Building economic decision-making capabilities of Chinese wool textile mills

Colin Brown, Scott Waldron, John Longworth and Zhao Yutian

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Cover photos by members of the ACIAR project team show, clockwise from top-right: spindles at the Qifa Textile Group mill in Li County of Hebei Province; sheep grazing at the Duosaite State Farm in Siziwang Banner in Inner Mongolia Autonomous Region; hand shearing on Regiment 129 Production and Construction Corps Farm near Kuitun in Xinjiang Uygur Autonomous Region; and CAEGWOOL training workshop with wool textile mill managers held in Wuxi City in June 2004.

Foreword

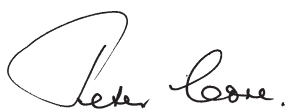
CHINA has the largest wool textile industry in the world and is Australia's largest market for wool, accounting for about 40 per cent of Australia's wool exports. Wool and wool textiles are the major trading items between China and Australia. These statistics emphasise the economic importance of the continued viability of the Chinese textile industry to both China and Australia. As well, the connection between the Chinese wool industry and sustainable development of China's pastoral region has seen a long involvement by ACIAR in China's wool and wool textile industries.

Recent economic reforms and market developments have posed major challenges to the viability of most Chinese wool textile mills. The mills are under pressure to become more competitive, to introduce better enterprise management and to improve their environmental standards. Yet, in many cases decision tools or skills needed to improve management practices are lacking.

Wool textile enterprises are actively seeking ways to improve management practices and to adopt a more analytic approach to decision making. The models and analyses presented in this report are designed to assist wool textile mills as they implement new operational procedures, management practices and decision-making processes.

The overarching goal of the ACIAR project was to improve the long-term viability of Chinese wool textile mills by facilitating adaptation to the changing market and policy environment and improving the efficiency of their operations. The core of the project was the adoption of a "whole-of-mill" approach to analysing key management decisions. These analyses were supported by three sub-projects which examined: the supply chain for imported raw materials; the sourcing of domestically produced wool; and the changing market for mill outputs.

This report presents analyses and findings from the core "whole-of-mill" investigation. In particular, it provides complete documentation for CAEGWOOL which is a significant output from this ACIAR project. CAEGWOOL is an EXCEL-based model designed to make better use of data already collected by most mills to evaluate a range of key economic decisions faced by wool mill managers in China. For example, the model helps managers decide: which fibre input combinations will minimise the cost of producing a particular fabric; what impact a specific piece of new processing or effluent treatment technolgy will have on the overall profitability of the mill; and what price to charge for a particular custom-processing order. An attached CD contains a working version of this model. ACIAR is very pleased to publish this report, which is also freely downloadable from our website at www.aciar.gov.au



Peter Core
Director
Australian Centre for International Agricultural Research

April 2005

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Preface

WITH rapidly changing markets, technology, ownership and governance structures, the managers of wool textile mills throughout China are under mounting pressure to make decisions in a more rigorous way. Economic decisions can range from evaluating a new investment, to determining the relative merit of different product orders, to managing costs at a workshop or product level. Chinese mill managers are keen to develop these analytic skills, but in an environment where many other short-term imperatives capture their attention, the tools must be readily adaptable, fit with their existing information systems and complement their current decision making processes.

As part of ACIAR Project ASEM1998/060, a series of models, approaches and analyses were conducted to help facilitate economic decision-making by Chinese mill managers, and are presented in this technical report. A CD containing the CAEGWOOL mill model is also attached to the report. This is the research version of the model developed during the project and validated at a Project Workshop in June 2004. Discussions were underway in early 2005 to develop the research model to a fully commercial model. A parallel version of this report in Chinese has also been prepared which includes a Chinese version of the CAEGWOOL model.

The development of the models and analyses of use to Chinese wool textile mills required a thorough understanding of mill systems and access to specific information. Intensive fieldwork with the full gamut of wool textile industry participants — including 30 mills — was conducted over a three-year period. The mill visits provided unique insights into the issues and problems that they confront, the information and tools required to resolve some of these issues, and the systems that needed to be accounted for in developing these tools. Apart from these general mill visits, several selected mills worked closely with the research team over a four-year period to develop the CAEGWOOL model presented in this report. The openness, enthusiasm and foresight of the managers and staff at these mills are gratefully acknowledged.

There are too many mill technicians and managers to thank individually here, but we would like to express our special gratitude to Wang Yu, Li Wei, Ding Cailing, Wei Jiebin, Liu Zhiyong and Li Jianjiong. We would also like to express our thanks to the other members of the research team who contributed directly or indirectly to the development of these models, including Ke Binsheng, Han Yijun, Ben Lyons and Liu Danan. We would also like to gratefully acknowledge the contribution of Professor Li Ping from China Agricultural University who accompanied the research team on many of the mill visits and whose understanding of financial management was invaluable. Professor Li was also instrumental in translating much of the English version of the report into Chinese. Finally we would like to thank Stephanie Cash from the CAEG research team for her help in preparing the report, and Robin Taylor from ACIAR for the production of the report.

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1. Introduction

WOOL textile mills in China are undergoing a series of fundamental changes. Directed or encouraged into new ownership and governance structures, wool textile mills are seeking ways to survive and thrive in a new socio-economic and market environment. The viability and profitability of Chinese wool textile mills is of immense importance to the communities and households that rely upon them. It is also of utmost importance to the Australian wool industry, which is so heavily reliant upon the Chinese wool textile sector.

Brown et al. (2005) highlight that the pressures and changes that Chinese wool textile mills are undergoing are also occurring within many industries in China. They break industry transition in China into three phases. In the first phase of industry transition, ownership and governance structures have undergone fundamental changes with a much more diverse set of structures compared with the central planning and early reform era. In the second phase of transition, the restructured enterprises have embarked on a process of upgrading their equipment and technology in an attempt to maintain international competitiveness. In the third phase of transition, new operational procedures, management practices and decision-making processes are being implemented.

The first two phases of industry transition have proved very challenging but are well underway within the Chinese wool textile industry. However, the wool textile industry has not proceeded far down the path of the third phase. Wool textile enterprises are actively seeking ways to improve management practices and to adopt a more analytic approach to their decision-making. The models and analyses presented in this technical report are designed to assist wool textile mills in this crucial third phase of industry transition.

1.1 Improving decision-making in Chinese wool textile mills

The multi-stage, multi-product nature of the wool textile processing means that managers face a myriad of decisions in trying to successfully guide the operation of wool textile mills. Figure 1.1 outlines some of the key economic decisions that mill managers face and are seeking guidance on how to analyse.

One of the most important sets of decisions relates to output pricing and the determination of the profitability of specific orders. Traditionally many Chinese wool textile mills have operated in a 'passive' mode of producing to particular customer orders rather than actively promoting or selling particular products. Even within a passive mode of operation, however, there are a number of key decisions that have to be made. For instance, decisions have to be made about how to price the particular order or, if the customer provides the wool input, what service charge should apply. Where markets set the price, decisions have to be made about whether to process the particular order or process other orders instead, necessitating detailed information about the relative profitability of the particular order.

Another important set of decisions relate to the choice of fibre or raw material inputs. That is, there are a number of ways to combine different wools and other fibres to produce particular wool textile outputs. Fibre inputs can impact on the profitability of processing a particular order through the direct fibre input cost as well as impacting on processing or transformation yields and affecting the unit costs of processing.

The tight margins associated with many orders as well as the multi-stage nature of wool textile processing mean that mill managers are also extremely concerned with cost management. In managing costs, a detailed breakdown of costs across mill departments or workshops is required along with the costs and revenues generated by specific orders. Furthermore, the allocation among workshops and orders must be of the real costs.

As mentioned, there has been enormous pressure on Chinese wool textile mills to modernise their operations and upgrade their technology. New technologies and processing equipment usually involve substantial investment. Due diligence and careful economic investigation are required to ensure that the investments are both profitable and feasible.

The decisions highlighted in Figure 1.1 represent only some of the decisions that mill managers confront. In addition to a raft of technical decisions, the economic decisions mentioned above sit high on the agenda of mill managers both in the importance they attach to them and the challenges faced in devising ways to improve their analytic capabilities in these areas.

1.2 ACIAR involvement and Project ASEM/1998/060

The complementarity between the Chinese wool textile industry and the Australian wool industry,

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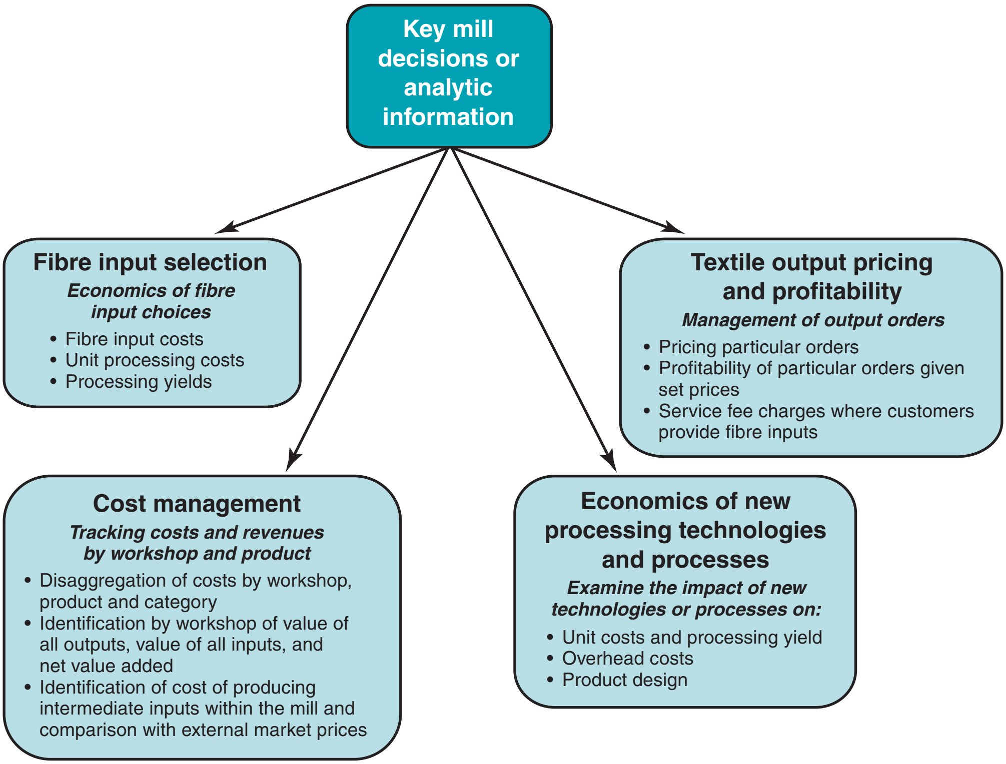

Figure 1.1 Key mill decisions

combined with the connection between the Chinese wool industry and sustainable development of China's pastoral region, has seen a long involvement by ACIAR in China's wool and wool textile industries. In the early 1980s, a series of technical projects examined various aspects and limitations to China's wool production. Apart from the series of technical projects, an economics project (ACIAR project EFS/88/11) was also conducted, with a focus on wool production and marketing.[1]

Throughout the 1990s a series of organisations in Australia (including AWC/AWRAP/IWS and AusAID) became involved in research (either as funder, facilitator or provider) to assist Chinese wool textile mills in their process of transformation. By the early 2000s, ACIAR also had a series of research projects aimed at assisting wool textile mills in areas such as spinning prediction and assessment of objective measurement (ACIAR Project AS1/97/070) and effluent treatment (ACIAR Project AS1/97/069). Project ASEM/98/060 formed part of these projects to assist with economic decision making within the wool textile sector.[2]

Figure 1.2 illustrates the structure of ACIAR project ASEM/1998/060 and highlights the whole-mill modelling approach that is embodied in the project. That is, the core of ACIAR project ASEM/1998/060 is concerned with the viability of wool textile mills, the development of models and conducting of analyses to assist mill managers in their economic decision making (Sub-project 1). However, around this core sub-project are a series of other sub-projects (Sub-projects 2, 3 and 4) designed to feed information to facilitate these mill decisions, and to assess wool marketing and wool textile marketing channels from a whole-mill and whole-industry perspective.

