of jobs lost and gained as a result of consumers switching their spending from tobacco products to other goods and services. An empirical study of the United States (Warner *et al*, 1996) shows that eliminating or reducing tobacco spending has a positive effect on national employment.

The number of countries categorized under Group 3 is also relatively limited. The prominent members are China, the Philippines, Pakistan, Bulgaria, and South Africa. Like the case for Group 2 countries, the net impact of domestic control policies on national employment in these 'self-contained' countries cannot be determined *a priori*. On the one hand, tobacco control policies in these countries lead to a reduction in tobacco spending, thus, a fall in tobacco-related employment. On the other hand, consumers spend their money freed from tobacco products on other goods and services, which generates more jobs. The additional jobs gained in other sectors offset the jobs lost in tobacco-related industries. Thus, the net impact of a tobacco control policy on national employment depends on the magnitude of the two effects. Empirical studies on countries in this group, such as South African and Scotland, find a net positive employment effect from reduced tobacco expenditures (see Table 5.2).

Most countries are categorized under Groups 4 and 5. In general, a tobacco control policy has a positive impact on their economies as a whole, since most or all job losses in the tobacco production sector do not occur in these countries. However, the job creation effect, a result of switching consumer spending from tobacco products to other goods and services, does affect their national economies. Empirical study for these countries, such as Bangladesh, shows a large positive employment impact if tobacco consumption is eliminated (see Table 5.2).

This analysis does not consider that tobacco consumption in developing countries is still growing, mainly as a result of increasing personal disposable income. Considering this consumption growth trend, tobacco control policies in developing countries may not reduce tobacco consumption, and therefore may not negatively

impact jobs associated with the tobacco industry, at least in the short-term. Instead, tobacco control policies may only slow the growth of tobacco-related employment.

In order to fully address policy makers' concerns about the impact of tobacco control policies on employment, it is necessary to go beyond qualitative analysis and conduct quantitative analysis. This will show the direction and magnitude of the impact of tobacco control polices on employment. In addition, such an analysis identifies changes in employment distribution across sectors or geographical regions, and indicates the magnitude of such an effect. Nearly all qualitative studies conducted to date use the input-output analysis framework.

# Use an Input-Output Analysis to Evaluate the Impact on Employment

## Theory of the Input-Output Analysis

Input-output analysis is a means of examining relationships within an economy, both between businesses and between businesses and final consumers. The analysis captures all monetary market transactions for consumption in a given time period. The resulting mathematical formulae allow examination of the effect of a change in one or several economic activities on an entire economy.

The core of the analysis is the construction and manipulation of input-output tables. These tables describe the flow of goods and services in the economy in matrix form. There are three different matrices in a standard input-output model:

1. inter-industry transaction matrix
2. direct requirement matrix
3. total requirement matrix

Each is explained below with the aid of a simple illustrative example.

### *Inter-Industry Transaction Matrix*

The inter-industry transaction matrix describes the flow of goods and services between all individual sectors of an economy in a given year. The columns of the transaction matrix show the composition of input required by a particular industry to produce its output. The rows of the transaction matrix display the distribution of a particular industry's output throughout the economy. In other words, the columns show purchases by a particular industry from all other industries, and the rows show sales by a particular industry from all other industries. In Table 5.7, the data in the farming (agriculture) sector column show that, in order to produce its $30 million output, the sector purchased $4 million from farm enterprises, $7 million

**Table 5.7. Illustrative Input-Output Transactions Matrix**

| | Agriculture | Manufacturing | Service | Final Demand | Total Output |
|---|---|---|---|---|---|
| Agriculture | 4 | 8 | 2 | 16 | 30 |
| Manufacturing | 7 | 15 | 6 | 22 | 50 |
| Service | 6 | 5 | 4 | 10 | 25 |
| Final Payment | 13 | 22 | 13 | 0 | 48 |
| Total Inputs | 30 | 50 | 25 | 48 | 153 |

from manufacturing firms, and $6 million from service sectors, and made $13 million in payments to the final payment sectors (households, gross savings, government, and imports). The data in the farming sector row indicate that the sector sold $4 million to farm enterprises, $8 million to manufacturing, $2 million to services, and $16 million to final demand.

### *Direct Requirement Matrix*

The direct requirement matrix indicates the requirements from each industry for a particular industry to produce an average $1 of output. Obtain these purchase coefficients by dividing the purchasing data in each industry column of the transaction matrix by the corresponding output value for that industry. The resulting purchasing coefficients, or input ratios, are the "production recipes" for a particular product. For example, Table 5.8 shows the results of these equations by using the data in Table 5.7, as follows. The first column (agriculture) shows that to produce an average $1 output, the sector buys $0.13 (4 ÷ 30) from farms, $0.23 (7 ÷ 30) from manufacturing firms, and $0.20 (6 ÷ 30) from service sectors, and makes $0.44 (13 ÷ 30) of payments to the final payments sectors. Of course, the sum of these input ratios is one.

