Growth and Efficiency of the Chinese Textile Industry

by

KELIANG SUN

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Declaration

This dissertation was written while I was undertaking a PhD program at the Australia-Japan Research Centre of the Australian National University. Apart from the references and acknowledgments in the Preface, this thesis is my own work.

Keliang Sun
March 1997

Preface

I am deeply indebted to my supervisors Professor Peter Drysdale, Professor Ross Garnaut and Associate Professor Christopher Findlay for their advice in completing this work.

It would have been impossible to have undertaken this study without the enthusiastic support of Professor Peter Drysdale. His extensive experience in economic research, his optimism and encouragement were essential to completing this task, and I benefited greatly from his guidance and comments on the individual sections of the thesis.

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I wish to thank Mr Gary Anson, who has helped me to express my ideas with greater clarity.

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Keliang Sun

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J. G. Crawford Building, ANU, Canberra

Abstract

The textile industry is one of China's leading industrial sectors, and its growth has been a central feature of Chinese industrial development. This thesis examines the growth of the Chinese textile industry. It explores: (i) the pattern and major features of textile industry growth; (ii) total factor productivity growth in the industry and its sub-sectors; (iii) sources of output growth; (iv) structural shifts and associated changes in industry efficiency; (v) allocative efficiency within the industry; and (vi) export performance of the textile industry and its impact on growth and efficiency.

The study focuses on the efficiency of the textile industry, using indexes of total factor productivity (TFP) as a key measure of efficiency. It shows that aggregate TFP improved remarkably along with rapid output growth, and that positive TFP growth was achieved in all sectors of the textile industry over the reform period.

The study identifies patterns of extensive and intensive growth in different phases of the growth of the textile industry. The former refers to growth via expansion of factor inputs, and the latter growth via improvement in the efficiency of factor use. The exploration of sources of growth reveals that in the pre-reform period, output growth in the textile industry relied heavily on the expansion of factor inputs, and the industry displayed a typical pattern of extensive growth. In the reform period, TFP growth represented a substantial share of industrial growth. The changed role of TFP growth implies transition in the Chinese textile industry, and a shift from a path of extensive growth to one of intensive growth.

Rapid growth of the Chinese textile industry has been accompanied by structural change. A shift in industrial structure can affect industry growth and efficiency through the link between structural change and productivity — referred to in this study as 'structural efficiency'. Using a normalisation technique, the study evaluates the industry's structural efficiency and shows that structural change made a positive contribution to overall TFP growth in the textile industry. The improvement in structural efficiency is largely attributable to steadily increasing market-orientation in the reform period.

The sharp expansion of China's textile exports since the late 1970s had a critical influence on the growth and efficiency of the textile industry. This study examines the industry's export performance and the significant structural change that took place in exports. China's textile industry is increasingly integrated into the world economy and dependent on international markets. By the mid-1990s overseas demand for China's textile goods became the dominant force driving growth in China's textile sector. The shift in textile exports from less processed to more processed and more labour-intensive product categories was the major trend in changing export structure and the evolution of dynamic comparative advantage in the Chinese textile industry.

The relationships between export expansion, output growth and TFP change are a central interest. The study confirms that a strong positive correlation exists between export expansion and output growth as well as between export expansion and TFP growth in the Chinese textile industry. The study also investigates differential productivity growth between the export and non-export sectors and estimates the efficiency gains of the textile industry from export growth. The results suggest that about one-fifth of overall TFP growth in the textile industry was attributable to the expansion of textile exports.

The study has important implications for textile industry strategy. To achieve consistent growth based on improvements in productivity the industry needs to undergo continuing adjustment through the strengthening of market disciplines and the encouragement of competition; change in output and ownership structures; an increase in export-orientation; and full liberalisation of the textile trade. With these strategies, the Chinese textile industry should be able to continue its growth, improve its efficiency, and maintain international competitiveness in the next phase of China's industrialisation.

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1 Introduction

The Chinese textile industry is one of the leading sectors in China's industrial economy. It is also the world's largest producer and exporter of textile goods as well as an important importer of fibres and textiles. The importance of China's textile industry naturally makes it a candidate for research attention, both from a Chinese and an international perspective. Recent studies[1] have increased understanding of developments in this industry considerably, but these studies have largely neglected some crucial issues in the industry such as growth patterns, structural change and efficiency. Rapid development of the national and international importance of this industry and these research gaps demand in-depth analysis that encompasses a longer time period, a wider product and market coverage, as well as a broader range of strategic issues than have been given attention in previous studies. The present study represents an effort to do just that.

Objectives and scope of the study

This study seeks to provide a better understanding of the dynamics of development of the Chinese textile industry and therefore to contribute to the making of policies and strategies for development of the textile industry. The study also reviews the impact of China's economic reform and opening up on the growth and efficiency of the textile industry, and pays particular attention to the reform period.

The study is designed to identify and analyse: (1) growth patterns and their major features; (2) the performance of the industry and its sub-sectors in respect of total factor productivity growth; (3) sources of growth; (4) structural shifts and associated changes in efficiency; (5) allocative efficiency; and (6) textile exports and their impact on growth and efficiency. The underlying logic connecting these issues is the inherent relationship between industrial growth, structural change, export expansion and efficiency.

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[1] As represented by Guo (1990), Bai et al. (1991), Lu (1991), Gao (1994) and Fei (1995).

The focus of the study is the efficiency of the textile industry. This choice is based on the crucial role of productive efficiency in industrial growth and development. The analysis of efficiency in this study consists of four major parts: estimation of total factor productivity (TFP) growth for the industry as a whole and for the individual sectors; identification of the contribution of productivity change to output growth; evaluation of structural and allocative efficiency; and assessment of efficiency gains from export expansion. Since the mid-1980s, studies of the TFP growth in Chinese industry have involved considerable controversy. This study attempts to contribute empirical evidence to the debate by drawing on the experience of China's textile industry.

Main issues

Output growth, export expansion, structural change, and TFP growth are interwoven in the dynamics of China's textile industry development. The focus of this study on the industry's efficiency makes the following research questions of primary concern.

(1) What has been the relationship between output growth and TFP change in the Chinese textile industry? In this context, four specific questions may be asked. First, has the industry's TFP improved since the early 1950s, particularly in the reform period? Second, has there been a positive relationship between output and TFP growth? The answer to this question is theoretically connected with the positive linear relationship between productivity growth and output growth in manufacturing that has been noted in many studies and is generally known as the 'Verdoorn law'. Third, by how much has output growth been the result of improvement in productivity? And fourth, what have been the nature and pattern of output growth in the textile industry?

These four questions are closely related. The most important of them is identification of the industry's growth pattern. The proportion of output growth accounted for by the increase in TFP is frequently used as an index for evaluating the growth pattern of an industry; that is, whether an industry's expansion is based on 'intensive' or 'extensive' growth.[2] Extensive growth is the result of using more of the same inputs, and intensive growth is mostly due to improved efficiency measured through TFP growth. The pattern of growth essentially reveals the development strategy pursued in the industry.

(2) What has been the relationship between structural transformation and efficiency? In this context, the following questions can be raised. What have been the most important shifts in industrial structure? What have been the pattern and features of structural shifts in the industry? In what way has structural change affected the industry's efficiency? And has the industry achieved favourable structural and allocative efficiency in the course of its growth?

Structural change is caused by different rates of growth among different sectors: some sectors grow faster than the others, so that over time their relative importance changes. Two types of structural change in the textile industry are discussed in this study: demand-induced and reform-induced structural changes. The former refers to the change in sectoral structure and the latter to the change in ownership structure.

Structural change is a result of uneven growth. On the other hand, structural change can inhibit growth if its direction is inefficient, or facilitate growth if it improves the allocation of resources. This suggests that structural change has a growth effect (positive or negative), which acts mainly through complementary changes in output structure and productivity. The structural change-productivity relationship can be summarised as structural efficiency. This study pays particular attention to variations in structural efficiency as well as allocative efficiency in China's textile industry.

(3) What has been the relationship between export expansion and output growth and changes in efficiency? The answer to this question involves analysis of the following specific issues: the trend and structural characteristics of China's textile exports; the degree of correlation between exports and output growth, as well as between export

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[2] Three aspects of industrial growth have been suggested by the literature: an increase in employment of inputs; increasing productivity of inputs in given uses; and reallocation of inputs to more or less productive uses (Wynnyczuk 1975). These three aspects are referred to in this study as extensive growth, intensive growth, and structural change.

expansion and TFP growth; and the efficiency gains from export growth in the textile industry.

On a theoretical level, a positive correlation is often posited between export expansion, output growth and productivity change. Contacts with foreign competitors that arise from exporting may lead to more rapid technical change, the development of native entrepreneurship, and the exploitation of scale economies. External competitive pressures may reduce X-inefficiency and lead to better product quality. Increases in export earnings may relieve the exchange constraint and facilitate the liberalisation of exchange control, both of which are likely to reduce allocative inefficiencies prevalent under exchange constraint and controls (Ram 1985; Kwon 1986; and Nishimizu and Page 1991). In addition, Feder (1983) finds that exports contribute to economic growth because the export sector is not only more productive than the non-export sector but it also generates some external effects that enhance the productivity of the non-export sector. As exports expand, both the resource reallocation effect and the externality effect lead to improved efficiency. On these theoretical grounds, positive relationships between export expansion and output growth as well as between export expansion and TFP growth in the Chinese textile industry are hypothesised and tested in this study.

Definition of the textile industry

It is important to define clearly and accurately the research target of the study; namely, the Chinese textile industry.

Textile manufacture is one of the most widespread industrial activities in the world. Although most countries and regions produce textile products, the definition of the 'textile industry' varies considerably. Even the definitions adopted by the various United Nations agencies have differed over time and from one study to another. In the International Standard Industrial Classification (ISIC) adopted by the United Nations Statistical Commission (UNSC 1968), which is the most widely used sectoral classification applied in statistical practice, the term 'textiles' is found to cover only selected textile items such as yarn, fabrics, tulle, lace and embroidery, made-up items, and floor coverings, which fall under the ISIC 321. Other important textile products such as clothing and clothing accessories are not included in the definition of 'textiles'.

For the purposes of the present study and to make good use of China's statistical data, the term 'textile industry' is defined here as an industry which processes fibrous materials into yarns, fabrics, knitted goods, garments, and so on, and which converts chemical materials into man-made fibres for its own use. Under this definition, the Chinese textile industry consists of seven sectors: (1) man-made fibre; (2) cotton processing; (3) wool processing; (4) bast fibre processing; (5) silk processing;[3] (6) knitting; and (7) apparel. This definition basically follows China's current administrative framework for the textile industry. The only difference is that the textile machinery and accessories sector is excluded from this study, though it comprises part of China's textile industry in terms of the administrative system employed in China. Considering that this sector is relatively small in the context of the whole industry and that statistically it is usually separated from the other sectors, the exclusion of this sector from the definition is unlikely to affect the accuracy of use of the Chinese statistics.

In contrast to the ISIC, this study's definition of the textile industry is wider in scope. The main differences between the two definitions are: first, the man-made fibre industry (ISIC 3513) and the apparel industry (ISIC 322) are excluded from the ISIC definition (UNSC 1968) but included in this study; second, the carpet industry is defined as part of the textile industry in the ISIC while it is excluded from the definition used in this study. The second difference derives from the fact that the carpet industry has long been administered by the Ministry of Light Industry in China and hence is not regarded as part of the textile industry. Correspondingly, the statistics of the textile industry generally do not count carpet production.

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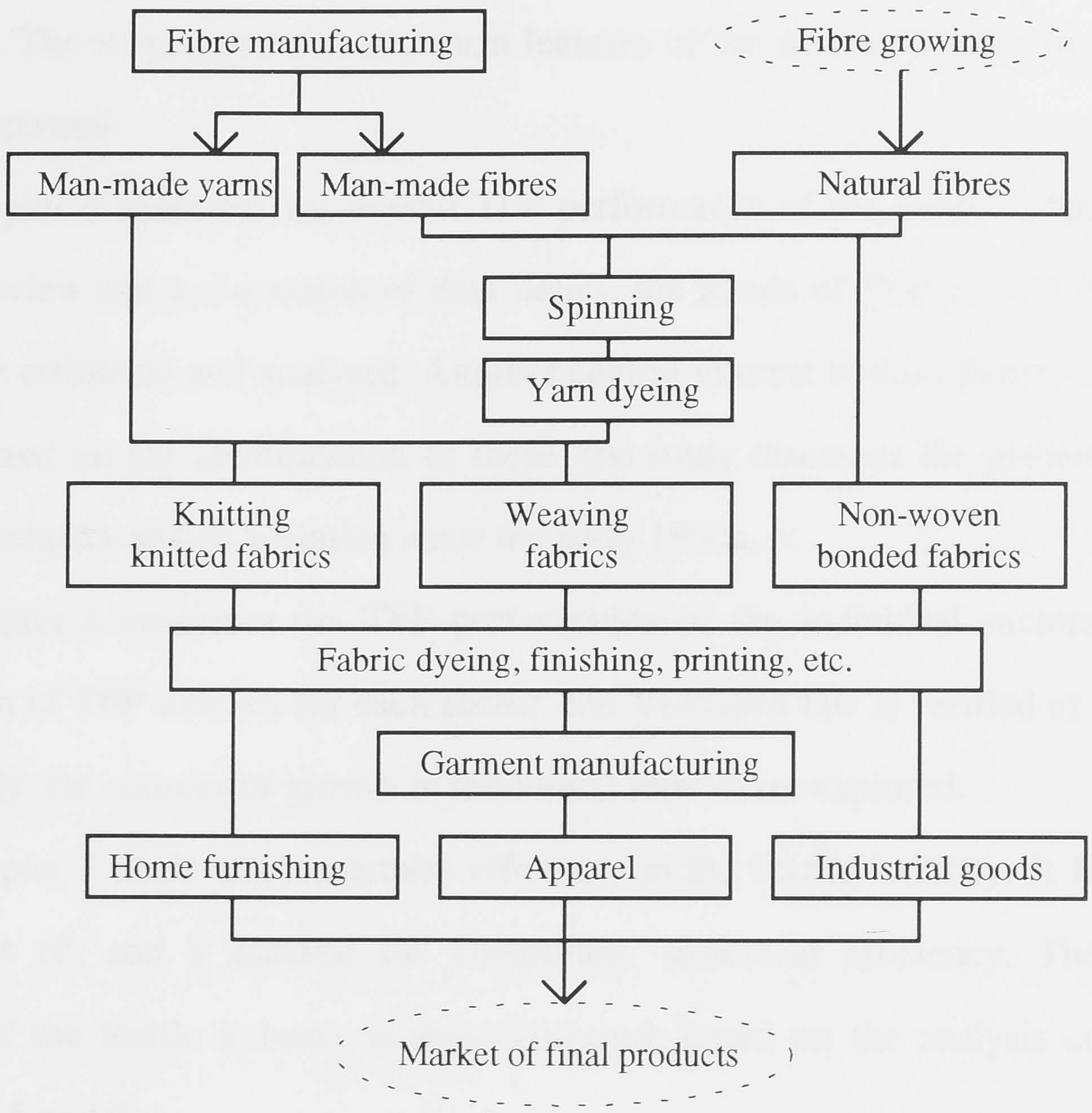
[3] For convenience, the four fibre processing sectors are referred to as cotton, wool, bast and silk in the following analysis.

In addition to the convenience of using data published by China's government agencies, the main merit in applying this broader definition is that many strategic issues can be handled and easily analysed in this framework, since the raw materials and final goods producing sectors are integrated into the analysis.

To facilitate the analysis, two other concepts need to be introduced into this study. One is the concept of 'primary textile industry', defined as an industry that converts raw fibres into yarn, fabric and other semi-processed or end-use products other than garments. Under this definition, China's primary textile industry contains four fibre processing sectors: cotton, wool, bast and silk. So defined, the Chinese primary textile industry roughly corresponds to the ISIC definition of textile industry. The second concept is that of 'clothing industry', defined as an industry processing yarn and fabrics into garments, including knitted and woven garments, and garment accessories. Under this definition, China's clothing industry consists of two sectors: knitting and apparel.

The general production processes of the textile industry also need to be outlined so as to assist understanding of the industry's economic, technical and organisational features. In terms of the production of conventional goods, textile manufacturing is presented as an ordered sequence of stages, beginning with fibre-making and other fibre preparing activities through to the production of intermediate goods of increasing degree of production and ending up with various final goods. These production processes can be divided into four stages: the production of man-made fibres, the treatment of raw fibres and their transformation into yarn, fabric making and finishing, and the assembly of end products from yarns and fabrics. These processes, together with the major sub-processes involved, are illustrated in the flow chart in Figure 1.1.

Figure 1.1 Principal processes and products of the textile industry



Source: Wu, X. and Cao, C. (eds), 1990, *A Practical Handbook of Textile Industry*, Chapter 4, pp.370-383, Textile Industry Press, Beijing.

Organisation of the thesis

The remaining chapters of this thesis are organised as follows.

Chapter 2 outlines a framework for analysing productive efficiency and a methodology for computing TFP growth.

Chapter 3 presents an overview of the Chinese textile industry. The main issues discussed in this chapter include the role of the industry in China's economy, the economic characteristics of the industry, and its historical development in the pre-reform period.

Chapter 4 examines the rates and pattern of the industry's output growth in the reform period and then analyses the structural change associated with growth. Two major aspects of the industrial structure — sectoral and ownership compositions — are considered. The trends, patterns and main features of the structural shifts in the industry are then discussed.

Chapter 5 examines the overall TFP performance of the textile industry. After a literature review and a discussion of data issues, the trends of TFP growth in the textile industry are estimated and analysed. Another central interest in this chapter is sources of growth. Based on the identification of these, the study discusses the growth pattern of the textile industry and its variation since the early 1950s.

Chapter 6 examines the TFP performance of the individual sectors. After the construction of TFP indexes for each sector, the Verdoorn law is verified at the sectoral level. Finally, the sources of growth in individual sectors are explored.

Chapter 7 deals with structural efficiency in the textile industry. It first explains the concept of, and a method for computing, structural efficiency. The structural efficiency of the textile industry is then estimated, based on the analysis conducted in Chapters 4, 5 and 6.

Chapter 8 evaluates the allocative efficiency of the textile industry. As allocative efficiency is an important indicator of the industry's efficiency, in addition to TFP growth, the study uses two different methods and data sets to double-check the industry's allocative efficiency.

Chapter 9 examines the export performance of the textile industry and its impact on the industry's growth and efficiency. The trends, patterns and structural features of the industry's export growth are discussed. The analysis in this chapter primarily concerns the export-growth and export-productivity linkages in the Chinese textile industry. Two relevant hypotheses are tested to verify these linkages. Finally, the industry's efficiency gains from export growth are estimated.

Chapter 10 summarises the main findings in the previous chapters and draws out some policy implications. The discussion seeks to identify a strategy that is likely to improve the growth and efficiency performance of the Chinese textile industry in the future.

2 Analytical framework and methodology

Focusing on the efficiency of the Chinese textile industry raises a number of basic analytical issues about efficiency and its measurement. This chapter discusses the definition of, and the computational method for identifying, TFP as a measure of efficiency. The first section discusses the concept and measurement of efficiency. The second section briefly reviews the literature of major studies of TFP. The third section presents an analytic model and introduces the notions of TFP and allocative efficiency. Finally, the fourth section discusses the methodology for estimating TFP growth.

Concept and measurement of efficiency

Efficiency is a widely used concept in economics. The various definitions of efficiency found in the literature mostly reflect a common view that efficiency measures the optimal relationship between inputs and outputs in economic activities. Forsund and Hjalmarsson (1974, p.141) define efficiency as 'the utilisation of resources, that is, efficiency is a statement about the performance of processes transforming a set of inputs into a set of outputs'. Stern (1983, p.79) proposes a broader but still formal definition of efficiency: a state of affairs is specified as efficient 'if it gives the minimum cost way of meeting some objective, or similarly maximises an objective function, given some resource constraint. Thus an improvement in efficiency would be to meet an objective at lower cost or get more out of the same resources'.

Various measures of efficiency have been proposed by economists, by far the most influential and widely used of these being the productivity measure. Fabricant (1969, p.3) has it that 'productivity refers to a comparison between the quantity of goods and services produced and the quantity of resources employed in turning out these goods or services'. So defined, the fundamental concept underlying all productivity measures is output per unit of input.

The importance of productivity growth to economic development is explained by many researchers in different dimensions. Kendrick (1977) argues that productivity growth causes conservation in the use of scarce resources per unit of output and, *ceteris paribus*, leads to a higher standard of living. Hulten (1979) views productivity growth as a dynamic feedback process. He points out that the importance of increase in productivity in a given period is not only the rise in output as inputs are used more efficiently but also the implication for the future because the rise in output in this period results in additional savings and capital formation, and this will in turn further improve the productivity performance of the economy in future years. Other studies have supported viewpoints that productivity growth may lead to such benefits as less inflation, improved balance of trade, greater leisure time, and even environmental improvements (Dogramaci 1981).

Given the importance of productivity growth and hence the importance of productivity analysis, the measurement of productivity becomes a crucial issue. Thus far in the empirical studies of productivity, two major categories of productivity measures can be identified: partial productivity measures and TFP measures. The two measures differ in respect of the scope of the inputs covered: the former is limited to a single input such as labour, capital or intermediate inputs, and the latter combines a few or all inputs.

Since a partial productivity measure focuses on an individual input alone, its implication for the overall productive efficiency of resource use is ambiguous. Thus, partial productivity measures such as labour and capital productivity are seldom adopted alone to measure efficiency nowadays. A more comprehensive and economically meaningful measure of efficiency is the notion of TFP. The TFP measure is a clear improvement over partial productivity measures in that changes in the quantity and quality of *all* inputs can be accounted for, at least conceptually. As suggested by Caves and Christensen (1980, p.960), 'the best single measure of productive efficiency is total factor productivity'. Therefore, this study uses TFP as a leading indicator to evaluate the efficiency of the Chinese textile industry.

In addition to the TFP measure, the industry's efficiency is also examined in this study by assessing its allocative efficiency. Allocative efficiency is formally defined as 'the production of the "best" or optimal combination of outputs by means of the most efficient combination of inputs' (Pearce 1986, p.13). The efficient combination of inputs is that which produces output at the least opportunity cost. An allocatively efficient condition requires that for any given amount of a commodity, two factors of production (in the simplest case) are used in such quantities that the ratio of their prices is equal to the ratio of their marginal products (Hirshleifer 1988). Any other combination of the factor inputs, at these relative prices, would produce a smaller output and appear to be allocatively inefficient.

With the aid of these two measures of efficiency — TFP and allocative efficiency — we can assess the efficiency performance of China's textile industry with respect to its use of productive resources.

A review of the literature of TFP

As this study pays particular attention to the TFP performance of the Chinese textile industry, it is useful to take a look at the previous studies of TFP.

By definition, TFP is 'the ratio of quantity of output produced to a weighted combinations of quantities of different factor inputs used' (Dogramaci 1981, p.7). Denoting TFP by A and the level of output produced by Y, we have

$$A = \frac{Y}{\sum_{i=1}^{n} \alpha_i X_i} \tag{2.1}$$

where X_i is the quantity of factor input i and α_i is some appropriate weight for i = 1, 2, ..., n.

The roots of TFP as a measure of efficiency go back to the studies of Abramovitz (1956), Kendrick (1956, 1961) Solow (1957), Fabricant (1959), Stigler (1961) and

Denison (1962). Their common purpose of using TFP measure was to explore the unexplained portion of output growth after accounting for the conventionally measured growth in factor inputs. Accordingly, TFP is often referred to as the 'residual' (Domar 1962), and the rate of TFP growth is defined as 'the difference between the rate of growth of real product and the rate of growth of real factor inputs' (Jorgenson and Griliches 1967, p.250). In the context of a production function, this relationship can be expressed as

$$\frac{\dot{A}}{A(t)} = \frac{\dot{Y}}{Y(t)} - \frac{\dot{X}}{X(t)} \tag{2.2}$$

where *A(t), Y(t) and X(t)* denote the consistent indexes of TFP, output produced and inputs used in period *t* respectively, and $\dot{A}$, $\dot{Y}$ and $\dot{X}$ are the time derivatives of *A*, *Y* and *X* respectively.[4]

The interpretation of this residual term has proceeded in at least two distinct directions. Denison (1962, 1967), Kendrick (1961, 1973) and Star (1974) view TFP as a broad measure that captures the influence of many effects on output per unit of input, while Solow (1957), Jogenson and Griliches (1967) and Hulten (1975) stress the relationship of TFP to technical progress that is reflected by a shift in the production function. Comparatively, most TFP studies of more recent generations are based on the latter interpretation.

Using an explicit production function in conjunction with certain technical and market assumptions, Solow (1957) shows that a change in TFP can be interpreted as a shift of the underlying production function. This interpretation establishes the correspondence between the characteristics of a neoclassical technology and improvement in TFP, and naturally leads to the use of a production function approach to the econometric estimation of TFP growth in the empirical studies. By Solow's

[4] In practice, the derivatives in equation (2.2) are replaced by finite differences because the data are generally available only for discrete periods of time. Obviously, as a residual term, TFP growth can easily be affected by misspecification of the production function and improperly measured inputs (Nadiri 1970).

conceptualisation, TFP change and technical change have become synonymous terms in production analysis.

Another widely used method for computing TFP growth — the index number approach — is also closely related to production function (Jorgenson and Griliches 1967; Christensen and Jorgenson 1969). Most TFP index forms can be naturally derived from production relationships. Diewert (1976) has verified that certain TFP index is 'exact' for a production function. For instance, the Tornqvist TFP index is exact for a homogeneous translog production function. In this sense, the index number approach for computing TFP growth is dual to the production function approach and both results can be explained by the shift of production function.

It should be noted that Solow's interpretation of change in TFP (or technical change) is fully valid only if a production function has constant returns to scale and if all marginal rates of substitution are equal to the corresponding price ratios. Otherwise, some elements in addition to a pure shift of production function such as scale effects can be involved. For instance, with increasing returns to scale, estimates of TFP growth will overestimate shifts in the technology alone, because the standard measure of TFP cannot distinguish between the scale effect and technical progress. Although the involvement of extra elements does not substantially affect the use of production function and index number approaches in the TFP analysis, some further decomposition of TFP growth is generally needed.[5]

A more recently developed approach to measuring TFP growth is the econometric estimation of a cost function (May and Denny 1979; Denny et al. 1981a, 1981b; Cowing et al. 1981; and Kwon 1986). The cost function approach is based on the production function approach and duality theory, and it can be used to relate such technological characteristics as scale economies, input substitution, and technical change to observed changes in TFP. The cost function approach provides a powerful method for estimating TFP growth, especially at the firm level (Cowing and Stevenson 1981). On

[5] See Jorgenson and Griliches (1967), Denny et al. (1981a), and Sudit and Finger (1981) for more detailed discussions on this issue.

theoretical grounds, a direct cost function estimation of TFP changes is preferable to a direct production function estimation. The former allows for endogenous treatment of input prices in the production decision, while the latter method does not. However, the direct cost function estimations cause statistical problems because a subset of the explanatory variables (the outputs) is stochastic, and because the estimations involve more independent variables (Sudit and Finger 1981). In addition, the cost function approach is very demanding in respect of data on input prices. In the case of insufficient information on input prices such as in this study, the use of the cost function approach is not feasible.

There have been much efforts to investigate the sources or determinants of TFP growth (Griliches and Jorgenson 1966; Nadiri 1970; Denison 1979; Harriss 1981; Syrquin 1986; and others). As pointed out by Nadiri (1970, p.1137), TFP change is 'both the cause and the consequence of the evolution of dynamic forces operative in an economy — technical progress, accumulation of human and physical capital, enterprise, and institutional arrangements'. More specifically, two major sets of determinants of TFP growth may be identified: the technical characteristics of the production process and the movement of the relative factor prices.[6] The first set of determinants include the efficiency of production, the bias in technical change, the elasticity of substitution, the scale economies, and the homotheticity of the production function. However, these technical characteristics of the production process are highly interdependent and cannot be easily distinguished in the empirical studies due to disagreement on the definition of bias in technical change, difficulties in separating the embodiment effect from the augmentation effect of factor inputs, and the inevitable problem of aggregation (Nadiri 1970).

In addition to the above-mentioned determinants of TFP growth, some authors point to another source of TFP growth. In their studies of TFP growth in the U.S. economy, Massell (1961), Denison (1967) and Kendrick (1977) show that the interaction

[6] Here we assume that the production function is accurately specified, and that the inputs are properly measured.

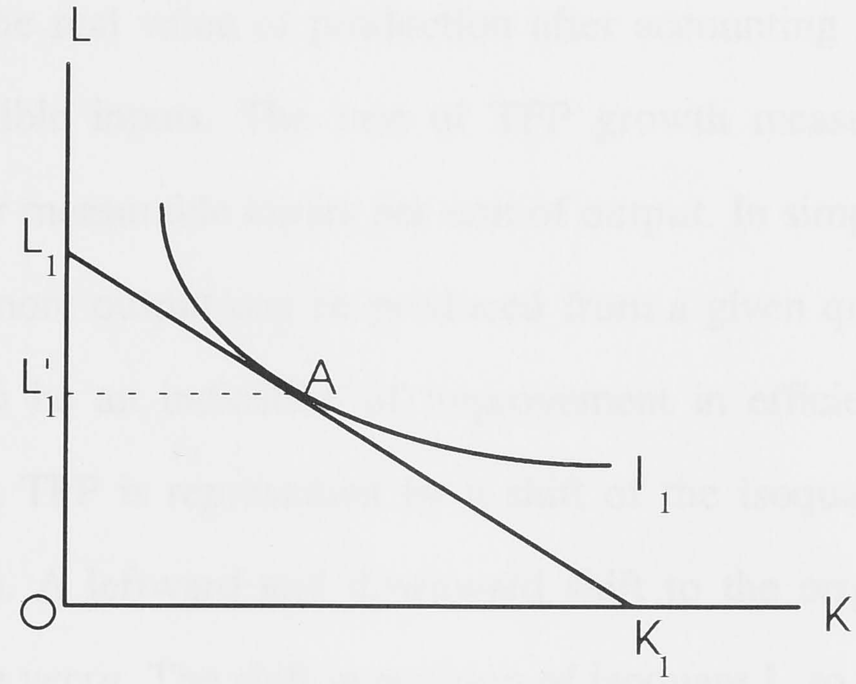
among various industries is an important source of overall increase in TFP. This is because TFP growth in one industry is generally transmitted to other industries in the form of improved quality of materials or external economies. On the other hand, growing industries with faster TFP growth create demand and cost pressures on the lagging industries and may force them to slow down further, and meanwhile, encourage the growth of complementary industries. Inter-industry shifts of resources and the changing role of technological progress among industries constitute dynamic forces which determine the acceleration or retardation of the overall growth rate in TFP and output (Nadiri 1972). Thus, it is also necessary to study the sources of TFP growth through the structural changes in an economy or in an industry.[7]

Analytic model of TFP and allocative efficiency

A graphical model of productivity measures of efficiency is illustrated in Figure 2.1 with the aid of isoquants.[8] The production isoquant is by definition the locus of the efficient combinations of inputs necessary to produce one unit of a given output. So, it represents an efficient frontier of the production. Assuming there are two inputs and one output, then the production process can be described as Y = f (K, L), where Y stands for output and K and L for capital and labour inputs respectively. The single isoquant I_1 in Figure 2.1 represents all the combinations of capital and labour capable of producing a maximum of one unit of output. The shape of an isoquant represents the specific characteristics of the production function. As long as the isoquant is convex to the origin with a continuously declining slope, it represents a production relationship characterised by elasticity of substitution between inputs larger than zero and smaller than infinity.[9] Some of the most widely used production functions such as the Cobb-Douglas, CES and translog functions can be characterised in this frame.

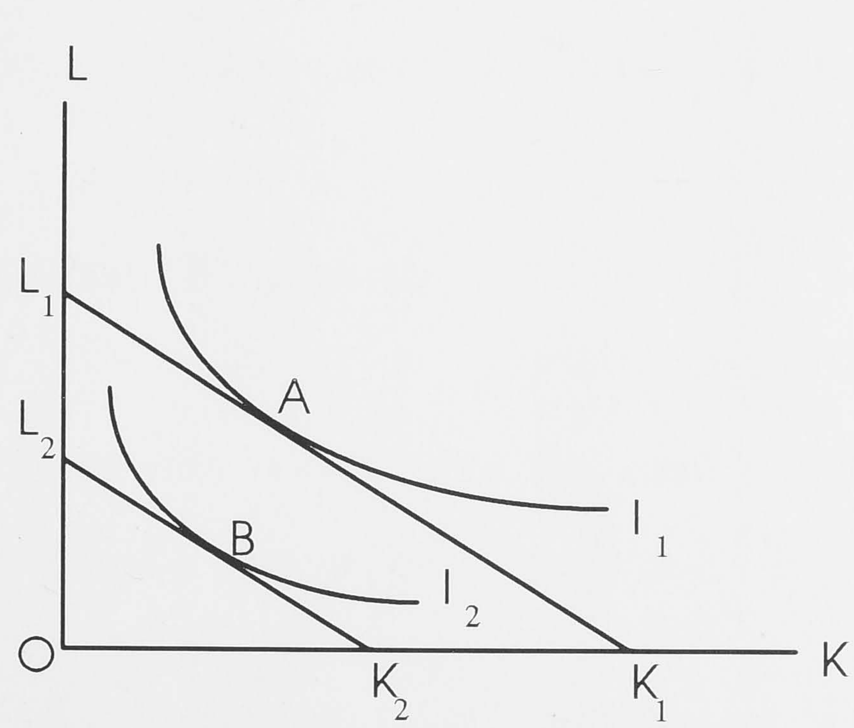
[7] In this study, this source of TFP growth is called 'structural efficiency' and analysed in Chapter 7.
[8] The basic idea of this graphical model is that of Wynnyczuk (1975). But, considerable modifications are made to incorporate both TFP and allocative efficiency in a single analytical framework.
[9] For more detailed discussion of isoquants, see Frank (1991) and Kreps (1990).

Figure 2.1 An illustration of productivity measures of efficiency



The actual employment of labour and capital per unit of output is determined by relative price. If relative price is represented by the slope of L_1K_1, then the most efficient way to produce one unit of output would be to use input combination A. The unit cost of production can in this case be measured in terms of either input. Productivity is then the reciprocal of the unit cost measurement. Should productivity here be measured in terms of quantity input of labour, total factor productivity will equal Y/OL_1, and labour productivity Y/OL_1'. Analogous measurements can be carried out in terms of capital.

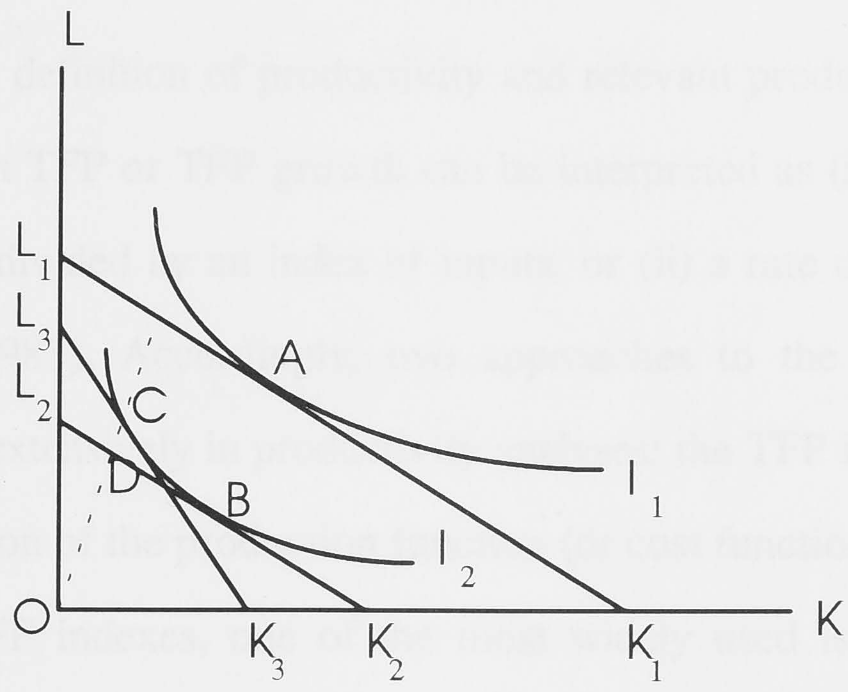
Figure 2.2 An illustration of change in total factor productivity



In empirical studies attention is often paid to TFP growth rather than its level (as it is in this study). As mentioned earlier, TFP growth is conventionally defined as the residual growth in the real value of production after accounting for the contribution of changes in the tangible inputs. The rate of TFP growth measures the extent of net savings in tangible or measurable inputs per unit of output. In simple terms, positive TFP growth means that more output can be produced from a given quantity of factor inputs and is considered to be an indication of improvement in efficiency. In this analytical model the change in TFP is represented by a shift of the isoquant (implying a shift in production function). A leftward and downward shift to the origin represents positive TFP growth and *vice versa*. The shift in position of isoquant I_1 to that of I_2 in Figure 2.2 results in an increase in TFP measured by OL_1/OL_2. By this shift, the optimal employment mix of inputs changes from A to B at the original prices.

Alternatively, change in efficiency may occur when the production process moves along an isoquant instead of a shift in position. Suppose that the relative price of labour

Figure 2.3 An illustration of allocative efficiency



declines, the new relative price is represented by the slope of line L_3K_3 shown in Figure 2.3. In this case, the optimal input mix becomes C instead of B. At this new optimal combination of inputs TFP does not change (measured at the new prices). However, there is a difference in allocative efficiency between B and C. C is thought to be allocatively more efficient than B and turns out to be the least-cost combination at the new relative price.[10] The proportional excess cost due to the use of an inappropriate combination of inputs is indicated by CD/OD. This distortion of input proportion refers to 'allocative inefficiency'. It follows that a pure allocative improvement takes place when the producer fails to achieve TFP growth but increases the output of one or more of the goods produced, without decreasing the output of any other goods, by reallocating inputs between processes away from a less efficient to a more efficient process.

Method for computing TFP growth

Since TFP plays a central role in this study, this section focuses on describing the computation of TFP growth. The methodological issues concerning assessment of

[10] Another way to see that B is allocatively inefficient is that at this point the conditions for producer equilibrium — marginal rates of transformation between pairs of inputs and outputs are equal to the corresponding price ratios — are not satisfied.

allocative efficiency will be discussed in Chapter 8 where allocative efficiency of China's textile industry is evaluated.

Based on the definition of productivity and relevant production theory discussed above, the changes in TFP or TFP growth can be interpreted as (i) the rate of change of an index of outputs divided by an index of inputs, or (ii) a rate of shift in a production function (Diewert 1981). Accordingly, two approaches to the measurement of TFP growth are adopted extensively in productivity analyses: the TFP index approach and the econometric estimation of the production function (or cost function).

Of all the TFP indexes, one of the most widely used is the Tornqvist (1936) index, which has been utilised empirically by Christensen and Jorgenson (1969, 1970) as a discrete approximation to the Divisia index and by Star (1974) in the context of productivity measurement. The Tornqvist index is a discrete approximation to the Divisia index and is based on the construction of the latter. The Divisia TFP index[11] can be derived from simple production relationships. Assuming competitive markets for all outputs Y and all inputs X, we obtain the following identity for total costs and revenues

$$\sum_{j=1}^{m} P_j Y_j = \sum_{i=1}^{n} W_i X_i, \tag{2.3}$$

where P_j and W_i are the unit prices of the jth output and the ith input, respectively.

Totally differentiating (2.3) with respect to time yields

$$\sum_{j=1}^{m} \dot{P}_j Y_j + \sum_{j=1}^{m} P_j \dot{Y}_j = \sum_{i=1}^{n} \dot{W}_i X_i + \sum_{i=1}^{n} W_i \dot{X}_i, \tag{2.4}$$

where a dot over a variable denotes the derivative of that variable with respect to time.

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[11] Divisia (1952) proposes application of the Divisia index to the measurement of TFP. The economic interpretation of the Divisia TFP index is discussed later by Solow (1957). As Sudit and Finger (1981) point out, the Divisia index has a number of attractive properties. It is unbiased subject to certain assumptions regarding underlying production function, thereby eliminating index-number biases related to base-year choices. The Divisia index also exhibits the reproductive property. This property is helpful for reducing the aggregation biases, particularly in the macro-level analysis. Finally, the Divisia index conforms to Fisher's reversal rule.

When we divide and multiply each term in (2.4) by the base-level value of its respective changing variable, and then divide the right-hand and left-hand sides of equation (2.4) by $\sum_{i=1}^{n} W_i X_i$ and $\sum_{j=1}^{m} P_j Y_j$, respectively, and then rearrange the equation, we get

$$\sum_{j=1}^{m} \frac{\dot{Y}_j}{Y_j}\beta_j - \sum_{i=1}^{n} \frac{\dot{X}_i}{X_i}\alpha_i = \sum_{i=1}^{n} \frac{\dot{W}_i}{W_i}\alpha_i - \sum_{j=1}^{m} \frac{\dot{P}_j}{P_j}\beta_j, \quad (2.5)$$

where

$$\alpha_i = \frac{W_i X_i}{\sum_{i=1}^{n} W_i X_i}$$

is the share of the cost of the ith input in total factor costs and

$$\beta_j = \frac{P_j Y_j}{\sum_{j=1}^{n} P_j Y_j}$$

is the share of the revenue of the jth output in total revenues.