[1] Numerous Chinese and English-language publications arose out of this project and they are listed on the www.nrsm.uq.edu.au/caeg website. Some of the key publications included Longworth and Williamson (1993) on sustainable development in China's pastoral region, Longworth and Brown (1995) on China's agribusiness reforms and wool marketing, and Chinese Team Members of ACIAR Project 8811 (1994) on many different economic aspects of Chinese wool production and marketing.

[2] The abstract from the Project document for ACIAR Project ASEM/98/060 appears in Appendix 1.

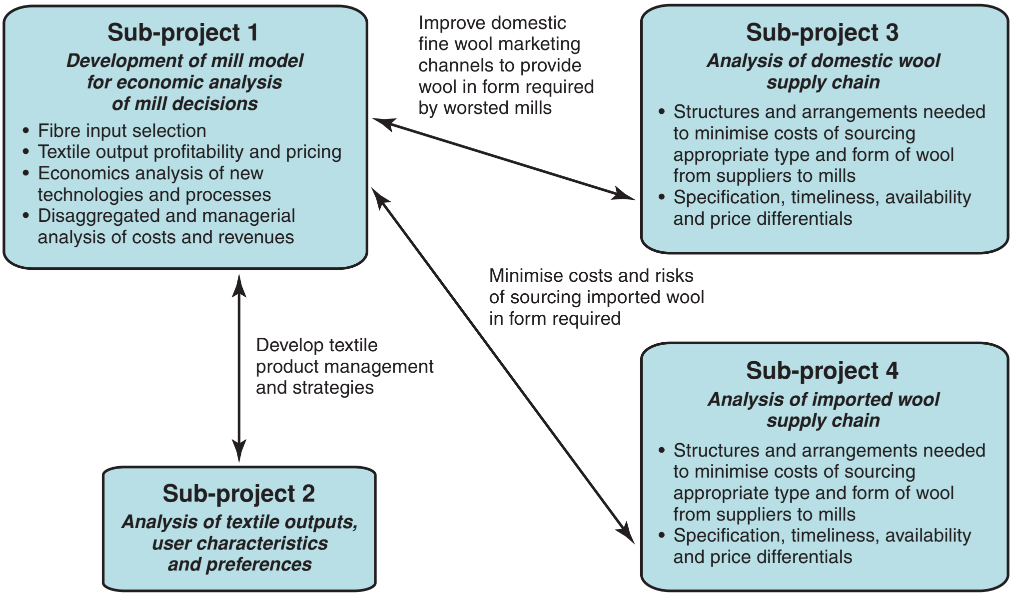

Figure 1.2 Whole mill modelling approach of ACIAR Project ASEM 1998/060

More specifically, Sub-project 2 is concerned with an analysis of user characteristics and preferences for wool textile outputs and is designed to aid mills develop their textile product management and strategies. Similarly Sub-projects 3 and 4 examine the supply chains for domestic and imported wool given that fibre inputs govern what textile products can be manufactured and also form a large part of overall costs. The issues that surround the domestic and imported wool supply chains differ, but both sub-projects are aimed at identifying efficient and effective means of supplying the wool in a form required by Chinese wool textile mills.

Thus, while most of the analysis and models presented in this report emerge from activities conducted as part of Sub-project 1, they are underpinned by substantial research in all the sub-project areas. Some more detailed findings from Sub-projects 2, 3 and 4 can be found in other publications including Brown et al. (2005).

Sub-project 1 involved visits to a large number of wool textile mills throughout China to develop an intricate understanding of mill issues, systems and decision-making processes. Development of the mill model was then made possible by close and ongoing co-operation and provision of data from a select group of mills. An intensive workshop attended by managers from more than 20 mills was then conducted in mid-2004 to train mill managers in the use of the model as well as to demonstrate some of the other approaches and analyses presented in this report such as the estimation of product cost and yield coefficients. Thus the models and analyses have been demonstrated, tested and calibrated among mills in China.

1.3 Synopsis

The report outlines analysis and findings that have emanated from ACIAR Project ASEM/98/060. The major section is the presentation of the CAEGWOOL model in Chapter 5, that has been designed to evaluate the economic decisions shown in Figure 1.1. However, in line with the whole mill modelling approach outlined in Figure 1.2, there are a series of analyses that feed information into the CAEGWOOL model. Furthermore, these analyses provide information in areas of vital importance to mill managers, including allocating costs (Chapter 2), determining yield coefficients (Chapter 3) and analysing prices (Chapter 4).

Chapter 5 presents a detailed manual for the 'research' or 'prototype' version of the CAEGWOOL model. An attached CD contains a working version of this model including the spreadsheet and embedded *Visual Basic* programs. A complete tutorial example appears in Appendix 5. Chapter 6 briefly illustrates how different scenarios can be analysed.

A parallel version of this report has been prepared in Chinese so that it can be used directly by managers of Chinese wool textile mills. The English version presented in this report will allow for a wider debate and scrutiny of the models and analyses that will benefit future model development.

2. Allocating costs accurately

ONE of the most pressing problems perceived by senior mill managers in evaluating new orders or products, or in determining prices for their outputs, is how to allocate costs of manufacturing to particular product orders. Products incur different unit costs of processing for three main reasons. First, characteristics of the product affect the type and level of processing. Second, attributes of the wool input may also require different processing. Third, each product may be associated with a unique yield or physical processing loss that, in turn, will affect the amount of input that has to be processed and so per unit costs.

In summary, different wool inputs and outputs involve different costs to process. Managers are aware of this through anecdotal observations such as extra breakages associated with tender wool requiring additional labour. However, they have little basis for determining the product-specific cost variations.

During the planning era, fixed coefficients for particular product types were specified by the Ministry of Textile Industries and applied within the SOE mill network. However, these coefficients were determined many years ago for a different set of products and processes. Some mills still use these old cost coefficients although they recognise that they are out-of-date. Because of these problems, in many instances, product/order costs are now simply based on per unit costs for all mill throughputs. Presuming that all order types have the same unit costs can lead to significant biases in cost or profit analysis, as well as in pricing orders.

From the mill manager's perspective, the problem can be expressed as how to determine cost coefficients to apply to particular products or orders. These coefficients would be normalised against standard products (that is, a coefficient of 1.08 would indicate that the particular product has unit costs 8% higher than that of a standard product).

The nature of the product cost coefficients is that they are highly mill-specific. Thus, generalised coefficients based on even a widespread group of mills may be of little relevance. Instead, it is an area where analysis may need to be conducted at an individual

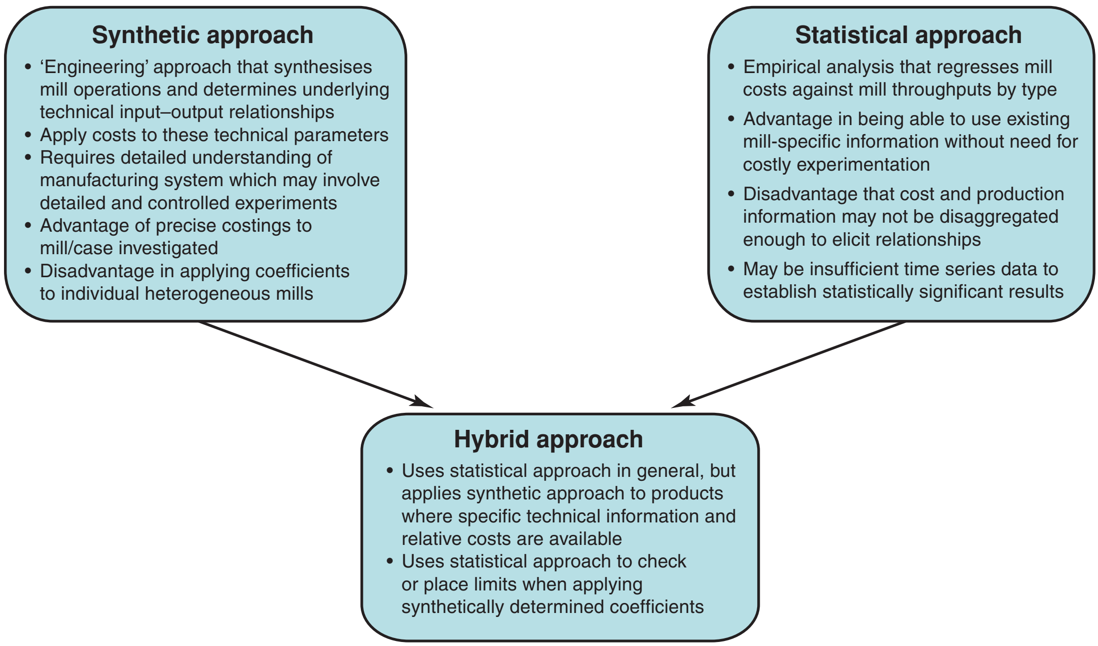

Figure 2.1 Approaches to estimating cost coefficients

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enterprise level. Thus, the discussion below focuses on describing the approach rather than on emphasising specific results.

2.1 Broad approaches to estimating cost coefficients

There are two main approaches to the estimation of product-specific cost coefficients as shown in Figure 2.1. The first of these is an engineering or *synthetic* approach and the second is a *statistical* approach. Alternatively, a combination of these approaches involving a *hybrid synthetic/statistical* approach can be employed.

Both the synthetic and statistical approaches have their merits and shortcomings. The synthetic approach calls for a detailed understanding of the manufacturing system and the underlying technical input-output coefficients. Appropriate costing of these technical parameters can reveal precise costings. However, to obtain the necessary technical information requires detailed and controlled experiments. Because of the plethora of processes and the complicated nature of wool processing, this requires numerous experiments. In practice, various organisations conduct experiments on key processes under selective conditions. That is, the information is specific to particular mills, or more precisely, specific machines, settings and operational procedures. The advantage of precise costings can be outweighed by the fact that different mills, equipment and settings can have a very different set of technical relationships and costings. Given the great heterogeneity in equipment and levels of management in Chinese wool mills, this makes the task of using synthetically determined cost coefficients difficult to apply to particular mills.

The statistical approach involves the regressing of various cost categories (such as monthly spinning labour costs) against various technical information about the throughputs in that workshop and time period (such as volume or share of pure wool yarn and blended yarn). The approach highlights the factors important in determining unit processing costs and also in the estimation of cost coefficients. The statistical approach has the advantage of being mill specific and so allowing for technical inefficiencies, specific mill operating practices, technologies and equipment to be reflected in the costs. Being able to determine costs to specific mills is a major advantage given the heterogeneity of wool textile mills. The disadvantage, however, is that the cost and production information collected by mills may not be in a form that is disaggregated enough to elicit the relationships. Furthermore, there may be an insufficient time series of data to be able to establish statistically significant coefficients.

The severe limitations of both the synthetic and statistical approaches suggest that a hybrid synthetic/statistical approach may be required. For instance, technical information may be used to check or place limits on the range of parameter coefficient estimates from the statistical analysis and vice versa.