Assuming this matrix also represents the spending pattern necessary for additional production, it is possible to predict the effect of a

**Table 5.8. Illustrative Direct Requirement Matrix**

| | Agriculture | Manufacturing | Service |
|---|---|---|---|
| Agriculture | 0.13 | 0.16 | 0.08 |
| Manufacturing | 0.23 | 0.30 | 0.24 |
| Service | 0.20 | 0.10 | 0.16 |
| Final Payment | 0.44 | 0.44 | 0.52 |
| Total Inputs | 1.00 | 1.00 | 1.00 |

change in final demand of the output on other sectors. For example, assume that export demand for agricultural products increases by $10 million. Based on the data in Table 5.8, the new demand requires purchases of $1.3 million from agriculture, $2.3 million from manufacturing, and $2.0 million from the service sector. This is called "direct effects" and in this example, they amount to a total impact on the economy of $15.6 million (the initial change of $10 million plus the total direct effect of $5.6 million).

The effect of the increase in export demand on an economy, though, continues beyond the point where the direct effect occurs, due to additional purchases elsewhere. In the example, the agricultural sector increases purchases of manufactured goods by $2.3 million. To supply agriculture's new need for manufacturing products, the manufacturing sector must increase production. To accomplish this, manufacturing firms purchase additional inputs from other sectors of the economy: $0.37 million (2.3 × 0.16) of agricultural goods, $0.69 million (2.3 × 0.30 = 0.69) from itself, and 0.23 million (2.3 × 0.10) from the service sector. Thus, the impact on the economy from an increase in agricultural exports is more than the $15.6 million first identified. The total impact is $15.6 million *plus* the indirect effect on manufacturing ($1.29 million) *plus* the indirect effect on the service sector ($0.96 million) for a total of $17.85 million.

### *Total Requirement Matrix*

The cycle doesn't stop, however, after only two rounds of impacts. To supply the manufacturing sector with the newly required inputs, agriculture must increase output again, leading to an increase in manufacturing and trade sector outputs. The calculations continue until the additional increases drop to an insignificant amount. The total impact on an economy, then, is the sum of a series of direct and indirect impacts. The total requirement matrix, also called the Leontief Inverse Table, contains both the direct and indirect requirements (presented in Table 5.9). In addition to the inter-industry interactions discussed above, this matrix can be extended to include the effect of household income and spending.

In Table 5.9, the data in the columns for each industry indicate the total requirements of all industries necessary for that industry to deliver $1 of output to final demand. For example, for the

**Table 5.9. Total Requirement (Direct and Indirect) Matrix**

| | Agriculture | Manufacturing | Service |
|---|---|---|---|
| Agriculture | 1.28 | 0.32 | 0.22 |
| Manufacturing | 0.55 | 1.64 | 0.52 |
| Service | 0.37 | 0.27 | 1.30 |

agricultural sector to increase its output by $1, it must increase its output by $1.28 (including the initial $1 increase), the manufacturing sector must increase its output by $0.55, and the service sector must increase its output by $0.37. The total output increase of agriculture is the sum of these three values, or 2.20 times larger that the initial output expansion in agriculture. This is the concept of an output multiplier, which is a summary measure of magnitude of the leverage that changes in one industry have on other industries.

The basic input-output model can be represented as a system of linear equations and expressed in matrix form.

Let $X_i$ = total output of industry i

where $X_{ij}$ = total amount of the product of industry i used by industry j

$Y_i$ = total amount of $X_i$ left over for final demand (consumption apart from other producing industries)

Then $X_i = Y_i + \Sigma_i X_{ij}$

(i.e., outputs are equal to the transactions plus final demands)

Let $a_{ij} = X_{ij} \div X_j$

Then $X_i - \Sigma_i a_{ij} \times X_j = Y_i$

meaning that output minus transactions equals final demands.

Let A = matrix of $a_{ij}$

X = vector of industry outputs

Y = vector of final demand

I = identity matrix

Then $X = (I - A)^{-1} \times Y$

where: $(I - A)^{-1}$ is called Leontief Inverse.

The equation shows that output is equal to Leontief Inverse multiplied by final demands. This relationship is also held in the form of changes:

$\Delta X = (I - A)^{-1} \times \Delta Y$

In many cases, the dollar value of sector gross outputs may not ultimately be the most important measure of interest. Translate gross output requirements into employment coefficients, as such:

$$E = \begin{bmatrix} e_1 \\ e_2 \\ e_3 \end{bmatrix}$$

Then $\xi = E \times X = E \times [(I - A)^{-1} Y]$ produces a vector whose element is the total amount of employment in each sector that accompanies the new final demand, or the change in amount of employments:

$$\Delta\xi = E \times \Delta X = E \times [(I - A)^{-1} \times \Delta Y]$$

Box 5.3 shows an example of reducing spending on tobacco products on a country's outputs and employment. For further reading, Millard (1994) provides the theory behind the input-output analysis and more detail descriptions of the use of input-output tables.