The conventional Divisia quantity indexes for aggregate output (Y) and total input (X) are defined in terms of proportional rates of growth as

$$\frac{\dot{Y}}{Y} = \sum_{j=1}^{m} \beta_j \frac{\dot{Y}_j}{Y_j}$$

and

$$\frac{\dot{X}}{X} = \sum_{i=1}^{n} \alpha_i \frac{\dot{X}_i}{X_i}$$

respectively. The corresponding Divisia price indexes for aggregate output and total input, say P and W, have rates of growth

$$\frac{\dot{P}}{P} = \sum_{j=1}^{m} \beta_j \frac{\dot{P}_j}{P_j}$$

and

$$\frac{\dot{W}}{W} = \sum_{i=1}^{n} \alpha_i \frac{\dot{W}_i}{W_i}$$

respectively.

As shown in equation (2.2), by definition the rate of TFP growth can be expressed as a difference between the rate of output growth and the rate of growth in factor inputs. Thus we have

$$\frac{\dot{A}}{A} = \frac{\dot{Y}}{Y} - \frac{\dot{X}}{X} = \sum_{j=1}^{m} \frac{\dot{Y}_j}{Y_j} \beta_j - \sum_{i=1}^{n} \frac{\dot{X}_i}{X_i} \alpha_i \ . \qquad (2.6)$$

Recall that A refers to the level of TFP.

According to (2.5), the rate of TFP growth can also be expressed as

$$\frac{\dot{A}}{A} = \frac{\dot{W}}{W} - \frac{\dot{P}}{P} = \sum_{i=1}^{n} \frac{\dot{W}_i}{W_i} \alpha_i - \sum_{j=1}^{m} \frac{\dot{P}_j}{P_j} \beta_j \ . \qquad (2.7)$$

These two expressions of TFP growth are dual to each other. Thus, the percentage changes in TFP can be computed either from quantity indexes of total output and total input or from the corresponding price indexes.

The Divisia quantity index of TFP growth derived in (2.6) is measured in terms of instantaneous changes. For data available at discrete intervals (this is the most common case), the Tornqvist TFP index can be used as an approximation to the Divisia continuous TFP index. The Tornqvist discrete TFP index is expressed as

$$\Delta A = \frac{1}{2} \sum_{j=1}^{m} (\beta_{jt} + \beta_{j,t+1}) \ln(\frac{Y_{j,t+1}}{Y_{jt}}) - \frac{1}{2} \sum_{i=1}^{n} (\alpha_{it} + \alpha_{i,t+1}) \ln(\frac{X_{i,t+1}}{X_{it}}). \qquad (2.8)$$

Equation (2.8) says that the percentage changes in TFP can be expressed as the difference between the sums of the weighted changes in the quantities of outputs and inputs. It has been shown by Diewert (1976) that the Tornqvist index of TFP growth in (2.8) is exact for a linearly homogeneous translog production function.[12]

Another commonly used method — the econometric estimation of TFP growth — involves the explicit specification of production function or cost function. The pioneering work in developing this approach is that of Solow (1957), who demonstrates that the rate of TFP growth can be identified with the rate of Hicks-neutral technical change. This achievement has clearly established the equivalence between technological progress and TFP growth, at least under the maintained assumptions of constant returns to scale and a competitive equilibrium.

The derivation of this approach begins with a general production function. Assuming a case of single-output, the underlying production function can be written as

$$Y = f(X_1, X_2, \ldots, X_i, \ldots, X_n, t), \tag{2.9}$$

where t is a time variable that represents the shift in the production function over time or technical change. Assuming that technical change is Hicks-neutral — that is, the innovative process does not affect the technical ratios among the inputs — then the production function in (2.9) takes the form

$$Y = A(t) f(X_1, X_2, \ldots, X_i, \ldots X_n), \tag{2.10}$$

where $A(t)$ is the TFP variable or technical change variable. Differentiating Y totally with respect to time, we have

$$\dot{Y} = \dot{A}(t)\frac{Y}{A} + \sum_{i=1}^{n} \frac{\partial f}{\partial X_i} \dot{X}_i A. \tag{2.11}$$

Rearranging and manipulating (2.11), we get

[12] Recall that many other production functions, including the Cobb-Douglas function used in this study, are special cases of the translog function.

$$\frac{\dot{A}}{A(t)} = \frac{\dot{Y}}{Y} - \sum_{i=1}^{n} \frac{\partial Y}{\partial X_i} \cdot \frac{\dot{X}_i}{Y} \cdot \frac{X_i}{X_i}. \tag{2.12}$$

Assuming profit-maximisation behaviour, the marginal products of factor inputs equal their respective market prices, i.e., $(\partial Y)/(\partial X_i) = W_i / P$, for all i

$$\frac{\dot{A}}{A(t)} = \frac{\dot{Y}}{Y} - \sum_{i=1}^{n} \frac{W_i X_i}{PY} \cdot \frac{\dot{X}_i}{X_i} = \frac{\dot{Y}}{Y} - \sum_{i=1}^{n} \alpha_i \frac{\dot{X}_i}{X_i}, \tag{2.13}$$

where $a_i = (W_i X_i)/(PY)$ is the share of ith input in the total value of output.[13]

The shift of the production function over time, $\dot{A}/A(t)$ in (2.13), is analogous to the Divisia continuous expression of TFP change in (2.6). This implies that in the empirical studies of TFP, the production function in (2.10) can be estimated either econometrically or through computation of TFP indexes. The major relative advantage of the TFP index approach is that it relies neither on the specifications of the production function nor on the statistical estimation techniques. Therefore, it can avoid those problems resulting from misspecification and estimation errors. The major disadvantage of the standard TFP index measure is the necessity to assume *a priori* the prevalence of competitive conditions in markets for all outputs and inputs. Otherwise, the cost and revenue shares used to calculate TFP indexes cannot be economically justified. Nevertheless, as described in the next paragraph, this problem can be largely solved by using the estimated output elasticities of factor inputs instead of real factor shares. Overall, the TFP index approach appears to offer a less sophisticated but potentially more reliable method for computing TFP growth than econometric estimation of the production function (Sudit and Finger 1981). Following many previous studies (Caves and Christensen 1980; Gollop and Roberts 1981; Denny and Fuss 1983; Luke Chan and Mountain 1983; Jorgenson et al. 1987a, 1987b; and Gao 1993), this study chooses to use

[13] Here α_i has the same meaning as that defined in equation (2.5), because as shown by equation (2.3), we assume that total costs equal to total value of output. So in both equations α_i represents the share of the ith input in total factor costs.

the TFP index as a major measurement of TFP. While this study mainly uses the TFP index approach, the econometric estimation of production function is also used whenever the index approach is less appropriate to the data.[14]

In the practice of constructing TFP indexes, one of the key steps is to determine cost shares of inputs and revenue shares of outputs, α_i and β_j in equation (2.6). In the single-output case, as in this study, the effort is reduced to properly determining the values of α_i. In the context of China's economy, however, use of factor shares as weights to compute TFP indexes is not justifiable. In the TFP index approach, factor shares are often used as estimates of the elasticities of individual input with respect to the total output. This procedure is satisfactory only if the factor prices equal their marginal products — that is, under the assumption of perfect competition in both output and input markets.[15] It is widely believed that such an assumption is unlikely to be plausible for China's industrial economy (Jefferson and Rawski 1988). Thus, the computation of TFP indexes in this study makes use of estimated output elasticities in place of real cost shares. On the other hand, it is important to note that along with the development of China's economic reform, the competition in output and input markets has been intensifying consistently. Therefore, we would expect that the estimated output elasticities of factor inputs are getting closer to real cost shares, especially using the data of the 1990s.

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[14] This situation arises in Chapter 9 when the pooled firm data are used to estimate TFP growth for the export and non-export sectors. In that case, use of firm level data causes computational difficulties in applying index approach and the production function approach becomes more practical and efficient.
[15] See Caves and Christensen (1980) for more detailed discussion on this point.

3 An overview of the Chinese textile industry

The present chapter provides a general overview of China's textile industry so as to facilitate the in-depth analysis of the industry's performance in succeeding chapters. The first section examines the major role of the textile industry in the Chinese economy. The second section analyses some key economic characteristics of the textile activity in China, and the third section reviews the development of the Chinese textile industry in the pre-reform period for the purpose of providing a background to the key analysis of the industry's performance in the reform period.

Role of the textile industry in China's economy

The textile industry was among the first industries to be established in China and has made a substantial contribution to the national economy. The industry's size, output, employment and export capacity are important indicators of its role in China's economy.

The textile industry has long been a major element in China's industrial base. In the 1950s, the textile industry accounted for one-fifth to one-fourth of China's gross industrial output value. Since the mid-1960s, the share of the textile industry in gross industrial production has been declining. However, the industry still accounted for 15.6 per cent of national industrial output in 1994.

As textile products are necessities of life, the textile industry naturally becomes a major supplier of consumer goods. In the 1970s and early 1980s, textiles accounted for over one-fifth of the total retail value of consumer goods. In the early 1990s, this share declined to about 16 per cent, though textiles remained the second largest consumer goods in China just behind food.

One of the key elements in assessing the role of the industry relates to the national objective of full employment. The labour intensive nature of textile activities is advantageous to the expansion of employment in this sector. In 1994 over 10 per cent of

China's industrial labour force was engaged in the textile industry (Wu 1995). The textile industry is currently the second largest urban industry employer in China.

Exports of textile goods have secured the foreign exchange resources necessary for China's industrialisation. Since the mid-1970s, the textile industry has accounted for a steady share of one-fifth to one-fourth of China's total export earnings. It is worth noting that since economic reform started in 1978, the importance of the textile industry in China's foreign trade has been rising. The industry's share in China's total export value increased from 24.1 per cent in 1977 to 29.4 per cent in 1994. Between 1986 and 1994, the industry maintained the number one position as foreign exchange earner in the Chinese economy.[16] Indeed, China's trade surplus in recent years can be attributed largely to the contribution made by textile exports. For example, the textile industry realised a net export value of US$18.9 billion[17] in 1994 but China's total trade surplus was only US$5 billion in the same year (CTERC 1995, No.5). Without exports of textile goods, China would have suffered a trade deficit of US$13.9 billion in 1994.

The role of the textile industry in some local economies is even more pronounced. For example, in China's largest textile base, Jiangsu province, the textile industry accounts for about one-fifth of gross industrial output value, one-tenth of provincial revenue and one-third of export earnings (Pang et al. 1989). In several provinces such as Zhejiang, Hubei and Shannxi, about one-half of export earnings derives from the textile industry (Xi 1989). In China's rural regions, the textile industry has become the largest industrial sector and plays a significant role in absorbing surplus labour from agriculture. The main indicators reflecting the industry's role in China's economy are summarised in Table 3.1.

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[16] The machinery industry has occupied number one position since 1995.

[17] Net export value = export value - value of imported goods related to the industry. Included in the import value are fibres and other raw materials, textiles, clothing, and textile machinery. In 1994 total value of these imports was US$16.68 billion and export value was US$35.55 billion. Thus, net export value is US$35.55 billion - US$16.68 billion = US$18.87 billion.

Table 3.1 Share of the textile industry in the national economy or industry
(percentage)

	Share in gross industrial output value	Share in retail value of consumer goods	Share in total industrial employment	Share in China's total export value
1952	27.4	19.3	18.8	11.2
1957	22.2	18.7	19.6	18.0
1965	18.4	19.1	8.9	21.9
1978	14.7	22.0	7.7	25.0
1980	17.4	23.0	9.0	24.1
1985	17.6	18.9	10.2	19.4
1990	16.1	16.3	11.7	22.3
1994	15.6	16.2	11.0	29.4

Source: *China Textile Yearbook*, 1995, pp.7-13.

Examination of the direct impact of the textile industry on the Chinese economy understates its role for there are secondary effects that occur through links with other industries and sectors. These secondary effects can be decomposed as an 'indirect' impact on other sectors which supply inputs to or use inputs from the textile industry, and an 'induced' impact on other sectors through the contribution of wages and taxes paid by the textile industry to the aggregate demand. On the basis of the 1987 China Input-Output Table, the output multiplier of the textile industry is calculated to be 2.35. This means that if the output of the textile industry increased by one unit, it would cause a corresponding increase in national production by 2.35 units. This multiplier effect does not include the effect of 'induced' demand. If the latter were taken into account, the textile industry would be expected to have an even larger impact on the Chinese economy.

In summary, at this stage of China's industrialisation the textile industry plays a dual role — namely, ensuring the proper utilisation of resources and the earning of foreign exchange for China's modernisation program. This role has been crucial to the Chinese economy in general and the growth of the textile industry in particular.

Major economic characteristics of the textile industry

Several factors account for the industry's growth, structure and productivity performance. These can be roughly classified into supply-related characteristics and demand-related characteristics.

Supply-related characteristics

On the supply side, three basic characteristics are essential to understanding the Chinese textile industry and its growth potential. The first is the low capital intensity of textile production which is just another way of saying that textile activity is relatively labour intensive compared with most other industrial activities. Table 3.2 lists the capital intensities of China's eleven major industries in terms of fixed capital per worker.[18] It is easy to see that the textile industry has been among the least capital-intensive, or most labour-intensive, sectors in the Chinese industry.[19] The relatively high percentage of labour involved in textile production means that textile industry is highly attractive in a labour-abundant economy like China.

Another fact revealed in Table 3.2 is that the capital intensity of the textile industry has risen more slowly than that of most other industrial sectors as well as Chinese industry as a whole. From 1952 to 1984 the capital intensity of Chinese industry as a whole increased by 3.9 times, but it increased by only 2.5 times for the textile industry. As a result, the ranking of the textile industry by capital intensity has declined while its labour-intensiveness has become even stronger. Two implications can be drawn from this. First, if the growth rate in capital intensity is taken as an approximate indicator of technical progress, then it would suggest that the Chinese textile industry has

[18] In the literature, there are a couple of ways to express capital intensity. Among these, the most common is to use capital-labour ratio. In this study, capital-labour ratios are represented by fixed capital per worker.

[19] The classification of the textile industry in this table does not include the apparel sector. Since the apparel sector is far less capital intensive than other sectors in the textile industry, the figures displayed in the table actually understate the degree of labour intensity of the Chinese textile industry.

experienced relatively slow technical advance. Second, the low requirement of capital combined with the slower increase in capital intensity indicates that the technology employed in the Chinese textile industry is relatively simple. This in turn points to a lower demand for skilled labour.

Table 3.2 Comparison of fixed capital per worker in the Chinese industry[a]

RMB¥

	1952	1957	1965	1978	1984
National total	2,918	4,473	8401	10,501	14,393
Metallurgical industry	5,418	9,100	16,315	16,060	21,895
Power industry	24,750	33,675	41,234	48,455	61,985
Coal industry	3,607	5,108	7,765	7,678	11,615
Petroleum industry	19,091	21,702	23,216	37,596	60,493
Chemical industry	3,090	4,323	10,760	11,814	15,518
Machinery industry	2,663	4,368	8,275	8,881	11,346
Building materials	1,479	2,637	5,699	6,852	10,195
Forestry industry	n.a.	1,770	3,840	6,689	8,977
Food industry	1,758	2,460	4,436	5,434	8,895
Paper-making industry	4,217	5,583	10,000	10,175	13,187
Textile industry[b]	2,488	3,203	4,469	5,731	8,721

Notes: (a) Figures in this table refer to state-owned industrial enterprises.
(b) Figures for the textile industry do not take the apparel industry into account.
Source: *Statistical data of China's Industrial Economy: 1949-1984*, p.113.

A second characteristic of the textile industry is its relatively low economies of scale. An accurate comparison of scale economies between different branches of industry is extremely difficult because of considerable variations between the adopted technologies and hence the different cost functions that reveal the economies of scale. Nevertheless, a rough comparison of scale economies may be made by comparing the average size of existing firms in the different industries. The use of this indicator is based on the theoretical underpinning of the survivor technique applied in the studies of economies of scale. The rationale of the survivor technique is that the firms that survive the best in competitive markets are those with minimum costs (Stigler 1958; Hay and Morris 1991).

Table 3.3 Average firm size in the Chinese manufacturing industry,[a] 1985

	RMB¥ 10 thousand Average firm size[b]
Total manufacturing	168.55
Food, beverages and tobacco	67.32
Paper-making	126.29
Power generation, steam and hot water production	855.94
Petroleum processing	3,237.87
Chemicals	412.96
Smelting and pressing of metals	2,062.70
Machine building, electric and electronic products	223.62
Textile industry	148.07
Of which: Man-made fibres	3,127.15
Cotton	366.66
Wool	371.42
Bast fibre	310.04
Silk	161.42
Knitting	92.94
Apparel	22.84
Primary textile and clothing	123.50

Notes: (a) Figures in this table include independent accounting manufacturing enterprises at township level and over.
(b) Average firm size is measured by the original value of fixed capital.

Source: *1985 Industrial Census Data of People's Republic of China, Volume 3: Total Industrial Enterprises*, pp.90-123, pp.166-200.

Firm size can usually be defined in terms of capital, number of workers, and output value. Among them, firm size defined by capital is considered to be the most appropriate in cross-industry comparison (Little et al. 1987). Table 3.3 shows the average size of enterprises in terms of fixed capital in China's eight major manufacturing industries in 1985. It can be seen that the average size of firms in the textile industry was smaller than the manufacturing industry as a whole. In particular, it was much smaller than the average size of firms in the heavy industrial sectors. If we exclude the man-made fibre sector from textile industry, then the average firm size in this industry will be further reduced, even smaller than the paper-making sector in light industry. It can also be seen that within the textile industry, firms in the knitting and apparel sectors have been much smaller in size than those in other sectors. The relatively small size of existing firms in the textile industry implies a low level of scale economies in textile activity.

A third feature is that the textile industry is generally more competitive than many other industries in China. This important structural characteristic is indicated by the relatively low share of large and medium sized enterprises in the textile industry. Table 3.4 shows this share in China's eleven major industries in 1986. It can be seen that the share of large and medium sized enterprises in the textile industry was slightly lower than for the national industry as a whole, and much lower than for most heavy industrial sectors. If we consider only the primary textile and clothing sector, then the relevant share in the textile industry appears to have been significantly lower than the industrial average.

Table 3.4 Share of large and medium sized enterprises in major industries, 1986

	Share of large and medium sized enterprises (%)
National total	43.76
Coal mining and dressing	47.47
Petroleum and natural gas extraction	72.94
Food, beverage and tobacco	29.45
Paper-making	33.87
Power generation, steam and hot water	78.98
Petroleum processing	73.24
Chemicals	48.30
Building materials and non-metal mineral products	25.76
Smelting and pressing of metals	60.49
Machine-making, electric and electronic products	50.97
Textile industry	43.38
Of which: primary textile and clothing	38.91

Notes: (a) The share of large and medium sized enterprises is defined in terms of the proportion of output value produced by large and medium-sized firms to gross industrial output value.
(b) The firm size is classified by the original value of fixed capital.
Source: *Statistical Yearbook of China*, 1988, pp.312-315, pp.391-399.

The relatively low share of large and medium sized enterprises points to relatively strong competition in the textile industry. This feature is closely related to the other two characteristics noted above and, to a large extent, determined by them. A low requirement for capital and scale economies, combined with the use of relatively simple technology, easy access to raw materials, and the presence of vast markets close at hand imply less barriers to entry and exit in the textile industry. In addition, the great similarities in technology between primary textile industry sectors also lead to relatively low switching costs (from one sector to another, from one product to another). These elements naturally result in stronger competition in the textile industry. Apart from acute competition in the domestic market, the Chinese textile enterprises also faces stronger and increasing competition in overseas markets because the textile industry has the heaviest export dependence among all of China's industries. The high degree of competition in China's domestic and export markets is expected to make a substantial contribution to the growth and efficiency of the textile industry.

Demand-related characteristics

On the demand side, the characteristics related to demand elasticities are considered important to understanding of the Chinese textile industry. The first such characteristic is that domestic demand for textile products is price-inelastic. The estimated price elasticity of demand for household textile goods, which forms a major part of textile consumption in China, was -0.43 during the period 1978-92 (see Table 3.5). This low price elasticity is mostly determined by the fact that textile goods are a major category of consumer goods, and have few substitutes. Although textile goods as a whole are relatively price inelastic, some goods within this category can still have considerably high price elasticity. As shown in Table 3.5, the price elasticities of demand for wool fabric, knitted wool, silk fabric, and knitted underwear are above unity due to the existence of close substitutes in the range of textile goods. By contrast, the low price elasticity of demand for cotton and chemical fibre fabrics mainly derives from the income effect rather than the substitution effect. According to household consumption survey data, at certain income levels cotton and chemical fibre fabrics have shown a tendency to become inferior goods in China.

Thus, a considerable proportion of the substitution effect can be offset by the income effect.

Table 3.5 Estimated price and income elasticities of demand for textiles(a)

	Price elasticity	Income elasticity
Textile goods as a whole	-0.43	0.91
Cotton & chemical fibre fabrics	-0.39	0.62
Wool fabric	-1.08	1.85
Knitted wool	-1.84	1.96
Silk fabric	-1.13	2.26
Knitted underwear	-1.05	1.23

Note: (a) Estimation is made for the period 1978-92. Double-log functions are used for estimation.
Sources: *Handbook of Textile Economy*, 1987, pp.96-104; *China Fibre Yearbook*, 1989, pp.83-92; *China Textile Yearbook*, 1995, pp.1-2, pp.31-33, pp.89-105.

Another demand-related feature is that domestic demand for textile goods is income-inelastic. The estimated income elasticity of demand for textile and clothing was 0.91 in the sample period 1978-92 (shown in Table 3.5). The estimated elasticity of textiles and clothing in this study is apparently higher than the previous estimation made by Van der Gaag (1984), which was between 0.67 and 0.72 for the period 1981-82; but is lower than and close to the income elasticity estimated by Byron (1992), which was 0.97 for the period 1982-87. However, all three estimations suggest that China's domestic demand for textile goods is income-inelastic. This result is also consistent with expectations based on economic theory. Textile goods are generally considered to be necessities more than luxuries, and hence the income elasticity of textile goods is expected to be below unity. It can also be seen from Table 3.5 that although textile goods as a whole have been income-inelastic, some goods within this group such as wool fabric, knitted wool, and silk fabric appear to have been income-elastic. As income elasticity reveals the growth potential of a product, those textile products with higher income elasticities are likely to grow more rapidly and gain shares in the industrial structure.

In summary, the Chinese textile industry is characterised by relatively high labour intensity, intense competition, and a low level of scale economies, as well as price-inelastic and income-inelastic domestic demand. An awareness of these characteristics is a prerequisite for further investigation of some important aspects of the industry's growth and efficiency.

Development of the Chinese textile industry in the pre-reform period

Before the attention is focused on the growth of the Chinese textile industry in the reform period, it is useful to review briefly the development of this industry in the pre-reform period (1949-77). [20]

The founding of the People's Republic of China in 1949 substantially changed the nature of China's social and economic regime. The semi-market economy that existed in the pre-1949 period was replaced by a centrally planned economy, and the means of production converted from private to public ownership. Correspondingly, enormous changes occurred in the Chinese textile industry.

During the period of economic recovery in 1949-52, the Chinese government took over all the mills previously run by the National Party (KMT) government. The government also took over the control and allocation of all raw materials used in textile production, and the production of state-owned and most privately-run textile enterprises was taken into the state planning channel. In order to deal with a shortage of cotton, the government raised the relative price of cotton to grain. In the meantime, the government took a number of other measures to stabilise the textiles market and to improve the management of textile enterprises. As a result, textile production fully recovered during this period. In 1952 the industry produced 3.6 million bales of cotton yarn and 3.8 billion metres of cotton fabric, which was double that of 1949 production levels. Other textile products also substantially exceeded 1949 levels.

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[20] A major source of data used in this section is Qian et al. (1984), unless otherwise specified.

Between the early 1950s and the mid-1970s, the main objectives of China's industrial planning were to lay a foundation for rapid industrialisation and a strong national defence. In order to achieve these goals, priority was given to basic capital and producer goods industries (heavy industry), and some restraints were put on the consumer goods industries (light industry). As the mainstay of China's light industry, the textile industry was accorded very low priority, receiving only 4.4 per cent of total industrial investment in this period. As a result, it achieved a very low rate of growth. Between 1952 and 1977, when the gross output value of national industry rose by 13 times and heavy industry surged by 23 times, the textile industry registered only a fourfold increase. The average annual growth rate of the textile industry was 5.8 per cent in this period (see Table 3.6). As a result, the share of the textile industry in the value of industrial output decreased from 27.4 per cent in 1952 to 14.5 per cent in 1977. In order to conduct a more detailed analysis, the pre-reform period is divided further into three sub-periods: 1953-57, 1958-65, and 1966-77.

In the period of China's First Five-Year Plan (1953-57), the industry's gross output value increased by 9.6 per cent annually, which was 3.8 percentage points higher than the rate of average growth realised during the 1952-77 period (see also Table 3.6). There were two events of real significance to the industry in this period. The first was a thorough shift in the industry's ownership structure. In 1949 privately-run enterprises produced 67 per cent of the total output value of the textile industry. During the recovery period this share gradually decreased, but still accounted for 50 per cent of total output value in 1953. After 1953 moves to turn private enterprises into public ownership accelerated. In 1955 the share of private enterprises in total output value declined sharply to 21.5 per cent, and one year later this share became zero. The second major event was the significant expansion of capacity in the industry. Between 1953 and 1957 the textile industry built 2.4 million cotton spindles and 33,000 wool spindles. The capacity of the cotton and wool processing industries increased by 67.9 and 20.8 per cent respectively. To improve regional distribution, new plants were mainly set up in the raw material producing regions.

Table 3.6 Growth of the Chinese textile industry in the pre-reform period, 1949-77

	Gross output value(a) (RMB¥ 100 million)	Indexes (1952=100)
1949	56.0	47
1952	118.1	100
1957	187.0	158
1962	163.4	138
1965	277.8	235
1970	327.8	277
1975	469.2	391
1977	482.7	409
Average growth rate (%)		
1952-77	5.8	
1953-57	9.6	
1958-65	5.1	
1966-77	4.7	

Note: (a) Figures of gross output value are at 1980 constant prices.
Sources: *China Fibre Yearbook*, 1991/92, p.5; *Compilation of Statistical Data of the Textile Industry: 1949-1988*, p.11.

From 1958 to 1965 the textile industry experienced its first setback. The Great Leap Forward which began in 1958 produced chaos in the industry. This was exacerbated by natural calamities between 1959 and 1962 that resulted in a substantial decrease in natural fibre production. In 1962 the production of cotton yarn fell to 3 million bales, only 65 per cent of the 1957 level. In the meantime, the ratio of capacity utilisation decreased from over 90 per cent to just 60 per cent. The industry's average growth rate of gross output value was -3.3 per cent between 1958 and 1962. However, over the next three years the industry restored its growth vitality. By 1965, China's production of cotton yarn increased to 7.2 million bales, which gave it a world ranking of second. In the period 1958 to 1965 the textile industry still managed to realise a growth rate of 5.1 per cent because the high growth rate in 1963-65 (21.3 per cent) successfully offset the negative effects of the 1958-62 period.

The commencement of the Cultural Revolution in 1966 produced another setback in the textile industry. From 1966 to 1977 textile production revealed a decline in six individual years. The average growth rate in terms of gross output value was only 4.7 per cent, the lowest in the pre-reform period. Remarkably, in 1970 China's production of cotton yarn and cotton fabrics reached 11.3 million bales and 9.2 billion metres respectively, which made China the number one producer of cotton yarn and fabric in the world. However, in terms of per capita consumption of textiles, China still had very low levels by international standards.

Three characteristics of the textile industry in the pre-reform period are worth noting.

First was the implementation of an import substitution strategy during this period. Prior to 1949 the industry's supply of textile products fell short of basic domestic needs. During the 1940s about one-half of China's textile needs was met by imports. This situation has changed substantially since the early 1950s. By 1977 China's self-sufficiency in textile products almost reached 100 per cent, with the help of rationing of cotton textile consumption. Moreover, with an annual surplus of US$1,629 million in textiles trade, China became a net exporter of textiles. Initially, the drive towards self-sufficiency, and later the urge to increase foreign exchange earnings through increased exports, exerted an expansionary influence on the Chinese textile industry. The change in the situation of China's textiles trade testifies to the success of the textile industry in implementing an import substitution strategy in the pre-reform period, which in turn created an appropriate basis for the implementation of its export promotion strategy in the subsequent period.

Second, there was an improvement in the structure of the industry, both in sectoral structure and regional distribution. Prior to 1949 the structure of the textile industry inclined mostly towards the cotton textile sector. The share of cotton textile products in the industry's gross output value was nearly 90 per cent in the late 1940s. Textile production was highly focused on the coastal region: some 87 per cent of cotton processing capacity and 90 per cent of wool processing capacity were located in this region in the late 1940s. Shanghai alone possessed 48 per cent and 75 per cent respectively of capacity in these two sectors. This structure had disadvantaged development of the textile industry and had to be corrected. Throughout the pre-reform period, there was steady progress in solving these structural problems. By 1977 the share of the non-cotton sectors in total output value increased to 29.2 per cent, and the share of inland areas in total cotton and wool processing capacity increased to 40 per cent and 21 per cent respectively. This improvement in the industry's structure is thought to have exerted positive impacts on the industry's growth and structural change in the reform period.

Third, the relatively slow growth of the textile industry in the pre-reform period appeared to derive from an unstable base that had been created, as reflected in the serious fluctuations in textile production. In this period the coefficients of fluctuation[21] ranged from -2.13 to 3.84, which is thought to be rather high for industrial growth. Most of the fluctuation was attributable to the economy-wide turbulence that characterised this period. In particular, the setbacks of the Great Leap Forward (1958-60) and the years of turmoil associated with the Cultural Revolution (1966-76) appear to have exerted large negative impacts on the Chinese economy as well as on the textile industry.

Conclusion

The textile industry is a leading industrial sector in China and plays a significant role in the utilisation of resources and the earning of foreign exchange for the Chinese economy. The Chinese textile industry is characterised by high labour intensity, a low requirement for scale economies and relatively intense competition, as well as by price-inelastic and income-inelastic demand for textile goods in the domestic market. These characteristics have been critical determinants of textile industry development.

In the pre-reform period, development in the textile industry was characterised by slow growth and pronounced fluctuations in production. This situation was mainly attributable to political turmoil during this period. To change this situation, the industry

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[21] The coefficients of fluctuation are defined as deviations of growth rates in individual years from the average growth rate of the industry during a certain period. The coefficients of fluctuation are calculated according to following formula:

(yearly growth rate - average growth rate) / average growth rate.

The range of changes in the coefficients of fluctuation is ultimately determined by the lowest and the highest annual rate of growth in a certain period.

had to rely on a comprehensive reform in China's economy. On the other hand, the industry successfully implemented import substitution and improved on the major structural problems that characterised the pre-reform period. These achievements provided a base for the industry's take-off in the reform period.

4 Growth and structural change of the textile industry

China's economic reform ended the slow growth of the textile industry in the pre-reform period. The acceleration in output growth was associated with structural dynamism in the industry. This chapter examines the growth performance of the Chinese textile industry and associated structural change in the reform period.

The first section of the chapter investigates the rates and pattern of growth in the reform period for the textile industry as a whole. The second section shows how variations in aggregate growth are related to what happens at the sectoral level. The concept of structural change is briefly introduced in the third section. The pattern, features and major determinants of change in the sectoral structure of the industry are discussed in the fourth section. The industry's ownership structure is analysed in the fifth section, while some conclusions are presented in the sixth section.

Rate and pattern of growth in the reform era

Annual growth rates[22] of China's textile industry in the reform period (1978-94) are shown in Table 4.1. The industry as a whole registered an average annual growth rate of 13.3 per cent between 1978 and 1994. This growth rate was not only much higher than the 5.8 per cent average achieved during 1952-77, but also higher than the best achieved during the pre-reform period of 9.6 per cent (attained during the period of the First Five-Year Plan, 1952-57). By virtue of the higher growth rates achieved over the reform era, the average annual growth rate of the textile industry in the 1952-94 period rose significantly to 9 per cent.

[22] The growth rates in this study are calculated from gross output value. Despite the defect of double-counting, gross output value provides the only comprehensive official data series that reflects the growth of the textile industry as a whole.

Table 4.1 Growth of China's textile industry in the reform period, 1978-94

	Gross output value[(a)] (RMB¥ 100 million)	Annual growth rate (%)
1978	608.5	-
1979	696.3	14.4
1980	856.8	23.1
1981	1,003.0	17.1
1982	1,008.9	0.6
1983	1,109.0	9.9
1984	1,261.9	13.8
1985	1,472.5	16.7
1986	1,521.6	3.3
1987	1,710.3	12.4
1988	1,938.7	13.4
1989	2,137.3	10.2
1990	2,312.0	8.2
1991	2,544.2	10.0
1992	3,058.7	20.2
1993	3,698.0	20.9
1994	4,489.3	21.4
Average annual growth rate (%)		
1978-94		13.3
1978-80		18.7
1981-85		11.4
1986-90		9.4
1991-94		18.0

Note: (a) Figures of gross output value are at 1980 constant prices.
Sources: *Almanac of China's Textile Industry* 1982 p.191, 1983 p.285, 1984/85 p.381, 1986/87 p.359, 1988/89 p.421, 1990 p.315, 1991 p.289, 1992 p.253, 1993 p.187; *China Textile Yearbook* 1995, pp.6-7; *Compilation of Statistical Data of the Textile Industry: 1949-1988*, p.8; *Textile Economic Information* 1995, No.9, p.1.

Growth of the Chinese textile industry in the reform period can be decomposed into four sub-periods: 1978-80, 1981-85, 1986-90 and 1991-94 (see Table 4.1).

In the period 1978-80 an attempt was made to correct the structural imbalance in the economy, with the Chinese authorities shifting the focus from heavy industry to the consumer goods industry. Priority was given to the needs of the textile industry for raw materials, power and funds (Qian et al. 1984). The textile industry responded favourably to this strategic adjustment. From 1978 to 1980 the industry realised an annual growth rate of 18.7 per cent. The profits and taxes generated by the textile industry increased even faster than output growth, with annual growth of 22.2 per cent in the corresponding period.[23] The rapid growth of the textile industry in this period was mainly driven by a sharp increase in domestic demand for textile goods. The evidence is that domestic consumption of textiles increased by 28 per cent in this period.[24]

In the period 1981-85, during the Sixth Five-Year Plan, physical rationing of consumption of cotton textiles was totally abolished. This marked a turning point in the industry's development. The release from consumption rationing in December 1983 suggests that the Chinese textile industry was able to meet China's domestic needs fully from that time. It was also a signal that the import substitution stage of industrial development had ended and that export promotion was underway. Along with ongoing of economic reform, some marketisation measures were implemented in the textile industry in this period. By the end of 1984 only about one-quarter of total textile products were still controlled by the state mandatory plans, compared with 90 per cent in 1979 (Guo 1990). Markets for some raw materials such as wool and silk were also established in 1985 (though they were closed a few years later). Such reform measures are thought to have exerted a positive impact on industrial growth. Although there appeared to be a slow down in 1982-83 due to a temporary slump in domestic demand, the average annual growth rate of the textile industry between 1981 and 1985 was still at the two-digit level — at 11.4 per cent.

In the period 1986-90, during the Seventh Five-Year Plan, the confrontations that existed between the slowdown in market demand, excessive capacity expansion and insufficient raw material supply intensified. In particular, the recessions that occurred in the domestic market in 1986 and 1989 hit the industry seriously. For instance, in terms of quantity, domestic consumption of cotton fabrics, wool fabrics, wool yarn and silk fabrics in 1989 declined by 2.2 per cent, 12.7 per cent, 19.9 per cent and 20 per cent respectively from 1988's level. This downward shift of the demand curve in the domestic market exerted strong negative effects on the industry's growth (Sun 1991a). As a result, the annual growth rate of the textile industry during 1986-90 declined to 9.4 per cent.

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[23] The value derives from *Handbook of Textile Economy* (CTERC & ISTI 1987), p.25.
[24] The figure derives from *Handbook of Textile Economy* (CTERC & ISTI 1987), p.96.

The most striking change in this period was the rapid expansion of China's exports of textiles. The export earnings of the textile industry increased by 21.2 per cent annually during this period. In 1989 China's exports of textile products reached 2.4 million tons (converted in equivalent fibres).[25] In terms of quantity exported, China became the world's number one exporter of textiles. This implies that China's textile industry carried out export promotion successfully in this period.

In the 1991-94 period the industry regained its vitality. The average annual growth rate sharply increased to 18 per cent, almost doubling the rate achieved during the 1986-90 period. With the annual growth rate exceeding 20 per cent in three consecutive years (1992-94), the industry's growth record in the reform era reached a new high. Rapid growth of the textile industry in this sub-period was mainly attributable to two elements: the tremendous growth of township and village enterprises (TVTEs) and further expansion of export activities. The TVTEs achieved an average growth rate of 30.3 per cent in this sub-period, and their contribution to the industry's output growth rose to 73.8 per cent.[26] In other words, about three-quarters of net output increase was attributable to the enormous growth impetus of the TVTE sector. On the other hand, export growth in this period maintained an average annual rate of 20.6 per cent. By 1994 China had become the world's largest exporter of textiles, in both value and quantity terms.[27]

On the whole, the Chinese textile industry grew at an average annual rate of 13.3 per cent in the period 1978-94. This growth record was considered marvellous by international standards. The industry's high performance in the reform period has rapidly promoted China to the number one position among world textile producers.

There has been a quantum rise in fibre consumption associated with the industry's rapid growth of output. It is worth noting that the quantity of fibres used in textile production has grown at a far lower rate than that of output value. In 1978-93

[25] The export figures derive from *China Textile Yearbook* (CTERC & CCFIA 1993), p.113, p.132.
[26] The figures derive from *Almanac of China's Textile Industry* (TEBACTI 1991-95).
[27] An overview and detailed discussion of China's textiles exports is presented in Chapter 9.

Table 4.2 Growth and improvement of industrial fibre consumption, 1978-93

	Total fibres processed (10,000 tons)	Growth rate of fibre consumption (%)	Realised value of fibres per ton[(a)] (yuan/ton)	Growth rate of unit value realisation (%)
1978	254	-	23,957	-
1979	262	3.1	26,576	10.9
1980	326	24.4	26,282	-1.1
1981	358	9.8	28,017	6.6
1982	380	6.1	26,550	-5.2
1983	410	7.9	27,049	1.9
1984	435	6.1	29,009	7.2
1985	442	1.6	33,314	14.8
1986	448	1.4	33,964	2.0
1987	569	27.0	30,058	-11.5
1988	600	5.4	32,312	7.5
1989	630	5.0	33,925	5.0
1990	660	4.8	35,030	3.3
1991	690	4.5	36,872	5.3
1992	715	3.6	42,779	16.0
1993	740	3.5	49,973	16.8
Average annual growth rate (%)				
1978-93		7.4		5.0
1978-85		8.2		4.8
1986-93		6.7		5.2
1990-93		4.1		10.2

Note: (a) The realised value of fibres per ton is calculated at 1980 constant prices.

Sources: *Handbook of Textile Economy* 1987, pp.29-41; *China Fibre Yearbook* 1990, pp.32-37, p.140, 1991/92, pp.36-42, p.149; *China Textile Yearbook* 1993, pp.36-42, p.140, 1994, pp.37-43, p.130, 1995, pp.37-41, p.130; *Textile Economic Information* 1989, No.1, pp.1-3, 1994, No.24, p.1, No.81, p.4.

total fibres processed by the textile industry grew on average by 7.4 per cent annually (see Table 4.2), compared to a 12.8 per cent growth rate in gross output value. This difference between growth rates in quantity and value terms indicates an increase in the unit value realisation of fibres.[28] Table 4.2 shows that the realised value of fibres per ton rose from 23,957 yuan in 1978 to 49,973 yuan in 1993 (all calculated at 1980 constant price), at an average annual growth rate of 5 per cent. It is also clear that the improvement of unit value realisation of fibre use was fairly consistent, as is evident from the rise in the growth rates of unit fibre realisation from 4.8 per cent during 1978-85 to 5.2 per cent over 1986-93. Moreover, in the period 1990-94 not only did the above trend

[28] The 'unit value realisation of fibres' is defined as the average value generated by processing one ton of fibre.