2.2 Statistical approach to estimating cost coefficients

Based on the need to develop a relatively straightforward and inexpensive approach that could be used by a wide range of mills to determine cost coefficients, the statistical approach was investigated. The following sections describe in detail the steps involved in this approach, including the data required.

2.2.1 Method of analysis

The statistical approach follows a series of stages indicated below. The basic approach is outlined in Figure 2.2. It involves breaking unit costs of a particular product into two components, namely a core cost (unrelated to product attributes) and marginal cost (dependent on product attributes). The sum of these two components then determines the total unit cost. Selecting one product as the ‘standard product’ with a cost coefficient normalised to a value of 1, the cost coefficients for other products can then be determined by dividing their unit costs with that of the standard product. Details of the approach are set out on page 6.

2.2.2 Data for analysis

The statistical analysis requires a time series of disaggregated cost and production information. First, the information needs to be disaggregated by processing stage or department/workshop of the mill (such as weaving, finishing, spinning). Normally mills do have their accounting systems structured along workshop lines and so are able to provide cost information by workshop. Second, costs within workshops need to be further disaggregated into various categories such as labour costs, energy costs, workshop overheads, dyeing costs and other costs. Typically, mills have even more disaggregated cost categories, allowing costs to be grouped in a number of ways. Third, production data needs to be disaggregated to allow throughputs of particular (wool) workshop inputs and outputs to be determined. This normally involves individual order/product information with sufficient details about the technical specification of the order. Mill workshops again normally systematically record details of particular orders. However,

Stage	Process/method
1	Identify cost centres or workshops used by the mill to collect cost information.
2	Collect monthly cost information by workshop (e.g. weaving, spinning, etc.).
3	Sort costs into cost categories to be considered in the analysis and for which coefficients are to be estimated (such as energy costs or labour costs).
4	Collect information on product orders processed by the workshops by month.
5	Aggregate throughputs of product orders of a particular type, such as volume of pure wool, blended wool, particular count wool, particular type of processing (e.g. single vs. double twist) etc.
6	Rescale monthly costs from Stage 2 to align actual mill throughputs (implicit in cost information) with aggregate throughputs in Stage 5.
7	Regress rescaled monthly cost estimates against the throughputs of particular product types. As the independent variables are throughputs of particular product types, regression coefficients indicate the marginal contribution to costs of an extra unit of the product type.
8	Calculate the 'unexplainable' variation in per-unit costs. That is, the independent variables explain only part of the variation in costs, and there is a need to calculate a per unit 'unexplainable' variation in costs to determine the total cost of an extra unit of throughput of a particular type. The per-unit 'unexplainable variation' is derived from the coefficient on the constant term divided by the average throughput in the period of the observation. (For example, in Appendix Table 2.2.1, the marginal cost contribution for PURE (wool) products is (Rmb)1.07.) The unexplainable variation is the coefficient on the constant — 166 186 — divided by the average monthly throughput — 269 181 metres — giving a per-unit unexplained variation cost of 0.62.
9	Add the marginal cost contribution of a particular product type to the per-unit 'unexplainable' variation in costs to determine the total cost of an extra unit of throughput of a particular type. Thus the total cost of the PURE product type is 1.69 [0.62+1.07] and the BLEND product type is 1.97 [0.62+1.35].
10	One product type is then chosen as a standard with a cost coefficient equal to 1. Cost coefficients for the remaining product types are then calculated by dividing the total per-unit cost of the product type (estimated in Stage 9) by the total per-unit cost of the standard product type. (For example, using the example in Stage 9 above, assuming the coefficient for PURE is 1, then the coefficient for BLEND is 1.17 [1.97/1.69] as is listed in Table 2.4.)

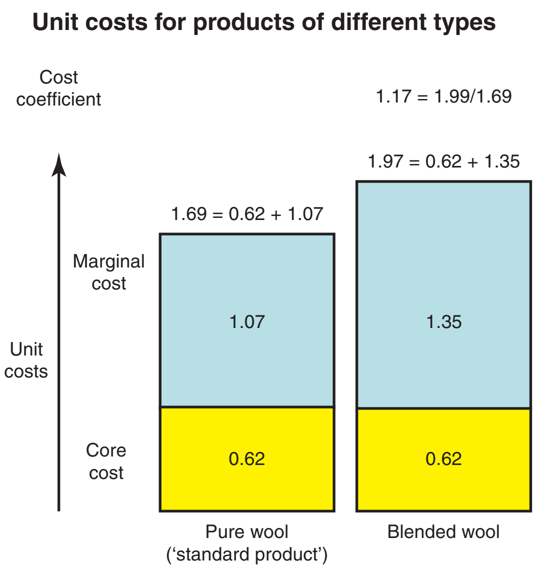

Figure 2.2 Calculating unit costs and cost coefficients for different products

as there may be in excess of 100 orders in a month, grouping these orders into particular types suitable for subsequent analysis can be difficult.

Observations about costs and production details from workshops are normally kept on a monthly basis. Cost and production details need to be at least disaggregated to a monthly basis in order to obtain sufficient records/observations to conduct the statistical analysis. However, even if mills record information on a more frequent basis (say weekly), it may be problematic to use this less-than-monthly information. That is, production orders can span many days and so attributing costs to clearly defined products or orders may not be possible on a weekly or daily basis.

2.2.3 Sources of data

The analysis below draws on the illustrative case of a mill in Eastern China. It involves data from 48 monthly observations of costs and throughputs over the period from 2000 to 2003. Data were obtained for four workshops in the mill — recombing/dyeing, spinning, weaving, and finishing — although the analysis in the following sections focuses on the

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weaving and spinning workshops only. Workshop cost data and physical information on individual product orders was available in electronic form, but required collation and transformation before it could be used in the analysis.

The monthly cost data were not deflated by a price index because inflation rates in China over the 2000 to 2003 period were virtually zero.

2.2.4 Cost categories

Monthly cost information for each of the mill workshops was provided in a form similar to that shown in Table 2.1. (This table uses hypothetical data to preserve the confidentiality of the original data.) A close examination of this table reveals several key aspects important for the subsequent cost modelling such as:

- One aggregate cost category considered was 'energy' which was to include categories such as water, steam, compressed air, air conditioning and electricity (Columns G, H, I, J, K and L). However, closer inspection revealed that many of these categories are either start-up costs (such as compressed air) or in other ways completely unrelated to throughput (such as steam). Only electricity appeared to vary in response to levels of throughput. Thus, coefficients were calculated for 'electricity' rather than 'energy'.
- 'Dyeing' (Column F) is a significant cost item seemingly unrelated to throughput. Thus, it may be better to incorporate dye cost directly into any mill profitability modelling/analysis rather than estimate dyeing costs through cost coefficients. Production managers at most of the mills interviewed indicated that dye costs could be directly attributed to individual orders or products.

Based on these considerations, costs were grouped into the following categories:

- Electricity (Column L in Table 2.1)
- Labour (Column O)
- Variable costs that exclude overheads and dyeing costs (D to E and G to O)
- Total workshop costs (Column B to O).

2.2.5 Product types

A sample from the production/technical information for individual products is shown in Table 2.2. The products had to be grouped into product types based on the approach outlined in Section 2.2.1. Provided information on the physical attributes is available, any number of categorisations or groupings of products is possible. However, because observations are normally on a monthly basis (see Section 2.2.3), the limited number of observations will restrict the degrees of freedom and impose a limit on the number of independent variable (product types) that can be included in the regression analysis.

Aggregating the throughputs associated with each category from the individual order data was performed using a Visual Basic macro in Microsoft Excel, the code of which is shown in Appendix 2.1. In the case of the analysis of weaving cost coefficients, four groupings of order types were considered. These groupings are highlighted below along with the group chosen as the standardised product (namely with a cost coefficient equal to one).

- A 2-type grouping of: purewool (100% wool) *{standardised product}*; and blended wool (<100% wool).
- A 3-type grouping of: purewool (100% wool) *{standardised product}*; medium blended wool (70% to 99% wool); and low blended wool (<70% wool).
- A 4-type (density) grouping of: purewool-high density (>299) *{standardised product}*; purewool-low density (<300); medium blend wool (70% to 99% wool); and low-blend wool (<70% wool).
- A 4-type (count) grouping of: purewool-high count (>70 count) *{standardised product}*; purewool-low count (<70 count); medium blend wool (70 to 90% wool) and low blend wool (<70% wool).

The restricted groupings outlined above reflected the limited number (48) of monthly observations. However, the hierarchical grouping allowed for a systematic analysis of the key product attributes.

In order for the regression coefficients—on which the cost coefficients are based—to be significant, there must be sufficient observations as well as enough variation in the independent values. The proportion of each product group in total output did vary markedly by month over the four-year period under investigation.

2.2.6 An alternative statistical approach

Instead of grouping the orders or batches into particular product groups, as outlined in Sections 2.2.1 and 2.2.5, an alternative statistical approach involved regressing unit monthly costs against the monthly averages for certain product attributes such as the average wool percentage, count or fabric weight for all orders in the particular month.[3] The advantage of this approach over that outlined in Section 2.2.1 is that it can directly indicate the contribution of a marginal change in variables such as wool percentage or wool count on unit processing costs. In this manner, the estimates can be compared with the

[3] A feature of these attributes is that they are continuous (or approximate continuous) variables rather than being discrete variables.

Table 2.1 Processing cost sheet*

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
Month	Fittings	Machine equipment	Machine materials	Fitting processing cost	Dye	Soft water	Hard water	Steam	Compressed air	Air conditioning	Electricity	Repairs	Discharge water	Wages	Throughput (m)
Jan	9 220	18 571	1 466	936	19 748	0	1 095	26 591	3 066	2 065	40 180	0	0	112 384	97 644
Feb	9 494	13 038	4 177	1 407	17 848	0	1 095	30 658	3 066	3 717	46 341	0	0	112 859	105 588
Mar	14 359	29 964	2 770	2 429	19 910	0	1 095	23 807	3 066	2 478	61 646	0	0	123 978	147 686
Apr	17 815	33 383	2 142	1 447	29 247	0	1 095	0	3 066	2 478	65 585	0	0	128 568	164 948
May	15 984	38 845	2 939	1 309	29 264	0	1 095	0	3 066	3 717	93 860	0	0	146 663	214 823
Jun	7 304	52 000	8 039	845	10 121	0	1 095	0	3 066	3 717	88 008	0	0	140 682	211 949
Jul	18 872	30 498	7 630	2 027	22 281	0	1 095	0	3 066	3 717	72 900	0	0	139 287	190 146
Aug	20 839	30 060	4 351	533	16 581	0	1 095	0	3 066	3 717	72 337	0	0	127 227	159 208
Sep	13 349	53 377	2 584	–13	25 447	0	1 095	0	3 066	2 684	79 090	0	0	150 180	208 268
Oct	17 508	31 441	4 576	1 219	23 125	0	1 095	0	3 066	2 313	105 198	0	0	151 343	212 336
Nov	13 719	25 906	9 861	1 330	9 313	0	1 095	31 910	3 066	2 478	104 410	0	0	141 640	177 852
Dec	17 398	40 505	4 624	1 062	24 054	0	1 095	13 765	3 066	1 858	89 218	0	0	143 463	205 586
Total	175 862	397 590	55 159	14 530	246 939	0	13 139	126 731	36 790	34 935	918 776	0	0	1 618 273	2 096 033

* The values reported in this table have been modified from that obtained and used in the analysis so as to preserve the confidentiality of the original data.