**Box 5.3. Impact of Reducing Tobacco Expenditure on National Output and Employment**

1. Assumptions
   a. Reducing tobacco expenditure by \$3 million results in a decline in final demand in three distribution sectors: \$1 million for agricultural goods, \$1.5 million for manufacturing goods, and \$0.5 million in the service sector ($\Delta Y_f$). In matrix form, this is

$$\Delta Y_f = \begin{bmatrix} -1.0 \\ -1.5 \\ -0.5 \end{bmatrix}$$

   b. Spending the released tobacco expenditures lead to an increase in final demand in three distribution sectors: \$0.5 million for agricultural goods, \$1.0 million for manufacturing goods, and \$1.5 million in the service sector ($\Delta Y_i$). In matrix form, this is

$$\Delta Y_i = \begin{bmatrix} 0.5 \\ 1.0 \\ 1.5 \end{bmatrix}$$

   c. The total requirement matrix or Leontief Inverse ($[I - A]^{-1}$) is the same as Table 5.8.

$$(I-A)^{-1} = \begin{bmatrix} 1.28 & 0.32 & 0.22 \\ 0.55 & 1.64 & 0.52 \\ 0.37 & 0.27 & 1.30 \end{bmatrix}$$

   d. Employment-output ratios (E) are 500 full-time jobs per million-dollar output for agriculture, 300 for manufacturing sector, and 600 for service sector. In matrix form, this is

$$E = \begin{bmatrix} 500 \\ 300 \\ 600 \end{bmatrix}$$

2. Net effect of changing consumer spending on the output of the economy
   a. The fall in output as a result of reducing tobacco spending ($\Delta X_f$) is

$$\Delta X_f = (I-A)^{-1} \times \Delta Y_f = \begin{bmatrix} 1.28 & 0.32 & 0.22 \\ 0.55 & 1.64 & 0.52 \\ 0.37 & 0.27 & 1.30 \end{bmatrix} \begin{bmatrix} -1.0 \\ -1.5 \\ -0.5 \end{bmatrix} = \begin{bmatrix} -1.87 \\ -3.27 \\ -1.43 \end{bmatrix}$$

   b. The increase in output as a result of spending the released tobacco money ($\Delta X_i$) is

$$\Delta X_i = (I-A)^{-1} \times \Delta Y_i = \begin{bmatrix} 1.28 & 0.32 & 0.22 \\ 0.55 & 1.64 & 0.52 \\ 0.37 & 0.27 & 1.30 \end{bmatrix} \begin{bmatrix} 0.5 \\ 1.0 \\ 1.5 \end{bmatrix} = \begin{bmatrix} 1.29 \\ 2.70 \\ 2.41 \end{bmatrix}$$

**Box 5.3. Impact of Reducing Tobacco Expenditure on National Output and Employment (continued)**

c. The net change in output ($\Delta X_n$) is

$$\Delta \mathrm{X_n} = \Delta \mathrm{X_f} - \Delta \mathrm{X_i} = \begin{bmatrix} -1.87 \\ -3.27 \\ -1.43 \end{bmatrix} - \begin{bmatrix} 1.29 \\ 2.70 \\ 2.41 \end{bmatrix} = \begin{bmatrix} -0.58 \\ -0.57 \\ 0.98 \end{bmatrix}$$

Since the unit of measure for outputs across the three sectors is the same, the output change can be summed. In this case, the net change in the national output is $–0.17 million (–0.58 + –0.57 + 0.98).

3. Converting the change in output into change in employment

a. The decline in employment due to reducing tobacco spending ($\Delta\xi_f$) is

$$\Delta \xi_{\mathrm{f}} = \mathrm{E} \times \Delta \mathrm{X_f} = \begin{bmatrix} 500 \\ 300 \\ 600 \end{bmatrix} \begin{bmatrix} -1.87 \\ -3.27 \\ -1.43 \end{bmatrix} = \begin{bmatrix} -935 \\ -981 \\ -855 \end{bmatrix}$$

b. The increase in employment from spending the released tobacco money ($\Delta\xi_i$) is

$$\Delta \xi_{\mathrm{i}} = \mathrm{E} \times \Delta \mathrm{X_i} = \begin{bmatrix} 500 \\ 300 \\ 600 \end{bmatrix} \begin{bmatrix} 1.29 \\ 2.70 \\ 2.41 \end{bmatrix} = \begin{bmatrix} 645 \\ 808 \\ 1443 \end{bmatrix}$$

c. The net change in employment ($\Delta\xi_n$) is

$$\Delta \xi_{\mathrm{n}} = \Delta \xi_{\mathrm{f}} - \Delta \xi_{\mathrm{i}} = \begin{bmatrix} -935 \\ -981 \\ -855 \end{bmatrix} - \begin{bmatrix} 645 \\ 808 \\ 1443 \end{bmatrix} = \begin{bmatrix} -290 \\ -173 \\ 588 \end{bmatrix}$$

Since the assumption is that the employment/output ratio is based on full-time employment, employment across the three sectors can be summed to get the overall employment impact. In this case, the change in employment is 125 (–290 + –173 + 588). Otherwise, part-time employment must be converted into the full employment base before summing (see the example in Table 5.10 for the conversion).