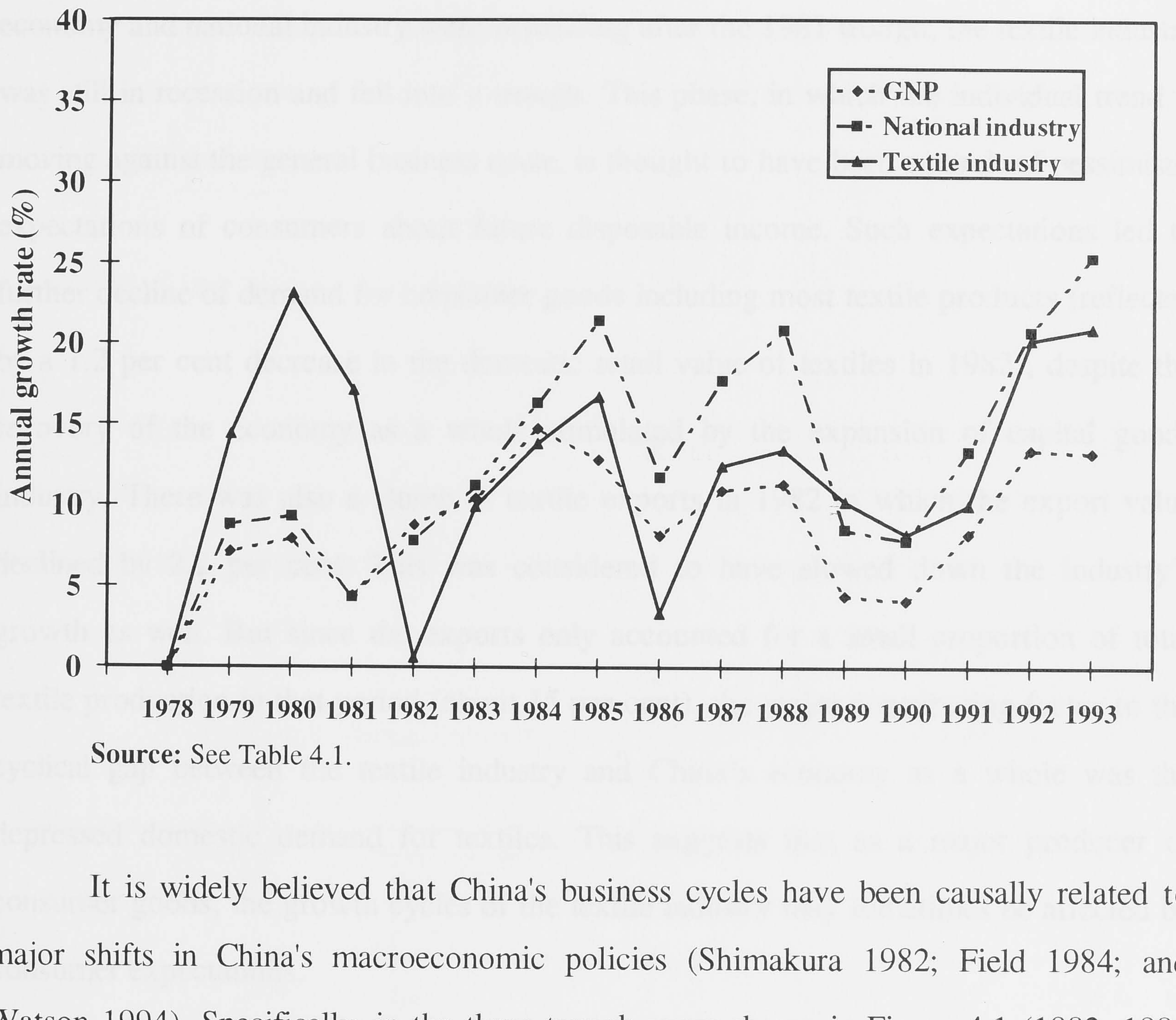
persist, but the growth rate accelerated to 10.2 per cent. This improvement of efficiency in fibre use is mainly attributable to two elements: one is the increased product quality, and the other is the upgrading of product mix by which more processed and value-added products have gained priority. This continuous rise in the realised value of unit fibre consumption implies that the growth of China's textile industry has not been one of simple expansion of output but has embodied considerable growth in quality.

The rapid growth of the Chinese textile industry was mainly a result of the economic reform and open-door policy implemented in China after 1978. The growth of the textile industry was encouraged by a series of reform measures and policies, the most important of which are: (1) increased market-orientation in industrial operations and in firm behaviour; (2) sharp expansion of the non-state ownership, especially the rural collective enterprises and joint ventures; (3) deep integration of the industry into the international economy; and (4) decentralisation of decision-making power at various levels. Such reforms are thought to have generated great growth incentives for textile producers. On the other hand, economic reform has also promoted effective demand for textile products and hence provided an essential market condition for the industry to achieve rapid growth.

On the one hand, growth of the textile industry in the reform period featured by the high average growth rates. On the other hand, the accelerative growth achieved by the industry in this period also revealed some cycles. This cyclical pattern of growth represented another feature in the industry's growth during the reform period.

The cyclical changes in the rate of growth are shown in Figure 4.1 which provides a comparison of growth cycles between the Chinese economy (represented by GNP growth), the national industry as a whole and the textile industry. It can be seen that from 1978 to 1993 there were three major cycles, each around four years in length (identified from trough to trough). The interval between the peak and the trough of each cycle ranged from one year (1985-86) to three years (1982-85). A very similar pattern of cyclical growth can also be observed for the Chinese economy and the national industry as a whole, which suggests that the cyclical growth pattern of the textile industry has followed in a general way the pattern of growth in the whole economy. This in turn indicates that the cyclical growth of the textile industry has been mainly determined by the prevailing cyclical forces in China's economy.

Figure 4.1 Comparison of the pattern of growth between the Chinese economy, national industry and the textile industry in the reform period



Source: See Table 4.1.

It is widely believed that China's business cycles have been causally related to major shifts in China's macroeconomic policies (Shimakura 1982; Field 1984; and Watson 1994). Specifically, in the three trough years shown in Figure 4.1 (1982, 1986 and 1990), though the decrease in the growth rates seems to be directly related to the slumps in domestic demand for textile products, the fundamental cause was actually the tightening of macroeconomic policy in China. The Chinese government's imposition of strict administrative controls on the economy in these years (or one year earlier) resulted in an economy-wide recession and hence a retardation or even decline in the domestic demand for textile products. This worsening in domestic market conditions caused a slowdown in the industry's growth, despite the considerable offset effect generated by a sharp increase in textile exports. Thus, to stabilise the growth of the textile industry, a steady macroeconomic environment and business climate in China are required.

While heavily influenced by general economic trends, there are some peculiarities in the textile industry's cyclical fluctuations, a typical illustration of this being the cycle that occurred in the early 1980s. It can be observed that in 1982 when the Chinese economy and national industry were expanding after the 1981 trough, the textile industry was still in recession and fell into a trough. This phase, in which the individual trend is moving against the general business cycle, is thought to have been a result of pessimistic expectations of consumers about future disposable income. Such expectations led to further decline of demand for consumer goods including most textile products (reflected by a 1.2 per cent decrease in the domestic retail value of textiles in 1982), despite the recovery of the economy as a whole stimulated by the expansion of capital goods industry. There was also a slump in textile exports in 1982 in which the export value declined by 2.2 per cent. This was considered to have slowed down the industry's growth as well. But since the exports only accounted for a small proportion of total textile production in that period (about 15 per cent), the major contributing factor to the cyclical gap between the textile industry and China's economy as a whole was the depressed domestic demand for textiles. This suggests that as a major producer of consumer goods, the growth cycles of the textile industry may sometimes be affected by consumer expectations.

In addition, the cyclical fluctuations have been also attributable to some inherent structural problems in the textile industry. For example, Chinese consumers since the mid-1980s have become more and more selective in respect of variety and quality of textile products. In particular, the demand for clothing has been directed more by fashion changes than by basic needs. However, the adjustment of product mix by the textile industry has lagged far behind the changes in consumer preference, which has meant that part of the domestic demand for textiles has never been satisfied while the total supply of textiles has already been in excess. This was particularly the case in the 1990 slowdown

(Sun 1991). Thus, to reduce cyclical fluctuations the textile industry needs to improve its productive structure.

Although there were considerable fluctuations in output growth during the reform period, they were far less serious than in the pre-reform period. The range of change in the coefficients of growth fluctuations[29] was only -0.95 to 0.74 over the reform period, compared to -2.13 to 3.84 in the pre-reform period. This improvement may suggest that the growth of the Chinese textile industry is taking place on an increasingly firm base.

Growth of the individual sectors

In order to gain a deeper insight into the industry's growth, investigation of the rate and pattern of growth at the individual sector level is needed. Growth rates for the seven sectors in China's textile industry over the reform period are reported in Tables 4.3 and 4.4.

Table 4.3 Annual growth rate of the individual sectors, 1978-93
(percentage)

	MMF[(a)]	Cotton	Wool	Bast	Silk	Knitting	Apparel
1978	-	-	-	-	-	-	-
1979	12.1	13.2	16.6	24.0	15.9	14.4	21.4
1980	50.7	22.5	18.6	13.6	10.8	28.2	21.6
1981	11.2	17.3	23.7	17.1	13.8	21.8	13.0
1982	12.9	-3.3	13.2	9.3	3.5	6.4	1.8
1983	11.6	9.0	27.4	26.4	14.5	3.9	3.4
1984	1.5	14.0	27.8	13.8	7.7	8.3	22.4
1985	18.7	13.5	29.5	24.5	33.1	13.1	13.9
1986	13.8	1.0	15.8	-3.1	5.9	1.2	-0.4
1987	24.5	12.0	15.7	4.9	5.6	14.8	6.8
1988	35.4	10.5	15.5	5.3	6.1	14.5	17.8
1989	24.3	7.8	11.3	10.2	8.7	7.9	14.4
1990	24.9	5.7	-5.8	-0.1	18.7	9.3	13.4
1991	21.9	8.6	14.7	19.2	28.2	10.0	6.2
1992	24.8	16.7	22.7	29.5	32.0	17.7	21.7
1993	24.3	16.1	24.5	29.5	29.3	24.8	25.2

Note: (a) MMF refers to the man-made fibre sector. The same as in following tables.

[29] The coefficient of growth fluctuations was defined in footnote 21 of Chapter 3.

Sources: *Handbook of Textile Economy* 1987, pp.6-7; *China Fibre Yearbook* 1989 pp.15-16, 1990 pp.13-14, 1991/92 pp.13-14; *China Textile Yearbook* 1993 pp.13-14, 1994 pp.13-14, 1995 pp.16-17; *Compilation of Statistical Data of the Textile Industry: 1949-1988*, pp.17-18.

All sectors achieved double-digit average growth in the 1978-93 period. Average annual growth rates ranged from 18.9 per cent for the man-made fibre sector to 10.8 per cent for the cotton textile sector. This gap suggests that there have been considerable variations in growth performance among sectors.

The high growth of the man-made fibre sector has been mainly driven by the industry's strategy of substituting man-made fibres for natural fibres. Under this strategy, the share of man-made fibres in total fibre consumption (including imported fibres) increased from 13 per cent in 1978 to 23 per cent in 1985, and rose further to 38 per cent in 1993 (Ren 1995). As a result, domestic production of man-made fibres increased from 0.29 to 2.22 million tons during the 1978-93 period, at an average annual rate of 14.7 per cent. This was much higher than the 7.4 per cent growth rate of total fibres processed by the industry in this period. The growth of the man-made fibre sector has tended to accelerate, indicated by its higher growth rate in the period 1986-93 compared with the period 1978-85. This may be taken as a sign of overall acceleration in fibre substitution in the industry.

Table 4.4 Average annual growth rate by sectors
(percentage)

	1978-93	1978-85	1986-93	1990-93
Total industry	12.8	13.5	12.2	14.7
MMF	18.9	16.2	21.4	18.6
Cotton	10.8	12.0	9.7	11.7
Wool	17.7	22.2	13.9	13.3
Bast	14.5	18.2	11.3	18.9
Silk	15.2	13.9	16.3	26.9
Knitting	12.9	13.5	12.3	15.3
Apparel	13.2	13.7	12.9	16.4
Primary textile	12.1	13.2	11.1	13.8
Clothing	13.0	13.5	12.6	15.8

Source: See Table 4.3.

The wool processing sector was the second-fastest growing sector in the textile industry. The high income elasticity of domestic demand for wool products (as revealed in Chapter 3) has been a major contributor to the rapid growth of this sector. In contrast, the slow growth of the cotton textile sector has been largely due to the disadvantage of low income elasticity of domestic demand for cotton textiles. However, in the period 1990-93 the growth rate of the cotton sector accelerated to 11.7 per cent, which exceeded its average level in the reform period. This mainly resulted from the strong influence of export demand for cotton textiles. At the same time, the growth of the wool processing sector slowed down to below-average because of its relatively weak export capacity. In contrast with the wool sector, the bast, silk, knitting and apparel sectors not only achieved above-average growth rates, but also accelerated in the first four years of the 1990s due to strong export expansion in these sectors. More detailed discussion of the relationship between output growth and export expansion is presented in Chapter 9.

To understand the dynamics of the individual sectors, it is helpful to examine sectoral growth elasticities. These elasticities can be obtained by dividing sectoral growth rates by the overall weighted industrial growth rate. Changes in growth elasticities summarise the performance and potential of growth in the individual sectors. The output elasticities for each sector are calculated in Table 4.5.

Table 4.5 Growth elasticities of the individual sectors[a]

	1978-93	1978-85	1986-93	1990-93
Total industry	1.00	1.00	1.00	1.00
MMF	1.48	1.20	1.75	1.27
Cotton	0.84	0.89	0.80	0.80
Wool	1.38	1.64	1.14	0.90
Bast	1.13	1.35	0.93	1.29
Silk	1.19	1.03	1.34	1.83
Knitting	1.01	1.00	1.01	1.04
Apparel	1.03	1.01	1.06	1.12
Primary textile	0.95	0.98	0.91	0.94
Clothing	1.02	1.00	1.03	1.07

Note: (a) The growth elasticities are calculated according to the formula: $GI_q = R_q / R_a$, where GI_q is the growth elasticity of sector q; R_a is the average growth rate of total industry; R_q is the growth rate of sector q.

Source: Calculations are based on Table 4.4.

It can be seen that in 1978-93 all sectors' growth elasticities were above unity except for the cotton sector. The man-made fibre sector displayed the highest growth elasticity of 1.48 in the textile industry. Next was the wool sector with a growth elasticity of 1.38. However, it is worth noting that their growth elasticities decreased to 1.27 and 0.9 respectively in the 1990-93 period. This may imply that the strong growth trend in these sectors is slowing down in the 1990s. The cotton processing sector had a low and declining growth elasticity over the whole period, suggesting its relatively small growth potential. The silk, knitting and apparel sectors showed a rising trend in their growth elasticities and are expected to accelerate in the years to come. The growth elasticity of the bast fibre sector was quite unstable, but could increase slightly in the near future due to increasing overseas demand (CTERC 1994, No.13).

The sectors in the Chinese textile industry can be divided into three groups according to different levels of growth elasticity: dynamic sectors (with high growth elasticities), average growth sectors (with growth elasticities close to unity), and slow-growth sectors (with growth elasticities below unity). The man-made fibre, wool and silk sectors belong to first group and have been the main contributors to the industry's growth. The bast, knitting and apparel sectors belong to the second group, which has made a relatively small but still positive contribution to the growth of the textile industry. The cotton sector belongs to the third group, which, despite being the largest sector in the textile industry, has made little or even a negative contribution to the acceleration of the industry's growth over the reform period.

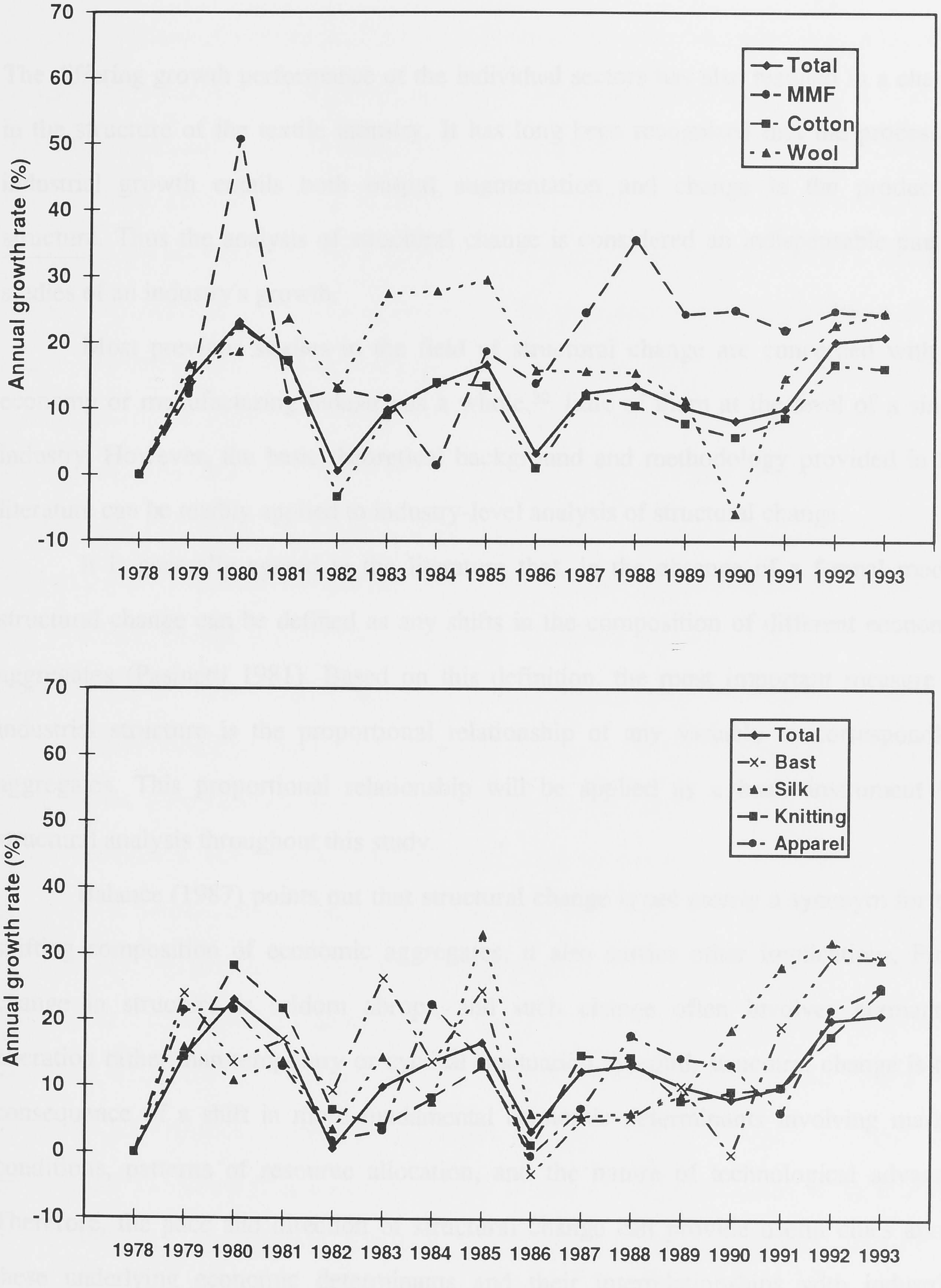
It is also useful to analyse sectoral growth according to the process of textile production. For this purpose, the textile industry is re-classified into three sectors: man-made fibre, primary textile (cotton, wool, bast and silk), and clothing (knitting and apparel). In this framework, three sectors form a complete stream of textile production: the man-made fibre sector provides intermediate inputs for the primary textile sector, and the primary textile sector supplies intermediate inputs for the clothing sector, as well as some products for final use. Table 4.5 shows that the man-made fibre and clothing sectors had above-unity growth elasticities, while the primary textile sector displayed below-unity growth elasticity because of low growth in the cotton sector.

The higher dynamism of the man-made fibre and clothing sectors reflects the industry's strategy which emphasised the raw material and final goods producing stages in textile production. In particular, the steadily increasing growth elasticity of the clothing sector in the post-1986 period indicates that the growth of the textile industry has been increasingly led by the promotion of higher value-added products. This has been a major contributor to the improved quality of the industry's growth in the reform period, as is discussed in the last section of this chapter.

A cyclical growth pattern can be clearly observed as well at the individual sector level (see Figure 4.2). The sectoral fluctuations of output growth basically followed the cyclical pattern of the textile industry as a whole, with the timing of most peaks and troughs of the growth cycles in the individual sectors matching similar movements at the industry level. This suggests that some common elements have caused the cyclical fluctuations at both industry and sectoral levels. As previously noted, one of the major elements has been the general cyclical forces in China's economy due to the instability of macroeconomic policies.

The computation of coefficients of growth fluctuation for the individual sectors shows that all seven sectors exhibited higher degree of fluctuation in their growth path than did the industry as a whole. The apparel sector showed the lowest degree of growth fluctuation with a coefficient of -1.03 ~ 0.9 in the 1978-93 period, compared with -0.95 ~ 0.74 for the industry as a whole. On the other hand, the man-made fibre sector appeared to have the highest degree of fluctuation of the seven sectors with a coefficient of -0.92 ~ 1.68 in the corresponding period. This situation suggests that: firstly, to reduce the fluctuation in the industry's growth, more effort needs to be made at the sectoral level; and secondly, the growth pattern at the industry level has smoothened concealing sectoral fluctuations, and hence the analysis of sectoral growth rates and patterns is necessary.

Figure 4.2 Growth pattern of the individual sectors



Note: The figures derive from data in Tables 4.1 and 4.3.

Conception of structural change

The differing growth performance of the individual sectors has also resulted in a change in the structure of the textile industry. It has long been recognised that the process of industrial growth entails both output augmentation and change in the productive structure. Thus the analysis of structural change is considered an indispensable part of studies of an industry's growth.

Most previous studies in the field of structural change are concerned with an economy or manufacturing industry as a whole,[30] little of them at the level of a single industry. However, the basic theoretical background and methodology provided in the literature can be readily applied to industry-level analysis of structural change.

It is generally agreed in the literature that, in the absence of a formal model, structural change can be defined as any shifts in the composition of different economic aggregates (Pasinetti 1981). Based on this definition, the most important measure of industrial structure is the proportional relationship of any variable to corresponding aggregates. This proportional relationship will be applied as a basic instrument for structural analysis throughout this study.

Balance (1987) points out that structural change is not merely a synonym for the shifting composition of economic aggregates, it also carries other implications. First, change in structure is seldom abrupt, and such change often involves permanent alteration rather than temporary or cyclical fluctuation. Second, structural change is the consequence of a shift in more fundamental economic determinants involving market conditions, patterns of resource allocation, and the nature of technological advance. Therefore, the pace and direction of structural change can provide useful clues about these underlying economic determinants and their interrelationships with industrial policies.

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[30] These studies include SECE (1977), Kim and Roemer (1979), Pasinetti (1981), Tuitz (1983), Kirkpatrick et al. (1984) and Chenery et al. (1986).

As Chenery and Syrquin (1986a) show, transformation of the production structure is essentially engendered by the requirements to meet changing demands and to make more productive use of technology. Given incomplete foresight and limits to factor mobility, structural change is most likely to occur under conditions of disequilibrium. Disequilibrium phenomena such as imperfect factor markets and lags in adjustment imply a potential for accelerating output growth by reallocating resources to sectors of higher productivity. Structural analysis is thought to be particularly important when studying developing economies, because disequilibrium is a widely observed phenomenon in these economies. Some studies in the area of development economics have established the importance of moving resources from lower productivity to higher productivity uses by, for example, expanding exports or turning from agriculture to the manufacturing sector (Chenery and Syrquin 1986b; Chenery et al. 1986). Theory and empirical results suggest that structural change is not only an outcome of differing growth rates at the sectoral level, but can also contribute to aggregate growth through the reallocation of resources. This interdependence of growth and structural change in the Chinese textile industry will be examined in the succeeding sections and chapters of this thesis.

Obviously, the structure of an industry can be studied along different lines or based on different criteria such as sectoral structure, ownership structure, firm size structure and regional distribution. It is neither feasible nor desirable to try to capture all the structural complexity of an industry in one study. Instead, the principle adopted in this study is to focus on those structures that are relatively important to the growth and efficiency performance of the Chinese textile industry. In line with this principle, the sectoral and ownership structures of the textile industry have been chosen as the research target. Because, the sectoral structure is the most commonly applied concept of industrial structure in the economic literature, and the ownership structure is possibly the most important structural influence on current and future growth in China's textile industry.

Change in the sectoral structure

Main pattern and characteristics

In this study, industrial structure is described by the composition of gross output value. Table 4.6 shows structural change in China's textile industry between 1965 and 1993[31] in terms of the shares of seven constituent sectors in gross output value.

Table 4.6 Composition of gross output value by sectors, 1965-93
(percentage)

	MMF	Cotton	Wool	Bast	Silk	Knitting	Apparel
1965	2.6	64.1	4.7	1.1	8.6	10.6	8.3
1970	2.9	63.5	4.6	1.1	8.8	10.9	8.2
1975	3.2	64.6	5.4	1.2	8.3	8.9	8.4
1978	5.0	62.8	5.4	1.2	7.9	9.5	8.2
1979	4.9	62.1	5.5	1.3	8.0	9.5	8.7
1980	6.0	61.8	5.3	1.2	7.2	9.9	8.6
1981	5.7	61.9	5.6	1.2	7.0	10.3	8.3
1982	6.4	59.5	6.3	1.3	7.2	10.9	8.4
1983	6.5	59.0	7.3	1.5	7.5	10.3	7.9
1984	5.8	59.1	8.2	1.5	7.1	9.8	8.5
1985	5.9	57.5	9.1	1.6	8.1	9.5	8.3
1986	6.5	56.2	10.2	1.5	8.3	9.3	8.0
1987	7.2	56.0	10.5	1.4	7.8	9.5	7.6
1988	8.6	54.6	10.7	1.3	7.3	9.6	7.9
1989	9.7	53.4	10.8	1.3	7.2	9.4	8.2
1990	11.2	52.2	9.4	1.2	7.9	9.5	8.6
1991	10.4	51.5	9.8	1.3	9.2	9.5	8.3
1992	10.8	50.0	10.0	1.4	10.1	9.3	8.4
1993	11.1	48.0	10.3	1.5	10.8	9.6	8.7

Source: See Tables 4.1 and 4.3.

Several features of change in the sectoral structure of the Chinese textile industry can be observed from Table 4.6. Firstly, the cotton textile sector is the dominant but declining sector in the Chinese textile industry. Its share in gross output value decreased from 64.1 per cent in 1965 to 62.8 per cent in 1978, and dropped further to 48 per cent in 1993. It is the only sector that exhibited a declining trend in output share over the reform period. Despite this declining trend, the share of cotton sector in gross output

[31] This period is selected mainly due to the availability of data for these years.

value still accounted for about one half of total textile production in the early 1990s, and it remains the largest and most important sector in the textile industry.

Secondly, with the largest gains in output share, the man-made fibre and wool processing sectors represented the main rising sectors in the Chinese textile industry. Between 1965 and 1993, the share of the man-made fibre sector in gross output value increased from 2.6 to 11.1 per cent, and the share of the wool sector increased from 4.7 to 10.3 per cent. The rise in the man-made fibre sector has been mainly due to the government's emphasis on self-sufficiency in textile raw materials as detailed in a policy implemented since the late 1960s (Qian et al. 1984). The expansion of the wool sector has been largely attributable to the sharp rise in domestic demand for wool products since the early 1980s, as reflected in Table 4.6.

Thirdly, the share of the silk sector rose from 8.6 to 10.8 per cent in the period under study, just behind the man-made fibre and wool sectors in terms of gains in output share. The rise of this sector has not been without fluctuations. In fact, prior to 1990 the position of the silk sector in the industrial structure declined from 8.6 to 7.2 per cent. Between 1990 and 1993, its share increased sharply to 10.8 per cent, to become the third biggest sector in the textile industry, ever larger than the wool sector. This suggests that the supply and demand conditions of the silk sector have improved since the 1990s.

Fourthly, the shares of the bast and apparel sectors in total output structure have been relatively steady. The range of change in the shares of these two sectors was, on average, within 1 percentage point during the 1965-93 period. However, there has been a relatively sharp increase in the share of the apparel sector during the 1987-93 period, mainly due to the acceleration of growth driven by increased export demand. On the other hand, although the output share of the bast sector did not appear to change much in terms of absolute value, its share did increase considerably in terms of proportional value because of the small size of the sector.

Fifthly, in addition to the cotton textile sector, there was also a drop in the output share of the knitting sector during the 1965-93 period. The share of the knitting sector in gross output value decreased from 10.6 to 9.6 per cent over this period. In the reform period, the output share of the knitting sector has been quite steady and marginally increased from 9.5 to 9.6 per cent. This may imply that domestic and export demand for knitted textiles has tended stable since the late 1980s.

Finally, the intensity of structural change has been much larger in the reform period (1978-93) than in the pre-reform period (1965-77). The intensity of structural change is defined as average change in the sectoral shares in a certain period and can be calculated by the formula: $sI = \frac{\Sigma\left|S_n - S_0\right|}{n}$, where S_0 is the sectoral share in base year, S_n is the sectoral share in year n, and n is the number of years in the observed period. Prior to 1978 the intensity of structural change was only 0.8 percentage points. In the reform period, the intensity of structural change rose to 2 percentage points. This implies that China's economic reform has produced intensified structural change in the textile industry, as a result perhaps of two major elements: (1) economic reform largely raised per capita income and hence caused radical changes in the structure of demand for textile products; and (2) economic reform accelerated industrial growth and led to larger disparities between sectoral growth rates.

The second element suggests that there is an association between the rate of growth and the intensity of structural change. A simple regression on two variables results in a positive coefficient of 0.13 with a highly significant t ratio of 6.69. This means that a strong interdependence exists between the level of output growth and the dynamics of structural change, so far as the Chinese textile industry is concerned.

Table 4.7 shows the change in the sectoral structure of the Chinese textile industry under the classification of the textile industry into man-made fibre sector, primary textile sector and clothing sector.

In this classification of the sectoral structure only the output share of the man-made fibre sector exhibited an increasing trend in the 1965-93 period, with the other two sectors showing uniformly declining trends, though the output share of the clothing sector decreased only slightly. With the focus on the reform period, both the man-made fibre and clothing sectors have increased their relative importance in the industrial structure. This pattern of structural change is generally indicative of an improvement in the sectoral structure of the textile industry, because it complies with the worldwide trend in this period whereby the consumption of man-made fibres and clothing products has been steadily increasing (CTERC 1995, No.6).

Table 4.7 Sectoral structure by the more aggregate classification
(percentage)

	MMF	Primary textile	Clothing
1965	2.6	78.5	18.9
1970	2.9	78.0	19.1
1975	3.2	79.5	17.3
1978	5.0	77.3	17.7
1980	6.0	75.5	18.5
1985	5.9	76.3	17.8
1990	11.2	70.7	18.1
1993	11.1	70.6	18.3

Source: According to Table 4.6.

The sharp rise in the share of the man-made fibre sector in the industrial structure suggests that this sector has played the role of 'leading sector' in the growth of the Chinese textile industry. According to Syrquin (1986, p.240), 'a sector is said to be a leading sector when its rate of growth exceeds the average rate for a period long enough to raise overall growth toward its rate and when it spreads its dynamism through substantial links to other sectors'. As the man-made fibre sector supplies intermediate inputs for the other sectors, there is a general requirement that such a sector expands more rapidly than other sectors. In the period 1965-93 the man-made fibre sector grew at an average annual rate of 15.5 per cent, much higher than the industrial average of 9.7 per cent. With its backward links to all other sectors, the above-average growth of the man-made fibre sector assured and pulled up the growth of the textile industry as a whole. On the other hand, this pattern of change in sectoral structure also reflected the considerable efforts made by the industry to overcome the shortage of raw materials and to substitute man-made fibres for natural fibres.

Main determinants of change in the sectoral structure

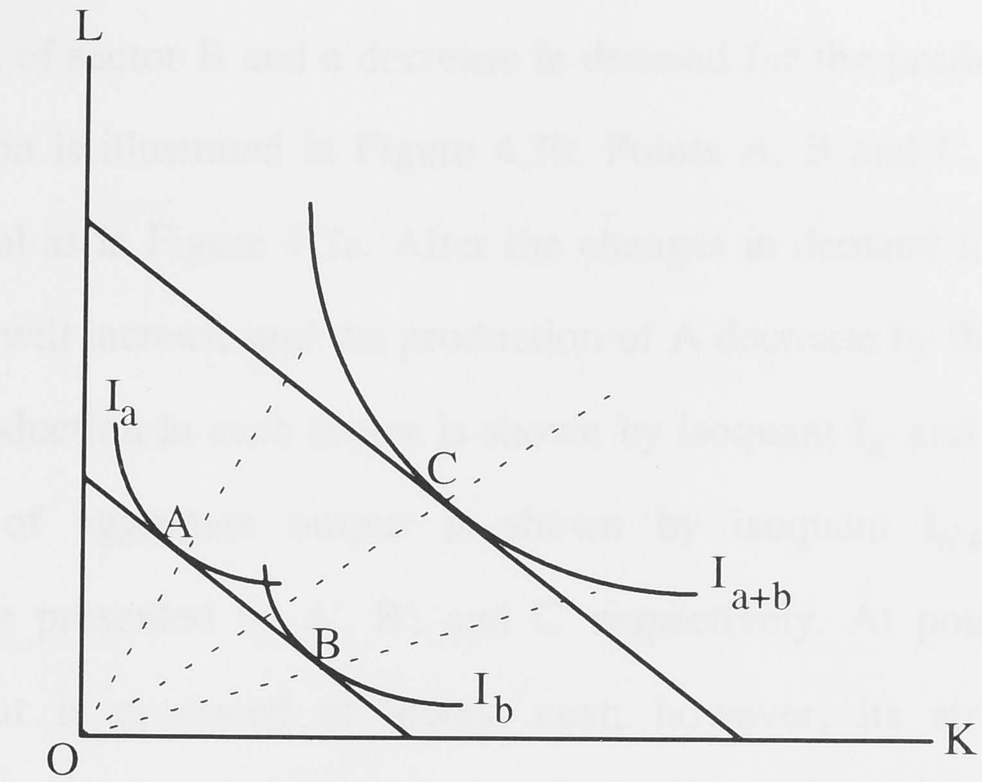
Chenery and Syrquin (1986a) point out that the common forces behind structural change are the shifts in the structure of demand. As per capita income rises, increments in demand will cluster in succession around different goods. This means that the rates of change in demand for various commodities will normally differ from each other. This shift in demand determines that the actual production of each sector will follow a growth path of its own and that growth of aggregate output will be affected in turn. As a consumer goods producer, the structure of the textile industry is in most cases directly determined by income level and patterns of demand. With a rise in income, the structure of demand for textiles moves more strongly in favour of certain products over others. This will lead to a corresponding change in growth rates between different products, and hence in the industry's sectoral composition. In this sense, the change in the sectoral structure of the Chinese textile industry is demand-induced structural change.[32]

The crucial impact of demand variation on the sectoral structure is illustrated in Figure 4.3. As explained in Chapter 2, the single isoquant in the figure represents all the combinations of labour (L) and capital (K) for producing a maximum of one unit of output. The slope of an isoquant represents the relative price between labour and capital. The shift of each isoquant is interpreted as the effect of technical change, while the shape of an isoquant represents specific characteristics of the production function.

Assuming that an industry consists of two sectors, A and B, and we start from an equilibrium position in input allocation, the initial situation is described in Figure 4.3a. I_a and I_b are isoquants representing output $Q_a=1$ and $Q_b=1$ respectively. Points A and B represent the lowest cost combinations of inputs for one unit of output in each sector. It is assumed further that the unit cost of A and B are equal, and thus their market prices

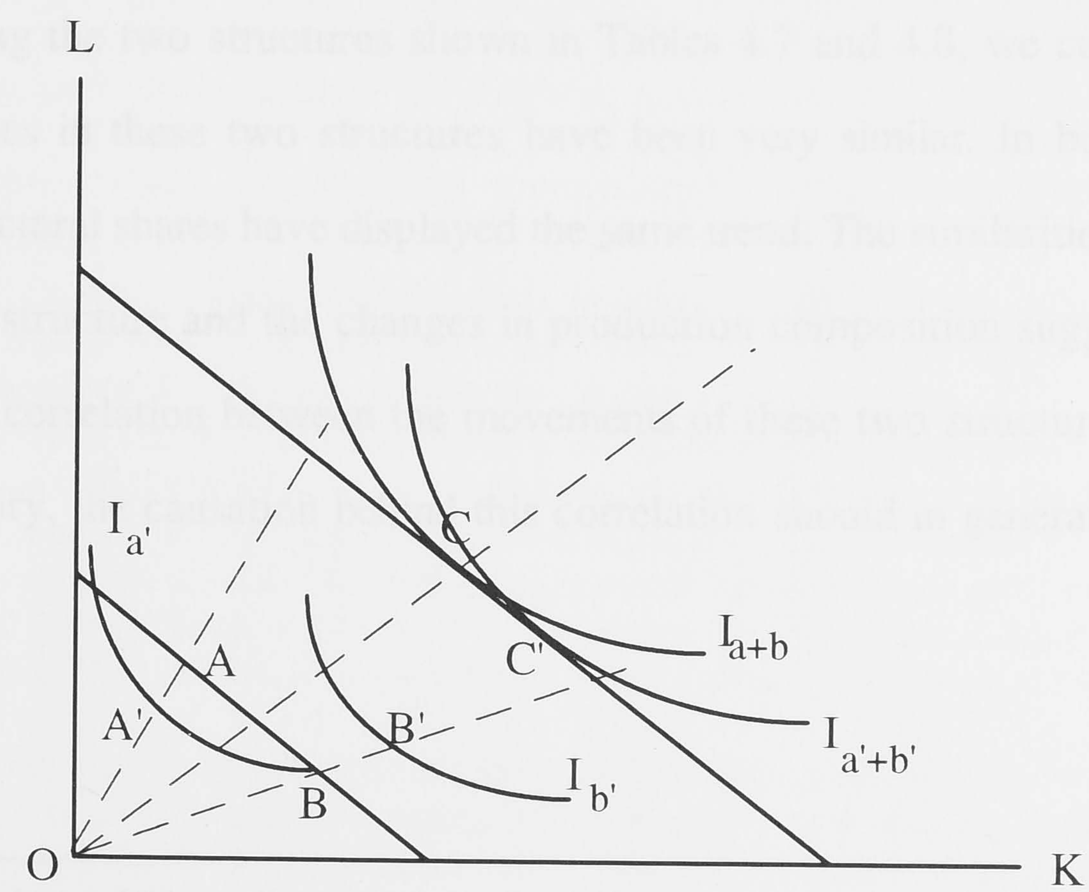
[32] The change in the sectoral structure certainly is influenced by supply as well. In the case of China's textile industry, demand is considered as a more important determinant for structural change than supply, because, as discussed previously, the rate and pattern of the industry's growth in the reform period were largely affected by the change in the demand conditions. Nevertheless, the term 'demand-induced structural change' is only used as a relative concept in this study.

Figure 4.3a An illustration of demand-related structural change



will be equal; and that the technology in each sector is characterised by constant returns to scale. Then I_{a+b} is the aggregated isoquant describing various combinations of labour and capital inputs needed to produce one unit of A and one unit of B. So as to simplify the analysis, we express a unit of aggregate output as one unit of output A plus one unit of output B. Point C represents the lowest cost of production at given relative prices between the inputs, as well as the initial structure of output in this industry.

Figure 4.3b An illustration of demand-related structural change



Assuming unchanged relative prices of inputs, as well as an increase in demand for the products of sector B and a decrease in demand for the products of sector A, the resulting situation is illustrated in Figure 4.3b. Points A, B and C, as well as isoquant I_{a+b}, are identical as in Figure 4.3a. After the changes in demand for two products, the production of B will increase and the production of A decrease by the same amount. The new level of production in each sector is shown by isoquant $I_{a'}$ and $I_{b'}$ respectively, and the new level of aggregate output is shown by isoquant $I_{a'+b'}$. The new input combinations are presented by A', B'; and C' respectively. At point C' a new unit of aggregate output is produced at lowest cost; however, its structure in terms of composition of output A and B has changed without corresponding changes in the individual production function.

To verify the relationship between changes in sectoral structure and shifts in demand in the Chinese textile industry, it is necessary to display the pattern of structural change in demand.[33] However, due to limitations in China's statistics, demand structure by sectors can only be specified at an aggregated level and for a shorter period—namely, at the three-sector level and for the period 1978-92 only as shown in Table 4.8. This may be sufficient for the current purpose of showing certain correlations between change in demand for textile goods and structural transformation of textile production.

Comparing the two structures shown in Tables 4.7 and 4.8, we can see that the pattern of changes in these two structures have been very similar. In both structures, changes in the sectoral shares have displayed the same trend. The similarities between the shifts in demand structure and the changes in production composition suggest that there is indeed a close correlation between the movements of these two structures. According to economic theory, the causation behind this correlation should in general run from the

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[33] Here I define the demand for textile products as domestic consumption plus exports. As in most other studies, I use realised domestic consumption as a proxy for domestic demand and realised exports as a proxy for overseas demand.

demand to the supply side—that is, the composition of output will be largely determined by the structure of final demand.[34]

Table 4.8 Structure of demand for textile products(a)
(percentage)

	MMF	Primary Textile	Clothing
1978	5.6	75.9	18.5
1985	5.3	75.5	19.2
1990	7.3	70.9	21.8
1992	7.8	68.8	23.4

Note: (a) Demand for textile products is approximated by domestic consumption of textiles plus exports of textiles. Calculation of sectoral shares are based on value terms.

Sources: *Compilation of Statistical Data of the Textile Industry: 1949-1988*, pp.108-118; pp.162-169; *Handbook of Textile Economy* 1987, pp.96-103, pp.110-113; *China Fibre Yearbook* 1991/92, pp.92-106, pp.121-124; *China Textile Yearbook* 1995, pp.92-108, pp.121-124.

Change in ownership structure

In terms of ownership, the enterprises in the Chinese textile industry can be classified into four categories: state-owned, collective-owned, privately-owned, and those with mixed ownership. The collective-owned enterprises can be further divided into two types: urban and rural collectives, the latter being comprised of township and village enterprises. There are also several types of mixed ownership, the most important of which is joint ventures. In summary, the Chinese textile industry consists of five major ownership groups—namely, state-owned enterprises,[35] urban collectives,[36] township

[34] Here we essentially conduct a demand-side analysis. In practice, supply can also influence demand by, for example, the shift in costs. However, there is no evidence that this sort of supply related elements have overweighted the demand related elements in the Chinese textile industry.

[35] State textile enterprise refers to textile enterprises in which the means of production is owned by the people as a whole. Due to different channels of investment and administration, state textile enterprises are subordinate to various levels of government and/or its agencies. At present, about 80 per cent of these enterprises are under the administration of China National Textile Council (the former Ministry of Textile Industry), and the rest are controlled by other government agencies such as Supply and Marketing Cooperatives, the Ministry of Foreign Trade and Economic Corporation, the Ministry of Domestic Trade, and so on.