Table 2.2 Sample from technical information for individual products

Weaving											
Month	Product label*	Weight (g/m)	Yarn lot no.	Throughput (m)	Production losses (%)	Raw materials					Weft density (fibres/ 10 cm)
						Count (S)	Count	Place of production	Blend (%)	Wool%	
1	32 694D	275	68s/2×44s/1	3557.9	96.1	66+2.5DP	66	W	W70/P30	70	238
1	27 134D	210	82s/2×48s/1	328.9	96.8	90	90	W	W100	100	340

* The product labels have been modified to preserve the confidentiality of the original data.

way that some mills advertise service processing fees. Consider Table 2.3, which shows how two large mills (Mingfeng and Sunshine) advertise service-processing fees in the Nanjing Wool Market Weekly. As shown, the processing fees for both wool tops and yarn are based on count (yarn as a simple linear cost related to count; tops in a more non-linear or discrete relationship with count).

The main disadvantage with this approach is that by averaging over all orders in the month, the average values for variables such as wool percentage or wool count may not relate well to average costs if non-linearities exist. That is, if costs of processing pure wool are considerably higher than blended wool, the costs associated with an average wool percentage of 90% will not be the same as that of an equivalent quantity of 100% wool and 80% wool. The second problem is that averaging reduces the variation across months, which may limit the ability of the regression to identify statistically significant relationships. Results of the alternative approach are reported in Section 2.3.2 for weaving cost coefficients, and in Section 2.4.2 for spinning cost coefficients.

Table 2.3 Table of service processing fees from Nanjing Wool Market Weekly (April 2002)

A. Mingfeng Group

Yarn manufacture (spinning) fee — Rmb260/count/tonne

Combing Fee

Count	Fee (Rmb/tonne)
58/60s	3500
64s	3600
66s	3700
70s	3900
80s	4200
90s	6000
100s	7000

B. Sunshine Group

Spinning fee — ordinary Rmb300/count/tonne
— mercerised Rmb350/count/tonne

Combing Fee

Count	Fee (Rmb/tonne)
60s	3300
64s	3400
66s	3600
70s	3800
80s	4200

2.3 Analysis of cost coefficients for weaving

2.3.1 Product type approach

Results of some of the regressions conducted are reported in a series of appendix tables. Specifically the 2-categorisation regressions are listed in Appendix 2.2, the 3-categorisation in Appendix 2.3, the 4-categorisation (density) regressions in Appendix 2.4, and the 4-categorisation (count) regressions in Appendix 2.5. The throughput coefficients were all significant at a 5% level of probability except for some of the coefficients associated with electricity weaving costs, especially for the ‘pure wool, low density’ and ‘pure wool, low cost’ categories. The cost coefficients derived from these latter insignificant throughput coefficients varied markedly from the other cost coefficients and should be ignored. Although the limited number of observations restricted the number of independent variables, and hence product types, the regressions still explained a large proportion (50% to 80%) of the variation in the dependent variable (unit weaving costs).

The results are summarized in Table 2.4. The 2-type regressions reveal that blended wool fabrics have cost coefficients around 20% larger than pure wool fabrics. However, the results for the 3-type regressions reveal more about this differential. Specifically, low blend wool fabrics (<70% wool) are responsible for the higher cost coefficients for blended wool fabrics as they have cost coefficients more than 30% higher than pure wool products. Indeed the medium blend wool products (70% to 99% wool) have lower total cost and labour cost coefficients than pure wool products.

The 4-type regressions (both count and density) confirm this pattern of much higher cost coefficients among the low wool blend products, and low coefficients for the medium blend wool products. Among the pure wool products, low count wool (less than 70 count) has much lower cost coefficients than the high count wool. However, low density wool appears to have a higher labour cost coefficient compared with high density wool.

2.3.2 Alternative statistical approach

The results of the regression analysis using the alternative statistical approach outlined in Section 2.2.6 appear in Appendix 2.6. The only significant regression coefficients to emerge from the analysis were for weft count, and these results are summarised in Table 2.5. The results indicate that a 1 unit increase in warp count decreases total costs by Rmb0.11 per metre, variable costs by Rmb0.08 per metre and labour costs by Rmb0.06 per metre.

Given the variation between models and the lack of statistically significant coefficients, the approach was not considered useful in determining cost coefficients for weaving, at least for this limited and particular set of data.

2.4 Analysis of cost coefficients for spinning

An analysis was also conducted on spinning workshop cost and production data to determine cost coefficients for various yarns.

2.4.1 Product type approach

The yarn products were classified into four types based on yarn count. Specifically these were:

- Products with yarn counts less than 60
- Products with yarn counts between 60 and 70 *{standardised product}*
- Products with yarn counts between 70 and 80
- Products with count greater than 80.

The second category (products with yarn counts between 60 and 70) was chosen as the standardised product on which to calculate the normalised cost coefficients. The coefficients were determined using the approach outlined in Section 2.2.1, and are listed in Table 2.6. All of the regression coefficients on which the cost coefficients were based were highly significant, while the overall regression equations explained a high proportion of unit spinning costs (around 90%), as shown in the regressions in Appendix 2.7.

The results suggest that the lower count wools (less than 60 count) had total and variable cost coefficients similar to the standard product (counts between 60 and 70), although the coefficients for specific cost categories such as labour and electricity were even lower. Conversely, the cost coefficients for products with higher yarn counts of between 70 and 80 were 20% higher or more than the standard product for all cost categories except electricity. The highest count yarns (count greater than 80) exhibited cost coefficients similar to that for the 70 to 80 count yarns and around 30% higher than the 60 to 70 count yarn with the exception of electricity costs.

Table 2.4 Cost coefficients* for weaving

		Total cost	Variable	Labour	Electricity
2-type	Blended wool	1.17	1.27	1.14	1.23
3-type	Medium blend (70–99%)	0.96	1.02	0.87	1.26
	Low blend (<70%)	1.31	1.38	1.36	1.23
4-type	Pure wool, low count (<70)	0.85	0.79	0.88	0.37†
	Medium blend	0.90	0.90	0.82	0.94
	Low blend	1.24	1.24	1.30	0.98
4-type	Pure wool, low density (<300)	1.07	0.94	1.16	0.27†
	Medium blend	0.98	1.00	0.90	0.93
	Low blend	1.34	1.35	1.43	0.89

* Assuming pure-wool product has a normalised standard coefficient of 1. In the 4-type-density classification, the standard product is pure wool and high density, while in 4-type-count classification, the standard product is pure wool and high count.

† The regression coefficients on which these cost coefficients were based were not significant. All other regression coefficients were highly significant.

Table 2.5 Selected coefficients for weaving — alternative approach*

	Total cost	Variable cost	Labour cost
Weft count	–0.109 (0.047)	–0.081 (0.039)	–0.059 (0.024)

* Figures in brackets are standard errors.

Table 2.6 Cost coefficients* for spinning

	Total cost	Variable	Labour	Electricity
Less than 60 yarn count	0.98	0.92	0.84	0.83
From 70 to 80 yarn count	1.25	1.20	1.43	0.96
Over 80 yarn count	1.33	1.21	1.36	1.02

* Assuming that 60 to 70 yarn count product has a normalized standard coefficient of 1.

2.4.2 Alternative approach

As mentioned previously, the alternative approach was of particular interest for spinning costs as mills often advertise service-spinning fees on a per count basis. The approach, as outlined in Section 2.2.6, involved regressing monthly observations of unit spinning cost by category (such as unit spinning electricity cost) against the average monthly values for certain product attributes (such as wool percentage, warp count, yield). The regressions in the analysis represent the impact of a one unit change in the product attribute on unit spinning costs.

As the mill advertisements for service fees focus on count, a more limited set of regressions was undertaken, regressing unit spinning costs against the average values for yarn count and wool percentage. These regressions appear in Appendix 2.8. The relevant regression coefficients are shown in Table 2.7. They reveal that a 1 unit increase in yarn count increases unit spinning total costs by Rmb0.091/kg, unit spinning variable costs by Rmb0.065/kg and unit spinning labour costs by Rmb0.057/kg. Thus the analysis suggests spinning costs of Rmb91/tonne/count compared with Rmb260/tonne/count in the advertised service fees. A comparison of the results with the advertised service fees is difficult, not least because of the limited number of observations, the large proportion of unexplained variation in the regressions and the fact that the service fees undoubtedly capture other elements not included in the costs such as profit margins and taxes. If they do prove robust with more observations, however, it suggests that the mills may be basing their service charges on average (count) costs where a base plus marginal (count) cost may provide a more accurate price. Ultimately mills should price and charge according to a range of factors, which is the purpose of the larger mill modelling exercise outlined in Chapter 5.

2.5 Extensions

The analysis reported illustrates only the nature of the approaches being considered and the many issues that need to be addressed in conducting the analyses. This initial analysis will be extended to cover the other mills and workshops. The preliminary analysis also highlights the crucial importance of additional observations.

Table 2.7 Coefficients for yarn count from spinning regressions[1]

	Count	
Total cost	0.091[2]	(0.034)
Variable cost	–0.065	(0.030)
Labour cost	–0.057	(0.021)

[1] Figures in brackets are standard errors.

[2] Can be interpreted as a 1 unit increase in yarn count increases total unit spinning costs by Rmb0.09.

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3. Estimating yield coefficients

WOOL processing is a demanding mechanical process that places great pressure on wool fibres at various stages of transformation. This results in breakages and short fibres, damaged fibres, neps, etc, that cannot be used in subsequent stages. Although the losses are highly pronounced in processes such as initial combing, yield losses occur at all stages of processing. These yield losses can have a large impact on wool textile mill profitability.

Yield losses can be defined as the amount of fibre inputs that are not reflected in the output. They are normally expressed as 'yield'. For instance, a spinning yield of 97% indicates that the weight of the yarn is only 97% of the weight of the tops used to produce the yarn, and that 3% of the tops will end up as spinning 'wastes'.

One of the major tasks for mill production managers is to try to minimise these production losses (maximise the yields at each stage) through equipment settings and other procedures. However, yields can also vary according to the type of wool input being processed and output being produced. Thus, the yield losses associated with particular product orders or types will be crucial to mill profitability. From the mill and workshop managers' perspective, the problem can be expressed as how to determine yields to apply to particular product orders or types.

3.1 Approaches to estimating yield coefficients

As was the case with estimating cost coefficients, there are two main approaches to estimating yield coefficients, namely an engineering/synthetic approach and a statistical approach.

The synthetic approach involves a detailed understanding of the processing/manufacturing system and the technical input-output coefficients. This results in a set of problems when trying to use the synthetic approach to estimate yield coefficients. The necessary technical information requires very controlled experiments. For the many processes and complicated nature of wool processing this requires numerous experiments. In practice, various organisations conduct experiments on key processes under selective conditions (i.e. specific to particular mills or more precisely specific machines, settings and operational procedures). The advantage of precise estimation of the yields can be outweighed by the fact that different mills, equipment and settings can have a very different set of technical relationships and yields. Given the great heterogeneity in equipment and levels of management in Chinese wool mills, this makes the task of using synthetically determined yield coefficients difficult to apply to particular mills.

The statistical approach to estimating yield coefficients, however, is much more straightforward than the statistical approach to estimating cost coefficients. The major problem in using the statistical approach to estimate cost coefficients is that the unit of observation is months because costs were not available on a product basis but on a monthly workshop basis. With yield coefficients, however, mills are able to track the physical amounts associated with any particular product or order. That is, they know how much wool input went into a particular product or order and also how much of the product was produced. Thus the unit of observation is the individual product or order. Because there are hundreds of products produced in any year, there is no problem in having sufficient observations to arrive at robust and statistically significant regression coefficients. (Compare this with the case for cost coefficients where even if four years' data is available, there will still only be 48 observations available for the analysis). The statistical approach has the advantage of being mill specific and so allowing for technical inefficiencies, specific mill operating practices, technologies and equipment to be reflected in the yields. Being able to determine costs to specific mills is a major benefit given the heterogeneity of wool textile mills.