4. Sensitivity analysis

Question: How might changes in assumed consumer expenditure patterns affect the impact of reducing tobacco expenditure on employment?

Answer: Assume that a larger percentage of the released tobacco expenditure is spent on the service sector (i.e., repeating steps 2–3 yields an increase of 242 in national employment).

$$\Delta \mathrm{Y_i} = \begin{bmatrix} 0.5 \\ 0.5 \\ 2.0. \end{bmatrix}$$

Conclusion: Reduced smoking leads to a decline in the national output by $0.17 million, but an increase in the national employment of 125 full-time jobs. The positive impact of reduced smoking on employment increases as more of the surplus tobacco expenditure is spent on labor-intensive industries.

## How to Collect Data for the Input-Output Analysis

The heart of any input-output analysis is the table of coefficients describing the relationship between inputs and outputs for a particular economy. Unfortunately, the raw information needed for producing such a table is not always available from published government statistical data in many countries. Even if available, the information may not be in a form usable for the specific requirement of the input-output table. Acquiring this information through surveys is an expensive and time-consuming task. Thus, it is not advisable to construct such tables from scratch.

However, input-output tables of national economies have been constructed for many countries, and are available from various government agencies, academic institutions, commercial consulting firms, and international organizations. Amachree (1988) identifies tables available from the National Economic Social Development Board in Thailand, the Ministry of Economic Affaire and Finance in Ivory Coast, Malaysian Statistical Office in Malaysia, National Economic and Development Authority in Philippine, and the Ministry of Economic Affair and Finance in Jordan. In South Africa, tables are available from commercial banks (Van der Merwe, 1998a). In the United Kingdom, the Central Statistical Office provides a table. In the United States, input-output tables for the national economy or regional economies are available from the commercial firm, Minnesota IMPLAN Group, Inc. This firm also produces the commercial software *IMPLAN*, which provides step-by-step procedures in conducting input-output analysis for the United States and its subregions. The U.S. Department of Commerce also maintains a national input-output table (U.S. Department of Commerce, 1990a). In China, academicians constructed a national input-output table and periodically update it for use in economic planning and policy analysis (Polenska and Chen, 1991). Input-output tables are also constructed by international organizations such as the World Bank (Van der Merwe, 1998b and 1998c) and the United Nations Industrial Development Organization, which publishes input-output tables for a number of developing countries, including Algeria, Bangladesh, Burundi, Chile, Congo, Ghana, Ivory Coast, Kenya, Madagascan, Malta, Mexico, Papua New Guinea, Philippines, Republic of Korea, Senegal, Sri Lanka, and Zambia (UNIDO, 1985).

In some cases, the input-output table for a country is available but needs adjustment or modification. For instance, the table might be based on national economy data that is now out of date. In this case, adjust the table based on the current condition of the economy. However, updating the technical coefficients of an input-output table is a complicated and time-consuming process and involves complex methods. Thus, it is advisable to work with an expert who is knowledgeable in input-output analysis. Refer to the book “Input-

Output Analysis: Foundations and Extension" by Miller and Blair (1994) for more information.

Another set of information needed for an input-output analysis is the level of reduction in tobacco expenditures as a result of tobacco control policy. Obtain data on consumer spending on tobacco products from relevant government statistical publications. For example, in the United States, the consumer expenditure on various tobacco products can be found in tobacco statistics published by the U.S. Departments of Agriculture and Commerce. The level of consumer spending on tobacco products can also be calculated as the quantity of tobacco products consumed multiplied by the average price of the tobacco product.

Additionally, data on how consumers spend money released from tobacco spending is also needed. Depending on availability, use the "average" expenditure pattern of the entire population or the spending patterns of former smokers or recent quitters. Information on consumer-spending patterns is normally based on data from consumer expenditure surveys, which can be obtained from either published or unpublished government statistical data. For example, the Family Expenditure Survey in the United Kingdom (Buck *et al*, 1990) and the Household Survey by Central Statistical Services in South Africa (van der Merwe, 1998a) provide information on consumer spending patterns. Or, conduct a literature search to identify published studies on consumer economics for data on consumer expenditure patterns.

The output-employment ratio must be known in order to convert changes in outputs (measured in monetary terms) into changes in employment. Calculate the output-employment ratio as the total output of an industry expressed in a monetary term divided by the total employment of that industry. The input-output table provides the information on outputs by industries, while employment data by industries is available in relevant government statistics. For example, in the United States, the Bureau of Labor Statistics of the Department of Commerce publishes information on employment (U.S. Department of Commerce, 1999b); in the United Kingdom, this information is available from the Department of Employment (Department of Employment, 1998). Employment data are commonly not classified in the same way as the industry categorizations of the input-output table. Therefore, regroup the employment data in a way consistent with the classification of the input-output table. If commercial software such as *IMPLAN* is used for the input-output analysis, information on the output-employment ratio is already built into the model (Minnesota IMPLAN Group, Inc. 1996).