[36] Collective enterprises refer to those enterprises where the means of production are owned by the members in the collectives. Urban collective enterprises are generally controlled by administrative units or some other organisations in the urban areas. Thus it is clear that the major difference between state and urban collective ownership is the different scope of public ownership in the cities. Actually, these two urban public ownerships are very similar in terms of management system and operation pattern. For this reason, urban collective ownership is sometimes known as 'semi-state ownership'.

and village enterprises (TVTEs),[37] joint ventures,[38] and private enterprises. Due to the availability of data, the analysis of ownership structure in this study is confined to the first four ownership groups; in other words, private ownership is excluded from the analysis.[39]

Table 4.9 shows the change in ownership structure in the Chinese textile industry in terms of gross output value and employment during the 1980-91 period. Choice of this time period is based on two considerations: first, intensive changes in ownership structure in the textile industry have only occurred alongside progress made in economic reform; second, there is no data on ownership composition for the textile industry beyond this time range.

The most striking feature of the change in ownership structure has been the sharp decline in the share of the state sector and a significant rise in the shares of the TVTEs and joint ventures. The state sector's shares in output value and employment fell by 34.1 and 32.9 percentage points respectively in the 1980-91 period. As a result, the state sector has lost its dominant position in the textile industry, though it remains the largest element in this industry. In the meantime, shares of the TVTEs sector over the two indicators increased by 31.3 and 27.6 percentage points respectively, a consequence being that over one-third of the Chinese textile industry has been operated by the rural sector since the early 1990s. The shares of joint ventures in output value and employment rose by 6.4 and 5.9 percentage points respectively, mainly starting from the late 1980s. In recent years joint ventures have appeared to be the fastest-growing ownership group in the Chinese textile industry. The urban collective sector was in a similar position declining just like the state sector, especially in terms of output value. In

[37] Township and village enterprises refer to rural enterprises run by townships and villages. By nature, these enterprises fall under rural collective ownership. However, since 1985 a number of privately-run enterprises in rural areas have been established under the name of township and village enterprises, and hence statistically classified into this ownership category. There is no way to distinguish this sort of privately-run enterprise from the statistics for the TVTEs sector. Nevertheless, according to some surveys, these non-collective enterprises only accounted for a small portion of the TVTEs sector (Chen and Liu 1991; Yang 1991). Thus, the word 'TVTEs' in this study essentially refers to rural collective textile enterprises run by townships and villages.

[38] Joint ventures refer to enterprises run cooperatively by Chinese and foreigners. In Chinese practice, this ownership group also covers enterprises run by foreign capital alone.

[39] Data on private textile enterprises at the industry level cannot be found in any sources.

contrast with its fall in output share, this sector experienced just a marginal decrease in the share of employment. This may be largely due to its role of absorbing urban surplus labour.

Table 4.9 Changes in the ownership structure of China's textile industry
(percentage)

		State(a)	UC(a)	TVTEs	JV(a)
1980	Output value	82.3	13.0	4.3	0.4
	Employment	75.0	12.8	11.9	0.3
1991	Output value	48.2	9.4	35.6	6.8
	Employment	42.1	12.2	39.5	6.2

Note: (a) State, UC, and JV refer to state-owned enterprises, urban collective enterprises, and joint venture enterprises respectively.

Sources: *Handbook of Textile Economy* 1987, pp.86-87; *Almanac of China's Textile Industry* 1993, pp.209-210; *Compilation of Major Financial Data of the Textile Industry* 1991, pp.1-6; *Operation Guide to the Township and Village Textile Enterprises* 1989, p.106.

Table 4.10 provides a comparison of ownership structures between the textile industry and national industry as a whole. A remarkable feature revealed by the comparison is that the output share of the non-state sector in the textile industry was higher than its counterpart in the national industry as a whole. In particular, the state sector maintained its dominant position in the national industry in the sense that it still produced over one half of total output in the early 1990s, while this was no longer the case in the textile industry.

Table 4.10 Ownership structures of the textile and national industries, 1990
(percentage)

	State	UC	TVTE	JV
Textile industry	48.9	10.7	34.2	6.2
National industry as a whole	53.6	10.4	31.5	4.5

Sources: *Statistical Year Book of China* 1991, p.391; *Compilation of Major Financial Data of the Textile Industry* 1990, p.6; *People's Daily*, 21 October 1991; *China Textile News*, 23 May 1991.

A number of inferences can be made from this comparison. Firstly, as the ownership compositions were basically the same in all industries in the pre-reform period, it appears that the later shifts in ownership structure have been more intensive in the textile industry than for the national industry as a whole. Secondly, the non-state sector in the textile industry has been strongly developed relative to its counterpart in national industry. The relatively advantageous position of the non-state sector in the textile industry would in all likelihood relate to certain characteristics of this industry (as discussed in Chapter 3), that tend to favour non-state enterprise. Thirdly, by way of comparison with the national industry, the dominance of the non-state sector over the state sector in the textile industry can be regarded as a turning point in this industry's structural evolution in ownership. Obviously, such a turning point occurred earlier in the textile industry than in the national industry as a whole.

The importance of the above change in ownership structure is that it ensured and enhanced growth in the textile industry during the reform period. Generally, output growth can be both the cause of and the outcome of change in ownership structure. However, in the Chinese textile industry change in ownership structure is more likely to cause output growth than the other way around. The sharp rise in the output share of the TVTEs and joint ventures implies that growth of the textile industry in the reform period derives largely from the tremendous expansion of these two dynamic sectors. When aggregate growth accelerates, the TVTEs and joint ventures typically lead the way, growing faster than other ownership groups. Because of their initial low output shares, the contribution they make to growth is at first modest and becomes increasingly large along with a progressive expansion in size. As the TVTEs and joint ventures have grown, their faster growth rate has pulled up the aggregate growth rate of the whole industry.

Table 4.11 shows the growth rates and growth elasticities of each ownership group in the Chinese textile industry for the period 1980-91. It is clear that inter-ownership variability in growth elasticities has been rather large. The TVTEs and joint ventures achieved tremendously high growth rates during the reform period. Their growth elasticities were much larger than one, and reached 3.7 and 4.8 respectively. In sharp contrast, the state and urban collective enterprises grew rather slowly, with growth

Table 4.11 Average growth rates and growth elasticities of each ownership group

	Total	State	UC	TVTE	JV
Growth rate %	8.44	3.29	5.29	31.42	40.48
Growth elasticity	-	0.39	0.63	3.72	4.80

Note: Figures in the table are calculated for the 1980-91 period.
Source: See Table 4.9.

elasticities that were largely below-unity. Strong growth in the TVTEs and joint venture sectors has become a driving force for sustained growth of the textile industry as a whole. Estimates show that some 68.6 per cent of total output growth in the textile industry during the period 1980-91 was from these two dynamic sectors. The two urban public ownership groups only accounted for 31.4 per cent of industrial growth. Moreover, the overall growth of the textile industry has tended to be more and more dependent on the growth impetus of the TVTEs and joint ventures, as shown in the fact that in the first two years of the 1990s the contribution of these two ownership groups to overall growth rose to over 80 per cent. At present, a less than 2.5 per cent increase in the output value of the TVTEs and joint ventures can accelerate the annual growth rate of the textile industry by 1 per cent (Sun 1991b). Strong growth momentum of the TVTEs and joint ventures originated from highly market-oriented operation and management system in these two sectors. As pointed out by Longworth and Brown (1995), TVTEs reacted more quickly to market forces and were often more adept than State enterprises at marketing their products.

Not only did the TVTEs and joint ventures make an important direct contribution to the growth of the textile industry, they also exerted indirect impacts on industrial growth in the sense that their rapid growth put competitive pressure on public enterprises, particularly the state sector, and this accelerated growth of these two urban ownership groups (Tseng et al. 1994).

Unlike the change in sectoral structure, which is essentially determined by rises in income levels and shifts in demand for different products, change in ownership structure in the textile industry derives from China's implementation of economic reform. Before economic reform, the Chinese textile industry was almost completely made up of two forms of urban public ownership, and rural collective enterprises accounted for only a negligible share, not to mention private enterprises and joint ventures. Economic reform and opening to the outside world provided a favourable environment for development of a multi-ownership structure. In particular, successful reforms in the agricultural sector gave rise to expansion of rural industries, and the open-door policy encouraged foreign investment. The change in the ownership structure of the textile industry was a direct outcome of China's ownership reform. If we consider change in sectoral structure as 'demand-induced' structural change, then we may regard change in ownership structure as 'reform-induced' structural change.

However, this classification is simply based on the major direct determinant of change in each structure. It by no means implies that the change in sectoral structure has no link to economic reform, or that the change in ownership structure has no connection to shifts in demand. Reform and demand could in all cases affect both structures, directly or indirectly, more or less. For instance, China's economic reform has increased consumers' income and hence given rise to higher demand for textile products, which has in turn affected the sectoral structure of the textile industry. It should thus be clear that only on a relative basis can one refer to the change in ownership structure as reform-induced and the other as demand-induced.

Conclusion

Following the implementation of economic reform and an open-door policy, the Chinese textile industry entered a period of rapid growth. The industry maintained double-digit growth between 1978 and 1994, which was considered spectacular by international standards. Two features of the industry's growth in the reform period are worth noting. One was the strong growth of the rural sector, and the other was sharply increased internationalisation associated with the industry's fast growth. On the other hand, the industry was subject to a cyclical pattern of growth. The main determinant of cyclical changes in the rate of growth has been the inconsistency in China's macroeconomic policy. Some industry-specific factors such as inappropriate product mix also appear to have had an impact on the cycle of growth.

Analysis of the rate and pattern of growth at the individual sector level reveals that all sectors in the textile industry achieved double-digit average growth in the 1978-93 period. Average annual growth rates ranged from 18.9 per cent to 10.8 per cent, suggesting considerable disparities in the growth record of the individual sectors. The man-made fibre, wool and silk sectors are considered to be the most dynamic sectors in the industry; the bast, knitting and apparel sectors the average growth sectors; and the cotton sector a slow-growth sector. When the textile industry is divided into fibre producing, primary textile and clothing sectors, the clothing sector shows increased growth elasticity since the mid-1980s. This suggests that growth of the textile industry has been increasingly dependent on the expansion of higher value-added products.

Structural change is an important factor in the growth of the Chinese textile industry. The most substantial aspects of structural change in this industry have been the shifts in sectoral and ownership structures. The main trend in sectoral structural transformation in the textile industry has been a decrease in the relative importance of the cotton sector accompanied by a rise in the man-made fibre, wool, silk and apparel sectors. Increased output of man-made fibres, wool and silk textiles, and clothing products above that implied by balanced growth has represented the greater part of structural evolution in the reform period. These sectors have played an increasingly important role in the development of the textile industry.

Change in sectoral structure is by nature demand-induced structural change. In contrast, change in ownership structure is essentially reform-induced structural change. The changing pattern of ownership structure in the textile industry shows that the relative importance of state ownership has been declining, while the role of non-state ownership has become increasingly important. In particular, the rise of the TVTEs and joint ventures represents a major change in ownership structure in the textile industry. A dominant portion of total output growth in the textile industry has been attributed to the expansion of these two dynamic ownership groups.

It has also been found that more intensive structural change in the textile industry occurred in the reform era than in the pre-reform period. This is because, after economic reform broke the initial balance, each sector had to respond to the new economic environment and these responses occurred at differing speeds. These differences in turn led to highly uneven expansion between sectors and ownership groups relative to normal periods. As change in ownership structure is by nature reform-induced structural change, it is to be expected that the current trend represented by an expansion of the TVTEs and joint ventures will continue and even accelerate with ongoing economic reform. On the other hand, the rate of change in sectoral structure may tend to slow down following the acceleration in the previous period.

While China's economic reform accelerated output growth and structural change in the textile industry, there is a question about whether economic reform has improved the industry's productivity performance as well. To answer this question, we need to analyse the changes in TFP in the Chinese textile industry.

5 TFP growth at the industry level

China's modernisation has seen a remarkable expansion of the role of textile production. A central interest of this study is in how productivity changed in the textile industry as a whole and in its individual sectors. Did the textile industry rely simply upon increments to factor inputs in achieving its recent remarkable growth as Krugman (1994) suggests to be the case for most East Asian industrial growth? Or did the Chinese textile industry achieve output growth through productivity gain and improved efficiency? These issues are to be analysed in this and subsequent chapters of the thesis.

The main objective of this chapter is to examine TFP performance for the Chinese textile industry as a whole. The chapter also investigates sources of output growth and identifies the relationship between output growth and TFP growth at the industry level. The first section presents a review of previous studies of TFP for China's industry; sections two and three discuss data issues and econometric model used to estimate output elasticities of factor inputs; the fourth section identifies changes in TFP; and, finally, section five investigates sources of output growth in the Chinese textile industry.

Previous studies of TFP growth in China's industry

Since the early 1980s, many studies of productivity changes in China's economy have been conducted by Western and Chinese researchers. In these studies, TFP is employed as a major criterion in assessing the impact of China's economic reform. For example, Reynold (1987, pp.291-2) defines economic reform as 'a process of institutional change which serves to increase the rate of growth of total factor productivity'. This definition suggests that TFP is the single most important indicator of success of economic reform in China.

Among the large number of studies that have dealt with TFP growth in the Chinese industry, there has been considerable disagreement about its TFP performance.

The controversy has focused on two closely related issues: how fast was industrial TFP growth in the reform period; and has this growth been significantly faster than that in the pre-reform period? Answers to these questions are key interest in this study.

Previous studies of China's industrial TFP have been carried out at three levels: for Chinese industry as a whole; for state-owned industry; and for individual sectors (usually at the three-digit industry level). The following survey covers all three levels. However, as far as the third-level is concerned, it is only the textile industry that is of interest here.

At least six of these earlier studies have analysed TFP growth for Chinese industry as a whole. Using a Cobb-Douglas function and econometric estimation, Chow (1985) finds that there was no evidence of any improvement in industrial TFP in the years 1979 to 1981. Using a similar method, Jin et al. (1990) estimate that the average annual growth rate of TFP for the 1980-87 period declined by 1.2 per cent in Chinese industry. In sharp contrast with these two studies, Li and Liang (1988), Jefferson et al. (1992), Gao (1993) and Li et al. (1993) find evidence of positive growth in industrial TFP in the reform period. Li and Liang claim that TFP growth averaged 1.2 per cent in the 1979-84 period, while Gao finds that it was even higher, averaging 3.5 per cent during the 1978-87 period. Jefferson et al. calculate TFP growth rates for the state and collective industrial sectors respectively and find that in both sectors annual TFP growth averaged between 2.04 to 4.19 in 1980-88. It follows that the industry as a whole realised a TFP growth rate of approximately 2.8 per cent in this period. Using a more sophisticated method to adjust the data, Li et al. compute average annual rates of TFP growth for 28 Chinese industrial sectors between 1981 and 1987. They find that 20 of the 28 sectors enjoyed positive TFP growth (the textile industry was among these 20 industries). Although they do not calculate TFP growth for the whole industry, by using the appropriate weights, it is clear that there was a positive growth rate for Chinese industry as a whole. Another common feature of these four studies is that, unlike Chow and Jin et al., they all use the TFP index approach, though this does not necessarily imply that it is their different methodology that is responsible for the conflicting results.

Of the six studies mentioned above, Li and Liang, and Gao compare TFP growth rates between the reform and pre-reform periods. They do not, however, find any evidence to suggest that the rate of TFP growth in the reform period was significantly higher than in the pre-reform period. As a matter of fact, Li and Liang even find evidence of a slowdown in TFP growth in the 1979-84 period compared with that in 1953-78. This result contradicts the findings of most studies of China's state-owned industry.

A majority of studies in this area have focused on the state sector, for three main reasons. Firstly, Chinese statistical data and other information for the state sector are relatively complete and accurate. Secondly, the state sector represents the major ownership group in the Chinese industry, with output value accounting for more than one half of total industrial output value until the early 1990s. Thirdly, and most importantly, most economists argue that the key area of China's economic reform is the state sector. Thus, the TFP performance of this sector is taken to be a critical indicator of the success of reform.

A few studies in this category (World Bank 1985; Tidrick 1986; Perkins et al. 1992) claim that the state sector experienced negative TFP growth in the reform period.[40] Using a TFP index approach, Tidrick finds that TFP growth averaged -0.1 to -1.2 per cent (depending on input weights chosen) in 1978-83, and Perkins et al. find there was a -2.26 per cent trend rate during the period 1981-89. Accordingly, Tidrick concludes that China's performance measured by TFP has been extremely disappointing. Perkins et al. (1992, p.30) compare TFP performance of the state sector in two sub-periods within the reform era and assert that 'while productivity generally improved in the first half of the 1980s, this has not been the case in the latter half of this decade'.

Yet a large majority of studies[41] find that there were positive rates of TFP growth in the state sector over the reform period. The average annual rates of TFP growth in the reform era reported by these studies range from 1.1 per cent (Wang 1990) to 5.7 per cent (Chen et al. 1988). The representative work in this group is that

[40] The study of World Bank (1985) reaches this conclusion without specifying TFP growth rates.
[41] Such studies include Shi et al. (1985), Chen et al. (1988), Zuo (1988), Chen (1989), Collar (1990), Lau and Brada (1990), Wang (1990), Jia (1991), Gordon and Wei (1991) and Jefferson et al. (1992).

undertaken by Chen et al. (1988) and Jefferson et al. (1992). Using a TFP index approach, adjusted data, and estimated output elasticities of capital and labour inputs, Chen et al. find that TFP in the state industrial sector grew by 4.2 to 5.7 per cent annually (depending on the functional forms used) between 1978 and 1985. For the purpose of comparison with Tidrick's (1986) result, Chen et al. also calculated TFP growth for the 1978-83 period and find it to be significantly larger than zero (around 2 per cent) rather than negative. Jefferson et al. first include intermediate inputs as an input variable in addition to capital and labour in the TFP analyses concerning China's industry. They find that annual TFP growth rate averaged 2.4 per cent in the state sector during 1980-88. In addition, they find that TFP growth in the state sector accelerated noticeably after 1984. This finding conflicts sharply with the conclusion reached by Perkins et al. (1992), as cited above. Based on the results of Jefferson et al., the World Bank (1992) changes its earlier assessment of China's TFP performance (World Bank 1985) and concludes that China realised very strong gains in TFP over the reform period, in all sectors of the economy.

Several studies have compared rates of TFP growth in the state sector in the reform period with that in the pre-reform period. Tidrick (1986) and Rawski (1983, 1986) find that there was a slowdown of TFP growth in the reform period. Rawski (1986) therefore asserts that there was no evidence of a general upward break in productivity growth following the onset of reform in China's industrial sector. On the other hand, other studies (Chen et al. 1988; Zuo 1988; Dollar 1990; Lau and Brada 1990) find that the state industrial sector experienced accelerated TFP growth since the commencement of reform. Of these, Chen et al. estimate that TFP growth was between 0.4 and 1.1 per cent (depending on the functional form chosen) for the 1957-78 period, which was significantly lower than the corresponding rates of 4.2 to 5.7 per cent in the reform period. Chen et al. therefore conclude that Chinese industry has indeed begun to display improved productivity since the commencement of economic reform.

A number of studies have conducted TFP analysis at the three-digit industry level. Some of these estimate TFP growth for the textile industry but none of them provide a detailed analysis of this issue.[42] Like the studies undertaken at the other two levels, the assessments of TFP performance in China's textile industry have also involved sharp disagreement.

Two studies (Perkins et al. 1992; Zhao 1993) show negative TFP growth rates for the state sector of the textile industry during the reform period. Perkins et al. find that TFP growth averaged -4.87 per cent in the 1981-89 period, while Zhao finds that it declined consistently between 1980 and 1988. Again, a majority of studies in this category (Rawski, 1983, 1986; Shi et al. 1985; Jia 1991; Wang 1992; Gao 1993; and Li et al. 1993) find that TFP growth was positive for the textile industry over the reform period. Rates of TFP growth in these studies ranged from 0.96 per cent (Li et al. 1993) to 8 per cent (Gao 1993). In this group of studies, the representative work is that by Li et al., which employs a translog index approach and adjusted data and find that TFP grew 0.96 per cent annually in the textile industry and 1.91 per cent in the apparel industry[43] during 1981-87.

As for the question of whether TFP growth in the textile industry has been faster over the reform period than in the pre-reform period, only two studies attempt to provide an answer. Rawski (1986) finds that annual TFP growth was 6.1 per cent in the 1980-83 period, which was significantly higher than the pre-1980 record of 3.8 per cent. In contrast to Rawski's result, Gao (1993) estimates in a Cobb-Douglas version that average TFP growth in the textile industry was substantially lower in 1978-87 than in the pre-reform period. In addition, Cheung et al. (1993) estimate that the rate of TFP growth for the cotton yarn sector of the textile industry averaged 1.5 per cent during 1922-86. As their estimates for the 1978-86 period are statistically insignificant, they conclude that China's economic reforms have not had a dramatic impact on TFP growth.

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42 Cheung et al. (1993) estimates TFP growth for China's cotton yarn industry but not for the textile industry as a whole. This is the only work I have found that focuses on the textile industry to some extent.

43 In previous studies, the apparel industry is not included in the textile industry. This differs from the definition of the textile industry used in this study. TFP analysis in this study is conducted for a widely-defined textile industry (including the apparel sector) rather than a narrowly-defined textile industry (excluding the apparel sector).

Because of the use of different data and methods and the coverage of various periods, the results of these studies are not strictly comparable. Hence attention should be paid to some methodological issues involved in these studies rather than their results. While previous studies have made a substantial contribution to TFP analyses of China's industry, there are still some methodological problems associated with these studies.

First, all of the studies except Jefferson et al. (1992) and Li et al. (1993) use value added to describe output variable. By doing so, intermediate inputs are excluded from both input and output aggregates. As Dogramaci (1981) points out, the value added TFP measure is valid only under very restrictive assumptions with regard to production technology or in cases where prices of outputs and intermediate inputs vary in strict proportion. Without justification of these conditions, this measure fails to capture the full impact of total inputs on productivity. For example, the value added TFP measure may, to some degree, distort TFP changes related to substitution of labour or capital for intermediate materials, particularly at the level of individual sectors. Li et al. (1993) show that neither prices nor growth rates of output and intermediate inputs move in strict proportion in China's industry. It is thus clear that without accounting for intermediate inputs, estimation of China's industrial TFP is very likely to produce biased results. In particular, the use of the value added TFP measure is undesirable in a sector such as the textile industry where intermediate inputs (mainly raw materials) account for over 60 per cent of total costs (CTERC 1993, No.18). So, a gross output measure rather than a value added measure may be better to use in TFP analysis of the Chinese textile industry.

Second, all of the studies except Li et al. (1993) fail to take into account quality changes of factor inputs. Growth theory suggests that quality improvement in factor inputs lead to so-called 'embodied' growth. This type of growth is different from TFP growth. If the inputs are not adjusted properly for quality changes, the impact of 'embodied" growth will be counted as a part of TFP growth and therefore cause certain bias in TFP analysis (Nadiri 1970). As shown by Li et al. (1993), in the absence of quality-correction of inputs, the evaluation of TFP growth in China's industry indeed can involve some bias. To avoid this deficiency, the input data needs to be adjusted for quality changes before calculating or estimating TFP growth.

Third, most previous studies use highly aggregated data to analyse China's industrial TFP. In particular, all studies of the Chinese textile industry use aggregate data at the industry level except for that of Zhao (1993).[44] With the use of aggregated data, the aggregation biases of data are likely to produce biased TFP estimates. Dogramaci (1981) points out that if technical change (TFP growth) manifest itself simultaneously in increasing prices of related inputs as well as their relative growth rates, productivity analysis based on improper aggregation will tend to overestimate TFP. Thus, use of disaggregated data is desirable for TFP studies.

Obviously, further studies of Chinese industrial TFP can be improved with respect to these three methodological issues. This study makes an effort to enrich TFP analysis along these lines in relation to China's textile industry.

Data issues

As Chapter 2 explained, this study mainly uses a TFP index approach to compute TFP growth for the Chinese textile industry. Construction of the TFP index requires constant price measures of gross output value, capital and intermediate inputs, along with a physical measure of labour.

All original data are obtained from Chinese statistical sources. These include *Statistical Yearbook of China* 1992, *Almanac of China's Textile Industry* 1982-92, *China Fibre Yearbook* 1989-92, *China Textile Yearbook* 1993, *Compilation of Statistical Data of the Textile Industry: 1949-1988*, *Annual Financial Data of the Textile Industry* 1988, *Compilation of Major Financial Data of the Textile Industry* 1989-91, *1985 Industrial Census Data of People's Republic of China, Volume 14: Textile Industry*, and *Statistical Data of China's Industrial Economy* 1949-92.[45]

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44 Zhao (1993) uses a small sample with only 20 textile enterprises involved.
45 See References for detailed information about these sources.

As the calculation of the TFP index is sensitive to data quality, this study involves some concerted work on data adjustments. The major adjustments include: (1) converting the values of fixed assets and intermediate inputs into a constant price basis; (2) excluding non-productive capital and labour from the original data; and (3) adjusting the inputs for the quality changes.

The procedures for generating appropriate data series are as follows.

Output

Gross output value data in 1980 constant price for the textile industry as a whole for the 1952-91 period are available from *Compilation of Statistical Data of the Textile Industry: 1949-1988*, *China Fibre Yearbook*, and *Almanac of China's Textile Industry.*

Capital

Unlike most previous studies of China's industrial TFP growth which excluded working capital from the capital input, this study uses a combination of fixed assets and working capital to express capital variable. There are three reasons for this. Firstly, working capital is an indispensable element in industrial production. In China's industry, working capital generally accounts for one-fourth to one-half of the value of fixed assets. There is evidence that working capital can seriously affect output growth. For instance, lack of working capital appeared to be a constraint for the textile industry in 1986 and 1989 because of contractionary monetary policy implemented by the central government. Secondly, working capital is mainly used for stock at various production stages, and according to international accounting practice, stock is usually considered to be a part of capital. Thirdly, in order to verify the empirical relationship between working capital and output growth, a simple regression was undertaken on them for the 1952-91 period. The estimated coefficient is significantly different from zero.

To obtain an appropriate data series for fixed assets, several steps are involved:

A. The net value of fixed assets is used for TFP calculation in this study. Data for net value of fixed assets for 1976-91 are available in *Annual Financial Data of the Textile Industry* and *Compilation of Major Financial Data of the Textile Industry*, though, only original value of fixed assets can be found for 1952-75. In this case, the net value of fixed assets for 1952-75 is derived as follows:

$$IOK_t = OK_t - OK_{t-1} \quad (5.1)$$

where IOK_t denotes annual increments to the stock of fixed assets at original cost at year t, and OK_t and OK_{t-1} is original value of fixed assets at year t and t-1 respectively.

$$NK_t = NK_{t-1} + IOK_t - d_t OK_{t-1} \quad (5.2)$$

where NK_t and NK_{t-1} refers to net value of fixed assets at year t and t-1 respectively, and d denotes the depreciation rate. It is assumed that changes in prices of capital goods were negligible prior to 1952, so the original value of fixed assets in 1952 can be used as a base year figure to construct the series of net value of fixed assets for 1952-75. Official composite depreciation rates are applied to the calculation. These rates ranged from 3.6 to 4 per cent in the textile industry during 1952-75.

B. The Chinese official data on fixed assets are constructed on the basis of current year prices, hence they fail to reflect the real stock of fixed capital. To avoid this deficiency, net values of fixed assets should be converted to real values by using appropriate price deflators:

$$RNK_t = NK_t / DFK_t \quad (5.3)$$

where RNK denotes real value of fixed assets, and DFK is the price deflator (taking 1980 price as the basis). Since insufficient information does not allow generation of price deflators of fixed assets in the textile industry, price deflators are constructed using the data presented in two previous studies — Chen et al. (1988a), who provided price deflators of China's industrial investment for 1952-1985, and Li et al. (1993), who supplied price deflators of fixed assets in the textile industry for 1980-87. For the 1988-91 period, I construct price deflators by using the price index for textile machinery in this period as a proxy, as relevant data can be obtained from *Annual Financial Data of the Textile Industry* and *Compilation of Major Financial Data of the Textile Industry*.

C. As Chen et al. (1988a) have pointed out, Chinese industrial enterprises usually provide various service facilities such as housing, schools and stores for their workers. Chinese statistics conventionally categorise these assets as a part of fixed capital. Since these assets are not used directly in the production process, under international accounting practice they should not be regarded statistically as fixed capital. Thus, this study needs to exclude non-productive assets form fixed capital. Values of productive assets for 1988-91 are available in *Annual Financial Data of the Textile Industry* and *Compilation of Major Financial Data of the Textile Industry*. Corresponding figures for 1952-87 are obtained using the following formula:

$$PRNK_t = (1-s_t)\, NK_t \tag{5.4}$$

where $PRNK_t$ denotes the deflated net value of productive assets, and s_t is the proportion of non-productive assets in total fixed assets. Values of s_t for the textile industry in 1980 and 1985 can be calculated according to the data in *1985 Industrial Census Data of People's Republic of China, Volume 14: Textile Industry*. I thus use the 1980 figure of s_t for the years 1980-84 and the 1985 figure for 1985-87. As for the 1952-79 period, I use the relevant figures presented in Chen et al. (1988a, p.259) as approximations of s_t in the textile industry.

D. There is need to adjust for quality of fixed assets. In empirical studies, quality changes in fixed capital are frequently characterised by the vintage of capital. This approach is closely related to the embodiment hypothesis of technical progress, which says that if new technical knowledge can be embodied in new capital goods, more recent additions to the capital stock must be weighted more heavily than earlier additions when evaluating their effects on output growth. Based on this concept, I use a simple model to construct a quality index of fixed assets for the Chinese textile industry. The model can be expressed as follows:

$$QIYK_t = \frac{\ln RIOK_t}{\sum_{j=0}^{4} \ln RIOK_{t-j}} \qquad (5.5)$$

where $QIYK_t$ is the quality indicator of fixed capital at time t, and $RIOK_t$ and $RIOK_{t-j}$ is the real value of new capital formed in year t and t-j (j = 0, 1,..., 4) respectively. Equation (5.5) says that the quality of fixed capital can be approximated by the ratio of the logarithmic value of newly constructed capital in year t to total logarithmic values of newly built capital in the last five years (year t is included). In using equation (5.5) we assume that there was no change in the quality of fixed assets during 1952-55. Therefore, the calculation of the quality index of fixed capital starts with 1956. Data on RIOK can be obtained from steps A and B. Thus, the values of QIY_t can be calculated for each individual year, and, correspondingly, it is possible to construct readily a quality index of fixed capital based on these values for the whole sample period. The $PRNK_t$ value obtained from equation (5.4) is then adjusted further with the quality index and generates a new series of fixed assets denoted as $FPRNK_t$, which is the revised final value of the fixed assets.

As mentioned previously, the capital input used in this study is the addition of fixed assets and working capital, namely:

$$K_t = FPRNK_t + WK_t \qquad (5.6)$$

where WK_t denotes working capital used in year t and K_t is the revised value of capital which is to be used for the computation of TFP index. Average values of working capital for each year between 1952 and 1991 can be found in *Compilation of Statistical Data of* *the Textile Industry: 1949-1988*, *Annual Financial Data of the Textile Industry* and *Compilation of Major Financial Data of the Textile Industry*.

Labour

Adjustment of labour data is relatively easy. The first step is to exclude non-productive workers in the enterprises. It can be done by using the formula:

$$ROL_t = OL_t \times (1-z_t) \qquad (5.7)$$

where ROL_t is the number of productive workers, OL_t is the unrevised number of workers, and z_t is the ratio of non-productive workers to total employees. Values of z_t for the 1980-91 period are derived from *1985 Industrial Census Data of People's Republic of China, Volume 14: Textile Industry*, *Annual Financial Data of the Textile Industry* and *Compilation of Major Financial Data of the Textile Industry*. The 1980 value of z_t is then used as an approximation for the 1952-79 period,[46] because relevant data can not be found for this period.

Quality of labour in the textile industry can be represented by average technical levels of workers. Data for this indicator can only be found for some individual years (1952, 1957, 1965, 1975, 1980-85, and 1988-90). Since the existing data show few changes in this indicator during the sample period, I simply derive the gap years' values by linear interpolation between the available values. Then, a series of quality index for labour in the textile industry can be constructed. Finally, ROL_t obtained from equation (5.7) is adjusted with this quality index to obtain a revised number for labour, L_t, which is used for the calculation of the TFP index.

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[46] Since the z_t values for the 1980-91 period tended to increase, it is thus expected that the average z_t values in the 1952-79 period were not higher than the 1980 value of z_t.

Intermediate inputs

Data on intermediate inputs cannot be directly obtained from Chinese statistics. Following Jefferson et al. (1992), I derive the nominal value of intermediate inputs from the following accounting identity:

$$INT_t = Y_t - NY_t - DF_t - MRF_t \qquad (5.8)$$

where INT is value of intermediate inputs, Y represents gross output value, NY denotes net output value, DF is depreciation fund, and MRF refers to major repair fund. Data for Y, NY, DF and MRF are available in *Compilation of Statistical Data of the Textile Industry: 1949-1988*, *Annual Financial Data of the Textile Industry*, *Compilation of Major Financial Data of the Textile Industry* and *1985 Industrial Census Data of People's Republic of China, Volume 14: Textile Industry.*

In order to correct for the effects of inflation, the nominal value of intermediate inputs obtained from (5.8) needs to be deflated. Since a ready deflator of intermediate inputs for the textile industry is not available, I use purchasing prices of cotton as a proxy to derive a price deflator for intermediate inputs. As cotton accounts for more than one half of raw materials in the Chinese textile industry, its price is considered a reasonable and reliable proxy for the total price of intermediate inputs. Data on purchasing prices of cotton can be found in *Statistical Yearbook of China.* A price index of cotton and hence a price deflator of intermediate inputs can be created based on these data. Then constant value (at 1980 prices) of intermediate inputs can be calculated by the formula:

$$M_t = INT_t / DFM_t \qquad (5.9)$$

where M_t denotes real value of intermediate inputs and DFM is the price deflator of intermediate inputs. Values of M_t obtained from (5.9), together with K_t and L_t, are used to calculate TFP index for the textile industry.

Unfortunately, a quality adjustment for intermediate inputs cannot be made because of heterogeneity of intermediate inputs used in textile production and hence the difficulties in choosing a representative indicator.[47] According to Li et al. (1993), change in the quality of intermediate inputs used in textile production was only minor in the period 1981-87.[48] Based on this evidence, we may reasonably assume that the exclusion of quality adjustment for intermediate inputs will not affect the analysis substantially.

In addition to the above-mentioned adjustments, data for the Great Leap Forward period of 1958-60 are omitted from the data set because of doubts about their reliability (Rawski 1976; Chen et al. 1988b).

Estimation of output elasticities of factor inputs

As pointed out in Chapter 2, the assumption of perfect competition is not applicable to the Chinese textile industry, and thus the output elasticities of factor inputs should be estimated econometrically rather than using real input shares. This section seeks to obtain estimates of these elasticities.

Model specification

The model is based on the economic theory of production. Assuming that output is a function of capital, labour, intermediate inputs and time, a general form of the production function for the Chinese textile industry can be written as:

$$Y = f(K, L, M, t), \tag{5.10}$$

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[47] A likely representative indicator would be cotton. However, even if cotton was chosen, there was still a problem of lacking suitable data to describe the quality change in cotton.

[48] Li et al. (1993) estimate that in the period 1981-87, annual growth rates of quality of intermediate inputs were -0.23 per cent and 0.08 per cent respectively for the primary textile and apparel industries. As they did not explain specifically about their method for obtaining these estimates, it is not convincing to use their estimates in this study to make quality adjustment for intermediate inputs.

where Y is output; K, L, M and t refer to capital, labour, intermediate inputs and time respectively.

We assume further that technology in the Chinese textile industry can be represented by a Cobb-Douglas production function, which is characterised by constant returns to scale so that the elasticities and the value shares sum to unity:

$$\ln Y = \alpha_0 + \delta t + \alpha_K \ln K + \alpha_L \ln L + \alpha_M \ln M \tag{5.11}$$

The output elasticities of capital (s_K), labour (s_L) and intermediate inputs (s_M) are simply α_K, α_L and α_M. Output elasticities remain constant through the sample period.

The use of the Cobb-Douglas production function can be justified for two reasons. First, Cobb-Douglas function is the simplest and most efficient functional form for the estimation of output elasticities of factor inputs. Second, the applicability of Cobb-Douglas production function to China's industry has been confirmed by several previous studies that compared different functional forms for the Chinese industry (Chen et al. 1988b; Jefferson 1990; Jia 1991; Perkins et al. 1992; and Cheung et al. 1993). Among them, Chen et al., Jefferson, and Perkins et al. compared the Cobb-Douglas function with the translog form, and Jia and Cheung et al. compared the Cobb-Douglas and CES functions. These authors all reached the conclusion that the Cobb-Douglas form was to be preferred. In particular, Cheung et al. found that the Cobb-Douglas specification was the preferred functional form for the cotton yarn sector of China's textile industry.

After obtaining the output elasticities of factor inputs, the TFP index can be constructed using revised data for output and input. In this one-output, three-input case, the rate of TFP growth can be computed from the Tornqvist quantity index:

$$\begin{aligned} T\hat{F}P(t) &= \ln Y(t) - \ln Y(t-1) - \bar{s}_k\left[\ln K(t) - \ln K(t-1)\right] \\ &\quad - \bar{s}_L\left[\ln L(t) - \ln L(t-1)\right] - \bar{s}_M\left[\ln M(t) - \ln M(t-1)\right] \end{aligned} \tag{5.12}$$

Data and estimation results

Pooled time-series and cross-sectional data are used to estimate the output elasticities of factor inputs. The use of panel data for econometric estimation has, as argued by Hsiao (1986, p.213), at least three benefits over conventional cross-sectional or time-series data approaches: '(1) identification of economic models and discriminating between competing economic hypotheses; (2) eliminating or reducing estimation bias; and (3) reducing problems of data multi-collinearity'. As far as this study is concerned, the major advantage of applying panel data is to reduce estimation bias and improve the efficiency of econometric estimates.

Input and output data are disaggregated by seven sectors of the textile industry: man-made fibre, cotton, wool, bast, silk, knitting and clothing. As capital data on individual sectors for 1952-74 are not available, the estimation makes use of sectoral data only for 1975-91 period. It is assumed that output elasticities of factor inputs remain constant throughout 1952-91 period. Compared with most previous studies which use aggregate time-series data in their estimation procedure, the use of panel data at the sectoral level in this study is expected to reduce substantially the potential for an aggregation bias, though it does not eliminate the aggregation problem completely.

Data on capital, labour and intermediate inputs are revised using the procedures described in the last section except for quality adjustments, since insufficient information about input quality at the sectoral level does not allow for such adjustments. As the purpose here is to estimate output elasticities of factor inputs, the absence of quality adjustments is expected to have negligible effect on the estimation results.

The estimated coefficients of equation (5.11) are shown in Table 5.1. The satisfactory value for R^2 indicates that the model has appropriate explanatory power and the assumption of constant returns to scale cannot be rejected. A residual analysis conducted later also confirms that the equation fits the data quite well. The estimated output elasticities of factor inputs can now be used to construct TFP indexes for the Chinese textile industry.

Table 5.1 Estimation results for equation (5.11)

	δ	α_K	α_L	α_M	R^2
Estimate	0.01	0.37	0.18	0.45	0.97
	(2.65)	(5.69)	(3.78)	(6.19)	

Notes: (a) Figures in parentheses are t statistics.
(b) All coefficients are statistically significant at the 95% confidence level.

The values of estimated δ indicate a positive and small technical change in the textile industry during the sample period. Economic theory suggests that TFP growth occurs as a result of technical changes due to advances in knowledge and from the realisation of economies of scale resulting from expansion of product markets. Denny et al. (1981a) have shown that in the case of constant returns to scale, the rate of TFP growth is identical to the rate of technical change. As this study uses an index approach to determine the rate of TFP growth, the estimate of technical change obtained here is only taken as a reference.

Trends of TFP growth in the textile industry

The TFP indexes (with 1952=100) and the annual average rates of TFP growth for the 1952-91 period are calculated and reported in Table 5.2. According to the figures shown in the table, we can draw the following inferences.

(1) During the pre-reform period (1952-77) the average annual rate of TFP growth was 0.46 per cent in China's textile industry. Of the 22 observed years (1958-60 are omitted), 11 appear to have had negative TFP growth. This finding is consistent with most previous studies which find that there was sustained productivity stagnation in the Chinese industry in the pre-reform period.

(2) The average annual growth rate of TFP in the Chinese textile industry was 3.65 per cent during the reform era (1978-91). This growth rate is substantially higher than that in the pre-reform period. This finding is in line with the conclusions reached by

Table 5.2 TFP changes in the Chinese textile industry, 1952-91

	TFP indexes	TFP growth		TFP indexes	TFP growth
1952	100.00	-	1972	105.77	-0.0243
1953	100.12	0.0012	1973	107.30	0.0145
1954	98.93	-0.0119	1974	102.76	-0.0423
1955	97.47	-0.0148	1975	110.13	0.0717
1956	102.60	0.0526	1976	105.03	-0.0463
1957	100.09	-0.0245	1977	112.26	0.0688
1958	n.a.	n.a.	1978	120.43	0.0728
1959	n.a.	n.a.	1979	127.27	0.0568
1960	n.a.	n.a.	1980	137.26	0.0782
1961	97.03	-0.0305	1981	145.72	0.0619
1962	95.50	-0.0157	1982	141.65	-0.0279
1963	99.01	0.0368	1983	146.12	0.0315
1964	103.59	0.0463	1984	153.60	0.0512
1965	109.52	0.0572	1985	161.94	0.0543
1966	111.45	0.0176	1986	158.62	-0.0205
1967	99.90	-0.1036	1987	166.74	0.0512
1968	99.34	-0.0056	1988	174.79	0.0483
1969	107.58	0.0829	1989	181.70	0.0395
1970	110.39	0.0261	1990	179.79	-0.0105
1971	108.40	-0.0180	1991	185.56	0.0321

most previous studies concerning China's industrial TFP growth, while in conflict with the studies of Perkins et al. (1992) and Zhao (1993), in which the trend rates of TFP growth are found to be negative in the Chinese textile industry over the reform period. On the other hand, this finding does not agree with the view of either Gao (1993) or Cheung et al. (1993) that the rate of TFP growth in the textile industry during the reform period was lower than in the pre-reform period.