In order to be used in the broader mill modelling exercise, product yield coefficients were required for different workshops/departments/stages of processing such as topmaking, spinning, weaving and finishing. Physical data on individual products was obtained from each department of the mill. Apart from the yield (expressed either directly or implicitly derived by comparing the amount of product with the amount of fibre input), the physical data also contained technical information on the attributes of the particular product.

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The stages in the analysis were as follows:

Stage	Process/method
1	Collect physical/technical information on products by workshop (such as weaving, spinning).
2	If yields are not directly stated in this information, derive by dividing the weight/amount of product by the weight/amount of fibre input used to produce that product.
3	Regress yields against the physical/technical characteristics (such as count, strength, wool percentage, density) of particular products.
4	Depending on the functional form of the regression function, the regression coefficients on the physical characteristics will indicate the marginal contribution to yields of an extra unit of the attribute.
5	Yields for particular products can then be determined by using these yield regressions (that is, substitute specific information on product characteristics).

3.2 Data for analysis

The statistical analysis requires disaggregated yield technical information by product for different processing stages or department/workshops of the mill (such as weaving, finishing, spinning). To illustrate the approach, detailed workshop data were collected for the finishing, weaving, spinning and recombing/dyeing workshops of the mill.

An example of the type of information available for the different products is highlighted in Table 3.1. The data contains: order information such as product number, timing and throughput (Columns A, B and E); technical information on the order such as fabric weight, count of yarn inputs, wool percentage and weft density (Columns C, D, K and L); as well as yields (Column F). Altogether, more than 1700 observations were provided in electronic form, although the data required some manipulation prior to analysis.

As the yield coefficients may be influenced by changing equipment, technology or operating practices, data was collected over the four-year period 2000 to 2003. The statistical and regression analysis were then performed for each of the four years separately and the results reported later in this paper are also presented along year lines to highlight any variations.

3.3 Processing yields

The mean yields by year for finishing, weaving, spinning and recombing/dyeing along with their standard deviations are shown in Table 3.2. The histograms of their distribution along with other summary statistics over the entire period are shown in Figs 3.1–3.4.

The numbers in Table 3.2 reveal that the mean yields are very similar across years. Spinning yields are a little higher and recombing/dyeing yields lower in 2000 compared with 2001 and 2002, while finishing yields are lower in 2003. Furthermore, the variation among products within years as reflected by the standard deviation is also relatively small. Indeed the histograms for all products across all years (Figs 3.1–3.4) indicate that the yields are clustered around a relatively small band of yields.

Despite the relatively small variation in yields, because wool inputs are a large proportion of overall costs, even a slight change in yields can impact markedly on profitability. Thus, it is worth identifying whether product attributes influence these yields.

3.4 Finishing yields

Results from the regression analysis of weaving yields based on the approach outlined in Section 3.1 are highlighted in Table 3.3. Unlike the analysis

Table 3.1 Sample from technical information for individual products in the weaving workshop

A	B	C	D	E	F	G	H	I	J	K	L
						Raw materials					Weft density (fibres/ 10cm)
Month	Product label[1]	Weight (g/m)	Yarn lot no.	Throughput (m)	Yield (%)	Count (S)	Count	Place of production	Blend (%)	Wool %	
January	32598D	275	68s/2×44s/1	3557.9	96.1	66+2.5DP	66	W	W70/P30	70	238
January	24876D	210	82s/2×48s/1	328.9	96.8	90	90	W	W100	100	340

[1] The product labels listed are hypothetical to preserve the confidentiality of the original data.

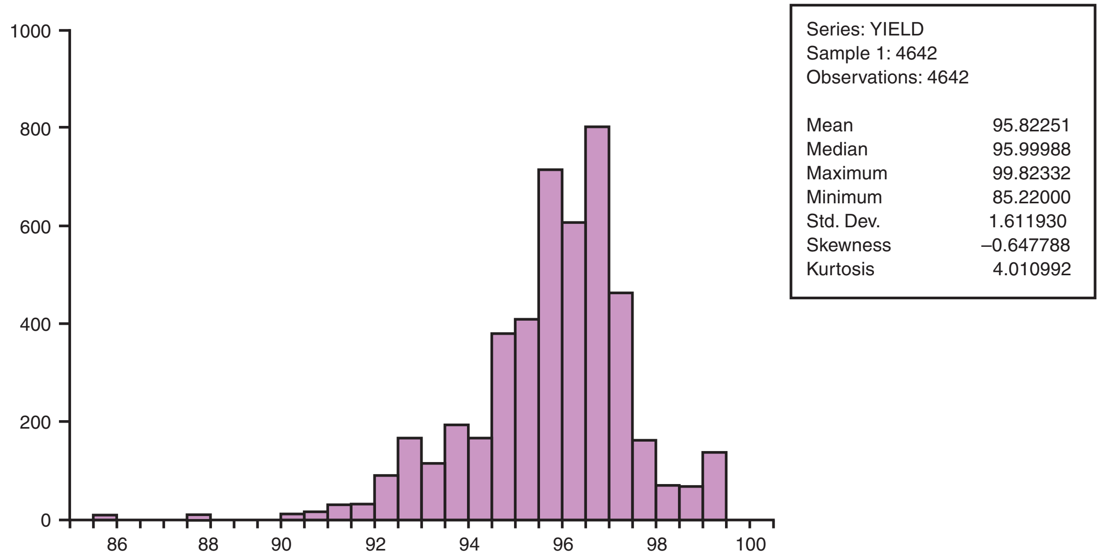

Figure 3.1 Finishing yield distribution 2000–03

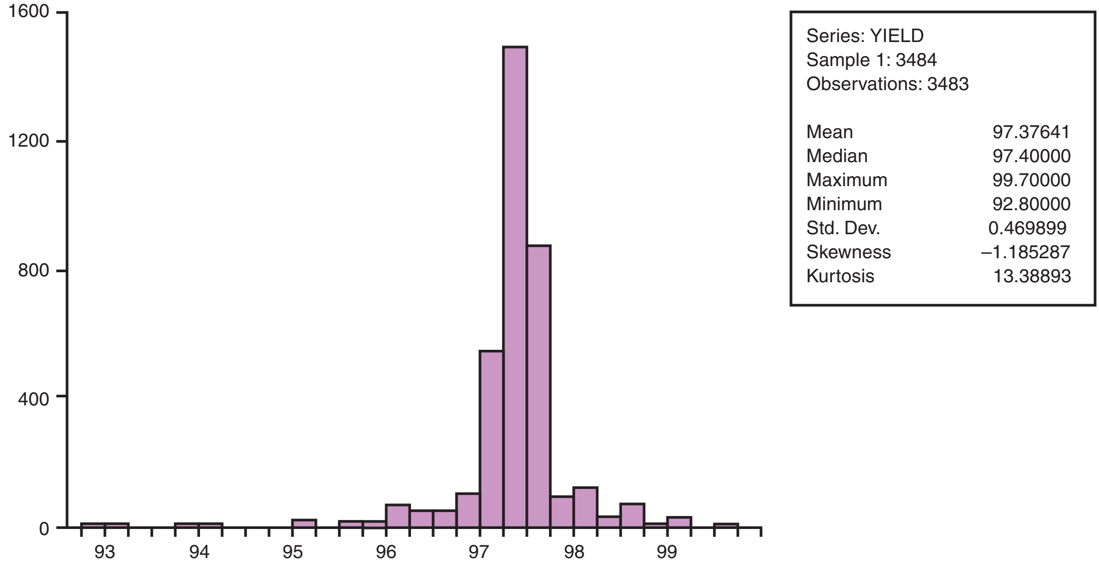

Figure 3.2 Weaving yield distribution 2000–03

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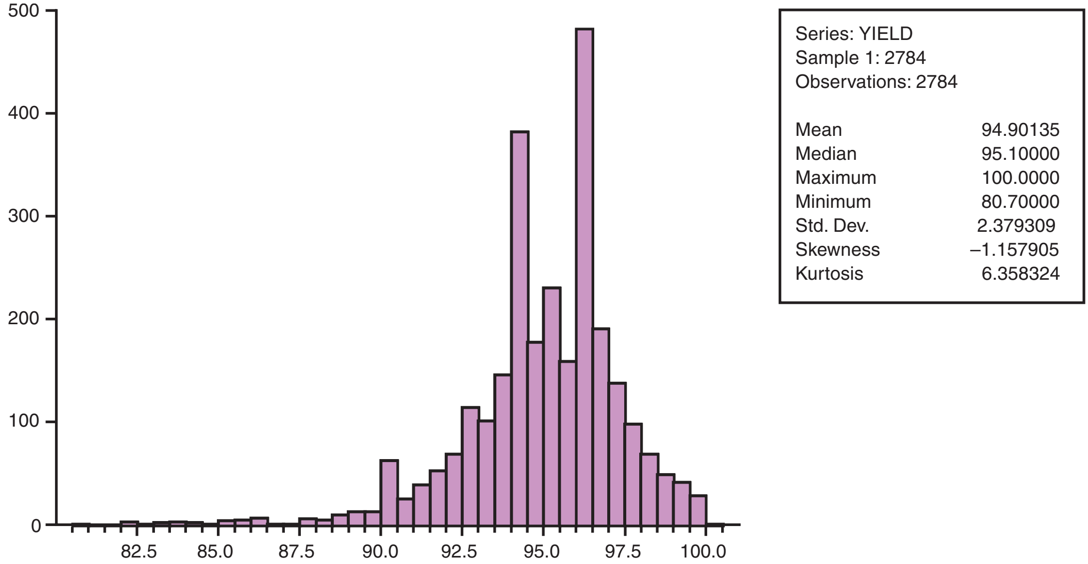

Figure 3.3 Spinning yield distribution 2000–03

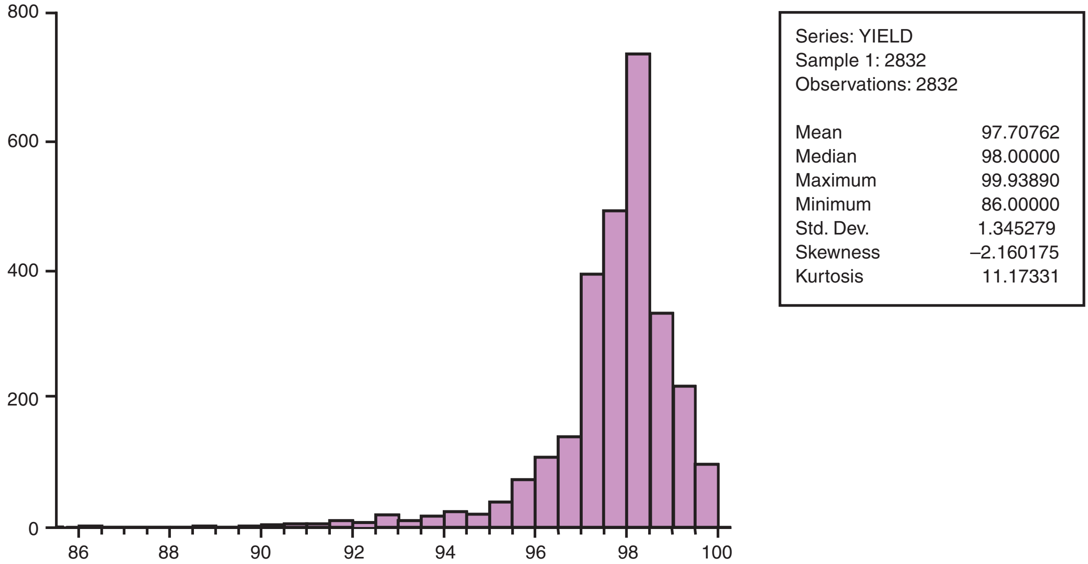

Figure 3.4 Recombing/dyeing yield coefficients 2000–03

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Table 3.2 Summary of processing yields at different stages

	2000	2001	2002	2003
Finishing				
• Mean	96.65	96.59	96.43	95.41
• Standard deviation	1.97	0.56	1.39	1.56
Weaving				
• Mean	97.42	97.32	97.24	97.43
• Standard deviation	0.42	0.56	0.81	0.14
Spinning				
• Mean	95.66	94.58	94.50	94.98
• Standard deviation	1.76	1.86	2.14	2.68
Recombing/dyeing				
• Mean	97.10	97.77	97.76	97.90
• Standard deviation	2.26	0.80	0.93	1.13

described below for weaving, spinning and recombing yields, the analysis of finishing yields was based on data from 2003 where products were able to be categorised into different types. Both the weight of the fabric as well as a dummy variable for 'Type 3' (wool-linen blend fabrics, uniforms and flannels) were significant although the overall regression explained less than 2% of the variation in yields.