## Step-by-Step Instructions to Conduct the Input-Output Analysis

In general, the process of conducting an input-output analysis involves three main procedures:

1. Estimate the change in final consumer demand for goods and services from a reduction in tobacco expenditure.
2. Calculate the induced changes in outputs resulting from the change in consumer demand.
3. Convert the change in outputs into changes in employment.

### *Estimate the Change in Final Demand*

To estimate the change in consumer expenditure:

1. Specify the policy or policy scenario being examined. This can be hypothetical—such as banning smoking entirely in a society—or a real tobacco control measure under policy discussion—such as restricting smoking in public places or increasing a tobacco product tax.
2. Determine the consequence of the policy scenario on the level of consumer spending on tobacco products. If the policy scenario is a ban on smoking, then the consequence of the policy is the elimination of tobacco expenditure. If the scenario is tighter tobacco control measures, then determine if a one-time reduction or a multi-year reduction in tobacco expenditure is more plausible.
3. Estimate how the released money from a reduction in tobacco spending needs to be reallocated among other goods and services. Since it is unknown how smokers who stop or reduce their tobacco consumption will spend their released money, it is normal to make assumptions on the pattern of consumer expenditure. Based on the available data, the assumed expenditure pattern can be that of an "average" consumer, former smokers, or recent quitters. If data on alternative consumer spending patterns are available, test how different consumer expenditure patterns affect employment resulting from a tobacco control policy.
4. Translate the change in consumer spending into the change in final demand for goods and services in the input-output table. It may be necessary to perform data adjustments during the process of reallocating consumer expenditure among different goods and services. For example, it might be necessary to regroup the spending category if the classification of goods and services based on consumer spending patterns is different from the classification of goods and services in the input-output table. The proportion of the released tobacco expenditure that will go towards consumers savings also needs to be specified if one believes

that this savings is a significant proportion of the released expenditure. If the policy scenario is a tobacco product tax increase, consider the increase in government tax revenues when determining the change in final demand of the input-output table. Further, the input-output table may require the valuation of goods and services at basic rather than purchaser's prices, in which case the allocated expenditure among the goods and services, normally valued at the purchaser's prices, needs to be adjusted to the basic price level.[2]

In countries where tobacco is highly taxed relative to other consumer goods, a large reduction in sales by a non-tax tobacco control measure can lead to a net loss in overall government tax revenue. Thus, it is likely that the Exchequer will react to this revenue loss. Under most circumstances, this means either an increase in other taxes to make up the shortfall, or a reduction in government spending. Assumptions about this government reaction are also required in order to determine the change in final demand of goods and services in the input-output table as a result of government reaction.

### *Determine the Output Consequence*

Estimate the change in outputs resulting from changes in final demand in three steps:

1. Calculate the reduction in outputs resulting from the fall in demand for tobacco products.
2. Estimate the increase in outputs from the increases in demand for other goods and services.
3. Calculate the net change on outputs due to the change in final demand as the difference of the two.

The key information needed for estimating the output consequence of changes in final demand is the total requirement matrix (or Leontief inverse matrix) and the matrix of change in final demand for goods and services resulting from the changes in final demand. Details of this three-step procedure are illustrated in Box 5.3.

### *Translate the Change in Outputs to the Change in Employment*

Convert the changes in outputs that are expressed in a monetary term into changes in employments. This is straightforward; just multiply

[2] Basic prices are defined as the purchase price minus taxes on production and expenditure and distributor trade margins plus subsidies (Buck *et al*, 1995).

the output matrix by the output-employment ratio matrix (step 3 of the example in Box 5.3 shows this calculation). Some commercial software for input-output analysis, such as *IMPLAN*, can perform this transition directly. When applying output-employment ratios, be absolutely clear if these ratios are measured in a full-time employment base or a mixed part-time and full-time employment bases. If the latter is true, convert the part-time employment into a full-time base. The example in Table 5.10 illustrates how one can covert employment with a mixed case (part-time and full-time) into employment with a full-time case. To cover a part-time job into a full time job, one needs to covert the part-time job into the number of working hours per year, then divide this number by the number hours needed for a full- time job (e.g., 2,000 hour/year).

### *Perform a Sensitivity Analysis*

Performing a sensitivity analysis is necessary due to a large number of assumptions made for the input-output analysis and uncertainties associated with some of the data used. A sensitivity analysis recalculates the result of an input-output analysis by changing the value of one or more parameters. The purpose of a sensitivity analysis is to determine how sensitive the estimated result is to changes in parameter values. An example of the sensitivity analysis is presented in Box 5.3.

In general, a sensitivity analysis involves three steps:

1. Identify the uncertain parameters.
2. Specify the plausible range over which uncertain factors are thought to vary.
3. Calculate study results based on the combination of the best guess.