The theory of industrial organisation predicts superior productivity performance under market conditions characterised by more effective competition among firms. The crucial reason is that in competitive markets productive efficiency is a prerequisite for survival. As China's economic reform has successfully enhanced market discipline and produced considerable competitive pressure on enterprises, it is reasonable to expect that TFP performance has improved in the textile industry. The empirical results in this study demonstrate that this is indeed the case.

(3) Although TFP growth in the textile industry appeared to be positive during 1952-91, the average annual rate of TFP growth was only 1.6 per cent — a rate that is considered to be quite low by international standards.[49] At the same time, it is very likely, according to the results of previous studies (Shi et al. 1985; Chen et al. 1988b; Li and Liang 1988; Wang 1990; and Jia 1991) that TFP growth in the textile industry since the early 1950s has been lower than the Chinese industrial average. Thus the issue of how to improve TFP performance further remains critical for the textile industry. On the other hand, the relatively low level of TFP growth also suggests that the Chinese textile industry still has great scope for achieving accelerated TFP growth.

(4) Considerable fluctuations can be observed in TFP growth over the sample period, particularly in the pre-reform period. It can be seen from Table 5.2 that economic reform not only accelerated TFP growth but also substantially reduced the TFP fluctuations in the textile industry. The changes in the coefficients of TFP fluctuation[50] ranged between -23.5 and 17.0 during 1952-77 but between only -1.8 and 1.3 in 1978-91.

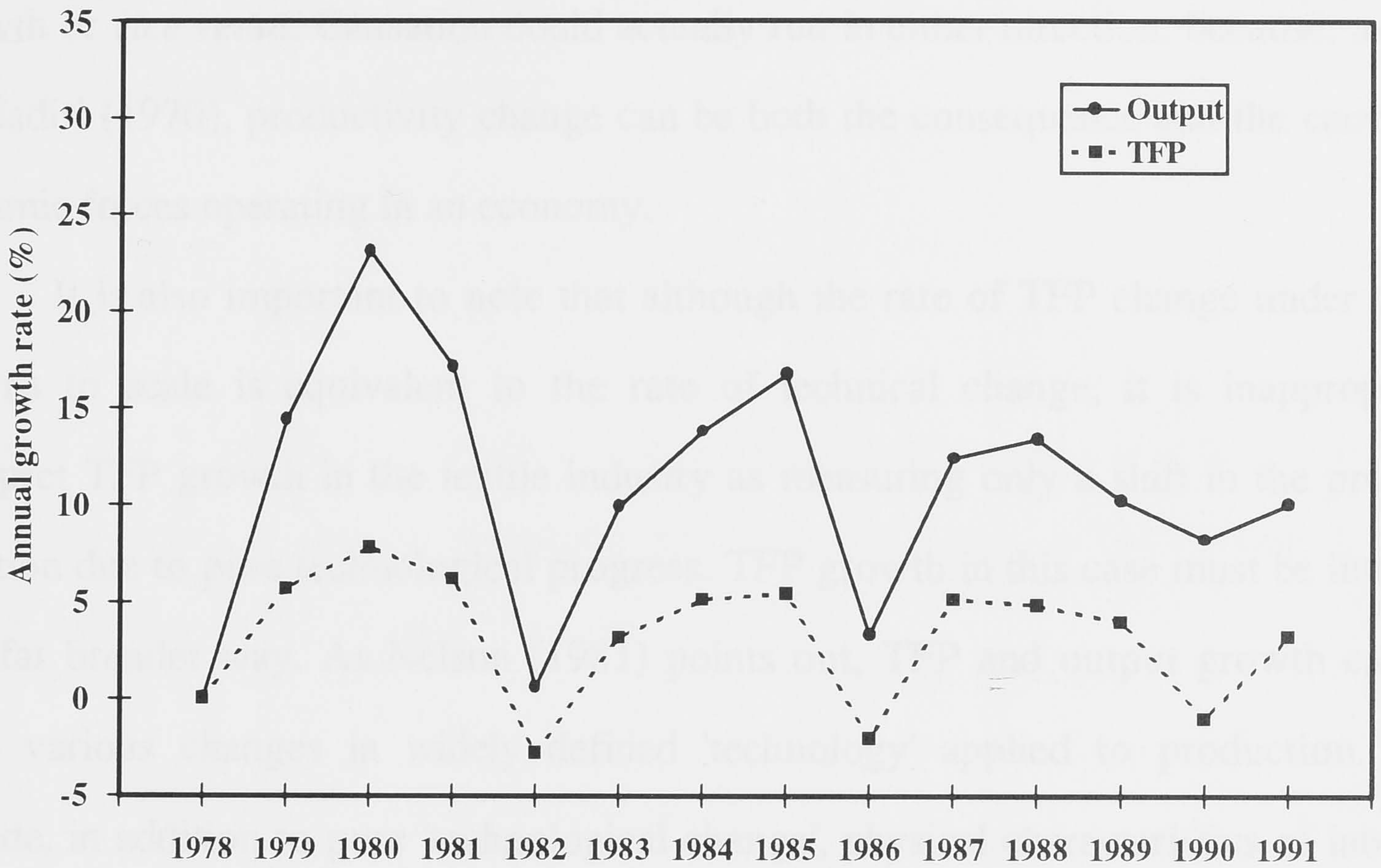
It is also of interest to observe that the pattern of fluctuations in TFP growth has closely followed the pattern of output growth. This is shown in Figure 5.1, which plots the annual rates of TFP and output growth for the 1978-91 period. It can be seen from the figure that TFP growth in the textile industry also has exhibited a cyclical pattern. Moreover, this cyclical pattern virtually mirrors the pattern of output growth. It can be observed that from 1978 to 1991 three major cycles occurred in both output and TFP growth (if we ignore the extra slowdown of TFP growth in 1984). In particular, the timing of peaks and troughs in the two series appear to coincide to a high degree. This suggests that the cyclical forces generated by output growth have been primarily responsible for the cyclical fluctuations of TFP growth in the textile industry. Due to unavailability of data, this study cannot evaluate TFP growth beyond 1991 for the textile

[49] Because of the paucity of international studies of TFP for the textile industry, I have had to use the data on manufacturing TFP growth of some countries to make this international comparison. Thus, the judgement here is rather rough and not easily justified.

[50] See footnote 20 in Chapter 3 for the definition and calculation of the coefficients of fluctuation.

industry. The observed cyclical pattern of TFP growth, seen in Figure 5.1, suggests that the decline in the rate of TFP growth reached a trough in 1990 and will return to a new peak following the high rates of output growth in the 1992-94 period.

Figure 5.1 Comparison between the patterns of TFP and output growth



Source: Derived from Tables 4.1 and 5.2.

The similar patterns of TFP and output growth is highly suggestive of positive correlation between the two variables. A simple regression on the rates of TFP and output growth reveals a positive coefficient of 0.53 with a highly significant t ratio of 8.71 (R^2 = 0.87). This indicates that the rate of TFP growth has been positively related to the rate of output growth in the Chinese textile industry — namely that faster output growth has generally been accompanied by higher rates of TFP growth and *vice versa.*

The existence of a positive linear relationship between productivity growth and output growth in manufacturing has been identified in many studies (Kaldor 1967; Mishimizu and Robinson 1984), and was described as the 'Verdoorn law' by Kaldor (1966) in recognition of the earlier contribution of Verdoorn (1949). This relationship is chiefly explained in terms of differential rates of technological progress and economies of scale. The faster demand for an industry's product grows, the faster the rate of growth of investment in that industry; also, the faster an industry grows, the greater will be the productivity gains from 'learning by doing'. The empirical evidence found in this study confirms that the Verdoorn law also holds in the Chinese textile industry.

The verification of the Verdoorn law does not help in determining the direction of causation between the two variables — whether faster output growth accelerates TFP growth or *vice versa*. Causation could actually run in either direction, because, as argued by Nadiri (1970), productivity change can be both the consequence and the cause of the dynamic forces operating in an economy.

It is also important to note that although the rate of TFP change under constant returns to scale is equivalent to the rate of technical change, it is inappropriate to interpret TFP growth in the textile industry as measuring only a shift in the production function due to pure technological progress. TFP growth in this case must be interpreted in a far broader way. As Nelson (1981) points out, TFP and output growth can result from various changes in widely defined 'technology' applied to production. It may include, in addition to pure 'technological change', physical characteristics of labour and intermediate inputs, industrial and plant organisation, management ability, marketing skills, technological training and 'learning by doing', engineering know-how, and even the pressures from domestic and international competition.

Because of the lack of relevant data, the analysis of TFP in this study has been unable to identify which of the above elements may be involved in TFP growth in the Chinese textile industry. To paraphrase Nishimizu and Robinson (1984, p.182), the analysis 'really treats production units as a black box. We measure the inputs and the outputs, but make no real attempt to describe exactly what is going on inside the plant gate'. The task of finding out how the 'black box' works is important, but must await collection of the necessary data.

Sources of output growth

To analyse sources of output growth in the textile industry one needs to make use of the growth accounting relationship. Derivation of growth accounting identity is based on the specification of the production function, and the procedure is similar to the derivation of TFP growth in Chapter 2. In that chapter, the underlying production function for a single-output case was written as

$$Y = f(X_1, X_2, \dots, X_i, \dots, X_n, t), \qquad (2.9)$$

where Y and X stands for output and input respectively, and t is a time variable that represents technical change. Assuming that technical change is Hicks-neutral, then the production function (2.9) takes the form

$$Y = A(t) f(X_1, X_2, \dots, X_i, \dots X_n), \qquad (2.10)$$

where $A(t)$ is the TFP variable. Differentiating Y totally with respect to time, we have

$$\dot{Y} = \dot{A}(t)\frac{Y}{A} + \sum_{i=1}^{n} \frac{\partial f}{\partial X_i} \dot{X}_i A. \qquad (2.11)$$

Manipulating (2.11), we get

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A(t)} + \sum_{i=1}^{n} \frac{\partial Y}{\partial X_i} \cdot \frac{X_i}{Y} \cdot \frac{\dot{X}_i}{X_i}. \qquad (2.12)$$

Assuming profit-maximisation behaviour, the marginal products of factor inputs equal their respective market prices — that is, $(\partial Y)/(\partial X_i) = W_i / P$, for all i:

$$\frac{\dot{Y}}{Y} = \frac{\dot{A}}{A(t)} + \sum_{i=1}^{n} \frac{W_i X_i}{PY} \cdot \frac{\dot{X}_i}{X_i} = \frac{\dot{A}}{A(t)} + \sum_{i=1}^{n} \alpha_i \frac{\dot{X}_i}{X_i}, \qquad (2.13)$$

where P and W_i are the unit prices of output and the ith input respectively, and $a_i = (W_i X_i)/(PY)$ is the share of ith input in the total value of output. If we substitute the symbols used in this study, equation (2.13) becomes

$$\frac{\dot{Y}}{Y} = s_K \frac{\dot{K}}{K} + s_L \frac{\dot{L}}{L} + s_M \frac{\dot{M}}{M} + T\hat{F}P, \qquad (5.17)$$

as mentioned previously, where $s_K=\alpha_K$, $s_L=\alpha_L$ and $s_M=\alpha_M$. This accounting identity serves to isolate the contributions of primary factor inputs and the rate of TFP growth to the growth of output. Using identity (5.17), the sources of output growth in the Chinese textile industry are calculated for the 1952-91 period (see Table 5.3).

It can be seen from Table 5.3 that in most years between 1952 and 1991 growth of capital and intermediate inputs were the major sources of output growth. TFP growth was a leading source of output growth in only 11 of these years, mostly in the reform era.

The contribution ratios of each element to output growth for the whole sample period as well as for several sub-periods are calculated and shown in Table 5.4.

During the 1952-91 period TFP accounted for 19.3 per cent of output growth in the textile industry. This was higher than that of labour (9.5 per cent) but much lower than that of intermediate inputs and capital. Over the whole period, the largest proportion of output growth was explained by the growth of intermediate inputs (36.1 per cent) and capital (35.1 per cent). This implies that growth in China's textile industry relied heavily on the expansion of factor inputs, particularly intermediate inputs and capital, other than increase in TFP.

According to Wynnyczuk (1975), industrial growth generally comprises extensive growth, intensive growth and structural change. Extensive growth is the result of an increase in employment of factor inputs; intensive growth is achieved by raising productivity of factors in use; and structural change results from the reallocation of inputs among different uses. These three aspects of growth can occur simultaneously. However, one may dominate at a certain stage of growth. The pattern of growth that characterised the Chinese textile industry over the whole period is basically that of extensive growth.

Table 5.3 Accounting for output growth in China's textile industry, 1952-91

	Rate of output growth	Weighted growth in capital	Weighted growth in labour	Weighted growth in intermediate inputs	Rate of TFP growth
1952	-	-	-	-	-
1953	0.1695	0.0612	0.0371	0.0700	0.0012
1954	0.1017	0.0432	0.0374	0.0330	-0.0119
1955	-0.0395	0.0250	0.0126	-0.0129	-0.0148
1956	0.1571	0.0481	0.0229	0.0335	0.0526
1957	0.1033	0.0506	0.0223	0.0549	-0.0245
1958	n.a.	n.a.	n.a.	n.a.	n.a.
1959	n.a.	n.a.	n.a.	n.a.	n.a.
1960	n.a.	n.a.	n.a.	n.a.	n.a.
1961	-0.0543	-0.0105	-0.0081	-0.0052	-0.0305
1962	-0.1068	-0.0277	-0.0133	-0.0501	-0.0157
1963	0.1187	0.0395	-0.0025	0.0449	0.0368
1964	0.2515	0.0782	0.0200	0.1070	0.0463
1965	0.2350	0.0713	0.0207	0.0858	0.0572
1966	0.0988	0.0406	0.0072	0.0334	0.0176
1967	-0.1173	0.0196	0.0016	-0.0075	-0.1036
1968	0.0048	0.0069	0.0056	-0.0021	-0.0056
1969	0.1815	0.0496	0.0135	0.0355	0.0829
1970	0.1761	0.0677	0.0176	0.0647	0.0261
1971	-0.0539	0.0119	0.0167	0.0073	-0.0180
1972	0.0292	0.0194	0.0061	0.0280	-0.0243
1973	0.0785	0.0305	0.0050	0.0285	0.0145
1974	-0.0195	0.0118	0.0034	0.0076	-0.0423
1975	0.1593	0.0396	0.0067	0.0413	0.0717
1976	-0.0083	0.0173	0.0065	0.0142	-0.0463
1977	0.1752	0.0484	0.0061	0.0519	0.0688
1978	0.2506	0.0746	0.0142	0.0890	0.0728
1979	0.1443	0.0349	0.0196	0.0330	0.0568
1980	0.2305	0.0561	0.0239	0.0723	0.0782
1981	0.1706	0.0353	0.0238	0.0496	0.0619
1982	0.0059	0.0138	0.0135	0.0065	-0.0279
1983	0.0992	0.0344	-0.0106	0.0439	0.0315
1984	0.1378	0.0313	0.0115	0.0438	0.0512
1985	0.1669	0.0431	0.0139	0.0556	0.0543
1986	0.0333	0.0168	0.0121	0.0249	-0.0205
1987	0.1240	0.0276	0.0090	0.0362	0.0512
1988	0.1335	0.0303	0.0101	0.0448	0.0483
1989	0.1024	0.0240	0.0058	0.0331	0.0395
1990	0.0817	0.0373	0.0027	0.0522	-0.0105
1991	0.1004	0.0239	0.0065	0.0379	0.0321

Table 5.4 Contributions of major elements to output growth
(percentage)

	Capital	Labour	Intermediate inputs	TFP
1952-91	35.1	9.5	36.1	19.3
1952-77	41.3	9.8	40.8	8.1
1978-91	29.0	9.1	32.4	29.5
1978-85	28.3	8.6	31.1	32.0
1986-91	29.6	9.4	33.7	27.3

Source: Derived from Table 5.3.

There were, however, considerable variations over those sub-periods. During the pre-reform period (1952-77) the contribution of TFP to output growth was only 8.1 per cent. TFP growth was the least important element in the growth of the textile industry during this period. In sharp contrast with TFP, growth in capital and intermediate inputs accounted for 41.3 per cent and 40.8 per cent of output growth respectively. Of the factor inputs, labour was a relatively unimportant contributor to output growth, though it was still more important than TFP. In this period, the Chinese textile industry displayed a typical pattern of extensive growth.

Economic reform has effectively accelerated TFP growth in the textile industry. This is reflected in the sharp increase in the ratio of contribution of TFP to output growth. Between 1978 and 1991, TFP growth accounted for 29.5 per cent of output growth, much higher than in the pre-reform period. TFP became the second largest contributor to output growth in the reform period, just behind intermediate inputs. This implies that the pattern of growth in the textile industry has begun to shift away from extensive growth to intensive growth, though on the whole, the accumulation of factor inputs remains the dominant source of output growth in the industry.

Another noteworthy feature is that compared to the pre-reform period, the intermediate inputs in this period increased their importance and became the largest single source of output growth in the textile industry. Meanwhile, the relative importance of capital and labour in output growth declined. This finding may help to explain why the intermediate inputs (mainly raw materials) have frequently appeared to be the major constraints to growth in the textile industry during the reform period.

A large number of international studies of TFP suggest that TFP growth has typically contributed about one-third of aggregate output growth in middle-income developing countries and nearly one-half in the developed countries (World Bank 1985). In this comparative setting, TFP performance in the Chinese textile industry appears extremely disappointing prior to reform but more typical and satisfactory in the reform period. If we combine the two periods, the contribution of TFP to output growth in China's textile industry (19.3 per cent) appears to have been lower than the average contribution of TFP to output growth in middle-income developing countries.

Within the reform period, TFP made a greater contribution to output growth in the 1978-85 period than in the 1986-91 period. In the first sub-period, TFP growth accounted for 32 per cent of output growth and appeared to be the most important source of growth. However, in the second sub-period, TFP only contributed 27.3 per cent of output growth and dropped to number three position of the four contributors. This decline in the contribution of TFP to output growth was mainly due to the negative growth that occurred in 1986 and 1990 and can only be regarded as a short-term phenomenon, but it indicates that the industry has not established a solid base to effect a smooth transition from an extensive to an intensive pattern of growth.

Conclusion

This chapter has used revised data and a TFP index approach to examine the productivity performance of the Chinese textile industry. The main finding shows that the industry has been moving towards greater efficiency. In particular, TFP increased remarkably along with the rapid output growth that occurred in the reform era. This performance stood in sharp contrast to the pre-reform period, during which industrial TFP growth stagnated badly.

Economic reform not only accelerated TFP growth but also substantially reduced the fluctuation in TFP growth, which had been very serious in the textile industry prior to reform. The similar patterns of cyclical fluctuation in TFP and output growth can be explained by the positive relationship between the two variables identified in this chapter. This confirms the existence of the Verdoorn law in the Chinese textile industry.

Over the pre-reform period, output growth in the textile industry depended heavily on the supply of inputs and only a negligible portion of output growth was generated by increased TFP. The industry displayed a typical pattern of extensive growth in that period. During the reform period, TFP growth became the second largest source of output growth, ranking only behind intermediate inputs, and was superior to capital and labour inputs. In particular, TFP was the single largest contributor to output growth in the 1978-85 period. This change in the role of TFP growth implies that the textile industry has been shifting from a pattern of extensive growth to one of intensive growth.

The above findings conflict with Krugman's (1994) argument that productivity improvement was of little importance in explaining the East Asian growth miracle. As far as the Chinese textile industry is concerned, the growth miracle in this industry (and in the reform era) was largely explained by improved TFP performance, as evidenced in the above analysis. A notable fact is that the industry's growth pattern has been becoming increasingly more intensive. It did not have a sustained trend of extensive growth as suggested by Krugman. Although these empirical findings are drawn from a single industry, they are suggestive in the context of current debate about the East Asian TFP performance more generally.

Appendix 5.1 Data set

Table A5.1 Price indexes for fixed assets

	Indexes		Indexes
1952	1.000	1972	1.440
1953	1.000	1973	1.450
1954	1.000	1974	1.460
1955	1.000	1975	1.470
1956	1.000	1976	1.480
1957	1.000	1977	1.490
1958	n.a.	1978	1.500
1959	n.a.	1979	1.580
1960	n.a.	1980	1.690
1961	1.140	1981	1.722
1962	1.190	1982	1.746
1963	1.210	1983	1.763
1964	1.280	1984	1.889
1965	1.370	1985	2.048
1966	1.380	1986	2.207
1967	1.390	1987	2.417
1968	1.400	1988	2.586
1969	1.410	1989	2.793
1970	1.420	1990	3.043
1971	1.430	1991	3.380

Sources: Chen et al., 1988a, p.261; Li et al., 1993, p.117; *Annual Financial Data of the Textile Industry*, 1988, pp.27-28;. *Compilation of Major Financial Data of the Textile Industry*, 1989, pp.29-30, 1990, pp.29-30, 1991, pp.29-30.

Table A5.2 Price indexes for intermediate inputs

	Indexes		Indexes
1952	1.000	1972	1.120
1953	0.945	1973	1.120
1954	0.961	1974	1.120
1955	0.981	1975	1.120
1956	0.981	1976	1.120
1957	0.981	1977	1.120
1958	n.a.	1978	1.225
1959	n.a.	1979	1.433
1960	n.a.	1980	1.580
1961	0.982	1981	1.580
1962	0.982	1982	1.580
1963	1.086	1983	1.580
1964	1.085	1984	1.532
1965	1.085	1985	1.907
1966	1.085	1986	1.898
1967	1.085	1987	1.987
1968	1.085	1988	2.158
1969	1.085	1989	2.648
1970	1.085	1990	3.421
1971	1.098	1991	3.490

Source: *Statistical Yearbook of China*, 1992, p.269.

Table A5.3 Quality indexes for fixed assets

	Indexes		Indexes
1952	1.000	1972	0.990
1953	1.008	1973	0.991
1954	1.004	1974	0.993
1955	1.002	1975	0.995
1956	1.006	1976	1.002
1957	1.003	1977	1.004
1958	n.a.	1978	1.008
1959	n.a.	1979	1.002
1960	n.a.	1980	1.003
1961	0.956	1981	1.014
1962	0.945	1982	1.005
1963	0.993	1983	1.025
1964	0.991	1984	1.006
1965	0.998	1985	1.006
1966	0.981	1986	0.992
1967	0.979	1987	1.013
1968	0.980	1988	0.993
1969	0.980	1989	1.000
1970	0.982	1990	0.996
1971	0.990	1991	1.010

Sources: *China Textile Yearbook*, 1993, pp.21-23; *Compilation of Statistical Data of the Textile Industry: 1949-1988*, pp.35-36; *Annual Financial Data of the Textile Industry*, 1988, pp.3-4; *Compilation of Major Financial Data of the Textile Industry*, 1989, pp.3-4, 1990, pp.3-4, 1991, pp.3-4.

Table A5.4 Quality indexes for labour

	Indexes		Indexes
1952	1.000	1972	0.962
1953	0.993	1973	0.961
1954	0.985	1974	0.960
1955	0.978	1975	0.960
1956	0.971	1976	0.960
1957	0.964	1977	0.959
1958	n.a.	1978	0.959
1959	n.a.	1979	0.958
1960	n.a.	1980	0.958
1961	0.964	1981	0.959
1962	0.965	1982	0.960
1963	0.967	1983	0.960
1964	0.968	1984	0.961
1965	0.969	1985	0.962
1966	0.968	1986	0.963
1967	0.967	1987	0.964
1968	0.966	1988	0.965
1969	0.965	1989	0.965
1970	0.964	1990	0.966
1971	0.963	1991	0.966

Sources: *Statistics of China's Industrial Economy: 1949-1984*, p.112, p.121; *1985 Industrial Census Data of People's Republic of China, Volume 14: Textile Industry*, pp.22-23, p.29; *Annual Financial Data of the Textile Industry*, 1988, pp.6-7, p.686; *Compilation of Major Financial Data of the Textile Industry*, 1989, pp.35-36, 1990, pp.35-36, 1991, pp.35-36.

Table A5.5 Capital data

RMB¥ billion

	Net value of fixed assets	Real value of fixed assets	Real value of fixed assets in productive use	Real value of fixed assets adjusted for quality	Total value of capital (working capital included)
1952	1.828	1.828	1.645	1.645	1.702
1953	2.022	2.022	1.819	1.833	1.982
1954	2.173	2.173	1.955	1.963	2.211
1955	2.267	2.267	2.040	2.044	2.359
1956	2.455	2.455	2.209	2.222	2.663
1957	2.671	2.671	2.403	2.410	3.023
1958	n.a.	n.a.	n.a.	n.a.	n.a.
1959	n.a.	n.a.	n.a.	n.a.	n.a.
1960	n.a.	n.a.	n.a.	n.a.	n.a.
1961	2.990	2.623	2.360	2.245	2.938
1962	2.971	2.497	2.247	2.123	2.720
1963	3.227	2.667	2.400	2.383	3.008
1964	3.878	3.030	2.727	2.702	3.639
1965	4.665	3.405	3.064	3.058	4.334
1966	5.029	3.644	3.188	3.127	4.806
1967	6.792	4.886	4.275	4.185	5.058
1968	6.923	4.945	4.326	4.239	5.152
1969	7.572	5.370	4.698	4.604	5.837
1970	8.517	5.998	5.239	5.145	6.897
1971	8.749	6.118	5.353	5.299	7.117
1972	9.101	6.320	5.530	5.475	7.486
1973	9.650	6.655	5.823	5.770	8.090
1974	9.910	6.788	5.939	5.897	8.355
1975	10.668	7.257	6.349	6.317	9.242
1976	11.063	7.475	6.540	6.553	9.671
1977	12.072	8.102	7.089	7.117	10.926
1978	13.613	9.075	7.713	7.775	13.112
1979	15.141	9.583	8.145	8.161	14.339
1980	17.652	10.445	8.878	8.905	16.495
1981	19.426	11.281	9.588	9.722	18.056
1982	25.802	14.778	12.561	12.623	18.724
1983	28.085	15.930	13.540	13.879	20.450
1984	32.238	17.066	14.506	14.593	22.166
1985	38.378	18.743	14.994	15.084	24.728
1986	42.948	19.460	15.568	15.461	25.841
1987	49.993	20.684	16.547	16.762	27.753
1988	57.179	22.111	17.688	17.564	30.007
1989	65.136	23.321	18.656	18.656	31.936
1990	76.997	25.303	20.242	20.161	35.130
1991	90.188	26.682	21.346	21.559	37.382

Sources: *China Textile Yearbook*, 1993, p.23; *Compilation of Statistical Data of the Textile Industry: 1949-1988*, pp.35-36; *Annual Financial Data of the Textile Industry*, 1988, pp.2-4; *Compilation of Major Financial Data of the Textile Industry*, 1989, pp.3-4, 1990, pp.3-4, 1991, pp.3-4; *1985 Industrial Census Data of People's Republic of China, Volume 14: Textile Industry*, pp.16-17, pp.20-21; Chen et al., 1988a, p.259.

Table A5.6 Labour data

million persons

	Number of total employees	Employees for productive use	Employees after adjusted for quality
1952	1.013	0.891	0.891
1953	1.231	1.083	1.075
1954	1.499	1.319	1.299
1955	1.615	1.421	1.390
1956	1.832	1.613	1.566
1957	2.075	1.826	1.760
1958	n.a.	n.a.	n.a.
1959	n.a.	n.a.	n.a.
1960	n.a.	n.a.	n.a.
1961	1.988	1.751	1.688
1962	1.841	1.620	1.563
1963	1.811	1.594	1.541
1964	2.010	1.769	1.712
1965	2.239	1.970	1.909
1966	2.329	2.050	1.984
1967	2.352	2.070	2.002
1968	2.430	2.138	2.065
1969	2.613	2.299	2.219
1970	2.872	2.527	2.436
1971	3.142	2.765	2.663
1972	3.252	2.862	2.753
1973	3.345	2.944	2.829
1974	3.413	3.003	2.883
1975	3.541	3.116	2.991
1976	3.668	3.228	3.099
1977	3.799	3.343	3.206
1978	4.101	3.609	3.461
1979	4.555	4.008	3.840
1980	5.159	4.540	4.350
1981	5.835	5.135	4.924
1982	6.263	5.512	5.292
1983	5.963	5.188	4.980
1984	6.339	5.515	5.300
1985	6.817	5.931	5.706
1986	7.349	6.320	6.086
1987	7.707	6.628	6.389
1988	8.129	6.991	6.746
1989	8.489	7.216	6.964
1990	8.608	7.317	7.068
1991	8.915	7.578	7.320

Sources: *Compilation of Statistical Data of the Textile Industry: 1949-1988*, pp.27-28; *China Textile Yearbook*, 1993, p.12; *1985 Industrial Census Data of People's Republic of China, Volume 14: Textile Industry*, p.22; *Statistics of China's Industrial Economy: 1949-1984*, p.112, p.121.

Table A5.7 Data of intermediate inputs

RMB¥ billion

	Nominal value of intermediate inputs	Real value of intermediate inputs
1952	1.711	1.711
1953	1.870	1.979
1954	2.043	2.126
1955	2.024	2.064
1956	2.177	2.219
1957	2.445	2.491
1958	n.a.	n.a.
1959	n.a.	n.a.
1960	n.a.	n.a.
1961	2.418	2.462
1962	2.146	2.186
1963	2.613	2.406
1964	3.235	2.982
1965	3.856	3.554
1966	4.143	3.819
1967	4.075	3.755
1968	4.056	3.738
1969	4.378	4.035
1970	5.010	4.618
1971	5.154	4.694
1972	5.585	4.987
1973	5.943	5.306
1974	6.043	5.396
1975	6.702	5.894
1976	6.812	6.082
1977	7.602	6.788
1978	9.970	8.139
1979	12.524	8.740
1980	16.042	10.153
1981	17.822	11.280
1982	18.082	11.444
1983	19.857	12.568
1984	20.793	13.573
1985	29.105	15.262
1986	30.580	16.112
1987	34.608	17.417
1988	41.352	19.162
1989	54.496	20.580
1990	78.628	22.984
1991	87.016	24.933

Sources: *Compilation of Statistical Data of the Textile Industry: 1949-1988*, p.11, p.38; *Annual Financial Data of the Textile Industry*, 1988, pp.5-6; *Compilation of Major Financial Data of the Textile Industry*, 1989, p.6, p.9, 1990, p.6, p.9, 1991, p.6, p.9; *1985 Industrial Census Data of People's Republic of China, Volume 14: Textile Industry*, pp.14-17.

Table A5.8 Growth of factor inputs in the textile industry (revised data)

	Capital		Labour		Intermediate inputs	
	Indexes	Growth rate	Indexes	Growth rate	Indexes	Growth rate
1952	1.000	-	1.000	-	1.000	-
1953	1.164	0.1641	1.207	0.2065	1.157	0.1566
1954	1.299	0.1158	1.459	0.2084	1.242	0.0738
1955	1.386	0.0670	1.561	0.0700	1.206	-0.0289
1956	1.564	0.1289	1.758	0.1266	1.297	0.0749
1957	1.776	0.1354	1.976	0.1239	1.456	0.1228
1958	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1959	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1960	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1961	1.726	-0.0282	1.888	-0.0447	1.439	-0.0116
1962	1.598	-0.0743	1.748	-0.0741	1.281	-0.1121
1963	1.767	0.1059	1.723	-0.0141	1.409	0.1004
1964	2.138	0.2097	1.914	0.1110	1.747	0.2394
1965	2.546	0.1912	2.135	0.1151	2.082	0.1919
1966	2.823	0.1088	2.219	0.0393	2.238	0.0747
1967	2.972	0.0525	2.239	0.0091	2.200	-0.0168
1968	3.027	0.0185	2.309	0.0315	2.190	-0.0047
1969	3.429	0.1330	2.482	0.0746	2.364	0.0794
1970	4.052	0.1815	2.724	0.0978	2.706	0.1447
1971	4.181	0.0319	2.978	0.0932	2.750	0.0163
1972	4.398	0.0520	3.079	0.0338	2.922	0.0626
1973	4.758	0.0818	3.164	0.0276	3.108	0.0638
1974	4.908	0.0316	3.224	0.0191	3.161	0.0170
1975	5.430	0.1062	3.345	0.0375	3.453	0.0924
1976	5.682	0.0464	3.466	0.0361	3.563	0.0318
1977	6.419	0.1298	3.586	0.0345	3.977	0.1161
1978	7.703	0.2000	3.871	0.0795	4.768	0.1991
1979	8.424	0.0936	4.295	0.1095	5.120	0.0738
1980	9.691	0.1504	4.865	0.1328	5.948	0.1617
1981	10.608	0.0946	5.507	0.1320	6.609	0.1110
1982	11.000	0.0370	5.919	0.0747	6.704	0.0145
1983	12.014	0.0922	5.569	-0.0590	7.363	0.0982
1984	13.022	0.0839	5.927	0.0643	7.952	0.0800
1985	14.528	0.1156	6.381	0.0766	8.941	0.1244
1986	15.182	0.0450	6.806	0.0666	9.439	0.0557
1987	16.305	0.0740	7.145	0.0498	10.204	0.0810
1988	17.629	0.0812	7.545	0.0559	11.226	0.1002
1989	18.763	0.0643	7.789	0.0323	12.057	0.0740
1990	20.639	0.1000	7.905	0.0149	13.465	0.1168
1991	21.962	0.0641	8.187	0.0357	14.607	0.0848

Source: See Tables A5.5, A5.6 and A5.7.

6 TFP growth at the sectoral level

The analysis of the industry's aggregate TFP performance in the last chapter is based on industry-wide statistics and hence conceals variations among different sectors. To gain a clearer understanding of the industry's productivity performance, TFP analysis at a more disaggregated level is needed. Most previous studies of TFP neglect productivity performance at the sectoral level and the importance of structural shifts on the industry's efficiency. There is a special interest in this study, therefore, in analysing TFP performance of individual sectors in the textile industry. The sectoral TFP growth examined in this chapter combined with the structural analysis in Chapter 4 lays the basis for assessment of the industry's structural efficiency in the next chapter.

Using firm and sectoral level data, this chapter examines TFP performance and sources of growth in the individual sectors. The first section presents the data issues; the second section estimates output elasticities of factor inputs for each sector; the third section examines TFP growth; the fourth section discusses the growth-productivity relationship at the sectoral level; and the fifth section explores sources of growth in the individual sectors.

Data used for constructing sectoral TFP indexes

Like industry level analysis, the construction of TFP indexes for individual sectors also requires constant price measures of gross output value, capital and intermediate inputs, along with physical measures of labour. Due to an insufficiency of data,[51] it is necessary to confine TFP analysis at the sectoral level to the reform period (1978-91).

All original data for the 1978-91 period are obtained from Chinese statistical sources. These sources include *Statistical Yearbook of China*, *Almanac of China's Textile Industry*, *China Fibre Yearbook*, *China Textile Yearbook*, *Compilation of*

[51] Capital data for the individual sectors during the pre-reform period are incomplete and thus it is not possible to construct TFP indexes based on sectoral data for this period.

Statistical Data of the Textile Industry: 1949-1988, *Annual Financial Data of the Textile Industry*, *Compilation of Major Financial Data of the Textile Industry*, *Handbook of Textile Economy* and *1985 Industrial Census Data of People's Republic of China, Volume 14: Textile Industry*.

To calculate the TFP indexes with greater accuracy, two adjustments are made to the data: (i) fixed assets and intermediate inputs are converted into constant price bases; and (ii) non-productive capital and labour are excluded from the original data. It is not possible to adjust for quality change in factor inputs for each sector because of a difficulty in choosing appropriate indicators or proxies and/or a lack of suitable data to describe the quality change in presumable proxies.[52] The absence of quality adjustments is likely to affect the computation of TFP index for the individual sectors slightly, but not substantially. Because, as shown in Chapter 5, quality changes in capital, labour and intermediate inputs are in general very small for the industry as a whole, we can assume that corresponding changes in the individual sectors were not so large that the analysis would be notably affected.

Data for the value of gross output in 1980 constant price disaggregated at the sectoral level are available from *Almanac of China's Textile Industry*, *China Fibre Yearbook*, *China Textile Yearbook and Compilation of Statistical Data of the Textile Industry: 1949-1988*. The procedures to generate the required data series for capital and labour are essentially the same as those described in Chapter 5 and hence are not repeated here. However, it is necessary to explain the adjustment of data on intermediate inputs.

As shown in Chapter 5, the nominal value of intermediate inputs can be derived according to equation (5.8). In order to correct for the effects of inflation, the nominal value of intermediate inputs needs to be deflated. Since no ready deflators of intermediate inputs for individual sectors are available, it is necessary first to construct these price deflators. I use purchasing prices of cotton, wool, bast fibre and silk to derive

[52] Because of use of different procedures and price deflators for data adjustment as well as the choice of different base years, the sum of sectoral figures for output and factor inputs used in this chapter does not coincide with the figures for the industry total used in Chapter 5.

price deflators for intermediate inputs used in the cotton, wool, bast and silk sectors respectively. Data on these purchasing prices are available from the *Statistical Yearbook of China*. The intermediate inputs used in the knitting and apparel sectors derive mainly from the cotton textile industry and thus the output deflator of the cotton textile industry is used as a proxy. Data on the output value of the cotton textile sector in both current and constant prices can be found in *Compilation of Statistical Data of the Textile Industry: 1949-1988*, *Annual Financial Data of the Textile Industry* and *Compilation of Major Financial Data of the Textile Industry*, and hence it is possible to create a relevant price deflator for the intermediate inputs used in the knitting and apparel sectors. It is relatively difficult to create a price deflator for the intermediate inputs used in the man-made fibre sector because the raw materials used in this sector are mainly made either by itself or the chemical industry, and there is insufficient price data for these products. In this case, it is assumed that the price of intermediate inputs is closely related to the price of output in the man-made fibre sector, and an output deflator is used for this sector as an approximation of the price deflator for intermediate inputs. Data on the value of output for the man-made fibre industry in current and constant prices are available from *China Fibre Yearbook* and *China Textile Yearbook*, which makes it possible to create a price deflator for intermediate inputs. After constructing price deflators for intermediate inputs used in each sector, the constant value (at 1980 price) of intermediate inputs for the individual sectors can be calculated with the aid of equation (5.9).

Estimation of output elasticities of factor inputs

As demonstrated in the last chapter, a key step in the construction of a TFP index is the estimation of the elasticity of individual inputs with respect to total output. In this chapter, the output elasticities of factor inputs are first estimated econometrically with pooled enterprise data. These estimates are then used, together with time-series data for output and inputs, to compute TFP indexes for each sector.

Model and data

As argued above, technology in the Chinese textile industry can be represented by a Cobb-Douglas production function which is characterised by constant returns to scale, namely:

$$\ln Y = \alpha_0 + \delta t + \alpha_K \ln K + \alpha_L \ln L + \alpha_M \ln M \qquad (6.1)$$

where α_K, α_L and α_M are the output elasticities of capital, labour and intermediate inputs respectively; and the coefficient δ represents the exponential rate of Hicks-neutral technical change. By construction, the output elasticities of factor inputs remain constant through the sample period and sum to unity.

The estimation of the Cobb-Douglas production function uses pooled enterprise data, obtained from *Annual Financial Data of the Textile Industry* and *Compilation of Major Financial Data of the Textile Industry* for the period 1988-91, which records 33 economic indicators for all the large and medium-sized state-owned enterprises in the textile industry except for the apparel sector.[53] There are more than 1,000 firms covered by the data. However, since some enterprises do not have continuous records for the entire sample period, the number of enterprises actually used for estimation is reduced to 905. The firm data for the apparel sector is obtained from *Compilation of Annual Report of Apparel Industry*, which covers all 34 medium-sized firms (there are no large-sized firms in this sector) for the period 1989-91. The distribution of sample firms in the seven sectors is shown in Table 6.1. It can be seen from the table that the sample firms account for a considerable share of output in each sector, which suggests just how important these firms are in the textile industry.

[53] The terms of 'large and medium-sized enterprises' are used by the relevant Chinese statistical sources. However, the definitions of large and medium-sized enterprises for each sector are not specified in these sources.

Table 6.1 Distribution of sample enterprises in individual sectors

	Number of sample firms	Share in gross output value (%)[a]	Years covered	Total observations
MMF	56	48.9	1988-91	224
Cotton	320	21.7	1988-91	1280
Wool	100	25.0	1988-91	400
Bast fibre	31	24.8	1988-91	124
Silk	160	20.5	1989-91	480
Knitting	238	20.1	1988-91	552
Apparel	34	6.9	1989-91	102

Note: (a) Figures in this column are shares of sample firms in the gross output value of the corresponding sector in 1991.

Sources: *Annual Financial Data of the Textile Industry*, 1988, pp.538-685; *Compilation of Major Financial Data of the Textile Industry*, 1989, pp.986-1145, 1990, pp.1054-1233, 1991, pp.952-1149; *Compilation of Annual Report of Apparel Industry*, 1989, pp.122-185, 1990, pp.146-212, 1991, pp.150-222.

It needs to be pointed out that the sample period is not ideal in the sense that it covers roughly a decline-to-trough stage in the industry's cyclical experience during the reform period. The availability of data restricts the choice of sample years used for this estimation. It should be emphasised that the interest here is in estimating the output elasticities of factor inputs rather than trend rates of TFP growth. It is necessary to assume that the estimated elasticities are largely free from the influence of such short-run fluctuations in the business cycle. Thus, the usage of data in this sample period does not lose generality, and it is expected that the sample period exerts little adverse effect on the estimation results.