3.5 Weaving yields

The analysis for weaving yields was based on 3483 observations over the 2000 to 2003 period. The independent variables included in the analysis were warp count, weft count, weft density, weight of the fabric, wool percentage, order throughput (amount) and a dummy variable for fabrics in which both the warp and weft yarn were either both single or both double. The analysis was conducted for each of the four years separately.

Table 3.3 Finishing yield regressions — 2003

	2003
R-squared	0.016
F statistic	3.66
Variables[1]	
• Type 3 fabric (wool-linen blends, uniforms, flannels)	0.3555 (0.1789)
• Weight	–0.0029 (0.001)

[1] Only significant variables (at a 10% level or less) have been listed.

Table 3.4 lists the overall regression coefficients and F statistics as well as the regression coefficients and standard errors on the variables that are significant at a 10% level of significance. The feature of Table 3.4 is that while significant regression equations were obtained in all but 2002, the included variables accounted for less than 4% of the variation in weaving yields. None of the included variables were significant in the regression on 2002 data, while only warp count and weight were significant for 2001, and wool percentage for 2003. In 2000, weft count and the dummy for the same warp and weft count were also significant along with warp count and weight. However, the magnitude of the regression coefficients on variables such as warp count and weight was very small, while they also had an ambiguous direction of impact between 2000 and 2001. Thus the regression coefficients were unable to reveal any useful relationships on weaving yields.

3.6 Spinning yields

The analysis for spinning yield was based on 2784 observations in the 2000 to 2003 period. Apart from the wool percentage of the top, other variables in the analysis included whether the yarn was single or double, as well as the twist of the yarn ('ZSZ' twist or otherwise). In addition, the count and twist of both the warp and weft yarns associated with the particular product order were included.

The results of the regression analysis appear in Table 3.5. Relative to the analysis of weaving yields and recombing/dyeing yields, the analysis of spinning yields yielded more significant and consistent results. Nonetheless, the R-squared statistic indicated that less than six per cent of the variation in spinning

Table 3.4 Weaving yield regressions

	2000	2001	2002	2003
R-squared	0.0377	0.0263	0.0053	0.0037
F statistic	3.52	1.92	0.644[2]	1.10
Variables[1]				
• Same warp weft count	–0.117 (0.06)			
• Warp count	–0.0047 (0.002)	0.0083 (0.0035)		
• Weft count	0.0045 (0.0016)			
• Weight	–0.0011 (0.0004)	0.0017 (0.0008)		
• Wool percentage				–0.00042 (0.0002)

[1] Only significant variables (at a 10% level or less) have been listed.
[2] Not significant.

Table 3.5 Spinning yield regressions

	2000	2001	2002	2003
R-squared	0.0573	0.2217	0.051	0.019
F statistic	3.12	13.17	4.31	3.99
Variables[1]				
• Throughput	0.0001 (0.00004)		0.00016 (0.00005)	0.00043 (0.00014)
• Wool percentage	–0.0083 (0.005)	–0.0128 (0.005)	–0.022 (0.0057)	
• Warp count		–0.073 (0.014)	–0.0275 (0.013)	
• Weft count	–0.0157 (0.008)			
• Warp twist				0.015 (0.008)

[1] Only significant variables (at a 10% level or less) have been listed.

yields could be explained by the included variables using the 2000, 2002 and 2003 data, although more than 22% of the variation was explained using data from 2001. An increase in yarn count decreased spinning yields by between 0.016 to 0.073 percentage points. Similarly, a 1 percentage point increase in wool percentage decreased spinning yield by between 0.008 and 0.02 percentage points. (Scatter diagrams of yield against warp count and wool percentage are shown in Figures 3.5 and 3.6.) The other variable that was significant was throughput or size of the product order which showed a positive relationship between the size of the order and spinning yield. That is, a one tonne increase in order size increased spinning yield by around 0.1 percentage points.

3.7 Recombing/dyeing yields

Top dyeing is normally associated with a recombing of the raw top to produce a finished top. The recombing will result in a yield loss associated with the noil and neps being removed from the finished top, although the process of dyeing can itself add weight to the finished top.

The analysis was undertaken based on data from 2000 to 2002 with a total of 1864 observations. The yield loss associated with the top-dyeing and associated recombing of around 2% to 3% is relatively minor compared with the much greater yield loss associated with initial combing. Figure 3.4 reveals yields varying from 95% to 100%, but clustered around the 97% to 98% yield.

Regression analyses of recombing/dyeing yields were conducted for each of the four years with the results summarised in Table 3.6. The analysis for 2000 revealed a significant overall regression equation but the independent variables still only explained 3% of the variation in top-dyeing yields. Furthermore, none of the specific top attributes were significant in the regression, with only throughput or order size showing a significant but very modest relationship with recombing/dyeing yield. Figure 3.7 provides a scatter diagram of yield against throughput. It reveals that very small orders can exhibit significant variation in yields that may be related to the yield losses associated with starting up a run for a new order or product batch.

3.8 Discussion and implications

Despite the large number of observations, the inclusion of key product attributes, and the variation in the sample for these key attributes, the statistical analysis of yields did not identify the key factors that influence yields. Even in the case where significant yield coefficients were identified — namely for warp count and wool percentage in spinning yields — the regression could only explain a small proportion of the variation in spinning yields.

There are various reasons why significant yield coefficients may not have emerged from the regression analyses. Foremost may be that the variation in yields was relatively modest with both top dyeing and weaving yields clustered around 97.5% yield and with standard deviations of less than 0.8% in

Table 3.6 Recombing/dyeing yield regressions

	2000	2001	2002	2003
R-squared	0.0311	0.0085	0.0012	0.0093
F statistic	5.18	1.34	0.28	3.71
Variables[1]				
• Throughput	0.000085			0.000024
	(0.00002)			(0.000015)
• Wool percentage				–0.0061
				(0.002)

[1] Only significant variables (at a 10% level or less) have been listed.

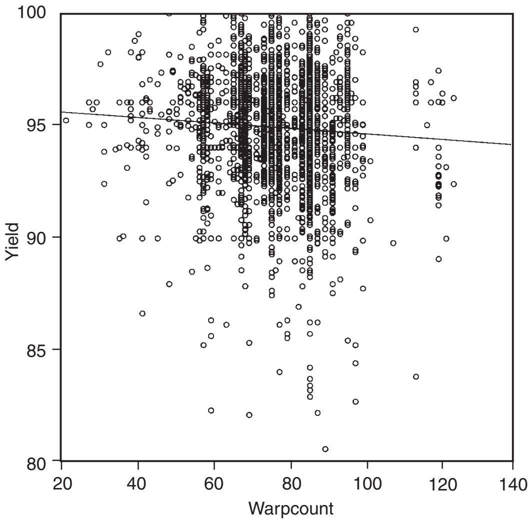

Figure 3.5 Scatter diagram of spinning yield against yarn count

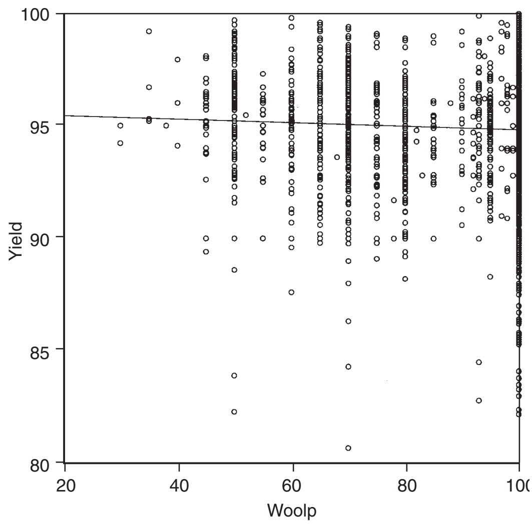

Figure 3.6 Scatter diagram of spinning yield against wool percentage

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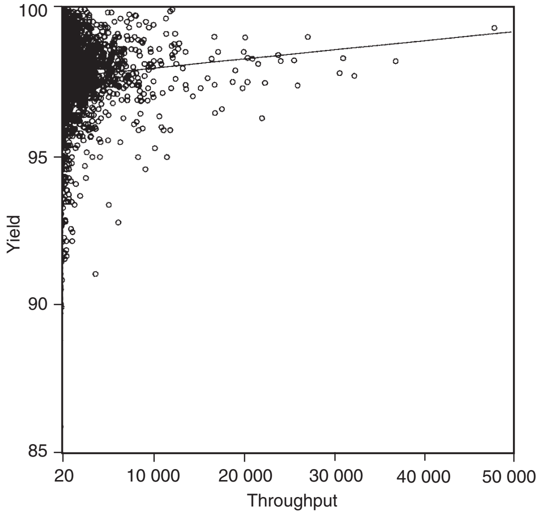

Figure 3.7 Scatter diagram of recombing/dyeing yield against order throughput

most instances. The more significant relationships to emerge from the analysis of spinning yields — which had a greater variation — lend support to this notion. However, of more importance is that there may have been factors other than those for which data was available that influence yields. In particular, equipment settings such as comb width and spindle tension could be expected to influence yields. Note, however, that there could also be an expectation that these other variables could be related to the actual variables included in the analysis.

In respect of the mill modelling described in Chapter 5, the mean and standard deviations of the yields are crucial in the profitability and risk analysis, and so these descriptive statistics will be a useful adjunct to the model. However, the analysis did not identify specific characteristics of the product that influence yields (except for spinning) and so incorporation in the model for yields to vary with specified characteristics of the product order may be of little relevance. It may be that mill practices do impact on yields and that a deeper understanding of these relationships and their association with particular product orders is needed.

4. Analysing prices

IN ANY investigation of the viability and profitability of Chinese wool textile mills, an analysis of wool and wool textile prices figures prominently, either indirectly (in terms of aiding understanding of the incentives of different participants in wool production, marketing and processing) or directly (such as providing endogenous inputs into the mill model). Figure provides an overview of the various price analyses conducted as part of ACIAR project ASEM/1998/060 in terms of data, methods, outputs and use in the various sub-projects. Specifically, the analysis of wool and wool textile prices centred on three main areas of investigation, namely: (a) the determination of the implicit price or value of the attributes that make up wool and wool textile products; (b) analysis of the extent of price integration across wool markets in space, time and form dimensions; and (c) identification of the extent of seasonal and between-year variation in wool and wool textile prices as well as the general trend in wool prices relative to other fibre and livestock product prices. Each of these foci is investigated in turn.