Parameters that face a large degree of uncertainty can indicate that assumptions are made and the quality of the data is poor. Examples include different patterns of consumer spending for the released

**Table 5.10. Converting Jobs from a Mixed Part-time and Full-time Base into a Full-time Base**

| Sector | Total Mixed Part- time and Full-time Jobs | Percent of Part-time Jobs | Hours Worked Per Part-time Worker Per Year | Hours Worked Per Fullt-time Worker Per Year | Total Full-time Jobs |
|---|---|---|---|---|---|
| | a | b | c | d | e = (a × (1 – b)) + (a × b × c ÷ d) |
| Agriculture | –290 | 40% | 1,200 | 2,000 | –244 |
| Manufacturing | –173 | 10% | 1,700 | 2,000 | –170 |
| Service | 588 | 30% | 1,500 | 2,000 | 544 |
| Total | — | — | — | — | 130 |

tobacco expenditure, the proportion of the freed expenditure that goes to saving, and different government reaction to a lower level of tax revenue. Determine a plausible range for the parameter by reviewing the literature or by consulting expert opinions. Then present the result of the sensitivity analysis based on the combination of best guesses in one of three ways:

- The best (or optimistic) outcome is the result when the most favorable values of the parameters are used.
- The worst (or conservative) outcome is the result when the least favorable values of the parameters are used.
- The most likely result is the one when the most realistic value of the parameter is used or what would most likely occur if the policy scenario were carried on in the real world.

## Reporting the Result of an Input-Output Analysis

Results of the input-output analysis should be appropriately interpreted and presented in an easily understood manner. To properly interpret the employment impact, focus on the net impact of eliminating (or reducing) tobacco expenditure on employment. The net impact of changing tobacco expenditure on employment is the employment outcome under a scenario that final demand for tobacco products is eliminated (or reduced) and the released consumer expenditure is allocated to other goods and services. This net impact represents the most likely impact on employment resulting from reduced tobacco consumption.

To correctly report the study result, do not confuse the net impact with the gross effect. The gross impact is the employment outcome if one assumes the released tobacco expenditure simply disappeared from the economy. This is the impact estimated in the tobacco industry-sponsored studies; and in the input-output analysis, this is the scenario that final demand for tobacco products is eliminated (or reduced) but no increase in final demand for other goods and services is made. In theory, the gross impact on employment estimated in the input-output analysis should be the same, in magnitude, as the estimated employment contribution in the industry-sponsored studies, yet larger than the estimated number of employment directly related to tobacco.

Report any changes in both the aggregate level and the distribution of employment resulting from the examined policy scenario. The aggregate change shows the impact of the policy on employment in a nation as a whole, while the distribution effect shows how jobs are shifted among industries in the economy as a result of the tobacco control policy. Information on changes in employment distribution shows the losers and winners from a reduction in tobacco use. *This is very important information for policy-makers and the public health community in formulating an effective tobacco control policy.*

Normally, report changes in the distribution of employment in a table form. It may be necessary to regroup industries contained in the input-output table to a more aggregate level due to the large number of industries in the original input-output model.

Also report results from the sensitivity analysis, and identify the importance of each major assumption in terms of its impact on the employment outcome, and how changing values of data where uncertainties exist affects the study's conclusion. Be sure to compare the results of the study against those of previous studies to determine if the result is logical and reasonable.

Discuss the policy implication of the study's results, addressing such issues as:

- what the study result means to tobacco control
- the validity of the argument made by the tobacco industry on the negative employment of tobacco control policy
- the implication of changes in employment distribution (such as the losers and winners) by both industry and by region as a result of tobacco control policy
- whether policy maker concerns over job losses are necessary.

Finally, mention any limitations of the input-output analysis as well as other limitations of the study, such as assumptions made due to a lack of good data. For example, the input-output analysis is a static analysis and can't show how the economy adjusts over time during the transition to a smaller or tobacco-free economy. Further, the input-output analysis is demand driven, and the input-output table links the industries in the economy with a fixed technical coefficient. Thus, price adjustments and alternative resource allocations are not taken into account. Using fixed coefficients ignores the possibility of substitution in consumption, production, imports, and exports, and does not capture supply-demand interaction of agents acting across markets in response to shifts in market signals (van der Merwe, 1998a).

Studies that use input-output analysis to examine the employment impact of eliminating (or reducing) tobacco expenditure have been conducted in a number of countries (see Table 5.2). These studies provided good examples of how to use the framework of input-output modeling to examine the employment impact of tobacco control policies. Among them, two studies (Buck *et al*, 1995; Van der Merwe, 1998a) provide many technical details on applying the input-output methodology to the problem of reducing tobacco expenditure, and are thus good references for conducting similar analyses.

# Consider Other Approaches to a Quantitative Policy Analysis

As discussed above, the input-output analysis has a number of limitations. In spite of them, the simplicity and availability of the data needed by the methodology still make the input-output analysis the most widely-used approach for examining the income and employment impact of tobacco control policies. However, the following two approaches can also be used to examine the employment effect of a tobacco control policy.