Compared with most previous studies which use aggregate time-series data to estimate output elasticities of factor inputs, the use of the firm-level panel data in this study represents an improvement. It substantially reduces the potential for aggregation bias and increases the number of data points, and hence improves the efficiency of the econometric estimates.

Data for output, capital and intermediate inputs are revised to get real values at 1990 constant price. Other adjustments on factor inputs are not undertaken since they are not essential for the estimation of output elasticities. Estimation is conducted for each sector separately.

After obtaining the output elasticities of factor inputs, a TFP index can be constructed for each sector using time-series data for output and inputs. The rate of TFP growth can be computed according to equation (5.12)

Estimation results

The estimated coefficients of equation (6.1) for seven sectors are shown in Table 6.2. All coefficients are significant at the 95 per cent confidence level. The satisfactory values of the R^2 indicate that the functional form fits the data quite well and the assumption of constant returns to scale cannot be rejected.

Table 6.2 Estimation results of equation (6.1) for seven sectors

	δ	α_K	α_L	α_M	R^2
MMF	0.029	0.439	0.112	0.449	0.96
	(6.91)	(10.28)	(3.33)	(4.25)	
Cotton	-0.010	0.266	0.151	0.583	0.98
	(-12.02)	(7.94)	(3.43)	(9.89)	
Wool	-0.008	0.308	0.136	0.556	0.97
	(-7.51)	(8.53)	(4.98)	(3.73)	
Bast	-0.004	0.258	0.161	0.581	0.91
	(-1.94)	(3.55)	(2.43)	(12.69)	
Silk	0.024	0.246	0.155	0.599	0.94
	(6.69)	(3.13)	(5.43)	(3.05)	
Knitting	0.011	0.215	0.178	0.607	0.96
	(2.06)	(6.21)	(5.15)	(12.23)	
Apparel	0.019	0.180	0.219	0.601	0.96
	(6.72)	(4.48)	(13.21)	(2.98)	

Note: Figures in parentheses are t statistics.

The values of estimated δ point to the presence of positive technical changes in the man-made fibre, silk, knitting and apparel sectors but negative technical changes in the cotton, wool and bast sectors over the sample period. As mentioned earlier, TFP growth occurs as a result of technical changes and from the realisation of economies of scale; in the case of constant returns to scale, the rate of TFP growth is identical to the rate of technical change. The likely reason for negative TFP growth in the cotton, wool and bast sectors is the sharp decline in demand for these sectors' products through this period, which in turn limited their ability to achieve technical progress.[54]

The estimated output elasticities of factor inputs shown in Table 6.2 are used to calculate the TFP indexes for each sector of the Chinese textile industry.

TFP growth at the sectoral level

The TFP indexes for 1978-91, with 1978=100, are reported in Table 6.3; the rates of TFP growth in the individual sectors are reported in Table 6.4. Four conclusions emerge from this analysis.

Table 6.3 TFP indexes for seven sectors of China's textile industry, 1978-91

	MMF	Cotton	Wool	Bast	Silk	Knitting	Apparel
1978	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1979	104.10	106.30	103.00	103.60	104.50	104.80	107.00
1980	119.51	114.49	110.83	108.68	108.37	113.81	115.03
1981	129.07	121.47	120.25	116.07	114.11	121.66	121.12
1982	125.84	116.73	125.90	119.32	111.60	118.01	118.70
1983	132.00	120.23	134.21	127.79	116.73	119.20	121.31
1984	130.55	126.37	144.01	133.54	121.17	124.56	131.02
1985	143.35	131.67	156.25	144.62	131.59	129.92	138.09
1986	147.94	126.01	160.31	167.25	134.22	128.88	136.43
1987	167.61	132.19	170.89	135.46	132.88	136.35	141.21
1988	187.05	137.48	176.36	136.95	135.94	143.31	151.80
1989	204.45	141.33	181.30	140.92	141.40	147.75	163.34
1990	209.97	137.37	169.15	132.18	148.58	149.96	170.36
1991	219.41	140.25	175.23	137.07	161.66	154.31	174.79

(1) During the reform period, all seven sectors in the textile industry exhibited a trend of positive TFP growth. The average annual rate of TFP growth ranged from 2.5 per cent in the bast fibre processing sector to 6.2 per cent in the man-made fibre sector. At the same time, each sector suffered negative TFP growth in some individual years.

[54] This result justifies the concern that the use of this sample period may cause certain bias in the estimation, though the bias is unlikely to affect the estimates of output elasticities substantially.

Most declines in TFP occurred in 1982, 1986 and 1990 when the industry as a whole experienced slowdowns in output and TFP growth.

Table 6.4 Rates of TFP growth in seven sectors of the textile industry, 1978-91

	MMF	Cotton	Wool	Bast	Silk	Knitting	Apparel
1978	-	-	-	-	-	-	-
1979	0.041	0.063	0.030	0.036	0.045	0.048	0.070
1980	0.148	0.077	0.076	0.049	0.037	0.086	0.075
1981	0.080	0.061	0.085	0.068	0.053	0.069	0.053
1982	-0.025	-0.039	0.047	0.028	-0.022	-0.030	-0.020
1983	0.049	0.030	0.066	0.071	0.046	0.010	0.022
1984	-0.011	0.051	0.073	0.045	0.038	0.045	0.080
1985	0.098	0.042	0.085	0.083	0.086	0.043	0.054
1986	0.032	-0.043	0.026	-0.051	0.020	-0.008	-0.012
1987	0.133	0.049	0.066	-0.013	-0.010	0.058	0.035
1988	0.116	0.040	0.032	0.011	0.023	0.051	0.075
1989	0.093	0.028	0.028	0.029	0.038	0.031	0.076
1990	0.027	-0.028	-0.067	-0.062	0.053	0.015	0.043
1991	0.045	0.021	0.036	0.037	0.088	0.029	0.026
1978-85	0.053	0.040	0.066	0.054	0.040	0.038	0.047
1986-91	0.074	0.011	0.019	-0.009	0.035	0.029	0.040
1978-91	0.062	0.026	0.044	0.025	0.038	0.034	0.043

(2) Rates of TFP growth differed considerably between the individual sectors. For example, the average annual rate of TFP growth was 7.4 per cent in the man-made fibre sector, but negative in the bast sector during the 1986-91 period. The considerable gaps in TFP growth between the individual sectors imply that the textile industry still had a considerable potential to improve its efficiency performance by lifting the slow-growing sectors to best practice levels. Further examination reveals that the differential pattern of TFP growth among sectors was rather close to that of output growth. This suggests that a close relationship may exist between TFP and output growth in the individual sectors. This relationship is examined in more detail in the next section.

(3) Rates of TFP growth in the man-made fibre, wool, apparel and silk sectors were higher than the industrial average of 3.7 per cent during the 1978-91 period. This implies that these four sectors have made the largest contribution to overall TFP growth in the textile industry. Considering that these sectors also increased their shares in total

textile production, as discussed earlier, it follows that they contributed to greater structural efficiency in the industry.

(4) There have been some fluctuations in TFP growth at the sectoral level. The changes in the coefficients of TFP fluctuation ranged from -1.23 to 0.86 in the apparel sector to -3.48 to 2.32 in the bast sector. It is also worth noting that in all sectors except for the man-made fibre sector, TFP growth slowed down during the 1986-91 period compared with the 1978-85 period. The largest decline in TFP growth occurred in the cotton, wool and bast sectors, all of which belong to the primary textile industry. In the two major textile sectors, cotton and wool, annual TFP growth averaged 4 per cent and 6.6 per cent for 1978-85, but only 1.1 per cent and 1.9 per cent respectively for 1986-91. However, given that this slowdown derived mainly from the two cyclical setbacks in 1986 and 1990, it does not necessarily indicate a long-run trend of declining TFP growth. In fact, the sharp increase in rates of output growth in the post-1991 period suggests that the individual sectors could experience a corresponding acceleration of TFP growth. This expectation can be justified by assessing the Verdoorn law in the individual sectors.

Assessment of the Verdoorn law at the sectoral level

The empirical evidence presented in Chapter 5 confirmed that the Verdoorn law holds for the Chinese textile industry as a whole. To verify whether this law also holds at the sectoral level, a linear regression of productivity growth on output growth is run for each sector and for the 1978-91 period. The regression takes the form $T\dot{F}P = a + b\dot{Y}$, where $T\dot{F}P$ *and* $\dot{Y}$ stand for the rate of changes in TFP and output growth respectively. The estimation results are shown in Table 6.5.

The values of the b coefficients are positive and significant at the 99 per cent confidence level for all sectors. This implies that a positive relationship exists between the rate of TFP growth and the rate of output growth in all seven sectors of the textile hold, in general, for the individual sectors of the Chinese textile industry. On the other

Table 6.5 Estimation results of equation $\dot{TFP} = a + b\dot{Y}$

	MMF	Cotton	Wool	Bast	Silk	Knitting	Apparel
a	0.01	-2.84	-2.41	-2.75	-0.30	-0.99	-0.85
	(0.01)	(-3.52)	(-2.25)	(-2.69)	(-0.40)	(-1.09)	(-1.19)
b	0.32	0.55	0.40	0.42	0.31	0.38	0.40
	(3.83)	(8.13)	(7.22)	(6.36)	(6.43)	(5.62)	(7.98)
R^2	0.51	0.86	0.83	0.79	0.79	0.74	0.85

Note: Figures in parentheses are t statistics.

hand, some low R^2 ratios indicate that in some sectors (particularly the man-made fibre sector), there has been considerable deviation from the Verdoorn relationship. Overall, the regression results give the impression that although there are additional factors that influence rates of TFP growth, they do not appear to have been strong enough to weaken seriously the underlying relationship between productivity and output growth.

The validity of the Verdoorn law at the sectoral level may help to explain the differences in rates of TFP growth between sectors and some fluctuations in TFP growth within each sector during the period studied. For instance, the decline in TFP growth in most sectors in the post-1986 period is probably attributable to the slowdown in output growth in these sectors. Similarly, the different rates of TFP growth between sectors may, for the most part, be a result of divergence in rates of output growth between sectors.

It is important to note that this explanation does not point to a simple relationship in which TFP growth is merely a consequence of output growth. As implied by general production theory, TFP growth or efficiency improvement is one of the major determinants of output growth rather than a neat consequence of output growth. In fact, there is no single direction of causation between output and TFP growth, as far as the Chinese textile industry is concerned. Thus it would be equally reasonable to argue that different rates of output growth among the sectors may have resulted from distinct TFP performance in these sectors.

Sources of output growth in the individual sectors

To analyse sources of output growth in the individual sectors, the growth accounting relationship derived in Chapter 5 can be used again. Recall that the growth accounting identity is:

$$\frac{\dot{Y}}{Y} = s_K \frac{\dot{K}}{K} + s_L \frac{\dot{L}}{L} + s_M \frac{\dot{M}}{M} + T\hat{F}P, \quad (5.17)$$

Using this accounting relationship we can calculate the contribution ratios of each element to the output growth of the individual sectors. The results are shown in Table 6.6.

During the 1978-91 period the contribution of TFP to output growth ranged from 20.2 per cent in the bast fibre processing sector to 37 per cent in the apparel sector. This means that the primary proportion of output growth in individual sectors resulted from the expansion of capital, labour and intermediate inputs. This heavy dependence on the augmentation of factor inputs rather than increased efficiency indicates in turn that sectoral growth in the textile industry has not yet cast off the pattern of extensive growth.

In the man-made fibre and apparel sectors, TFP growth was the largest single contributor to output growth. About one-third or more of output growth was attributed to TFP growth in these two sectors. This indicates that the transition from an extensive to an intensive growth pattern has been relatively successful in the raw material and final goods producing sectors of the textile industry. In the meantime, TFP growth was the second most important contributor (behind intermediate inputs) to output growth in the silk and knitting sectors. The ratio of the TFP contribution to output growth was close to 30 per cent in these two sectors in the 1978-91 period. As the contribution of TFP growth to output growth has exceeded that of capital, this may be taken as a sign of smooth transition from extensive to intensive growth in these two sectors. On the other hand, TFP growth was the third most important contributor to output growth (just prior to labour) in the cotton, wool and bast sectors, implying that growth in these three sectors has been more heavily dependent on the expansion of factor inputs.

Table 6.6 Contribution of major elements to sectoral output growth
(percentage)

		Capital	Labour	Intermediate inputs	TFP
MMF	1978-85	31.87	8.75	26.25	33.13
	1986-91	30.34	2.56	35.48	31.62
	1978-91	30.93	5.67	31.44	31.96
Cotton	1978-85	27.48	7.63	34.36	30.53
	1986-91	36.49	8.11	10.53	14.87
	1978-91	30.64	7.71	36.60	25.05
Wool	1978-85	28.40	7.83	33.92	29.85
	1986-91	34.34	8.29	40.07	17.30
	1978-91	30.19	7.93	35.82	26.06
Bast	1978-85	26.81	10.77	38.48	23.94
	1986-91	48.51	7.44	44.05	negative
	1978-91	31.45	9.68	38.71	20.16
Silk	1978-85	24.64	7.97	38.40	28.99
	1986-91	27.50	5.83	37.50	29.17
	1978-91	26.15	6.93	37.69	29.23
Knitting	1978-85	24.16	9.22	38.80	27.82
	1986-91	25.40	5.82	38.09	30.69
	1978-91	24.72	7.93	38.36	28.99
Apparel	1978-85	20.86	12.23	33.10	33.81
	1986-91	12.55	9.00	36.61	41.84
	1978-91	17.65	10.92	34.45	36.98

The contribution of intermediate inputs to output growth accounted for over 30 per cent in all sectors, and appeared to be a dominant source of output growth in five out of seven sectors (the exceptions being the man-made fibre and apparel sectors). In particular, intermediate inputs have maintained their leading position in all four sectors of the primary textile industry. This shows how important intermediate inputs were to the growth of the primary textile sectors and hence to the growth of the textile industry as a whole. This finding may also help to explain why it is that intermediate inputs (mainly raw materials) were frequently a major constraint to growth in the four primary textile sectors in the reform period.

The contribution ratios of capital were over 20 per cent in all sectors except for the apparel sector, implying that capital is still a relatively important source of growth in the textile industry. Labour's contribution to output growth ranged from 5.7 per cent in the man-made fibre sector to 10.9 per cent in the apparel sector. This range reflects different labour intensities between sectors. Overall, labour has been the least important element underlying output growth and its importance has been clearly declining in the textile industry. This suggests that although the Chinese textile industry is still considered to be labour intensive, its growth no longer depends on the expansion of labour input. Rather, it depends on increases in efficiency, capital intensity and the use of intermediate inputs.

As shown in Table 6.6, TFP made a greater contribution to output growth in the 1986-91 period in the apparel, knitting and silk sectors than in the 1978-85 period. The largest increase occurred in the apparel sector where the contribution ratio of TFP growth to output growth rose from 33.8 per cent in the 1978-85 period to 41.8 per cent in the 1986-91 period. This provides clear evidence of the transition from extensive to intensive growth in these sectors. In contrast, the contribution ratio of TFP growth decreased in the cotton and wool sectors from 30.5 per cent and 29.9 per cent in the first sub-period to 14.9 per cent and 17.3 per cent respectively in the second sub-period. The contribution of TFP to output growth even turned negative in the bast sector during the 1986-91 period. The declining trend in the share of TFP in output growth may imply that the transition from extensive growth to intensive growth has been rather unsteady in these three primary textile sectors.

Conclusion

One of the main findings of this chapter is that each sector in China's textile industry achieved positive TFP growth during the reform period. Of the seven sectors, the man-made fibre, wool, silk and apparel sectors contributed most to aggregate TFP growth of the textile industry by virtue of their above-average rates of TFP growth. On the other hand, considerable variation in the rates of TFP growth between individual sectors suggests that the Chinese textile industry has great potential still to improve its productivity performance by reducing the gap between the poorest and the best levels of practice among the individual sectors.

This study has identified a positive linear relationship between output growth and TFP growth at the sectoral level. This confirms once more the existence of the Verdoorn law in the Chinese textile industry. This finding may provide at least a partial explanation of the different rates of TFP growth between sectors and fluctuations in TFP growth within individual sectors during the reform period.

The analysis of sources of growth shows that the accumulation of factor inputs has remained the dominant source of output growth in all sectors of the Chinese textile industry. This heavy dependence on the augmentation of factor inputs rather than increased efficiency indicates in turn that sectoral expansion in the textile industry has not yet freed itself from the pattern of extensive growth. It is important to note that in most sectors of the textile industry, output growth has been increasingly more dependent on TFP growth or improved efficiency, and this represents the major trend of change in the growth pattern of the Chinese textile industry.

Another noticeable fact is that in the Chinese textile industry, labour's contribution to output growth has been consistently declining and labour has become the least important element underlying output growth. Nowadays, the growth of this labour-intensive industry relies heavily on increases in TFP, intermediate inputs and capital rather than the expansion of labour. This is not only a significant tendency in the textile industry, in a broader context it also represents a general trend in all labour-intensive industries in China. It is reasonable to expect that in the near future, growth of the Chinese textile industry will be based on continuous decrease in the use of labour input.

Following the examination of productivity performance in the individual sectors, the question of how TFP growth in these sectors has affected the overall efficiency of the industry as a whole requires attention and is analysed in the next chapter. This question is related to the industry's structural efficiency, which is important in efficiency analysis but often neglected by many studies in this field.

Appendix 6.1 Data set

Table A6.1 Price indexes for intermediate inputs used in the individual sectors

	MMF	Cotton	Wool	Bast	Silk	Knitting	Apparel
1978	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1979	1.005	1.170	1.003	1.048	1.213	1.002	1.002
1980	1.083	1.290	1.009	1.115	1.218	1.011	1.011
1981	1.071	1.290	1.044	1.112	1.218	1.012	1.012
1982	1.092	1.290	1.083	1.106	1.218	1.012	1.012
1983	1.104	1.290	0.861	1.087	1.226	1.045	1.045
1984	1.115	1.251	0.922	1.125	1.226	1.066	1.066
1985	1.203	1.557	1.483	1.225	1.292	1.275	1.275
1986	1.316	1.549	1.767	1.156	1.388	1.462	1.462
1987	1.409	1.622	1.849	1.069	1.721	1.731	1.731
1988	1.879	1.762	3.173	0.827	3.232	1.968	1.968
1989	1.851	2.162	2.668	0.952	3.449	1.781	1.781
1990	1.911	2.793	1.952	0.954	3.335	1.797	1.797
1991	2.002	2.849	1.965	0.971	3.325	1.885	1.885

Sources: *Statistical Yearbook of China*, 1992, pp.267-271; *Handbook of Textile Economy*, pp.6-7, p.16; *Compilation of Statistical Data of the Textile Industry: 1949-1988*, pp.5-8; *Annual Financial Data of the Textile Industry*, 1988, pp.689-693; *Compilation of Major Financial Data of the Textile Industry*, 1989, p.6, 1990, p.6, 1991, p.6.

Table A6.2 Revised capital data for the individual sectors, 1978-91

RMB¥ billion

	MMF	Cotton	Wool	Bast	Silk	Knitting	Apparel
1978	4.708	22.223	3.229	1.265	3.285	1.946	1.356
1979	5.136	24.223	3.626	1.613	3.804	2.180	1.649
1980	7.299	28.850	4.014	1.813	4.127	2.849	2.051
1981	7.393	33.494	4.612	2.065	4.598	2.523	2.279
1982	8.821	37.648	5.120	2.160	4.842	4.045	2.343
1983	9.279	41.601	7.147	2.797	5.708	4.458	2.537
1984	9.344	47.051	9.255	3.197	5.896	4.663	3.171
1985	10.129	54.108	11.838	3.878	8.220	5.334	3.787
1986	11.162	59.356	13.826	4.118	8.582	5.403	3.976
1987	12.758	65.589	15.306	4.518	9.311	6.231	4.107
1988	15.947	72.935	17.540	4.780	9.916	7.096	4.563
1989	18.451	77.019	20.206	5.353	10.719	7.856	4.819
1990	22.049	87.956	20.590	6.306	13.238	8.987	5.354
1991	24.960	96.576	23.679	7.921	17.541	10.075	5.589

Sources: *Compilation of Statistical Data of the Textile Industry: 1949-1988*, pp.43-46; *Annual Financial Data of the Textile Industry*, 1988, pp.3-5; *Compilation of Major Financial Data of the Textile Industry*, 1989, pp.3-5, 1990, pp.3-5, 1991, pp.3-5; *1985 Industrial Census Data of People's Republic of China, Volume 14: Textile Industry*, pp.16-17, pp.20-21.

Table A6.3 Revised labour data for the individual sectors, 1978-91

million persons

	MMF	Cotton	Wool	Bast	Silk	Knitting	Apparel
1978	0.124	1.948	0.184	0.119	0.382	0.379	0.412
1979	0.137	2.208	0.206	0.136	0.419	0.438	0.480
1980	0.185	2.488	0.239	0.153	0.459	0.508	0.538
1981	0.208	2.702	0.311	0.187	0.515	0.597	0.621
1982	0.224	2.856	0.358	0.215	0.576	0.621	0.662
1983	0.217	2.777	0.340	0.221	0.537	0.531	0.605
1984	0.229	2.872	0.365	0.229	0.567	0.613	0.660
1985	0.294	3.042	0.426	0.252	0.618	0.613	0.687
1986	0.334	3.208	0.480	0.285	0.666	0.631	0.716
1987	0.353	3.318	0.545	0.286	0.716	0.655	0.747
1988	0.363	3.526	0.613	0.297	0.736	0.683	0.775
1989	0.371	3.708	0.610	0.294	0.750	0.701	0.799
1990	0.383	3.783	0.613	0.293	0.758	0.707	0.828
1991	0.407	3.894	0.629	0.302	0.795	0.736	0.866

Sources: *Compilation of Statistical Data of the Textile Industry: 1949-1988*, pp.27-30; *1985 Industrial Census Data of People's Republic of China, Volume 14: Textile Industry*, p.22, *China Textile Yearbook*, 1993, p.12.

Table A6.4 Revised data of intermediate inputs for the individual sectors, 1978-91

RMB¥ billion

	MMF	Cotton	Wool	Bast	Silk	Knitting	Apparel
1978	2.241	18.592	1.655	0.356	1.993	2.597	2.108
1979	2.380	19.391	1.898	0.423	2.192	2.776	2.388
1980	3.094	21.971	2.086	0.449	2.319	3.243	2.670
1981	3.174	24.080	2.330	0.472	2.466	3.599	2.771
1982	3.596	25.308	2.456	0.496	2.572	3.926	2.849
1983	3.859	26.852	2.866	0.591	2.849	4.139	2.926
1984	4.006	29.107	3.402	0.642	2.955	4.263	3.312
1985	4.182	31.290	4.022	0.743	3.613	4.663	3.538
1986	4.608	31.822	4.476	0.721	3.711	4.757	3.474
1987	5.046	33.890	4.798	0.766	3.923	5.147	3.578
1988	6.307	35.619	5.326	0.795	4.040	5.610	4.025
1989	7.272	37.257	5.699	0.855	4.214	5.795	4.368
1990	9.381	40.051	5.727	0.875	4.737	6.223	4.826
1991	11.633	42.455	6.346	1.001	5.575	6.616	4.971

Sources: *Compilation of Statistical Data of the Textile Industry: 1949-1988*, pp.11-12, pp.39-40; *1985 Industrial Census Data of People's Republic of China, Volume 14: Textile Industry*, pp.14-17, pp.40-43; *Annual Financial Data of the Textile Industry*, 1988, pp.4-6; *Compilation of Major Financial Data of the Textile Industry*, 1989, pp.4-6, 1990, pp.4-6, 1991, pp.4-6.

7 Structural efficiency of China's textile industry

While it is clear that productivity improvement in the individual sectors of the textile industry contributed to overall TFP growth, there is an important question as to how much of the measured improvement in TFP for the industry as a whole was merely a consequence of structural change in the industry, and what policy measures might be important to the enhancement of efficiency through structural change. To answer this question, a study of the structural determinants of productivity growth — that is, structural efficiency in the Chinese textile industry — is essential.

The evaluation of structural efficiency in this chapter is based on the analysis of structural change in Chapter 4 and TFP growth in Chapters 5 and 6. It is organised as follows. The first section of this chapter explains the notion of structural efficiency; the second section discusses some methodological issues in the computation of structural efficiency; and the third section discusses the estimation results of structural efficiency in the Chinese textile industry.

Concept of structural efficiency

Structural efficiency expresses the relationship between structural change and aggregate productivity change. Acceleration of the aggregate rate of productivity growth involves two elements. The first arises from individual improvement in productivity which exceeds the weighted average for the industry as a whole. The second arises from the shift in the weight of sectors with slower productivity growth to sectors with faster productivity growth. Improvement in overall productivity arising from the second element is called structural efficiency.

The notion of structural efficiency was first introduced by Farrell (1957) to measure the performance of an industry rather than an individual firm. Farrell (1957, p.262) describes structural efficiency as 'comparing an industry's performance with the efficient production function derived from its own constituent firms. The "technical efficiency" of an industry, measured in this way, will be called its structural efficiency, and is a very interesting concept. It measures the extent to which the industry keeps up with the performance of its own best firms. It is a measure of what it is natural to call the structural efficiency of an industry — of the extent to which its firms are of optimum size, to which its high-cost firms are squeezed out or reformed, to which production is optimally allocated between firms in the short run'. In simple terms, structural efficiency is a reflection of the dispersion in overall efficiency among different branches or firm groups in an industry.

Later, Salter (1966) drew a remarkably similar distinction between average-practice and best-practice technologies. Salter recognises the variation between input requirements in average-practice and best-practice firms as an important characteristic of industry performance and offers hypotheses concerning the dispersion in overall efficiency among the component firms in an industry. Salter's important contribution to this field is his empirical work on structural efficiency, in which he investigates the relationship between structural change and aggregate productivity for the British economy over the period 1924-48. The key step in Salter's analysis is to decompose the total increase in recorded productivity into two components — the 'productivity effect', which measures the contribution made by productivity increase within each sector, and the 'composition effect', which measures the contribution made by inter-sectoral shifts. Obviously, Salter's 'composition effect' is nothing but Farrell's notion of structural efficiency. The major difference between Salter's and Farrell's expressions is that Salter's description of structural efficiency is based on a productivity measure rather than a frontier measure. Obviously, Salter's expression and measure of structural efficiency are more desirable for this study.

The potential importance of structural efficiency can be illustrated by the hypothetical, two-industry, two-subsector model presented in Table 7.1.

Table 7.1 **Structural efficiency: a hypothetical example**

	Industry 1			Industry 2		
	Labour	Output	Productivity	Labour	Output	Productivity
Sector A	40	400	10	10	120	12
Sector B	10	50	5	40	280	7
Total	50	450	9	50	400	8

In this case, although the comparative efficiency measured by labour productivity[55] in both subsectors is higher in industry 2 than in industry 1, comparative efficiency in the industry as a whole is the opposite, with industry 1's overall efficiency being higher than that of industry 2. The explanation of this apparent paradox lies in the structural differential between the two industries: industry 2's labour force is concentrated in sector B, where absolute productivity level is lower compared with sector A, while industry 1's labour force is concentrated in sector A with higher productivity. The structural effect in this case accounts for the difference in overall productivity at the industry level, or, in other words, the efficiency differential between the two industries is entirely attributable to differed structural efficiency.

In Salter's (1966) empirical study of the British economy for the period 1924-48, the structural effect is shown to be almost as important as the productivity effect (47.8 per cent of increase in productivity was attributed to the structural effect).[56] This suggests that structural shifts made a substantial contribution to the overall improvement in productivity. The close relationship between structural change and efficiency performance naturally has important policy implications concerning industrial efficiency. It not only is important for the improvement of efficiency in the input-output relationship in the different branches of an industry but there is also a need to allocate its resources to the higher productivity sectors of the industry in an optimum manner. The sectors with higher levels of productivity should in general be vigorously promoted. If such sectors

55 Using labour productivity instead of TFP as a measure of efficiency makes the example more straightforward and understandable.

56 Salter's result was based on the evaluation of labour productivity for 28 British industries and hence cannot be directly compared with the result of this study.

grow rapidly and, by so doing, increase their relative importance and their contribution to development of the industry, then the industry's overall efficiency will certainly improve due to the improvement in structural efficiency.

Despite the importance of structural efficiency in the real world, it has been largely neglected in previous studies of efficiency. In particular, an analysis of structural efficiency in relation to an individual industry has not been found so far. Here an attempt is made to plug this gap by investigating the structural efficiency of China's textile industry.

Methodology

Structural efficiency is in this study measured by the proportionate contribution of changes in output structure to overall TFP growth. More specifically, the actual increase in TFP is compared with the increase that would have occurred if there had been no change in sectoral structure. There is no readily available method for calculating structural efficiency based on TFP. The technique described below follows that employed by the Secretariat of the Economic Commission for Europe (SECE, 1977) but with slight modifications.

The rise in productivity in the textile industry as a whole is a ratio of two weighted averages, namely:

$$\frac{\sum_i P_{i1} S_{i1}}{\sum_i P_{i0} S_{i0}} \qquad (7.1)$$

where P_i represents TFP index in sector i, and S_i represents the share of sector i in the total output value of the industry; subscripts 0 and 1 represent successive time periods. As shown by equation (7.1) the average increase in TFP derives from a combination of a productivity component and a structural component, the first of which measures the contribution made by productivity increases within each sector and the second of which measures the contribution made by structural shifts. It is thus clear that in the extreme case, a rise in overall TFP can arise entirely from shifts in output structure without a change in TFP growth in the individual sector. To calculate structural efficiency in the textile industry, the overall change in productivity needs to be developed into these two separate components according to a simple normalisation technique, as follows:

$$\frac{\sum_i P_{i1}S_{i1}}{\sum_i P_{i0}S_{i0}} = \frac{\sum_i P_{i1}S_{i0}}{\sum_i P_{i0}S_{i0}} * \frac{\sum_i P_{i1}S_{i1}}{\sum_i P_{i1}S_{i0}} \qquad (7.2)$$

The first term on the right-hand side gives the productivity contribution of sectors by normalising for output structure, and the second term gives the contribution of the structural change by normalising for sectoral productivity.

Equation (7.2) employs a Laspeyres index for the sectoral productivity effect and a Paasche index for the structural effect. If the reverse procedure is adopted, as shown in equation (7.3), then the product of the two components will still equal the total rise in productivity, but their proportionate contribution will be different. This difference is an arithmetic phenomenon known as the index number problem which arises simply from the fact that for any set of index numbers there is always a choice of weights.

$$\frac{\sum_i P_{i1}S_{i1}}{\sum_i P_{i0}S_{i0}} = \frac{\sum_i P_{i1}S_{i1}}{\sum_i P_{i0}S_{i1}} * \frac{\sum_i P_{i0}S_{i1}}{\sum_i P_{i0}S_{i0}} \qquad (7.3)$$

However, most applications of this technique ignore the index number problem and arbitrarily choose to use either equation (7.2) or (7.3). Such an approach introduces biases into the estimation procedure and so gives an impression of inaccuracy in estimates of the relative importance of the individual components.

In this particular application, there is no objective basis for choosing one set of indexes rather than another. To reduce the estimation bias resulting from the index number problem, I use both Paasche and Laspeyres indexes for the decomposition procedure. In this case, it is not possible to provide a unique estimate of the proportionate contribution of structural movements to overall TFP change, but rather a range for the ratio of structural efficiency.

Following the practice of SECE (1977), the structural efficiency is actually calculated in this study on absolute differences, as follows:

$$\Delta P = \sum P_{i1}S_{i1} - \sum P_{i0}S_{i0}$$

$$S_L = \sum P_{i0}S_{i1} - \sum P_{i0}S_{i0}$$

$$S_P = \sum P_{i1}S_{i1} - \sum P_{i1}S_{i0}$$

where S_L and S_P is the structural component estimated according to the Laspeyres and Passche indexes respectively; and ΔP is the overall increase in TFP for the industry as a whole. Thus, the proportionate contribution of changes in output structure to the overall TFP growth ranges from

$$\frac{S_L}{\Delta P} \text{ to } \frac{S_P}{\Delta P}. \qquad (7.4)$$

Structural efficiency evaluated using sectoral composition

Following the analysis of sectoral structure in Chapter 4 and the construction of sectoral TFP indexes in Chapter 6, it is now possible to compute structural efficiency for the textile industry as a whole using the method described above. This is done for the 1978-91 period and the results are shown in Table 7.2.

Table 7.2 **Structural efficiency in the Chinese textile industry**[a]

	Rate of overall TFP growth %	Range of structural efficiency %
1978	7.28	-
1979	5.68	-1.35 ~ 1.54
1980	7.82	-1.38 ~ 0.87
1981	6.19	0.21 ~ 0.72
1982	-2.79[b]	-2.79 ~ 1.55[b]
1983	3.15	1.39 ~ 4.14
1984	5.12	-1.20 ~ 2.84
1985	5.43	2.06 ~ 3.87
1986	-2.05	11.59 ~ 17.95
1987	5.12	11.74 ~ 18.80
1988	4.83	12.51 ~ 24.01
1989	3.95	-20.17 ~ 8.28
1990	-1.05	-22.59 ~ -33.73
1991	3.21	-2.04 ~ 6.57
1978-1985	4.69	-1.36 ~ 2.53
1986-1991	2.30	13.38 ~ 23.62
1978-1991	3.65	6.27 ~ 12.68

Notes: (a) Recall that structural efficiency is measured by the proportional contribution of a shift in output structure to a total increase in TFP.
(b)With negative rate of TFP growth, the negative value of structural efficiency actually means positive contribution of structural shift to TFP rise in the specified period.

As explained above, it is not plausible to present a unique value of structural efficiency because of the index number problem. Table 7.2 therefore gives a range for the estimated contribution of structural movements to overall TFP growth. The results show that the effect of shifts in sectoral structure was favourable to productivity growth in the textile industry over the reform period, as implied by the positive contribution made by structural change to the overall rate of TFP growth in the industry. Had the output structure remained constant, the rate of TFP growth for the industry as a whole would have been around 3.3 per cent per year instead of the actual rate of 3.7 per cent. On the other hand, structural efficiency is estimated to have ranged between 6 per cent and 13 per cent for the 1978-91 period, suggesting that the shifts in the sectoral structure played a relatively minor role in overall TFP growth. In other words, the level of recorded growth of aggregate TFP derived mainly from efficiency gains within individual sectors, and the use of structural policy to reallocate resources has not yet become a major mechanism for improving the overall efficiency within the textile industry.

The finding that there was positive structural efficiency has been anticipated to a degree in the pattern of changes in sectoral structure as output shares shifted towards the relatively high productivity sectors such as the man-made fibre, wool, silk, and apparel sectors. It is useful to consider the exact way in which these sectors contributed to the increase in aggregate efficiency. The most obvious reason is that these sectors achieved faster TFP growth than other sectors. With higher rates of productivity growth, these sectors also gained from rapidly improving technology and related economies of scale. More technical opportunities have meant that the production costs in these sectors are continually falling relative to those of other sectors, making possible falling relative prices and rapidly expanding output. As these more efficient and technically progressive sectors are able to reduce the relative prices of their products, less efficient industries are robbed of their markets because the prices of substitutes are reduced. This is evident in the textile industry where man-made fibres have displaced natural fibres, and cotton textiles have been replaced by wool and silk products. This substitution process has brought about a re-grouping of growth resources towards sectors where productivity growth has been relatively dynamic, while sectors where the possibilities for productivity growth are lagging have become less important. The increases in the relative importance of more efficient sectors in the output structure make it possible for them to further influence TFP and output growth in the industry as a whole. In the meantime, the expansion of slowly growing sectors such as cotton textiles has not only been restricted on the demand side by low income elasticity for their products, and by the substitution of textiles made from other fibres, but also on the supply side by declining comparative advantage and the availability of natural resources due to low productivity growth.

Such a hypothetical process implies that not only do output growth and structural changes affect TFP growth but the latter can also influence the former. Unbalanced productivity growth appears to be one of the underlying reasons on the supply side for the shift in comparative advantage and the transformation of output structure. The above hypothesis could be justified empirically by testing for an inverse relationship between movements in relative prices and differential TFP changes. Unfortunately, this cannot be done in this study owing to the unavailability of price data.

It is also of interest to note that structural efficiency largely improved in the 1986-91 period compared to the 1978-85 period. This improvement may have been closely related to the slowdown of TFP growth in individual sectors that left greater scope for a structural contribution to productivity improvement. On the other hand, it may have also derived from the fact that as economic reforms enhanced further the role of market mechanisms during this period, more and more resources were allocated in response to market signals and hence increased the contribution made by shifts in the inter-sectoral distribution of factor inputs. This trend of improving resource reallocation among sectors is expected to continue in the future if further reforms are introduced to promote a market regime.

Conclusion

This chapter has used a normalisation technique to examine the structural efficiency of the Chinese textile industry. The positive contribution made by structural change to overall TFP growth suggests that structural efficiency has been favourable to productivity improvement in the textile industry. On the other hand, relatively small contribution ratios indicate that the growth of aggregate TFP derived mainly from efficiency gains within individual sectors and that reallocation of resources between sectors played only a minor role. Improvement in structural efficiency in the post-1986 period may be largely attributable to the progress in economic reform which introduced more market mechanisms that assisted in the inter-sectoral reallocation of resources.

These results may have some policy implications for productive efficiency in China's economy in general and for the Chinese textile industry in particular. It is not enough that such policies should simply encourage individual sectors to become more efficient. To reap the gains from shifting factors from low productivity sectors to high productivity sectors, the contribution that may be made simply by ensuring that a climate exists where expanding sectors are not curbed in their growth nor declining sectors artificially supported is also important. The ideal is a highly flexible environment which allows resources to be moved from declining to expanding sectors where productivity growth or technical progress is relatively fast. Obviously, this will require not only effort by the textile industry itself but will also depend heavily on ongoing economic reform in China.

8 Allocative efficiency of the Chinese textile industry

Improved structural efficiency in China's textile industry is closely associated with a more efficient reallocation of resources, whereby some resources are reallocated from sectors with lower productivity to those with higher productivity. While structural efficiency measures the inter-sectoral reallocation of resources, it does not give an indication of the efficiency of overall resource allocation in the industry, which consists of not only inter-sectoral but also intra-sectoral and intra-firm reallocation of resources. To measure the industry's overall efficiency in allocating resources, an evaluation of allocative efficiency is needed.

The concept and measurement of allocative efficiency were introduced in Chapter 2 with the aid of a graphical model. In this chapter, two different methods are used to examine allocative efficiency for China's textile industry as a whole.

Evaluation of allocative efficiency with factor returns approach

Recall that allocative efficiency is formally defined as 'the production of the "best" or optimal combination of outputs by means of the most efficient combination of inputs' (Pearce 1986, p.13). An allocatively efficient condition requires that the producers set marginal revenue products of factor inputs equal to the competitive market prices. Allocative efficiency in this sense involves prices as well as technical possibilities. Direct estimation of allocative efficiency needs to use price data, which is not feasible in this study because of the insufficiency of data on factor prices. Instead, this study uses two other methods to estimate allocative efficiency in the Chinese textile industry. The methodology follows that of Jefferson et al. (1992) and Dollar (1990). In this section, allocative efficiency is evaluated by identifying the convergence of factor returns between different sectors of the textile industry. This approach has been adopted by Jefferson et al. (1992) to evaluate the success of the reform objective of injecting market-like outcomes in China's industrial economy. Another method is introduced in the following section.

Marginal returns of factor inputs are represented by marginal products of these inputs. Theory suggests that to allocate a resource efficiently across different production activities is to choose the allocation for which the marginal product of the resource is the same in every activity. Thus, evidence of improved allocative efficiency in an industry would be provided by the elimination or reduction of differences in marginal products of factor inputs between different sectors. In the textile industry, the divergence of marginal products between different sectors was believed to be considerable in the pre-reform period because of the absence of the market mechanism. The hypothesis of improved allocative efficiency in the reform period can be tested by examining whether the gaps in marginal products of factor inputs between different sectors of the textile industry have narrowed.

A test to evaluate allocative efficiency in the Chinese textile industry is conducted across the two major textile sectors of cotton and wool. Marginal products of factor inputs are calculated for each sector, and then they are compared to check whether convergence in marginal product differences between the two sectors has occurred. The following expressions are used to calculate marginal products of capital, labour and intermediate inputs respectively for the cotton and wool sectors:

$$
\begin{aligned}
MP_K(t) &= \alpha_K \frac{Y(t)}{K(t)} \\
MP_L(t) &= \alpha_L \frac{Y(t)}{L(t)} \qquad (8.1) \\
MP_M(t) &= \alpha_M \frac{Y(t)}{M(t)}
\end{aligned}
$$

where α values are obtained from the estimates of equation (6.1), and the data for Y, K, L, and M are available from time-series data. Unlike the construction of TFP indexes, the calculation of marginal products requires nominal values of capital and intermediate inputs. In addition, in order to increase comparability between this study and the study of

Jefferson et al. (1992), input data used here are not adjusted for the changes in quality, and working capital is excluded from capital input.

The calculated indexes of marginal products of three factor inputs for the cotton and wool sectors are shown in Table 8.1. The results suggest that a noticeably improvement took place in allocative efficiency in the Chinese textile industry during the reform era in that there were reduced differences in marginal products of all three factor inputs between the two sectors. During 1978-91 the degrees of convergence of the factors' marginal products between the two sectors were 16.7 percentage points for labour, 10.1 percentage points for capital, and 6.7 percentage points for intermediate inputs.