4.1 Analysis of the value of wool attributes

Wool and wool textile products are not homogeneous but comprise many different attributes each of which take on different levels. As user requirements and preferences depend on these attributes, rather than the composite product per se, an analysis of the implicit price or value of these attributes — or the contribution of each of the attributes to the price of the composite product — is worthwhile. Exchange and allocation mechanisms in the past have involved inaccurate pricing systems where many of the implicit prices of the attributes did not reflect their true values. However, as pressure grows for more accurate prices, both in procuring wool inputs and pricing wool textile outputs, and where increasingly tight profit margins depend crucially on these fibre input/textile product choices, an understanding of these premiums and discounts associated with particular input and product characteristics becomes paramount.

The implicit prices associated with product attributes can be obtained through direct questioning or contingent valuation type approaches. However, with some well-defined wool markets, the values have also been obtained indirectly using existing market data through hedonic price type analysis. (See, for example, Angel et al., 1990 for an analysis of Australian greasy wool prices.) The latter approach — hedonic price analysis — is adopted here.

Because of the range of wool types to be considered in the price analysis, as highlighted in Figure 4.1, market data from a variety of sources was used. The three main sources were:

- *Analysis of Australian greasy wool prices*. Hedonic price analyses of Australian greasy wool prices are widespread. Indeed, as reported in Section 4.1.1, they have become institutionalised in the price reporting of some agencies. They provide useful and accurate information about the value or implicit price of attributes in Australian greasy wool. Thus, they would be of most use to users purchasing direct from the auctions. However, most greasy wool is purchased in China after passing through a series of intermediaries. Use of these implicit prices presumes that the Law of One Price holds, namely that the prices of Australian greasy wool sold in China follow that of the equivalent wool at the Australian auction. Furthermore, as many mills purchase tops rather than greasy wool, the value of the top attributes rather than the greasy wool attributes will be of importance.
- *Analysis of Nanjing Wool Market prices*. The Nanjing Wool Market provides what could best be described as a 'bulletin board' of offer and bid prices in both print and electronic form. The offer and bid prices do not reflect negotiated prices and so may bias the implicit prices. Conversely, they do reflect prices in China after the 'barrier' of market traders and other intermediaries.
- *Analysis of Chinese auction prices*. The Chinese wool auctions are extremely limited as outlined in Brown (1997). However, they provide a more detailed specification of the greasy wool for sale than the Nanjing Wool Market information and involve the wool more closely aligned with Chinese worsted mills. Compared with the analysis of the Australian auction prices, they overcome the issue of the value of the attributes within China. The limited number of observations and 'contrived' nature of the auctions limits their usefulness. However, they may be of value in revealing information about the better Chinese wool used in the Chinese worsted wool processing systems.

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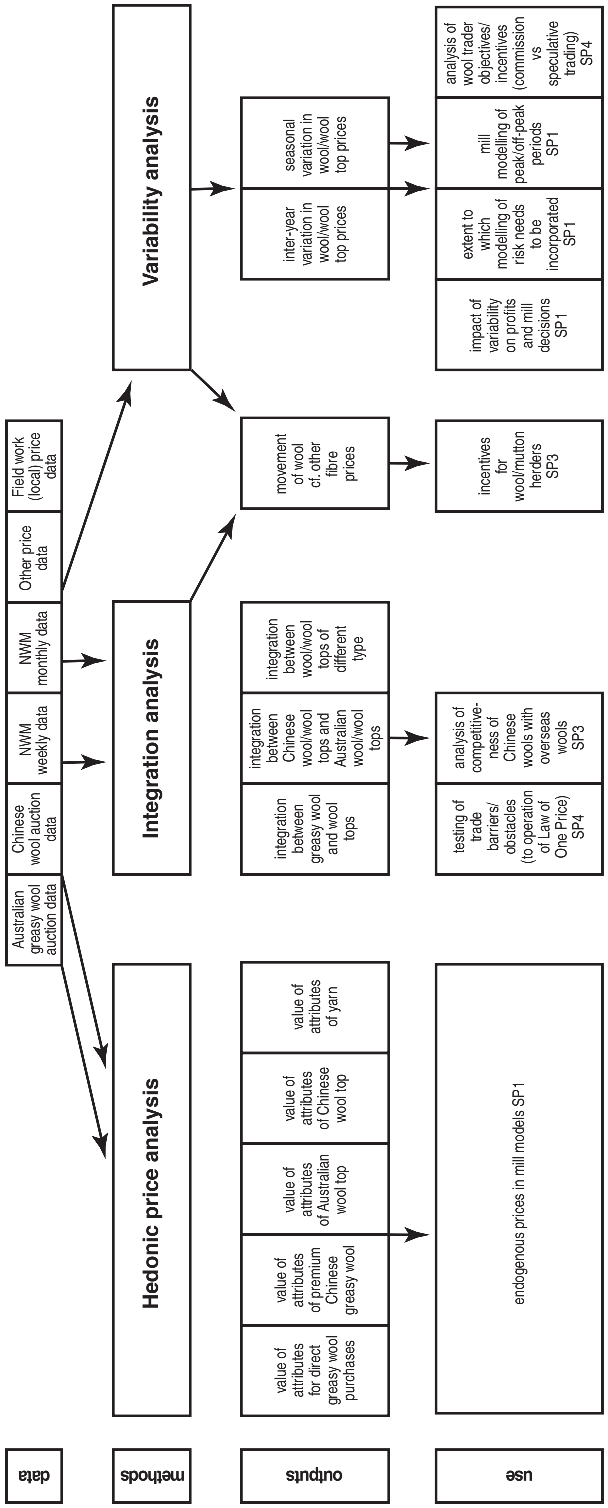

Figure 4.1 Overview of price analysis

4.1.1 Analysis of Australian greasy wool auction prices

Various hedonic price analyses have been conducted on Australian wool auction prices. One of the first of these studies reported in academic journals was that of Angel et al. (1990). These studies and this approach have subsequently become the basis for Australian wool industry organisations reporting of 'price determining wool characteristics'. One of the recent AWEX figures quoted the following proportions of wool price made up by the following attributes: micron 53%; length 12%; strength 11%; vegetable matter 8%; colour 2%, style 1%; staple measurement 4%; and other marketing factors (region, sale by separation, re-handling and lot size) 9%.

4.1.2 Analysis of Nanjing Wool Market prices

Another source of information to conduct a hedonic price analysis was the Nanjing Wool Market. Through a membership network of major wool textile mills and wool traders in China, Nanjing Wool Market publishes offer and bid prices on a weekly basis. Although these prices are not the actual prices negotiated, they may reflect the pattern in these prices. The prices are for various types of wool including greasy wool, wool pieces, noil, scoured wool, carbonised wool, wool top, and chemical fibres and include both domestic wool as well as wool imported from Australia, New Zealand and other countries. The column headings for the records that appear in the Nanjing Wool Market publication list the indicators of micron, length, strength and vegetable matter. However, very few entries record values for attributes such as strength.

In terms of recording only a few select attributes and in not representing the actual prices for each lot, the Nanjing Wool Market information has severe limitations for a hedonic price analysis. Nonetheless, it may provide some information about the value of some key attributes such as fineness and staple length. One advantage of the data over some other potential sources of data is that it represents the prices within China and so avoids any assumptions that need to be made about traders' margins etc.

To conduct the analysis, some records were taken from the Nanjing Wool Market publications spanning at least one week in each month from January 1998 to October 2001. Although a number of product types were included in these records, the main categories recorded and subsequently investigated were Australian wool top combed in China (3743 useable records)[4] and Chinese wool top (3988 useable records).

In addition, Nanjing Wool Market information on yarns was collected covering the period January 2001 to June 2002.

Australian wool top combed in China

Many wool textile mills in China do not import greasy wool but instead purchase wool tops made from Australian wool but processed by specialised top makers within China. Thus, an analysis of these prices provides information on wool top inputs of relevance to a broad group of spinning mills within China.

Descriptive statistics for the 3743 records are shown in Table 4.1. The sample included a wide range of tops with average micron varying from 16.3 to 37 micron and average staple length from 58 mm to 93 mm. The sample for analysis was narrowed down to tops with an average fibre diameter of less than 25 micron and average staple length greater than 60 mm. Furthermore, observations initially were constrained to the 'representative' calendar year of 2000 with the robustness of the estimates examined through the subsequent investigation of implicit prices in other years. This reduced the sample to 965 observations but provided a more focused sample of the wool top used by Chinese worsted spinning mills. Descriptive statistics for this sample of 965 records appear in Table 4.2.

A variety of functional forms were tested on the data but it was a reciprocal transformation on the key fineness (micron) variable that provided the best fit. The results of the regression appear in Appendix

[4] Because of transcription errors, some of these records were not able to be used in the subsequent analysis.

Table 4.1 Descriptive statistics for Australian wool top combed in China

	Price (Rmb/kg)	Micron	Length (mm)	Amount (tonne)	Count
Mean	49.37	23.90	93.06	30.86	61.79
Median	45.00	23.10	93.00	30.00	62.00
Maximum	195.00	37.00	131.00	150.00	100.00
Minimum	28.00	16.30	58.00	1.00	47.00
Std. Dev.	18.78	3.45	11.18	18.26	6.58
Skewness	4.32	0.81	–0.14	1.32	1.14
Kurtosis	26.36	3.02	3.47	6.65	7.81

Table 4.1 and are summarised in Table 4.3. They reveal that a 1-micron change in fineness has a much larger effect than a 1 cm increase in average staple length. There also appear to be some economies of size in order size, with larger lots trading at a discount.

The analysis was repeated for the years 2001 and 1999 and the implicit prices are shown along with those for the year 2000 in Table 4.3. They reveal that the implicit price for micron varied from around Rmb7.7 per kg to Rmb12.3. The implicit price for staple length was lower but still showed some variation depending on the year (Rmb1.97 to 4.59). The implicit price associated with order size varied from Rmb0.02 to 0.1 for a 1-tonne increase in order size.

Chinese wool top

Although most Chinese worsted mills prefer to use wool tops made from Australian wool, they also use tops made from domestic wool, especially when Australian wool prices are high. Thus, an analysis of the implicit price of key attributes in Chinese wool tops is also needed.

Altogether there were 3988 records in the sample relating to Chinese wool top. However, in the first instance, the sample was narrowed to fine wool top of less than 25 micron in average fineness and average staple length greater than 6 cm for the year 2000. Descriptive statistics for this sample are shown in Table 4.4. A hedonic price analysis of this sample was conducted and the results appear in Appendix Table 4.2. Based on a preliminary investigation of the data, the relationship between price and micron was specified as a reciprocal transformation. The analysis was repeated for the years 1998, 1999 and 2001 and the implicit prices for the key attributes are shown in Table 4.5.

The implicit prices were similar across the years. A one-micron decrease in fineness resulted in prices rising between Rmb2.8 and 4.1 per kg. A 1 cm increase in average staple length increased top prices per kg by between Rmb2.09 and 2.74. Order size was not significant in year 2000 and was relatively modest (Rmb0.02 to 0.07 per kg increase in top price for a 1 tonne increase in order size) in other years.