Warner and Fulton (1994) and Warner *et al* (1996) simulate the employment impact of eliminating or reducing tobacco expenditure in the United Sates by using an existing macroeconomic model developed by the commercial firm REMI, in Amherst, Massachusetts. This macroeconomic model, named Regional Economic Models, is a complicated economic model containing five blocks with numerous equations (Treyz *et al*, 1992). The structure of the model incorporates inter-industry transaction (input-output table) and endogenous final demand feedback (econometric modeling). This integrated economic model is superior to input-output analysis because the former uses less-restricted assumptions and is closer to the reality of the economy. That is, unlike the input-output model where prices of the goods and services are fixed, this integrated economic model allows prices to adjust in response to changes in product and factor demands. However, using this approach is subject to the availability of the model for a country or region. The macroeconomic model is normally constructed for the purpose of economic forecasting and other macro economic policy analysis. For most developing countries, such a model may not be available, thus this approach is not feasible.

Another relatively new approach is computable general equilibrium (CGE) modeling. The CGE model is developed from macro-economic modeling and classic economic theory. Unlike traditional econometric methods, the CGE model does not estimate, but rather calculates the model parameters, and is "computable" in the sense that an explicit numerical solution is calculated. The term "general equilibrium" refers to an analytical approach which views the economy as a complete system of interdependent components—such as industries, households, investors, government, importers, and exporters. In this class of model, supply/demand equations are specified as functions of prices based on the economic theory of firms and households. Thus, unlike the input-output analysis, the CGE model determines the price and quantity of goods and services demanded and supplied endogenously. The mathematical descriptions of production and consumer demand relationship that characterize the situation—whether real or hypothetical—are specified in a very flexible, linear or nonlinear form. However, CGE modeling is much more technically complex than input-output

analysis, and since it is a relatively new approach, data needed by the model may not be available or poor in quality (Isard *et al*, 1998).

The feasibility of applying the CGE modeling framework for analyzing the employment impact of tobacco control measures is subject to the availability and expertise in constructing such models. CGE models of national and regional economies have been constructed for many countries, including Korea, India, Sri Lanka, Kenya, and Brazil (Palm and Smit, 1991). While this list is growing, there are many more countries and regions that are not on it. Therefore, using a CGE model may not be feasible. To learn more about the CGE model, books by Palm and Smit (1991) and by Isard *et al* (1998) provided good references.

# VI. Conclusion

A reduction in tobacco use can lead to a smaller tobacco industry, which in turn can affect the total number and distribution of employment in a nation or a region. The public health community should examine the employment aspect of tobacco control measures when considering an effort to reduce tobacco use for a number of reasons. This tool reviewed studies that estimate the potential impact of a reduction in tobacco use on employment from two distinguished groups: tobacco industry and its representatives, and academic and government researchers. The conclusions drawn from each group were evaluated. In addition, this tool provided a step-by-step procedure to conduct an analysis to address two important policy questions: how many people are currently directly employed in the tobacco industry, and what impact does a tobacco control measure, such as an increase in tobacco product taxes, have on employment in a country or nation?

A reduction in tobacco use has no, or possibly even a small positive, effect on the total output and employment of the national economy, except in a very few countries that are heavily dependent on tobacco production. However, reducing tobacco use leads to a change in employment among different sectors and even among different regions. Job losses will occur in those sectors immediately associated with tobacco product production, such as tobacco manufacturing and farming, or in tobacco dependent regions. But these losses are generally outweighed by increases in employment in all other industries or in non-tobacco dependent regions. It is important to identify those who are going to be negatively affected by a smaller tobacco economy in order to implement an effective tobacco control policy.

Following the step-by-step instructions in this tool, the reader should be able to count the number of employment with only a basic knowledge of economics and statistics. For those with an interest in using input-out analysis to examine the employment impact of a smaller tobacco economy, knowledge of advanced economics and statistical analysis, particularly input-output analysis, is necessary. In this case, collaboration with someone experienced in input-output analysis is advised. Further, if readers are interested in applying CGE

modeling and macro-economic models to analyze the impact of a smaller tobacco economy on national or regional outputs and employment, they are urged to consult someone who specializes in these two areas.

# VII. Additional References

Agro-Economic Services Ltd. and Tabacosmos Ltd. (1987), "The Employment, Tax Revenue and Wealth that the Tobacco Industry Creates", London: Agro-Economic Services

Allen, R.C. (1993), "The False Dilemma: The Impact of Tobacco Control Policies on Employment in Canada", National Campaign for Action on Tobacco: Ottawa, Ontario.

Amachree, S.M.A. (1988). Investment Appraisal in Developing Countries. Averbury, Gower Publishing Company Limited, Aldershot, England.

Arthur Andersen Economic Consulting, (1993), "Tobacco Industry Employment: A Review of the Price Waterhouse Economic Impact Report and Tobacco Institute Estimates of Economic Losses from Increasing the Federal Excise Tax", Los Angeles, CA: Arthur Andersen Economic Consulting.

Buck, D., Godfrey, C., Raw, M. & Sutton, M. (1995), "Tobacco and Jobs", Society for the Study of Addiction and Centre for Health Economics, York: University of York.

Capehart, T. (2000). U.S. Tobacco Farming Trends, Available at the US Department of Agriculture website (www.ers.usda.gov/briefing/tobacco/).

Department of Employment. (1998), *Employment Gazette*. Landon.