Table 8.1 Index of marginal products of factor inputs in the cotton and wool sectors

	MP_K		MP_L		MP_M	
	Cotton	Wool(a)	Cotton	Wool(a)	Cotton	Wool(a)
1978	100.0	138.7	100.0	157.5	100.0	138.1
1979	101.1	140.3	102.4	163.9	98.7	138.9
1980	102.1	141.1	108.5	169.9	103.5	134.2
1981	98.7	134.5	115.4	158.4	106.7	129.3
1982	95.5	128.7	105.3	152.1	101.1	130.8
1983	92.6	129.5	111.8	154.2	98.5	129.5
1984	93.7	132.2	115.6	148.9	99.6	132.9
1985	94.7	136.8	127.7	152.4	102.5	132.2
1986	92.5	133.7	122.4	146.2	99.0	130.8
1987	90.1	131.4	124.5	148.5	96.2	128.7
1988	93.6	129.5	131.2	143.6	98.4	126.9
1989	90.1	126.2	133.3	141.4	93.7	129.3
1990	89.4	125.4	129.6	142.5	95.7	131.8
1991	91.7	128.9	131.5	140.8	94.5	131.4

Note: (a) Index numbers for wool processing sector are relative magnitudes, with the figures for the cotton processing sector in the corresponding year being 100.0.

The finding of improved allocative efficiency in the Chinese textile industry accords with that of Jefferson et al. (1992). Jefferson et al. also found that allocative efficiency increased in China's industry during the 1980s. The present study finds that there was a decline in the marginal products of capital and intermediate inputs and an increase in the marginal product of labour in both sectors. This is also consistent with the finding of Jefferson et al., who found evidence of similar trends in China's state and collective industrial sectors.

Unlike Jefferson et al., who found that there was a large convergence of (and eventually almost identical) marginal returns to intermediate inputs but only modest convergence of marginal returns to capital and labour across the state and collective segments of China's industry, this study finds that marginal returns to labour and capital converged faster than marginal returns to intermediate inputs across the cotton and wool processing sectors of the textile industry. It is difficult to identify exact reasons for this phenomenon. A possible explanation is that unlike the general situation in the Chinese industry, capital and labour markets have been relatively effective compared to the intermediate inputs market in the textile industry, particularly since the second half of the 1980s. For example, in the late 1980s most state-owned textile enterprises were allowed to recruit contract workers from rural areas; this change in policy increased the mobility of labour forces and the flexibility of firms' labour management in the textile industry significantly. At the same time, as textile production requires relatively little investment, the textile capital market also tended to grow faster than that in many other industries. The positive impact of reinforced market operations on the allocation of labour and capital are evident from the growing convergence of marginal returns to labour and capital since the second half of the 1980s, as Table 8.1 shows. On the other hand, intermediate inputs markets, particularly for cotton and wool, have not been developed very well in the textile industry relative to labour and capital markets. A formal market for wool was created in 1985 and closed in late 1988.[57] A proper market for cotton has never been established. Thus far, cotton is still among the most strictly controlled industrial raw materials in China. It would appear, therefore, that the slower improvement in allocating intermediate inputs might be attributable mainly to the lack of functional markets for raw materials (particularly cotton) in the textile industry.

[57] A nation-wide market for raw wool was reestablished in 1992. In principle, any organisation or individual could trade in raw wool in this market. In practice, however, not all buyers were equally welcome — the market was far from level (Longworth and Brown 1995).

Allocative efficiency reassessed using firm-level data

The evaluation of the allocative efficiency by testing the convergence of marginal factor returns between individual sectors of the textile industry using the sectoral level data is one approach. Since the focus was on two sectors only and rather aggregated data was employed, it is possible that this approach introduces bias into the analysis. This section reassesses the allocative efficiency of the Chinese textile industry using a different method and firm-level data.

The method used here mainly follows the approach adopted by Dollar (1990), based on the relationship between labour productivity and capital intensity, and the extent to which the data on these two variables fit a production function, which is in this case a Cobb-Douglas function.

To measure allocative efficiency, it is assumed that the objective of textile enterprises is to maximise the value added produced by capital and labour, given input and output prices. This assumption is reasonable in the sense that China's industrial reform is clearly aimed at maximising the value of output produced from the resources. Under this maximisation behaviour a necessary condition for efficient resource allocation requires that the marginal revenue product of capital be equalised across enterprises; and the same requirement applies to the marginal revenue product of labour. Textile firms in different sectors produce different products with different technologies, so that optimally they will have divergent capital intensities, which are specified here by capital-labour ratios. The condition for efficient resource allocation implies the existence of a positive relationship between labour productivity (value added per worker) and value of capital per worker. A stronger positive correlation between the two variables usually indicates a favourable change in allocative efficiency. In terms of statistical inferences, improved allocative efficiency will be reflected in a tighter fit of data to the appropriate production function.

Using cross-sectional data at the firm level, the following equation is estimated to examine allocative efficiency in the Chinese textile industry.

$$\ln\frac{Q_i}{L_i} = \alpha + \beta \ln\frac{K_i}{L_i} \tag{8.2}$$

where, for each firm i, Q is net value of output, L is productive workers, and K is productive assets; and α represents an efficiency index. This exercise is equivalent to fitting a normalised Cobb-Douglas production function with constant returns to scale to the data. The change in allocative efficiency is measured by how well the data from the same enterprises in different years fit the Cobb-Douglas function.

The data of 146 textile enterprises for 1980, 1985 and 1991 are available from *Compilation of Major Financial Data of the Textile Industry* (1991), *Compilation of Annual Report of Apparel Industry* (1991) and *1985 Industrial Census Data of People's Republic of China, Volume 14: Textile Industry*. These 146 firms are large and medium-sized key enterprises in the textile industry. They have played an important role in each sector and for the textile industry as a whole, particularly before the mid-1980s. Among them, 5 belong to the man-made fibre sector, 64 to the cotton sector, 16 to the wool sector, 11 to the bast sector, 22 to the silk sector, 12 to the knitting sector and 16 to the apparel sector (data on apparel firms are only available for 1985 and 1991). All of these are state-owned enterprises except for 8 urban collective firms in the apparel sector. Data on net value of output are readily available, and data on capital and labour are adjusted for productive use respectively using the method described in the data issue in Chapter 5. The results of cross-sectional estimation for 1980, 1985 and 1991 are shown in Table 8.2.

The table shows, as expected, that all coefficients on the capital-labour ratio are positive. In 1980, however, the value of β was relatively low and only significant at the 90 per cent confidence level. Meanwhile, the R^2 value for that year is also quite low, implying poor goodness of fit. These statistical indicators suggest that the relationship between output per worker and capital input per worker was weak in 1980. This relationship became stronger in 1985, as shown by the increased values of β, R^2 and the t ratio. A further improvement can be observed in 1991 with a much tighter fit than in 1980 and 1985. These statistical inferences can be interpreted as evidence of improved allocative efficiency in the Chinese textile industry during the reform era.

Table 8.2 Cross-sectional estimates of equation (8.2)

	Number of firms	α	β	R^2
1980	130	1.32 (0.27)	0.28** (1.49)	0.54
1980	62 most efficient	2.36 (0.83)	0.46* (3.20)	0.66
1985	146	1.26 (0.77)	0.35* (3.17)	0.65
1985	67 most efficient	2.09 (1.58)	0.51* (4.22)	0.73
1991	146	1.45 (0.69)	0.42* (6.62)	0.82
1991	69 most efficient	2.18 (1.31)	0.58* (6.95)	0.85

Notes: (a) Figures in parentheses are t statistics.
(b) * the coefficient is significant at the 95 per cent confidence level; ** the coefficient is significant at the 90 per cent confidence level.

The following counterfactual experiment helps to verify this conclusion. The residuals from the estimated production function are used to define a productivity index (PI):

$$PI_i = \exp(\ln\frac{Q_i}{L_i} - \ln\frac{\hat{Q}_i}{L_i}) \qquad (8.3)$$

where $(\hat{Q_i / L_i})$ is the labour productivity for firm i predicted by the regression, given the firm's capital-labour ratio. A firm that lies on the regression line has PI = 1, above (below) the regression line has PI > 1 (< 1). This index number indicates how much value, compared to other firms, an enterprise produces with a given bundle of capital and labour. Using a productivity index, we may now define the most efficient firms — that is, those that have PI > 1. Based on this criterion, we can select some of the most efficient firms from each year's sample and estimate equation (8.2) for these firms. The results of this estimation are shown in Table 8.2.

If we look at the values of α which capture the firms' efficiency, we find that the gap between average efficiency and the best performance narrowed year by year. In 1980, total average efficiency was 79 per cent lower than that of the most efficient firms. This difference fell to 66 per cent in 1985, and to 50 per cent in 1991. The convergence of the firms' level of efficiency implies that tremendous gains in 1985 and 1991 resulted from shifting factor inputs to more productive uses. This suggests in turn that allocative efficiency improved markedly in the textile industry between 1980 and 1991. On the other hand, the results of the experiment also show that considerable potential gains can be reaped in the textile industry if further improvements are made in resource allocation.

Conclusion

Using two different methods and data sets, this chapter has examined the allocative efficiency of China's textile industry. Both exercises point to the improved allocative efficiency of the Chinese textile industry, mainly due to progress achieved in marketisation following on from the economic reform.

The examination of factor returns in the cotton and wool sectors reveals that gaps in marginal returns to labour, capital and intermediate inputs between the two sectors narrowed in the reform period. This is evidence of improved allocative efficiency in the textile industry. The analysis also shows that the improvement in allocative efficiency for the intermediate inputs, mainly raw materials, has not been satisfactory relative to the other two factor inputs. This problem could be solved by releasing current administrative controls on and establishing fully functional markets for those raw materials (particularly cotton and wool) used in textile production.

In summary, the performance of the Chinese textile industry with respect to allocative efficiency suggests that it still has great potential to increase its growth and competitiveness through the avenue of allocative improvement rather than pure expansion of factor inputs.

Thus far we have examined growth and efficiency performance of the Chinese textile industry. It is also of great interest to examine the industry's export performance, which is expected to have close relationship with, and an important influence on, the industry's output growth and productivity improvement. This is the subject of the chapter that follows.

9 Export expansion and its impact on growth and efficiency

China's textile industry is a leading export sector and occupies a prominent position in world exports of textile products. The energetic expansion of China's textile exports[58] since the late 1970s has been a feature of world trade growth and a crucial element in the growth and efficiency of the Chinese textile industry. Thus far little research attention has been paid to the export performance of this industry, not to mention the impact of export expansion on the industry's output growth and efficiency. This chapter seeks to fill this gap, paying particular attention to the linkages of export expansion with growth and efficiency.

The first section examines trends and pattern of export growth in China's textile industry. An analysis of change in product composition of textile exports is carried out in the second section. The third section discusses the relationship between export expansion and output growth. The fourth section verifies the export-productivity hypothesis using both industry-level and firm-level data. The final section evaluates the efficiency gains from export growth in the textile industry.

Growth of China's textile exports

The Chinese textile industry has a long history of exporting textile products to the international market. The reform and opening to the outside world since 1978 has seen China's textile exports enter a period of rapid expansion and strong international competitiveness. As a result of dramatic growth in both production and exports in this period, China became the world's largest producer and exporter of textile products. Since the reform period represents the most important stage in the development of China's textile exports, the analysis in this chapter focuses on this period.

58 The term 'textile exports' as used in this chapter refers to exports of textiles and clothing products. In other words, exports of textile fibres are not included unless otherwise specified.

The rapid output growth of the Chinese textile industry in the reform period has been associated with even more dramatic growth in exports. In the first seventeen years of economic reform, the value of textile exports rose sharply from US$2,431 million in 1978 to US$37,968 million in 1995. The average annual rate of export growth in the Chinese textile industry was 17.6 per cent during the period 1978-95, much higher than the 7.5 per cent growth rate in the period 1960-77 (see Table 9.1).

Table 9.1 China's textile exports, 1960-95

	Total[a]		Of which: Textiles		Of which: Clothing	
	Value (US$ million)	Share in China's total exports (%)	Value (US$ million)	Share in total textile exports (%)	Value (US$ million)	Share in total textile exports (%)
1960	539	29.0	290	53.8	249	46.2
1965	485	21.9	295	60.8	190	39.2
1970	495	21.9	340	68.7	155	31.3
1975	1,386	19.1	1,033	74.5	353	25.5
1976	1,628	23.8	1,162	71.4	466	28.6
1977	1,829	24.1	1,241	67.9	588	32.1
1978	2,431	25.0	1,723	70.9	708	29.1
1979	3,339	24.5	2,280	68.3	1,059	31.7
1980	4,409	24.1	2,756	62.5	1,653	37.5
1981	4,544	20.7	2,676	58.9	1,868	41.1
1982	4,445	19.9	2,496	56.2	1,949	43.8
1983	4,966	22.3	2,906	58.5	2,060	41.5
1984	6,345	17.6	3,602	56.8	2,743	43.2
1985	6,440	23.5	3,945	61.3	2,495	38.7
1986	8,570	27.7	5,068	59.1	3,502	40.9
1987	11,338	28.8	6,882	60.7	4,456	39.3
1988	13,085	27.5	7,458	57.0	5,627	43.0
1989	15,138	28.8	8,069	53.3	7,069	46.7
1990	16,786	27.0	8,443	50.3	8,343	49.7
1991	20,153	28.0	9,311	46.2	10,842	53.8
1992	25,335	29.8	8,587	33.9	16,748	66.1
1993	27,132	29.6	8,704	32.1	18,428	67.9
1994	35,548	29.4	11,827	33.3	23,721	66.7
1995	37,968	25.5	13,919	36.7	24,049	63.3
Average annual growth rate (%)						
1960-95	12.93	-	11.69	-	13.95	-
1960-77	7.45	-	8.93	-	5.18	-
1978-95	17.55	-	13.08	-	23.04	-

Note: (a) Total textile exports consist of textiles exports and clothing exports.
Sources: *China Textile Yearbook*, 1995, pp.114-115; *Textile Economic Information*, 1996, No.5, p.3.

Of the two product groups, textiles and clothing, textiles exports grew at an average annual rate of 13.1 per cent in the 1978-95 period, compared with 8.9 per cent in the 1960-77 period. In terms of clothing exports, the growth rate was as high as 23 per cent in the reform period, compared to 5.2 per cent in the 1960-77 period. As a result of faster growth, the share of clothing exports in total textile exports increased sharply since the late 1970s and came to dominate in the 1990s. This structural feature of China's textile exports will be discussed in more detail in the next section.

Along with a rapid rise in exports, China's textile industry has played an increasingly important role in world textile trade. In 1978-95, total world textile exports grew 9 per cent annually, much lower than the 17.6 per cent growth rate achieved by China's textile exports. As a result, China's share in total value of world textile exports increased steadily from 3.2 per cent in 1977 to 12.5 per cent in 1995 (see Table 9.2).

Table 9.2 China's share in total value of world textile exports, 1970-95
(percentage)

	Total	Textiles(a)	Clothing(b)
1970	2.6	2.7	2.4
1975	3.0	3.9	2.1
1977	3.2	3.6	2.5
1978	3.5	4.2	2.5
1979	4.0	4.6	3.1
1980	4.6	4.9	4.1
1981	4.7	4.8	4.5
1982	4.9	4.9	4.9
1983	5.4	5.7	5.1
1984	6.3	6.8	5.8
1985	6.3	7.1	5.3
1986	6.6	7.4	5.7
1987	6.9	8.3	5.5
1988	7.2	7.9	6.4
1989	7.7	8.1	7.3
1990	7.5	7.5	7.5
1991	8.3	7.8	8.7
1992	10.2	7.3	12.8
1993	10.6	7.1	13.9
1994	12.1	8.3	15.7
1995	12.5	9.4	15.5

Notes: (a) Share of China's textiles exports in world's total exports of textiles.
(b) Share of China's clothing exports in world's total exports of clothing.

Sources: *China Textile Yearbook*, 1995, p.116; *Textile Economic Information*, 1996, No.7, p.2.

The rise of China's clothing exports has been especially striking. The Chinese share of total world clothing exports increased from 2.5 per cent in 1977 to 15.5 per cent in 1995.

Table 9.3 Export dependence of China's textile industry[(a)]

	Ratio of export dependence (%)
1977	8.1
1978	12.3
1980	14.8
1985	16.1
1990	35.1
1991	38.7
1992	46.8
1993	49.6
1994	53.2

Note: (a) Since Chinese currency is considered to be overvalued by the official exchange rate, the calculation here uses China's secondary market exchange rates.[59] The 1981 exchange rate in China's secondary market is used to calculate the ratios of export dependence for 1977, 1978 and 1980. The 1994 figure is computed using official exchange rate for the two rates were unified in that year.

Sources: Compilation of Statistical Data of the Textile Industry: 1949-1988, p.11-12; *Textile Economic Information*, 1995, No.9, pp.1-2; *China Textile Yearbook*, 1995, pp.114-115; *Annual Financial Data of the Textile Industry*, 1988, pp.698-699.

Along with China's rising importance in international trade, growth of China's textile industry has become increasingly dependent on export expansion and foreign markets. Table 9.3 shows the ratio of export dependence of the Chinese textile industry

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[59] The exchange rates used for computing export dependence of the Chinese textile industry are listed in the table below.

	Official rate	Secondary market rate
1981	1.70	3.08
1985	2.94	3.23
1990	4.78	5.80
1991	5.32	5.90
1992	5.52	6.80
1993	5.80	8.81
1994	8.60	8.60

Note: Exchange rates shown in this table are in terms of amount of RMB yuan equivalent to US$1.

Sources: *China Foreign Trade Reform: Meeting the Challenge of the 1990s*, p.52; *China's Trade Reform and Transition: Opportunities and Challenges for the OECD Countries*, p.21.

for the selected years in the reform period. The table reveals a consistent and sharp increase in the export dependence of the textile industry over the reform period.[60]

The export dependence of China's textile industry was 8.1 per cent in 1977, which indicates that the industry's production was by and large oriented towards the domestic market in the pre-reform period. In 1978 the industry's export dependence rose to 12.3 per cent. In the economic literature authors such as Mishimizu and Robinson (1984, p.196) define export-oriented industries as those with a share of exports greater than 10 per cent of total production. By this criterion, we may say that China's textile industry had turned into an export-oriented industry after the start of economic reform. With sharply increased export dependence in the reform era, the industry has become a highly export-oriented sector. By 1994 the textile industry exported over half of its total production. This suggests that the main engine of output growth in the Chinese textile industry is no longer domestic demand but overseas demand for China's textiles.

The overseas demand for China's textile exports has been concentrated in East Asian markets as well as the Asia Pacific region. This pattern is shown in Table 9.4. The ratios of market share clearly indicate that the bulk of China's textile exports have been destined for East Asia and the Asia Pacific region.

Table 9.4 Share of regional markets in China's textile exports
(percentage)

	1981	1985	1990	1994
East Asia	51.8	53.5	60.7	62.1
Asia Pacific region	67.4	71.3	75.4	75.6
Rest of the world	32.6	28.7	24.6	24.4

Note: Share of each market in China's textile exports is calculated on the basis of value terms.
Sources: *Manual of Textile Economy*, 1987, pp.120-123; *China Fibre Yearbook*, 1989, pp.102-105, 1990, pp.107-110, 1991/92, pp.117-120; *China Textile Yearbook*, 1993, pp.116-119, 1994, pp.117-120, 1995, pp.117-120; *Textile Economic Information*, 1995, No.8, pp.1-2.

[60] It should be noted that before 1983 domestic demand for cotton textiles in China was bound by a ration system and thus textile exports expanded at the expense of domestic consumption. Considering this factor, the ratios of export dependence for 1978 and 1980 shown in Table 9.3 may overstate the export strength of China's textile industry in that period.

Despite already considerably high shares in the early 1980s, these two regional markets increased their shares constantly in the last one and half decades. In the 1981-94 period the share of East Asian markets in China's textiles exports rose from 51.8 per cent to 62.1 per cent, while the share of the Asia Pacific region increased from 67.4 per cent to 75.6 per cent.

In addition to its high export dependence on these markets, China's textile industry also has a heavy reliance on imports from the Asia Pacific region. By 1994 some 82.6 per cent of China's imports of fibres and textile goods were from Asia Pacific countries (CTERC, 1995, No.8). A large part of these imports are raw materials used in the production of China's exported textile goods. This clearly indicates a considerable degree of interdependence between China's textile industry and the Asia Pacific countries. The output growth and export expansion in China's textile industry has become increasingly reliant on the development of the Asia Pacific economy.

Change in the product composition of textile exports

As a result of differing growth rates between various elements of overseas demand, the structure of China's textile exports has exhibited considerable change over the reform period. The shift in the product mix constitutes the most important structural change to have taken place in China's textile exports.

Textile exports are here classified into four groups of textile exports by degree of processing. These are yarn, fabrics, textiles for household and industrial use (hereafter referred to as 'made-ups'), and clothing and clothing accessories (hereafter 'clothing'). In terms of the degree of processing each product group has undergone, yarn falls into the category of 'least processed' products. Fabrics, which are next in order of degree of processing, can be classified as 'less processed'. Though made-ups and clothing are all end-use products and involve a still higher degree of processing, the latter in general shows a higher additional value than the former. Hence, we may categorise made-ups as 'more processed' and clothing as 'most processed' in terms of product group. Obviously, the more processed a product is the more value-added it will embody and hence the more export value it will generate.[61]

Table 9.5 Product composition of China's textiles exports(a)
(percentage)

	Yarn	Fabrics	Made-ups	Clothing
	least processed	less processed	more processed	most processed
1980	9.9	36.5	16.1	37.5
1981	6.6	33.7	18.6	41.1
1982	8.9	32.8	14.5	43.8
1983	9.1	34.6	14.8	41.5
1984	9.6	33.1	14.1	43.2
1985	12.6	36.8	11.9	38.7
1986	13.3	34.9	10.9	40.9
1987	13.7	33.1	13.9	39.3
1988	10.7	31.0	15.3	43.0
1989	9.2	30.0	14.1	46.7
1990	7.0	29.4	13.9	49.7
1991	7.6	26.4	12.2	53.8
1992	4.7	20.5	8.7	66.1
1993	4.1	19.2	8.8	67.9

Note: (a) Calculation is based on value terms.
Sources: *Manual of Textile Economy*, 1987, pp.110-111, pp.118-119; *China Fibre Yearbook*, 1991/92, pp.132-136; *China Textile Yearbook*, 1995, pp.125-126; *Textile Economic Information*, 1992, No.14, pp.1-3, 1994, No.13, pp.1-3.

Changes in the product composition of China's textile exports between 1980 and 1993 are shown in Table 9.5. There was a clear trend towards exports of further processed or more value-added items during this period. For instance, the share of clothing exports alone increased from 37.5 per cent in 1980 to 67.9 per cent in 1993. The share of yarn exports, on the other hand, dropped from a peak value of 13.7 per cent in 1987 to 4.1 per cent in 1993. Likewise, the share of fabrics also decreased from a peak value of 36.8 per cent in 1985 to 19.2 per cent in 1993. During the 1970s China's textile exports primarily consisted of yarn and fabrics, which accounted for more than 60 per

[61] It is estimated that among China's exported textiles, one ton of 40^S cotton yarn can generate earnings of US$2,400; if this yarn is processed into colour fabric, then it generates US$5,320; if this fabric is processed further into furnishing textile such as curtain, it generates US$6,250; alternatively, if this fabric is processed into clothing, then it generates US$7,690 (CTERC, 1988, No.22). This confirms that value-added is indeed positively related to the degree of processing. In particular, the unit export value realised by clothing has in general remained much higher than that attained by other product groups.

cent of total exports. The share of clothing and made-ups was much lower and generally ranged from 30 to 35 per cent of total textile exports. This situation largely changed in the reform era. While the share of yarn and fabrics came down to 23.3 per cent in 1993, the share of end-use products — namely clothing and made-ups — increased to 60.8 per cent in 1989, rising further to 76.7 per cent in 1993.

As shown in Table 9.5, clothing represented the largest and most dynamic product group in the industry's exports, and was the only product group that registered a rising share in product composition in the 1980-93 period. By 1991 clothing accounted for more than one-half of the industry's total exports.[62] China's share of world clothing exports rose to 13.9 per cent in 1994 and made it the number one clothing exporter in the world. As the production of clothing is the most labour-intensive stage in the textile-processing chain, China is expected to enjoy stronger comparative advantage in clothing exports than in textiles exports. The index of revealed comparative advantage (RCA) is used to measure China's growing relative strength in textile trade,.[63] The results are shown in Table 9.6.

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[62] It is also worth noting that the changing product composition of China's textile exports has been consistent with the corresponding change in world textile exports. For instance, between 1980 and 1990, the share of clothing in total world textile exports increased from 41.6 per cent to 50.5 per cent. This structural consistency with world textile exports implies that China has been able to facilitate its textile exports by taking advantage of a positive trend in world textile demand.

[63] In various studies concerning trade issues, particular attention has been drawn to the concept of revealed comparative advantage (RCA). This concept can be easily quantified in the form of an index and thus is widely used in the studies of international trade. Stated simply, a country's revealed comparative advantage in the trade of a particular commodity can generally be measured by the country's share in world total exports of that commodity relative to the country's share in total world exports — namely:

$$R_{ij} = \frac{x_{ij}}{T_j} \bigg/ \frac{x_i}{T}$$

where R_{ij} refers to the index of RCA; x_{ij} is country i's exports of commodity j; T_j is world total exports of commodity j; x_i is country i's total exports; and T is world total exports. If the value of R_{ij} is less than unity, this generally implies that the country is at a comparative disadvantage in the trade of the commodity in question. On the other hand, if the value of R_{ij} exceeds unity, it indicates that the country has a revealed comparative advantage in exports of that commodity. The higher the ratio is above unity, the stronger a country's comparative advantage is in that commodity. It is clear that the RCA index also can be taken as an indication of a country's specialisation in the export of certain commodities (Drysdale 1988). The data required for computing the RCA indexes for China's textile exports are obtained from various issues of *Manual of Textile Economy*, *China Fibre Yearbook*, *China Textile Yearbook*, and *Almanac of China's Foreign Economic Relations and Trade*. For more detailed discussion of RCA indexes, see Liesner (1958) and Balassa (1965).

Table 9.6 Indexes of China's revealed comparative advantage in textile exports

	Total[(a)]	Textiles	Clothing
1978	4.38	5.25	3.13
1979	4.71	5.41	3.65
1980	5.05	5.44	4.55
1981	4.27	4.36	4.09
1982	4.08	4.15	4.15
1983	4.50	4.75	4.25
1984	4.52	4.93	4.20
1985	4.55	5.07	3.79
1986	4.48	4.93	3.80
1987	4.31	5.25	3.48
1988	4.24	4.65	3.81
1989	4.53	4.76	4.29
1990	4.21	4.21	4.21
1991	4.20	3.94	4.39
1992	4.47	3.20	5.61
1993	4.51	3.02	5.91

Note: (a) Total textile exports consist of two parts: textiles exports and clothing exports.

During the period 1978-93, China's RCA indexes in total textile exports ranged from 4.1 to 5.1. This is clear evidence that China has a strong comparative advantage in international trade in textile products. From 1978 to 1993 China's RCA indexes in textile exports increased only marginally from 4.4 to 4.5. Though the increase was small, a steady trend of around 4.3 to 4.5 was in evidence over this fifteen-year period. This may imply that not only does China have a strong comparative advantage in textile trade, it also has a particular strength in managing to maintain this advantage for decades.

If we divide China's textile exports into two categories — namely, textiles and clothing — we can see that the RCA indexes ranged from 3.0 to 5.4 for textiles and 3.1 to 5.9 for clothing. This indicates that China has a stronger comparative advantage in clothing exports than in textiles exports. It can also be seen from Table 9.6 that the RCA indexes have been decreasing for textiles and increasing for clothing. In the whole period, the RCA index for textiles exports dropped from 5.3 to 3.0. There was a major decline in the 1989-93 period, during which the RCA index decreased from 4.8 to 3.0. On the other hand, the RCA index for clothing exports increased from 3.1 in 1978 to 5.9 in 1993, indicating that China has developed stronger comparative advantage in clothing production and trade. The rising shares of clothing exports in both China's total textile exports and world total clothing exports testify to the success of China's textile industry in pursuing its advantage in world markets.

As the most processed or value-added product group — namely, clothing — continued to gain share, the unit value realisations[64] of China's textile exports have also improved. This is shown in Table 9.7. The unit value realisation of China's total textile exports was US$5,143 per ton of fibres in 1981, rising to US$10,836 in 1993. Although the increase in unit value realisation of textile exports can be attributed to many factors, the favourable changes in product composition appear to be the primary one. It can be seen from Table 9.7 that in the 1981-86 period, China's textile exports were increasing faster in absolute terms than in value terms (11.5 per cent compared with 11.1 per cent).

Table 9.7 Unit value realisations of China's textile exports

US$/ton fibre

	A Value of exports (US$ million)	B Quantity of exports (ton)	C(a) Unit value realisation (US$/ton)
1981	4,544	883,571	5,143
1982	4,445	867,361	5,125
1983	4,966	1099,153	4,518
1984	6,345	1,283,695	4,943
1985	6,440	1,291,879	4,985
1986	8,570	1,689,377	5,073
1987	11,338	1,997,626	5,676
1988	13,085	2,096,692	6,241
1989	15,138	2,393,257	6,325
1990	16,786	2,152,751	7,797
1991	20,153	2,495,747	8,075
1992	25,335	2,485,188	10,194
1993	27,132	2,503,944	10,836

Note: (a) C = A/B.

Sources: *Manual of Textile Economy*, 1987, pp.118-119; *China Fibre Yearbook*, 1990, pp.123-132, 1991/92, p.141; *China Textile Yearbook*, 1993, pp.131-132, 1995, p.126.

This implies that export growth in this period depended mainly on quantitative expansion rather than an increase in value-added. In the 1987-93 period, export growth in absolute terms appeared to be much lower than that in value terms (5.8 per cent compared with

[64] The unit value realisation of textile exports is defined as the value generated by exporting one ton of fibre equivalent textiles and clothing.

17.9 per cent). This means that export growth in this period was mainly due to the increase in value-added rather than quantitative expansion. It is apparent that these two stages of change in unit value realisation closely match the two stages of change in product composition. This is strong evidence that the main cause of improvement in the unit value realisations of China's textile exports has been the upgrading of the product composition of exports.

The shift in textile exports from less processed to more processed product categories represents an important enhancement of the industry's export structure. As a result of this improvement, the industry's export expansion has become increasingly qualitative rather than quantitative.[65] This is considered an essential part of the industry's strategic transition from an extensive to an intensive path of growth.

Relationship between export expansion and output growth

In the development literature, many hypotheses have been advanced concerning the role of trade policy in development strategy. Prominent among these is the hypothesis that rapid growth of exports accelerates economic growth. Empirical evidence in support of this hypothesis has constituted a substantial part of the literature.[66] This study also offers some empirical verification for the hypothesis. Unlike most previous studies using country-level data, this study tests the hypothesis in a single industry—the Chinese textile industry.

A production function approach is used here to estimate the export-growth relationship in China's textile industry. In this framework, exports are treated as an 'input' in the production process. This method has also been widely used in studies of the export-growth linkage. The notion that exports are a productive input can be justified on

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65 This means that the expansion of textile exports is increasingly dependent on improved efficiency of factor uses rather than simple augmentation of input quantity.

66 Studies belonging to this group include Michaely (1977), Balassa (1978, 1985), Heller and Porter (1978), Tyler (1981), Feder (1983), Kavoussi (1984) and Ram (1985, 1987), who employ macrodata; and Nishimizu and Robinson (1984) and Nishimizu and Page (1991), who use two-digit industry-level data.

the following grounds. First, export growth may represent an enlargement of the effective market size and thus offer greater economies of scale for an industry. Second, an increase in exports may loosen a binding foreign exchange constraint and allow an increasing use of imported intermediate inputs so as to ensure output growth. Third, export growth may lead to a better allocation of resources in terms of comparative advantage. Fourth, increasing competition in the international market along with export expansion may result in enhanced efficiency and hence lead to larger output. Finally, export growth may induce more rapid technological change.[67]

Again, let us assume a Cobb-Douglas production function which incorporates four factor inputs such that:

$$Y = AK^{\alpha} L^{\beta} M^{\gamma} X^{\delta} \qquad (9.1)$$

where Y is the industry's output; A is a technological constant; K, L and M are capital, labour and intermediate inputs respectively; and X denotes the level of exports. A time dimension can be added to the basic functional form by expressing all variables as a function of time. Taking total differentials with respect to time and manipulating the resulting equation, one can obtain the following:

$$\dot{Y} = \dot{A} + \alpha_K \dot{K} + \beta_L \dot{L} + \gamma_M \dot{L} + \delta_X \dot{X} \qquad (9.2)$$

where a dot over the variable indicates its rate of growth. It is important to note that equation (9.2) is by nature a production relation rather than a growth accounting identity, though it may look like the growth accounting identity derived in Chapter 5.

Equation (9.2) is estimated econometrically for the period 1978-91 to verify the relationship between export expansion and output growth in the Chinese textile industry. Industry-level data are used and the data on output, capital, labour and intermediate

[67] For detailed discussion of this issue, see Balassa (1978), Krueger (1980), Ram (1985) and Nishimizu and Page (1991).

inputs are basically the same as described in Chapter 5. Data on value of textile exports are obtained from various issues of *China Fibre Yearbook* and *China Textile Yearbook*.

Table 9.8 Estimation result of equation (9.2)

$\dot{A}$	$\dot{K}$	$\dot{L}$	$\dot{M}$	$\dot{X}$	R^2
2.82	0.28	0.75	0.31	0.22	0.81
(4.02)	(5.23)	(1.88)	(2.33)	(3.57)	

Note: Values in parentheses are t statistics.

The estimation result is shown in Table 9.8. All coefficients are significant at the 95 per cent confidence level. A positive value for the coefficient of the export variable confirms that there has been a positive correlation between export expansion and output growth in the Chinese textile industry. The estimated coefficients reported in Table 9.8 represent certain dynamic input-output relations in the textile production. However, they should not be interpreted as 'shares' of an input in total output and hence the coefficient of export variable is not a reflection of the behaviour of its share in textile production during the sample period. In addition, the positive value of the constant term implies a gain in technological progress in the reform period. This is consistent with the estimation result presented in Chapter 5.

Though the functional form and estimation result suggest that export growth is an important contributing factor to output growth, they do not point to the existence of one-way causation between the two variables. It seems equally plausible to say that output growth can cause export growth in certain circumstances. Consider an industry with excessive capacity and a domestic market in excess supply;[68] in such a case the producer is likely to have a strong incentive to open up foreign markets. The causal relation in this instance is one that runs mainly from output growth to export growth, at least in the initial stage.[69] Thus, whether the causal chain proceeds from higher exports

[68] This has been the situation facing the Chinese textile industry since the late 1980s.

[69] Even in this case, export growth still can facilitate output growth by way of improving efficiency, resource allocation, comparative advantage and economies of scale. This implies that, in general, there is a two-way causation between the two variables.

to higher growth, or *vice versa*, cannot be determined by this analysis. As far as the Chinese textile industry is concerned, the direction of causation is likely to be mixed.

Export-productivity linkage in the Chinese textile industry

As shown above, faster export expansion is associated with a higher rate of output growth in the Chinese textile industry. Another hypothesis has it that an important cause of this association is the favourable impact of exports on productivity growth. The hypothesis that export expansion can enhance TFP growth has been widely discussed and tested by many researchers, such as Kavoussi (1984), Nishimizu and Robinson (1984), Chen and Tang (1990) and Nishimizu and Page (1991). These researchers all find that a significant positive correlation exists between export expansion and TFP growth at the country level.

On a theoretical level, there are at least two explanations for a positive correlation between export expansion and TFP growth: one that emphasises competitive forces and another that stresses scale economies. Hart (1983) demonstrates that international competition forces individual firms to reduce their managerial idleness and to operate in a more efficient manner. More efficient operations mean higher productivity. The scale economies argument, on the other hand, emphasises the merits of improved capacity utilisation. Handoussa et al. (1986) argue that scale economies provide a plausible explanation for the superiority of export-promotion strategy—namely, that it can increase TFP growth by way of raising capacity utilisation. Obviously, these two interpretations are not mutually exclusive; the reality is most probably a mixture of the two.

In the following, the export-TFP hypothesis is tested for the Chinese textile industry using both industry-level and firm-level data.

Estimation of export-TFP linkage using industry-level data

In the simplest manner, the relationship between export expansion and TFP growth can be verified by a correlation test. Since the rate of TFP growth was estimated for the Chinese textile industry in Chapter 5, it is easy to undertake a correlation test here. A regression of the rate of export expansion on the rate of TFP growth for the 1978-91 period results in a positive coefficient of 0.22 with a significant t ratio of 6.75. This result indicates that export expansion has been positively correlated with TFP growth in the Chinese textile industry during the reform period.

As the estimated correlation between the two variables did not incorporate the effects of other variables, a more rigorous approach to testing the export-TFP linkage involves the specification and estimation of a complete model. The model used for such a test is essentially the same as that used earlier for estimating the export-growth relationship in the last section. The major difference between the two models is the different assumption made with respect to technical change. Following Kavoussi (1984), a model based on the simple production function can be specified as follows.

We assume an aggregate production function with disembodied technical progress:

$$Y(t) = f[K(t), L(t), M(t), t] \quad (9.3)$$

where Y, K, L and M stand for the same meaning respectively as in equation (9.1), and t refers to time. Furthermore, we assume that elasticities of output with respect to capital, labour and intermediate inputs are constant, and that technical change is Hicks-neutral and that its rate remains unchanged. By totally differentiating (9.3) with respect to time and manipulating the terms, one gets the familiar expression:

$$\dot{Y} = \alpha_0 + \alpha_1 \dot{K} + \alpha_2 \dot{L} + \alpha_3 \dot{M} \quad (9.4)$$

where a dot over a variable indicates its rate of growth. The hypothesis that export expansion facilitates TFP growth can be incorporated in equation (9.4) by changing the assumption about the rate of technical change, which represents the change in TFP growth in this model. Instead of assuming a constant rate of technical change, one can hypothesise that this rate is a linear function of the growth rate of exports, X. Thus (9.4) can be rewritten as:

$$\dot{Y} = \alpha_0 + \alpha_1 \dot{K} + \alpha_2 \dot{L} + \alpha_3 \dot{M} + \alpha_4 \dot{X} \tag{9.5}$$

It is apparent that equation (9.5) is essentially the same as equation (9.2), and if the same data are used to estimate (9.5), one will get exactly the same result as for equation (9.2). The only difference may be the somewhat different interpretation of constant terms. The estimation result of equation (9.2), shown in Table 9.8, hence serves a double purpose in that it helps in investigating both export-growth and export-productivity linkages. We already know that the coefficient of $\dot{X}$ is positive and statistically significant, and this suggests that the industry-level data support the hypothesis that export expansion enhances TFP growth in the Chinese textile industry. Since a positive relationship between TFP and output growth was confirmed in Chapter 5 as well as a positive correlation between export and output growth in the last section, it should have been possible to anticipate the finding that export expansion and TFP growth is positively related in China's textile industry.

As in the case of the export-growth relationship, the above result provides necessary but not sufficient confirmation of the hypothesis that export expansion has caused faster TFP growth in the Chinese textile industry, since we can always question the causality relationship of the estimated regression equations. In particular, one can interpret this relationship to mean that faster TFP growth may cause higher growth in exports since the former reduces unit cost of production, and falling unit cost can improve China's comparative advantage in terms of price competition and in turn lead to a rise in exports. From this standpoint, it can be said that export expansion and TFP growth have enhanced each other in the Chinese textile industry.

Productivity differential between export and non-export sectors

The existence of a positive correlation between export expansion and TFP growth implies that there should be substantial difference between efficiency performance in export-oriented and non-export-oriented sectors, such that the former enjoys higher TFP growth. This productivity differential may result from greater capacity utilisation, incentives for technological improvement, efficient management due to competitive pressures abroad, and other beneficial impacts of export orientation. After the confirmation of a positive export-TFP linkage at the industry level, it is necessary to go one step further by investigating the productivity differential in the textile industry using firm-level data.

Unlike the TFP index approach used in Chapters 5 and 6, here the rates of TFP growth for export and non-export sectors are estimated econometrically. A Cobb-Douglas production function characterised by constant returns to scale is used for the estimation. The model specification is the same as equation (5.11) derived in Chapter 5:

$$\ln Y = \alpha_0 + \delta t + \alpha_K \ln K + \alpha_L \ln L + \alpha_M \ln M \qquad (9.6)$$

where α_K, α_L and α_M are output elasticities of capital, labour and intermediate inputs respectively; and the coefficient δ represents the rate of Hicks-neutral technical change. As pointed out in Chapter 5, in the case of constant returns to scale, δ is equivalent to the rate of TFP growth. Thus, the focus here is on the estimation of δ value.

The estimation of equation (9.6) uses pooled enterprise data. The data base is the same as that used in Chapter 6, obtained from *Annual Financial Report of the Textile Industry*, *Compilation of Major Financial Data of the Textile Industry* and *Annual Report of Apparel Industry* for the 1988-91 period. As explained in Chapter 6, the

Table 9.9 Distribution of sample enterprises of the export sector

	Number of firms	Number of observations
Cotton	52	208
Wool	3	12
Bast fibre	2	8
Silk	23	69
Knitting	16	64
Clothing	12	36
Total	108	397

Sources: *Annual Financial Data of the Textile Industry*, 1988, pp.538-685; *Compilation of Major Financial Data of the Textile Industry*, 1989, pp.986-1145, 1990, pp.1054-1233, 1991, pp.952-1149; *Compilation of Annual Report of Apparel Industry*, 1989, pp.122-185, 1990, pp.146-212, 1991, pp.150-222; *Almanac of China's Foreign Economic Relations and Trade*, 1989, pp.819-823, 1990/91, pp.823-828, 1991/92, pp.965-973, 1992/93, pp.957-966.

original data cover 939 large and medium-sized textile firms. But since exports of man-made fibres are not classified as textile exports,[70] 56 firms in the man-made fibre sector are excluded from the current sample. The real difficulty here is how to divide these firms into two groups — namely, export and non-export sectors — for the data do not contain the export indicators. However, the *Almanac of China's Foreign Economic Relations and Trade* contains a list of enterprises which provide over RMB 50 million yuan worth of commodities for exports and a list of enterprises involved in direct export with earnings of over US$10 million for the 1988-91 period. There are 115 textile enterprises included in these lists. These firms are key exporters for the Chinese economy as a whole and certainly are the most important exporters in the textile industry. Of these 115 firms, 108 are covered in the data base used here. It is reasonable enough to define these 108 firms collectively as comprising the export sector. Since there is no way to discriminate among the other 775 firms, all these firms are assumed to comprise the non-export sector. The concept of export and non-export sectors here is only a relative one. It should be noted that most large and medium-sized enterprises in China's textile industry export products to international market, though to different degrees. It is impossible, therefore, to rule out the possibility that a dominant proportion of firms in the non-export sector are in fact exporters of textile products. Nevertheless, this possibility does not

[70] China is the world's principal importer of man-made fibres and export of man-made fibres to the international market has been negligible.

change the fact that these 775 firms as a whole have been far less export-oriented than the 108 firms in the export sector. The distribution of these 108 sample firms in the export sector among six branches of the textile industry is shown in Table 9.9.