FAO (1999), Food and Agriculture Organization of the United Nations Database, Italy: Rome.

Irvine, I.J. & Sims, W.A. (1997), "Tobacco Control Legislation and Resource Allocation Effects", Canadian Public Policy, 23(3), 259-73.

Isard, Walter, Iwan J. Azis, Matthew P. Drennan, Ronald E. Miller, Sidney Saltman and Eric Thorbecke (1998). Methods of Interregional and Regional Analysis. Ashgate, Publishing Limited, Aldershot, England.

Jocobs, Rowena, Gale, F., Capehart, T., Zhang, P., & Jha, P. (2000), "The Supply-side of Tobacco Control Policies," in Tobacco Control in Developing Countires, edited by Jha, P and Chaloupka, F. Oxford University Press, Oxford.

Maravanyika, E. (1998) "The economics of tobacco in Zimbabwe." In: *The Economics of Tobacco Control in South Africa.* Cape Town: School of Economics, University of Cape Town, June 1998

McNicoll, I.H. & Boyle, S. (1992), "Regional Economic Impact of a Reduction of Resident Expenditure on Tobacco products: A Case Study of Glasgow", *Applied Economics*, 24, 291-6.

Millard, D. (1994). Input-output tables for the United Kingdom. 1990. London:Central Statistical Office.

Miller, R.E. and Blair, P.D. (1985). Input-output Analysis: Foundations and Extensions. Prentice-Hall, Inc. Englewood Cliffs, New Jersey.

Minnesota IMPLAN Group, Inc. (1996). IMPLAN Professional Users Guide/Analysis Guide/Data Guide. Stillwater, MN: Minnesota IMPLAN Group, Inc., 1996.

Palm, C. Franz and Haddie P. Smit (1991). Economic Modeling and Policy Analysis, Averbury, Gower Publishing Company Limited, Aldershot, England.

PEIDA (1991), "The Economic Significance of the UK Tobacco Industry", London: Pieda.

Polenske, R. Karen and Chen Xichang (1991), Chinese Economic Planning and Input-output Analysis. Hong Kong, Oxford University Press.

Price Waterhouse (1992), The Economic Impact of the Tobacco Industry on the United States Economy, Arlington VA: Price Waterhouse.

Treys, G.I., Rickman, D.S., & Shao G (1992). "The REMI Economic-demographic Forecasting and Simulation Model," *International Regional Science Review*. 14, 221-53

Tobacco Merchant Association (1995). Tobacco's Contribution to the National economy. Princeton, NJ:Tobacco Merchant Association.

UNIDO (1985), Input-output Tables for Developing Countries. United Nations International Development Organization, Vienna: Austria, United Nations Publication, Sale No.: E.84.ii.B.6.

UNIDO (1999), United Nations International Development Organization Database, Vienna: Austria.

USDA (1999), US Department of Agriculture Database, USDA: Washington DC, USA.

U.S. Department of Commerce (1987a), County Business Pattern. U.S. Deparment of Commerce, Bureau of the Census. Washington, D.C.

U.S. Department of Commerce (1987b), Census of Wholesale Trade. U.S. Deparment of Commerce, Bureau of the Census. Washington, D.C.

U.S. Department of Commerce, 1990a. Input/output Accounts of the National Economy. U.S. Deparment of Commerce, Bureau of Economic Analysis. Washington, D.C.

U.S. Department of Commerce, 1990b. "1987 Census of Retail Trade, Merchandise Line Sales, U.S. Summary. Department of Commerce, Bureau of Census. Washington, D.C.

U.S. Department of Labor (1999), Bureau of Labor Statistics Database, Washington, D.C.

Van der Merwe, R. (1998a), "The implications of falling tobacco consumption for employment in South Africa." In: *The Economics of Tobacco Control in South Africa*. Cape Town: School of Economics, University of Cape Town, June 1998

Van der Merwe, R. (1998b), "Employment and Output Effects for Zimbabwe with the Elimination of Tobacco Consumption and Production", Population, Health and Nutrition Department, World Bank, August 1998.

Van der Merwe, R. (1998c), "Employment and Output Effects for Bangladesh following a Decline in Tobacco Consumption", Population, Health and Nutrition Department, World Bank, August 1998.

Warner, K.E. & Fulton, G.A. (1994), "The Economic Implications of Tobacco Product Sales in a Non-tobacco State", *Journal of the American Medical Association*, 271, 771-6.

Warner, K.E. & Fulton, G.A. (1995), "Importance of Tobacco to a Country's Economy: an Appraisal of Tobacco industry's Economic Argument", *Tobacco Control*, 4, 180-183.

Warner, K.E., Fulton, G.A., Nicolas, P. & Grimes, D.R. (1996), "Employment Implications of Declining Tobacco Product Sales for the Regional Economies of the United States", *Journal of the American Medical Association*, 275, 1241-6.

World Bank. 1999. Curbing the Epidemic: governments and economics of tobacco control. Jha, Prabhat and F. Chaloupka, eds. The World Bank, Washington, D.C. USA.