Estimation of equation (9.6) is carried out for the export and non-export sectors separately. The estimation results are shown in Table 9.10. It can be seen that all coefficients are significant at the 95 per cent confidence level. Satisfactory values of R^2 indicate that the functional form fits the data quite well and the assumption of constant returns to scale cannot be rejected. Since the focus of the current analysis is on TFP growth, discussion of the parameters associated with other variables is omitted. A higher value of δ for the export sector implies faster TFP growth in this sector. It is thus clear that the export sector has realised better TFP performance than the non-export sector. It can be inferred that this productivity differential has been primarily caused by the differences in export activities between the two sectors, though other factors may also have contributed to it.

Table 9.10 Estimation results of equation (9.6) for the export and non-export sectors

	δ	α_K	α_L	α_M	R^2
Export sector	0.023	0.304	0.166	0.530	0.91
	(2.73)	(4.26)	(2.33)	(4.54)	
Non-export sector	0.013	0.243	0.198	0.559	0.94
	(3.26)	(4.05)	(2.86)	(6.13)	

In a broad sense, the finding of a productivity differential between the export and non-export sectors implies an association between the degree of exposure to external competition, productivity change and improvements in international competitiveness. Activities with a higher degree of exposure to international competition will generally show superior productivity performance and international competitiveness compared to those with limited exposure to external competition.

Efficiency gains from increased export orientation

The existence of a productivity differential between the export and non-export sectors suggests that an increase in the weight of the export sector will accelerate the aggregate productivity growth of the industry. The degree of export orientation of the Chinese textile industry has been rising constantly in the reform period, as reflected in the increasing share of exports in total textile production. As shown in Table 9.3, between 1978 and 1994 the value share of exports in gross textile production rose from 12.6 per cent to 53.2 per cent. This change in the production structure (in terms of production for domestic consumption and for exports) is expected to have made an important contribution to overall TFP growth of the textile industry.

Recall that in Chapter 7 we introduced the concept of structural efficiency as well as the methodology of estimating structural efficiency. In the current analysis we can use the same method to estimate efficiency gains in the textile industry arising from increased export orientation, for the rise of exports in gross output may be treated as another aspect of structural change. Based on the estimated productivity differential shown in Table 9.10, it is possible to compute structural efficiency on the basis of changes in the degree of export orientation for the period 1978-91 and the two sub-periods of 1978-85, and 1986-91 (see Table 9.11).[71]

Table 9.11 Efficiency gains from increased export orientation

	Rate of overall TFP growth %	Range of structural efficiency[(a)] %
1978-85	4.32	5.77 ~ 10.25
1986-91	2.30	28.92 ~ 35.66
1978-91	3.65	14.84 ~ 21.19

Note: (a) Recall that structural efficiency is measured by the proportional contribution of shift in export share to total increase of TFP.

[71] It is assumed that the estimated productivity differential between the export and non-export sectors is applicable to the 1978-91 period.

As expected, export expansion in China's textile industry has contributed substantially to aggregate TFP growth over the reform period. In the 1978-91 period the increased export orientation appears responsible for about one-fifth of overall TFP growth in the textile industry. In the two sub-periods, the productivity gains from export expansion were substantially higher in the 1986-91 period than in the 1978-85 period. This resulted from the fact that the weight of the export sector in total production increased more rapidly in the post-1986 period.

The above analyses suggest that in the Chinese textile industry, not only did export expansion lead directly to higher rates of TFP growth at the firm level, it also contributed to improved aggregate efficiency through the rising importance of exports in the production structure. This suggests that China's textile industry has been altering its production structure to match changes in trade opportunities so as to reap more gains from its pursuit of comparative advantage in textile trade.

Conclusion

In line with rapid output growth in the reform era, the Chinese textile industry expanded exports at an even faster rate. This has made China the world's number one exporter of textile products. As China's textile industry becomes more deeply integrated into the world economy, it is becoming increasingly more dependent on international markets. By 1994 over half of China's gross output value was realised in foreign markets. This implies that overseas demand for China's textile goods has become the dominant force that drives the industry's growth. This demand side shift marks a turning point for the Chinese textile industry, since it will produce a series of crucial changes in terms of the industry's development strategy.

Along with quantitative expansion, China's textile exports also reveal some qualitative changes. The most important of these has been the shift in textile exports from less processed to more processed product categories. Continuous expansion of clothing exports has meant that higher value-added products as well as more labour-intensive products have dominated the industry's export basket. This shift represents the major change in dynamic comparative advantage in the Chinese textile industry. Meanwhile, the upgrading of the product mix indicates a trend of qualitative expansion rather than quantitative expansion in textile exports, reflected by the steady rise in unit value realisations of textile exports. This trend is consistent with the changing pattern of growth in the textile industry, represented by a shift from extensive growth to intensive growth.

Export expansion is found to be strongly associated with output growth in the Chinese textile industry. There is also a positive relationship between export growth and TFP change. Using firm-level data and a production function approach, the study finds empirical evidence that the more export-oriented sector achieved better productivity performance. The existence of this productivity differential indicates that substantial efficiency gains can be reaped through greater export orientation in China's textile industry. It is estimated that about 20 per cent of aggregate TFP growth in the textile industry was attributable to the increased export orientation during the reform period. Improved efficiency has in turn enhanced China's international competitiveness in the textile trade.

10 Main findings and policy implications

It is widely accepted that China's economic reform has accelerated industrial growth. This is indeed the case in the textile industry. Between 1978 and 1994 the industry grew at an average annual rate of 13.3 per cent in terms of gross value of output, much higher than the corresponding record in the pre-reform period of 5.8 per cent. However, there is sharp debate about the industry's productivity performance in the reform era. The study contributes empirical evidence to this debate.

This chapter summarises the main findings of this study and then draws some implications for the formation of industrial policy. The discussion seeks to identify a strategy that could help the Chinese textile industry achieve consistent intensive growth.

Productivity improvement and a shift to intensive growth

Using revised data and a TFP index approach, this study examined productivity change in the Chinese textile industry. It finds that TFP has improved remarkably along with the rapid output growth of the reform era. The average annual growth rate of TFP in the textile industry was 3.7 per cent during the period 1978-91, compared to 0.5 per cent in the pre-reform period. This result confirms that China's textile industry experienced favourable TFP change in the reform period. The result also suggests that apart from China's low labour cost in textile production, the growth of total factor productivity has been an important contributor to the improvement in China's international competitiveness.

This study adds to the productivity analysis by using firm-level data to examine TFP performance of individual sectors in the textile industry. It finds that positive TFP growth has been achieved in each sector over the reform period. At the same time, there was considerable variation in TFP performance across the individual sectors. The average annual rate of TFP growth ranged from 2.5 per cent in the bast sector to 6.2 per cent in the man-made fibre sector. This productivity gap indicates that there is still considerable room for the industry to pursue greater efficiency by promoting the poorer efficiency performer to the best practice level. The potential for exploiting sectoral productivity differentials in the process of structural transformation presents another opportunity to achieve higher rates of TFP growth in this industry.

The accelerated TFP growth that has been achieved by the industry is indicative of the success of the reform efforts undertaken following 1978. The pattern of TFP change is consistent with the view that textile firms adjusted to the changing economic environment due to economic reform and the open-door policy. Many elements are likely to have contributed to the improved TFP performance of the textile industry, the most important being: increased market-orientation, opening to the world market, reform of the trade regime, increase in effective demand, and increased autonomy at various levels. The focus of the reform policies has been to enhance market forces and produce competitive pressures on the textile enterprises. Improved efficiency is a predictable outcome of the increased competition in domestic and international markets.

A positive linear relationship between output growth and TFP growth during the reform period was identified at both the industry and sectoral levels. This finding is consistent with the Verdoorn law and may provide a partial explanation of the fluctuations in TFP growth in the industry and the different rates of TFP growth between sectors.

The exploration of sources of growth reveals that in the pre-reform period, output growth in the textile industry relied heavily on the expansion of factor inputs. The contribution of TFP to output growth was only 7.9 per cent. TFP growth was the least important element for the growth of the textile industry during this period. The industry displayed a pattern of typical extensive growth in the pre-reform period. In contrast, TFP growth represented a substantial share of industrial growth in the reform period. The contribution ratio of TFP to output growth rose sharply to 29.2 per cent between 1978 and 1991. Of the four contributing elements, increase in TFP has become the second largest contributor to output growth. The changed role of TFP growth implies that the textile industry has undergone transition, shifting from a path of extensive growth to one of intensive growth. The nature of this transition is such that output growth has been more and more dependent on improved efficiency rather than simple expansion of factor inputs.

The transition from extensive to intensive growth essentially reflects a shift in development strategy. It is expected that along with the deepening of China's economic reform, future growth in the textile industry will be increasingly determined by its efficiency performance.

Structural change and improved structural and allocative efficiency

Rapid growth of the Chinese textile industry has been accompanied by structural change, which is generally considered to be a result of unbalanced growth. However, shifts in industrial structure can also affect the industry's growth mainly through the structural change-productivity linkage — referred to in this study as 'structural efficiency'.

The main characteristic of transformation in the sectoral structure of the textile industry has been a rise in the relative importance of man-made fibres, wool, silk and apparel sectors accompanied by a decrease in the relative importance of the cotton textile sector. However, the cotton sector remains the largest and most important sector in this industry. Increased shares of output by the man-made fibres, wool, silk and apparel sectors represents the major trend in structural evolution of the textile industry.

The textile industry has, in the aggregate, become more capital intensive, though overall it remains a labour-intensive activity compared with other domestic industries or its counterparts in the industrial countries. This trend has its origin in the faster growth of relatively capital-intensive sectors such as man-made fibre and wool processing and their corresponding gain in output shares. By contrast, the most labour-intensive sector — namely, clothing (including both apparel and knitting sectors) — has not gained sufficient share in the output structure.[72]

[72] As China has greater comparative advantage in clothing exports and the high value-added nature of the clothing production, an improvement in the industry's sectoral structure requires a further rise in the share of clothing in gross output. Just in this sense, we say that clothing has not achieved sufficient

Another important aspect of structural change has been the shift in ownership structure. A major trend is that the relative importance of state ownership has been declining, while the relative position of non-state ownership has been increasing. In the period 1980-91 the state sector's share in the industry's gross output value fell from 82.3 per cent to 48.2 per cent, indicating that the non-state sector as a whole has come to hold a dominant position in the textile industry. In particular, the township and village textile enterprises (TVTEs) and joint venture enterprises represent the most dynamic players in the industry's growth. Estimates show that some 68.6 per cent of total output growth in the textile industry during the 1980-91 period was attributable to these two dynamic sectors. In the first two years of the 1990s the contribution of these two ownership groups to overall output growth rose to over 80 per cent, suggesting an increasing dependence by the textile industry on the growth impetus of the TVTEs and joint ventures.

Evaluation of the industry's structural efficiency shows that changes in output structure have favoured improvement of efficiency in the textile industry during the reform period. The estimated range of structural efficiency suggests that structural change made a positive contribution to overall TFP growth in the industry. Although structural efficiency has been favourable, small contribution ratios (some 6-13 per cent for the 1978-91 period) indicate that growth of aggregate TFP mainly derived from efficiency gains within individual sectors and reallocation of resources between sectors played a relatively minor role. On the other hand, it is also clear that over the period 1986-91, structural efficiency increased quite substantially. This improvement in structural efficiency has been largely attributed to increased market-orientation in this period and the associated improvement in the inter-sectoral distribution of resources. This finding suggests that industrial structure has played an increasingly important role in promoting growth and efficiency in the Chinese textile industry.

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share in the output structure. More detailed discussion of this issue will be undertaken in the last section of this chapter.

While structural efficiency measures the inter-sectoral reallocation of resources, a more comprehensive measure of efficiency in resource allocation is allocative efficiency. This study examines allocative efficiency for the Chinese textile industry as a whole by using two different methods and data sets. The first method tests the convergence of marginal factor returns between the cotton and wool sectors using sectoral-level data. The results show that gaps in marginal returns to labour, capital and intermediate inputs between the two sectors narrowed in the reform period. This provides evidence of improved allocative efficiency in the textile industry. To double-check this result, a second method based on the approach of Dollar (1990) was applied to the firm-level data. The results again show that allocative efficiency improved in the textile industry over the reform period.

In summary, the finding of a simultaneous improvement in TFP growth, structural efficiency and allocative efficiency in the Chinese textile industry suggests that the overall efficiency performance of the Chinese textile industry has improved considerably over the reform period.

Growth and efficiency gains from export expansion

In the pre-reform period, China's textile industry mostly revolved around import substitution. After the commencement of economic reform in 1978, the industry entered a new stage of export promotion. During the 1978-94 period the export value of textiles increased by 19.1 per cent annually. Not only did this growth rate far exceed the industry's output growth, it also appeared to be the highest rate in world terms. As a result of high and sustained growth in exports, China has become the world's number one exporter of textiles. In the meantime, China's textile industry has become highly dependent on the international market. At present, the industry's export dependence exceeds 50 per cent; in other words, over half of its total output value is realised in foreign markets. In the 1986-93 period over two-thirds of output growth in the textile industry was generated by the rise in export demand. Export demand for China's textile goods has become the driving force of growth in the industry.

The major foreign demand for China's textile exports has originated from the Asia Pacific market. At present, some 76 per cent of the industry's exports and 83 per cent of its imports centre on the Asia Pacific region, pointing to a high degree of interdependence between China's textile industry and the Asia Pacific economies. China's textile trade linkages with the Asia Pacific region underline the importance of increasing cooperation with the economies of the region.

The quantitative expansion of China's textile exports has been associated with changes in export structure. This study examined the shift in product composition, which is considered to be the most important element of structural change in textile exports. The remarkable feature of change in the product composition of China's textile exports was the upgrading of exported goods. The differences between the slower growth rate of physical volume and the more rapid growth of real value represent product upgrading. The study finds that in the 1978-93 period textile exports advanced only 9 per cent in quantity but rose 16 per cent in value, pointing to rapid upgrading. This has been a result of a shift in product composition towards the exports of more processed or higher value-added product categories. Representative of this has been the rise in the share of clothing exports. As clothing production is the most labour-intensive stage in the textile production chain, the rising share of clothing in the export structure captures the success of China's textile industry in pursuing its comparative advantage in international trade. At the same time, the upgrading of product composition has raised unit value realisations. Between 1981 and 1993 the unit value realisation of China's textile exports doubled. The improvement on this front has effectively facilitated the growth of China's textile exports, particularly under Multi Fibre Arrangement (MFA) restrictions.

Using a production function approach, the hypothesis that export expansion accelerates output growth was tested. The results confirm that a strong positive correlation exists between export expansion and output growth in the Chinese textile industry. Although this finding does not suggest that one-way causation exists between the two elements, in light of the previous conclusion drawn from demand-side analysis that export demand for China's textile products has become the dominant driving force for output growth, it would be reasonable to conclude that output growth in the Chinese textile industry has indeed been accelerated by the sharp export expansion.

Another hypothesis that export expansion can enhance TFP growth is also tested in this study. The study first identified a positive relationship between export growth and TFP change at the industry level, and then investigated productivity differentials between the export and non-export sectors using firm-level data. The results lend strong support to the hypothesis that export expansion can enhance TFP growth in that TFP growth occurred faster in the export sector than in the non-export sector. Based on these results, the study estimated the efficiency gains of the textile industry from export growth. The results show that between 1978 and 1991 some 15-21 per cent of TFP growth can be attributed to the growth of textile exports. The contribution rose to 29-36 per cent in the 1986-91 period because of the increased export orientation.

Taken together, the findings demonstrate that growth and efficiency gains can accompany superior export performance in a more open and market-oriented environment. In the meantime, such dynamic gains from export expansion are expected to strengthen China's comparative advantage and enable the Chinese textile industry to retain its superior position in world textile trade over a long period.

Some strategic issues concerning future development

The empirical findings of the study provide important insights into policy options and development strategy best suited to sustain the impressive growth and productivity gains achieved by the Chinese textile industry during the reform period. Subsequent discussion in this chapter considers appropriate directions for the industry's development.

Placing future development on the basis of intensive growth

The central issue in the industry's development strategy is to complete the transition from extensive to intensive growth. Some findings in this study suggest that this transition has not been smooth. Firstly, although TFP growth exhibited a positive trend in the textile industry, the average rate of growth was still quite low by international standards, suggesting that considerable room remains for further improvement. Secondly, the industry's transition from extensive to intensive growth is only in its initial phase and the pattern of extensive growth still dominates the industry. Thirdly, the industry has exhibited some fluctuations in TFP growth. In particular, the productivity performance of the industry in the earlier stage of the reform period was superior to that in the later stage, and the contribution of TFP growth to output growth also declined in the 1986-91 period. This decrease in TFP growth may not indicate a long-term trend but only a depressed stage in the growth cycle, but it could imply that the industry's transition from the extensive to intensive growth pattern has not been established on a solid base.

To facilitate the transition, the industry must consciously base its future growth on increased efficiency rather than simple augmentation of factor inputs. This means that the industry's development strategy must focus on continuous improvement in productive efficiency, including further improvement in TFP growth, allocative efficiency and structural efficiency. The necessity for implementing such a strategy derives from the fact that the initial advantage enjoyed by China's textile industry as a consequence of the low prices of factor inputs has been weakening. Thus, the pattern of extensive growth based on simple expansion of factor inputs is unlikely to help China maintain its competitiveness in textile production and trade in the future.

The past success of the Chinese textile industry in output growth and export expansion can be attributed, to a large extent, to the low cost of raw materials and labour, such that even simple augmentation of factor inputs helped China achieve superiority in textile production and trade. This advantage has been diminishing due to sharp increases in prices of fibres and labour since the mid-1980s.

Cotton dominates China's total consumption of fibres. Prior to the first half of the 1980s, China's agricultural programs held cotton prices well below international levels, which placed cotton textiles at an advantage. The price of domestic cotton was equal to only 10-15 per cent of world prices in the early 1980s. Nowadays, the domestic cotton price has increased to international levels and sometimes it is even higher (CTERC, 1994, No.78). China's cotton price is now much higher than that of its major competitors in the international market, such as Pakistan and Indonesia. In addition to cotton, prices of other fibres have also increased, or nearly so, to international levels. China's textile industry can no longer rely on cheaper raw materials to sustain its competitiveness.

Labour costs have also increased in both relative and absolute terms. For the textile industry as a whole, the share of labour in total costs was 5.7 per cent in 1981, rising to 12 per cent in 1992. Taking the example of 21^S cotton yarn, the labour cost per ton was 977 yuan in 1987 and 1,864 yuan in 1991 (CTERC 1993, No.18). The cost of labour in China's textile production has so far outstripped corresponding costs of many Chinese competitors. For example, in 1989 20^S cotton yarn per kg made in China was based on a labour cost of US$0.12, while labour cost for the same product made in Pakistan and India was only US$0.05 and US$0.04, respectively (CTERC 1991, No.37). As a result of increased cotton and labour costs, China lost market share to Pakistan in the cotton yarn market in the late 1980s. Although the cost of labour in China's textile production is still much lower than that of textile producers in the developed economies or newly industrialised countries, the gap has been falling. Considering that China's main competitors in the international market are Asian developing countries such as Bangladesh, India, Indonesia, Pakistan, Thailand and Turkey, low labour cost is unlikely to provide a major strength for ongoing development of the industry.[73]

[73] China is now shifting textile capacity from coastal regions to inland areas (mainly fibre growing regions) where labour costs are relatively low. While this will slow down the increase in labour costs to some extent, it is unlikely to change the rising trend of labour costs in textile production in the longer term. Labour costs in inland regions have also risen very fast in recent years. Besides, textile products shifted to inland regions are mostly aimed at the domestic market, and hence this process will not affect China's labour cost of exported textile goods substantially. Nevertheless, this shift is consistent with evolution of comparative advantage and the industry's strong competitiveness is expected to last longer as a result of this change in regional distribution of textile production.

Pushed by sharp rise in factor costs, the prices of textile products continue to increase. This has not only disadvantaged China's textile exports, it also has choked off domestic demand for textile products. In recent years, the increase in the average price of textile goods has exceeded China's per capita income growth and exerted an adverse impact on domestic demand, particularly for price-elastic textiles (CTERC 1993, No.36).

In the long run, it will not be possible, therefore, for China to maintain a competitive edge in textile production by relying on cheap factor inputs. As industrialisation proceeds and the industry integrates more deeply into the world economy, the prices of factor inputs will sooner or later rise to international levels. In the process, this will force the textile industry to improve its efficiency performance rather than to rely on simple expansion of factor uses. Otherwise, the industry will quickly lose its position to lower-cost competitors. China's textile industry has reached just such a turning point and is expected to adjust its development strategy to embark upon a path of intensive growth. With consistent improvement in efficiency, China's textile industry will be able to maintain strong competitiveness over the long term.

Strengthening market discipline and encouraging competition

The Chinese authorities are aware of the importance of promoting intensive growth in the textile industry. In recent years, in order to raise the utilisation of factor inputs,[74] they have implemented a series of policy measures to control expansion in productive capacity (especially in the cotton and wool sectors) and to accelerate technical progress in the textile industry. While these measures are designed to promote productivity growth and allocative efficiency of the industry, they do not seem as effective as expected. An important reason for this failure is that these administrative measures were

[74] Capacity utilisation in China's textile industry has been quite low since the mid-1980s (Sun 1991a), and this has in turn affected the utilisation of labour. This weakness restricted the industry's TFP growth in the last decade. The issue of factor utilisation is not analysed in this study because of lack of relevant data. But it remains an interesting issue and should be studied whenever the data needed are available.

not based solidly on and supported by market discipline and effective competition. Hence the firms of low efficiency are not necessarily or sufficiently disciplined.

Economic theory and the empirical results of this study suggest that the most important step in promoting efficiency in the textile industry was the enhancement of market disciplines. Increased market orientation and strengthened market discipline can effectively facilitate competition, and it is the force of competition — whether external or internal — that throws down the gauntlet to firms and leads to sustained efforts by enterprises to improve efficiency. The productivity improvement at various levels of China's textile industry over the reform period, as demonstrated in this study, lent strong support to this principle.

China's economic reform has, to a great extent, turned the textile industry into a market-orientated sector. However, there are still planning regulations on investment, prices, and output of certain products. The textile industry is a consumer goods producer, with highly versatile and complicated demand for its products that makes planning regulations for the industry highly inefficient. In most cases, the planning regulations act against the market mechanism and so tend to restrict competition. This discourages enterprises from improving efficiency. It is essential, therefore, that these planning regulations give way fully to market discipline in the course of future reform.

Policy measures related to further marketisation in the textile industry should include: further liberalisation of prices for textile products and factor inputs — that is, allowing prices to be determined solely by competition in the marketplace; ensuring full decision-making power by entrepreneurs with respect to investment, employment, and product quantity and variety; and meanwhile tightening budgetary constraints on firms and placing inefficient and non-profitable firms under bankruptcy pressures. This last measure has encountered great difficulties in the textile industry because of the incompleteness of China's social security system and certain ideological problems. However, the bankruptcy system is a crucial part of market discipline and provides a powerful instrument to improve firms' efficiency. Economic theory and practice show that if market forces are not allowed to impact on firms' survival, firms will not have sufficient incentives to raise productivity and reduce costs.

Carrying out structural adjustments to promote growth and efficiency

As this study shows, structural change can affect an industry's levels of overall efficiency and lead to shifts in comparative advantage. As long as the textile industry continues to undergo rapid growth, structural change will persist in playing an important role in the industry's productivity. To ensure the correct direction of structural change, policy will need to place more weight on efficiency considerations than it has to date. The following two adjustments with regard to sectoral structure and ownership composition are believed to be particularly important aspects of the industry's structural policy.

Establishing clothing's leading position in the structure of the industry

The industrial structure of the Chinese textile industry was centred on the fibre processing sectors, especially cotton. Although the return of the apparel sector to the textile industry in the mid-1980s facilitated a shift in focus, the basic pattern has not yet changed. Under this setup, end-use products have been neglected. As shown by the analysis of sectoral structure in this study, the combined position of the apparel and knitting sectors has been relatively weak in the industrial structure, while the four fibre processing sectors have dominated. Also, as an upstream activity, textile production failed to serve the needs of clothing production. On the one hand, over one half of exported clothing products relied on the use of imported fabrics, while on the other, many domestically produced fabrics became unsaleable due to ignorance of fashion needs (CTERC 1995, No. 39). The weak link in the production chain has been the dyeing and printing process. As industrial structure has been constructed around fibre processing, dyeing and printing have naturally become adjuncts to the fibre processing sectors. Dyeing and printing have therefore shown little concern about real demand in the clothing sector and thus the focus of the current industrial structure on fibre processing has produced a gap between textile and clothing production. This gap has adversely affected the overall growth and efficiency of the industry.

To correct this structural problem, the textile industry needs to shift its focus from fibre processing to clothing. There are at least two reasons that clothing needs to establish a leading position in the industrial structure. First, as shown in the study, the shares of clothing in total world textile trade and in domestic consumption of textile goods in China have been rising. This changing pattern of demand points to the increasing importance of the clothing sector. Second, since China has a stronger comparative advantage in clothing production than in fibre processing, the establishment of a central position in the industrial structure for clothing will consolidate China's superior position in world textile production and trade.

This structural adjustment could be expected to eliminate the breakdown in the production chain and bring about coordinated development across the industry. Strong output and export growth in clothing would probably raise productivity in this sector and generate more efficiency gains for the industry as a whole. To carry out this adjustment, dyeing and printing need to become an independent sector, thus creating a simple agent-client relation with other sectors. Under this structure, dyeing and printing would be able to meet all needs from the clothing and fibre processing sectors

Raising foreign and rural shares in the ownership structure

As shown in this study, the diversification of ownership structure has benefited the textile industry significantly in the reform era. To reap more gains from an improved ownership structure, the textile industry needs to further develop the non-state enterprises, especially the TVTEs and joint ventures[75]. Further expansion of these two sectors could be expected to lead to their greater contribution to the industry's output and productivity

[75] The term 'joint ventures' as defined in this study refers to enterprises involved in foreign investment and includes completely foreign-funded and foreign-run enterprises.

growth.[76] In addition, the establishment of private and individually-owned textile enterprises should also be encouraged. However, given China's current political environment, the strategic focus for the near future should be on the promotion of the TVTEs and joint ventures.

There has been a tendency since the late 1970s for more and more textile enterprises in the developed and newly industrialised countries to relocate to Asian developing countries as a consequence of increased labour costs in these economies, making their textile production less competitive and profitable. China has now emerged as an attractive choice for foreign investors, not only because of its cheap labour, but also because of its large and rapidly growing domestic market. China should thus take this opportunity to expand the share of joint ventures in ownership structure.

Joint ventures in the textile industry are valuable from at least two standpoints. Firstly, they have more advanced technology and equipment (which is a prerequisite for foreign investment in the Chinese textile industry) and better management. This means that joint ventures are generally more productive than local firms. Secondly, joint ventures in the textile industry are required to sell most of their products to the international market. As most foreign partners have long been exporters in their own countries, their experience in international marketing, quality control, quick delivery and the like ensures that the joint venture will be highly competitive in the export market. The superior export performance of joint ventures is confirmed by their sharply increased share in China's total textile exports in recent years. For instance, in the first half of the 1990s, the share of joint ventures in textile exports increased from 11.2 per cent to 24.6 per cent. As most joint ventures have been established in the clothing sector, their share in clothing exports even reached 27.9 per cent by 1994 (CTERC 1995, No.63). With enhanced efficiency and export performance among joint ventures, the textile industry will benefit more from further expansion of this sector, not only from the direct

[76] Due to lack of suitable data, this study cannot evaluate productivity performance of the TVTEs and joint ventures. According to their relatively market-orientated nature, TFP growth in these two sectors should not be inferior to the state and urban collective sectors. However, this point needs to be verified empirically in future study.

contribution of joint ventures to productivity and export growth, but, more importantly, from the positive externality generated by the joint ventures through competition and demonstration effects.

As pointed out earlier, the TVTEs have already played a critical role in the textile industry. Their strong growth has been a major source of the industry's output growth in recent years. The growth potential of the TVTEs sector is based on its exploitation of China's strong comparative advantage, with its most labour-intensive production of all the ownership groups. Further promotion of the TVTEs should be given high priority in the industry's development strategy, as this sector is able to capitalise on the industry's comparative advantage.

In past years, China's textile industry suffered from the lack of a unified strategy to coordinate growth of the urban and rural sectors. This was reflected in the high degree of similarity between the industrial structure of the urban sector and that of the rural sector. It is reported that the structural similarity coefficient between the TVTEs and the state textile sector has been as high as 0.99.[77] The consequence of this structural resemblance was a scramble for investment, raw materials, energy, land, human capital and markets between the urban and rural sectors, making it difficult to realise each sector's relative advantage adequately. To avoid this problem, the textile industry needs to establish a rational division of labour between rural and urban sectors.

Textile production generally incurs high opportunity costs in cities as opposed to rural areas, because urban investment is more productively directed to modern industries rather than traditional sectors. So the textile industry has been experiencing a decline in China's urban areas along with the upgrading of urban industrial structure. This trend is unavoidable and irreversible. To facilitate the change, the urban textile sector needs to shift capacity, products and technology to rural areas, and incorporate the TVTEs as an integral and major part of the Chinese textile industry.

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[77] This figure was calculated for the textile, food and machine-making industries as a whole, so it can only be taken as an approximation. But it is sufficient for us to infer a high correlation coefficient for the textile industry. For more details, see Yang (1991).

To give full play to each sector's strength, it is necessary to encourage individual sectors to specialise in different products and/or processes. The urban sector has a significant advantage in terms of investment ability, technology and quality of human capital. It should therefore specialise in capital and/or knowledge-intensive processes such as chemical fibre production, cotton and wool spinning for high-count yarn, dyeing and printing, and move 'up market' to high value-added products such as quality fashions and specialty textiles. The TVTEs enjoy an advantage in terms of labour cost and the availability of land and natural fibres, and they need to specialise in labour and/or resource-intensive products and the early processing stages of textile production — specifically, apparel and knitting, and 'down market' products in either spinning or weaving.

Although there are no satisfactory data for examination of the TVTEs' efficiency performance, some evidence from the relevant literature suggests that the TVTEs' low investment levels and small firm size in relatively capital-intensive processes are likely to have caused the loss of scale efficiency (SLDY 1990; Li 1989). By specialising in labour-intensive products or processing stages where the requirement for economies of scale is not critical, the TVTEs' hardships will be lessened. This is likely to improve the overall efficiency of the Chinese textile industry.

Increasing export-orientation as an engine of intensive growth

Export expansion in the textile industry has had a positive impact on both output and productivity growth. To complete the transition from extensive to intensive growth successfully, the industry needs to increase its export-orientation steadily. Meanwhile, textile exports should themselves be built on qualitative growth rather than quantitative expansion.

China has apparent superiority in textile exports based on its strong comparative advantage in this area. But superiority built on low labour costs could weaken rapidly if it is unsupported by increased efficiency, particularly in the export sector. The changing macroeconomic environment in China has in fact already forced textile exports onto a track of intensive growth. This is an outcome of changes in the exchange rate and in policy measures related to exports. The continuous appreciation of the renminbi (China's currency) since early 1995 has meant that textile exports have experienced some difficulties. This is expected to continue in the immediate future because of China's advantageous trade position. At the very least, it is likely that the renminbi will not be manipulated by administrative means as has sometimes happened in the past. In addition, the Chinese government has decided to reduce the ratio of refunded export duty to 6-9 per cent for exported manufacturing goods from the beginning of 1996, after a reducing it from 17 per cent to 14 per cent in mid-1995. This will reduce the revenue of export enterprises, *ceteris paribus*. Preferential interest rates for export loans were also abolished in the second half of 1995. In consequence, the interest rate for export loans has increased from 10.98 per cent to 12.2 per cent (CTERC 1995, No.91). At present, over 60 per cent of the operating funds of the export firms in the textile industry depend on export loans and, other things being equal, the rise in interest rate will increase the cost of exporting. These policy changes, correctly, comply with the requirements of the WTO and will benefit the textile industry in the long run, though they may mean that textile exporters are confronted by difficulty in the near future. With this change in China's macroeconomic environment, the success of the textile industry's export-oriented strategy will be more and more dependent on intensive growth rather than preferential treatment in the management of trade policy.

An important indication of qualitative growth in the export sector is the continuous improvement in unit value realisation of exported textiles and clothing. The strategic measure in improving unit value realisation of exports involves a further shift toward clothing exports. China not only has stronger comparative advantage in this relatively high value-added product category, but its comparative advantage in clothing exports is expected to be maintained far longer than that in textiles exports. This judgement is based on the fact that unlike other textile production, the labour-intensive nature of clothing production will prove difficult to change in the foreseeable future.

Technological progress in textile activities since the 1970s has shown that it is possible to mechanise production in fibre processing stages such as spinning, weaving, and dyeing and printing. The capital intensity of textile production has risen so substantially that today it almost equals the average level of manufacturing in the developed countries. On the other hand, the pace of technological change has been far slower in clothing production. Advances have been made in automating and integrating design and cutting, but sewing has been difficult to mechanise. The need to stay in close touch with rapidly changing fashion imposes constraints on mechanisation of the apparel sector, and hence the industrial countries have had little success at 'factor reversal'[78] toward capital intensity as a means of improving competitiveness in the clothing sector (Cline 1987). This suggests that the sharp difference in competitiveness between the industrial and developing countries in the clothing sector is likely to remain over the long run. In this light, further specialisation in clothing exports would presumably produce many sustained gains for the industry's development.[79]

As the real threat to China's long-term comparative advantage is from the developing countries rather than the industrial countries, the Chinese textile industry obviously needs to do more than simply upgrade its export structure. As more and more developing countries realise higher levels of quality of output and take advantage of their abundant labour, the natural evolution of comparative advantage will lead to an expansion of their exports. Faced with this challenge, another strategy for China's textile industry would be to increase product quality and its ability in non-price competition.

As pointed out by Yamazawa (1993), there are two determinants of comparative advantage in textile production: one of these is labour cost, since the industry is labour-intensive especially in clothing production; the other is the producer's ability to keep up

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[78] 'Factor reversal' occurs when the scope for replacement of labour can be so great as to cause a production process which relies heavily on unskilled labour to be transformed into an operation which is considerably capital-intensive. For more details, see Ballance (1987).

[79] Although, as discussed earlier, labour costs in China have been increasing substantially, they are still far lower than labour costs in the developed and newly industrialised countries. China's textile industry still enjoys strong cost advantage over the textile producers in these economies. This superiority is likely to be maintained longer if China makes more efforts to pursue its comparative advantage in the clothing sector.

with ever-changing and more demanding consumer tastes. The crucial factors for competitiveness in the latter respect are design, fashion, colour, quick supply, after-sale services and other non-price elements. The demand side determinant of competitiveness is important alongside the traditional supply side determinants.

China's textile exporters are considered quite weak in meeting these demand side requirements for competitiveness. For instance, frequent changes in fashion style require small volume production and quick delivery on the supply side. However, China's exporters are often reluctant to take small orders and have rather slow delivery times. Longer response times for exporters mean higher inventory costs for retailers, and the reduced ability of exporters to compete with local suppliers. A consequence of slow response to orders is that by the time they arrive on the market, China's textile products are often out of fashion and must be sold at a discount. Enhanced ability to make quality textiles and engage in non-price competition will not only consolidate China's long-term comparative advantage, it may also effectively increase the unit value realisation of China's textile exports. It is estimated that, on average, a one-month decrease in delivery time could increase the price of China's exported textiles by 10-15 per cent (CTERC 1992, No.69).

The negotiations of the end of the MFA should lead to the gradual removal of industrial country import restrictions on China's textile exports. But as quota restrictions on textile imports will not be fully removed until 2005, China's textile industry will still need to deal carefully with the remaining trade barriers over the next ten years. There are three ways of increasing exports under quota restrictions. First, upgrading of exported textiles provides an effective means to offset quota restraints, as quotas are on physical units imported. Product upgrading makes it possible for the real value of imports to rise more rapidly than their physical volume. One dimension of upgrading is the shift from less processed to more processed products, just as the Chinese textile industry has successfully undertaken. Another dimension is to improve product quality and hence increase price. China's textile exporters have appeared weak in this respect. Diversification to new, uncovered (by import quota) markets is an additional means of responding to quota restraints — Russia and the East European countries could be promising markets for China's textiles. A third way is to fulfil currently unbound quotas. In some markets and product categories, China's utilisation of import quotas has remained low. Thus, there is room for China to increase both quantity and value of its textile exports in these unbound areas. By persistent efforts on these three fronts, China will be able to expand its textile exports successfully under the remaining import restrictions.

In summary, intensive growth of the Chinese textile industry will be facilitated by further expansion of textile exports through efficiency gains from trade. In addition, an increase in export orientation will provide the industry with many growth opportunities that are now effectively denied. In a more internationalised industry, exports would assume a far more important role than they do under the current policy regime.

Liberalisation of textile trade

Along with the rapid expansion in textiles exports, China has also quickly become the world's major importer of fibres and textile products. Textile imports have grown even faster than textile exports in terms of value. Between 1978 and 1994 the value of fibres and textile imports increased by 18.9 per cent annually, compared to 17.3 per cent in the value of exports (including exports of fibres). In the 1986-1994 period, when export growth accelerated to 19.6 per cent annually, import growth increased even faster at 21.6 per cent.[80] A substantial proportion of imported fibres and semi-processed textiles have been processed into higher staged products for exports. Nowadays, China is not only the world's leading exporter of textile products but also the world's principal importer of textile materials. China's experience in textile trade (including trade in fibres) has been consistent with the view that the industrial structure needed for export-oriented growth strategy requires increased raw materials and intermediate imports. At the same

[80] Data used in this part are derived from *China Textile Yearbook* (1995).

time, China's role in world textile trade has led to increasing concern about its trade policy. The central issue is the liberalisation of China's imports of fibres and textiles.

As the world's largest producer and exporter, the Chinese textile industry is heavily dependent on imported fibres. The industry imports about one-third of the fibres it uses. China has become the world's leading buyer of all major fibres such as cotton, wool and man-made fibres. Yet, China maintains high barriers against fibre imports. China imposes import licensing on wool and man-made fibres, as well as relatively heavy import duties on all fibres. Morris et al. (1993) note that China's import tariffs on fibres and fibre products have been substantially higher than international levels. Meanwhile, China maintains its high tariffs on imports of textile products. In general, tariff rates increase with the degree of manufacturing process.

China's import policy is partly a vestige of import substitution policy in past years. It serves to protect domestic producers, as the country is not yet competitive in some fibres and quality textiles. But restrictive import policy leads to loss of efficiency in China's weaker sectors, for while China's import policy is designed to protect domestic producers from competing with more efficient opponents and better products, it fails to raise the weaker sectors of the industry to internationally competitive levels.

Import restrictions also tend to discourage the export sector in the textile industry. As China's textile industry has established itself as a processor of imported materials into higher stage exports, continuous expansion of intermediate imports has become an indispensable part of the industry's development strategy. Import licensing and tariffs on imported fibres have increased the administrative burdens of export firms.[81] In addition, the tedious bureaucratic processes of import licensing and tariffs in China have often caused a slowdown in the firms' responses to the orders. This reduced the efficiency and increased the cost of textile exporters. More importantly, while China

[81] Under current policy, the potentially adverse effects of import tariffs on the export sector are mitigated by a system of duty exemptions for export enterprises. Under this arrangement, with imported fibres being subsequently re-exported in the form of semi-processed and processed textile products, up to 100 per cent of the import duty can be reclaimed. Thus the import tariffs do not seem to increase the cost of textile exporters directly, but rather indirectly through the extra administrative burdens and slow bureaucratic processes.

maintains a highly restrictive policy on textile imports, the removal of import restrictions on its own textile exports is difficult, because China is expected to provide reciprocal liberalisation of its own markets. Thus China's import barriers against fibre and textile imports are likely to restrain its own export growth simultaneously. Such import policy generates no real benefit to the textile industry and needs to be adjusted. Liberalisation of imports for the textile industry will stimulate competition in the domestic market. A competitive home market allied to a competitive export market will more likely create future success in the textile industry. In addition, the removal of trade barriers would reduce consumer costs and benefit the Chinese people at large.

China's textile industry has entered the mid-1990s with a strong momentum to improve its efficiency and maintain its growth. Appropriate adjustments in industrial policies and development strategy will be needed to effect the transition from extensive to intensive growth in the Chinese textile industry. This transition can not only consolidate the industry's gains from the economic reform of the past eighteen years, but it can also generate a strong positive impact on sustaining the development and stability of China's textile production. As the industry enhances its efficiency, China is likely to maintain its competitive position in world textile markets over the next decade and beyond.

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