Table 4.2 Descriptive statistics for Australian wool top combed in China (Year 2000, micron < 25, length > 6 cm)

	Price (Rmb/kg)	Micron	Length (mm)	Amount (tonne)	Count
Mean	54.56	22.02	89.23	32.20	64.78
Median	45.50	22.40	91.00	30.00	64.00
Maximum	195.00	24.90	103.00	150.00	90.00
Minimum	31.50	17.50	62.00	2.00	59.00
Std. Dev.	26.14	1.66	7.42	19.16	5.93
Skewness	3.38	–0.83	–1.44	1.35	2.58
Kurtosis	14.82	3.10	5.67	7.02	10.77

Table 4.3 Implicit prices for Australian wool combed in China

(Change in) attribute	2001	2000	1999
Micron (1 micron decrease)[1]	7.66	12.3	9.93
Length (1 cm increase)	1.97	3.1	4.59
Amount (1 tonne decrease in size of order)	0.02	0.1	0.05

[1] Evaluated at mean micron level for sample for these reciprocal transformations.

Table 4.4 Descriptive statistics for Chinese wool top combed in China sample (Year 2000, micron < 25, length > 6 cm)

	Price (Rmb/kg)	Micron	Length (mm)	Amount (tonne)	Count
Mean	38.7711	21.93778	75.96564	64.17685	15.5618
Median	38.30	21.90	76.00	64.00	12.00
Maximum	110.00	24.85	98.00	80.00	80.00
Minimum	25.00	18.60	61.00	57.00	1.00
Std. Dev.	5.829396	1.104295	5.689903	2.317754	10.34022
Skewness	2.747712	0.427354	0.100414	–0.140448	1.631573
Kurtosis	25.76332	2.973404	3.673869	5.596098	6.802656

The results can be compared with those for Australian wool top combed in China presented above and summarised in Table 4.3. A comparison of Tables 4.2 and 4.4 reveals that the mean Chinese wool top prices are almost 30% lower than the corresponding Australian wool top prices or around Rmb16 per kg lower. This is also reflected in the implicit prices. The implicit price of a 1-unit increase in micron is around Rmb10 per kg for the Australian top compared with around Rmb3.5 for the Chinese top, or almost three times less. The implicit prices for an increase in staple length are also higher for the Australian top but not by the same magnitude as for micron. The order size effect is consistently modest in both cases.

In both the Australian wool top and Chinese wool top cases, the implicit prices varied according to the year and were typically higher in years with higher average prices. Thus any implicit prices used in subsequent modelling should also be linked or related to a base price.

Yarn

An analysis was also conducted on a separate set of Nanjing Wool Market data concerning yarn prices. A sample of 804 records covered each month in the period January 2001 to June 2002. However, information on yarn attributes in the Nanjing Wool Market data is confined to yarn type, wool percentage, yarn count and order size.

The descriptive statistics for this sample appear in Table 4.6. As the sample includes yarns of very different types and wool percentages, enormous variation arises in the price of these yarns. Thus, more relevant samples relate to particular types of yarn. Two broad groups were sampled, namely Australian pure wool yarn (287 of the 804 records) and Australian blended wool yarns (400 records).

The descriptive statistics for the pure wool yarn are shown in Table 4.7. In comparison with Table 4.6, the pure wool yarn prices are more than Rmb15 per kg higher than the average for the entire sample. Results from the regression of pure wool prices

Table 4.5 Implicit prices for Chinese wool top

(Change in) attribute	2001	2000	1999	1998
Micron (1 micron decrease)[1]	3.58	4.10	2.79	3.44
Length (1 cm increase)	2.09	2.36	2.74	2.46
Amount (1 ton decrease in size of order)	0.03	NS[2]	0.02	0.07

[1] Evaluated at mean micron level in these reciprocal transformation models.
[2] Not significant.

Table 4.6 Descriptive statistics for yarn sample

	Chinese	Count	Knotless	Price (Rmb/tonne)	Quantity (tonne)	Wool percentage (%)
Mean	0.05	40.81	0.19	43135.57	12.33	61.18
Median	0.00	48.00	0.00	36750.00	10.00	50.00
Maximum	1.00	66.00	1.00	83000.00	200.00	100.00
Minimum	0.00	18.00	0.00	7000.00	0.70	5.00
Std. Dev.	0.21	10.41	0.39	14458.99	11.43	35.13
Skewness	4.27	–0.43	1.58	0.50	6.96	0.10
Kurtosis	19.21	2.16	3.49	2.25	96.88	1.17

Table 4.7 Descriptive statistics for Australian pure wool yarn sample

	Price (Rmb/kg)	Count	Knotless	Quantity (tonne)
Mean	58.33	39.28	0.53	11.23
Median	58.00	38.00	1.00	10.00
Maximum	83.00	64.00	1.00	50.00
Minimum	21.00	20.00	0.00	0.90
Std. Dev.	9.20	10.62	0.50	8.22
Skewness	0.00	–0.18	–0.13	1.91
Kurtosis	4.02	2.18	1.02	8.59

against yarn count, order size and a dummy variable for 2002 prices (wool and wool yarn prices rose dramatically from January 2002) appear in Table 4.8. The results reveal that yarn price increases by around Rmb0.57 for each unit increase in yarn count.

Most yarn, however, is blended yarn and Table 4.9 presents the descriptive statistics for this category. The lower prices of chemical fibres push the price of the yarns down with the blended yarns Rmb25 per kg lower than the pure wool yarns. The difference depends on the wool percentage and other attributes of the yarn. Results from a regression of price on these attributes in Table 4.10 reveals that a one percentage point increase in wool percentage raises yarn price by around Rmb0.19 per kg, while a one unit increase in count raises yarn price by around Rmb0.24 per kg.

Table 4.8 Regression of pure wool yarn

Dependent Variable:	price
Method:	least squares
Date:	05/12/03 Time: 19:05
Sample (Adjusted):	1287 if Micron < 25 and Length > 60 and D2000 = 1
Included observations:	287 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	35.77528	1.668876	21.43676	0.00
Code	0.567956	0.037253	15.24581	0.00
Quantity	–0.12279	0.049451	–2.48315	0.0136
Y2002_1	5.906252	0.914985	6.455023	0.00

R-squared	0.484917	Mean dependent var.	58.33031
Adjusted R-squared	0.479457	S.D. dependent var.	9.196211
S.E. of regression	6.634946	Akaike info criterion	6.636417
Sum squared resid.	12458.37	Schwarz criterion	6.687421
Log likelihood	–948.326	F-statistic	88.80863
Durbin-Watson stat.	1.551653	Prob(F-statistic)	0.00

Table 4.9 Descriptive statistics for blended yarn sample

	Price (Rmb/kg)	Count	Quantity (tonne)	Wool percentage (%)
Mean	33.29	41.24	12.56	33.14
Median	32.00	48.00	10.00	30.00
Maximum	77.00	66.00	80.00	100.00
Minimum	18.00	20.00	0.70	10.00
Std. Dev.	6.39	10.15	9.68	15.29
Skewness	1.80	–0.53	3.33	2.05
Kurtosis	10.36	2.20	18.79	9.11

Table 4.10 Regression on blended yarn

Dependent Variable:	price
Method:	least squares
Date:	05/12/03 Time: 20:10
Sample (Adjusted):	1400
Included observations:	400

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17.40780	1.343184	12.96011	0.0
Count	0.237711	0.026257	9.053363	0.0
Woolper	0.193864	0.017415	11.13191	0.0
Y2002_1	–0.737853	0.530103	–1.391906	0.1647

R-squared	0.321674	Mean dependent var	33.294500
Adjusted R-squared	0.316535	S.D. dependent var	6.390400
S.E. of regression	5.283069	Akaike info criterion	6.176841
Sum squared resid.	11052.68	Schwarz criterion	6.216756
Log likelihood	–1231.368	F-statistic	62.596580
Durbin-Watson stat.	1.316063	Prob(F-statistic)	0.0

4.1.3 Analysis of Chinese wool auction prices

There are several advantages and major disadvantages in using Chinese wool auction information to determine attribute value. Their main advantage is that compared with most domestic wool traded in China the attributes for auctioned wool are specified in detail and accurately measured.

On the negative side, they represent only a very small proportion of the overall Chinese wool clip. However, in that this auctioned wool is likely to be used by Chinese worsted mills, it may yield useful information for these mills. Another problem is that the auction wool is relatively similar across lots. That is, there is a small variation in fineness, staple length and yield creating a statistical problem in determining the value of incremental changes in these attributes. Furthermore, the auctions are relatively small with few lots again creating problems from a statistical perspective.

A more fundamental problem, however, is that prices are not freely determined. Actual prices are strongly related to the reserve prices set. Indeed, for the 2002 auction results presented below, the price variables are the reserve prices. Thus, the implicit prices derived for the attributes to a large extent reflect the values applied by the officials setting the reserve prices.

A previous detailed analysis of two Chinese wool auctions held in 1991 appears in Longworth and Brown (1995, Chapter 8) and Brown (1997). These results are compared below with an analysis of the only wool auction held in China in 2002. The descriptive statistics for the auction held in 2002 appear in Table 4.11, while details of the regression appear in Appendix Table 4.3. A comparison of the value or implicit price of particular attributes from the two separate analyses appears in Table 4.12.

The results reveal that a 1 cm increase in staple length increased prices by around Rmb1.5 per kg clean both for the 2002 and 1991 auctions. A one micron decrease in wool fineness increased prices in the 2002 auctions by around Rmb1.1 per kg clean, which was higher than that observed for the 1991 auctions. Compared with the 1991 auctions, clean yield was significant for the 2002 auctions. However, the premium was relatively modest with only an Rmb0.8 per kg clean premium for a 10% percentage point higher clean yield. Lot size was not significant in either the 1991 or 2002 auctions. A comparison of the values must also account for the fact that mean wool prices were considerably higher in 2002 (Rmb41.53 per kg clean) than they were in 1991 (Rmb28.86 per kg clean).

Table 4.11 Descriptive statistics for variables in analysis of 2002 Chinese wool auctions

	Bales	Length (mm)	Micron	Price (Rmb/kg clean)	Yield
Mean	64.92	75.67	20.69	41.54	58.14
Median	42.00	74.00	20.78	42.00	58.30
Maximum	295.00	101.00	21.89	44.00	68.10
Minimum	4.00	54.00	19.41	34.50	42.61
Standard Deviation	63.65	8.38	0.64	1.93	5.58
Skewness	2.00	0.62	–0.21	–1.80	–0.54
Kurtosis	6.91	5.13	1.97	7.40	3.34

Table 4.12 Implicit prices from analysis of 1991 and 2002 wool auctions in China

(Change in) attribute	Implicit price (Rmb)	
	2002 auction	1991 auctions[1]
Mean price (Rmb per kg clean wool equivalent)	41.53	28.86
Decrease of 1 micron	1.1	0.4[2]
Increase of 1 cm in staple length	1.5	1.4
Increase of 10% in clean yield	0.8	Not applicable[3]

[1] Average of values from the two auctions analysed.

[2] Statistically significant results for micron were obtained for only one of the auctions in 1991 because of the narrow range of fineness across the wool lots.

[3] No statistically significant results for clean yield arose from the analysis of the 1991 auctions partly because prices are specified on a clean wool equivalent basis and partly because most of the variation in yields occurs across regions (XUAR and IMAR) and each of the 1991 auctions comprised wool from a separate region.

Ultimately the severe limitations of the analysis using auction data restrict its value in revealing the attribute values. Thus they should be considered only in the light of other information presented in Section 4.1.

4.1.4 Summary of implicit price analysis

Although there is a great volume of information recorded on various wool prices, much of this is in a form not suited to sophisticated implicit price analysis. Thus the analyses are limited in the extent to which they can reveal the implicit prices or values of attributes, and require careful interpretation given the reliability and nature of the information. Thus, they form only part of the mosaic of determining the implicit price for various wool and wool product attributes.

In terms of linking with mill decision-making models, the results may go some way to endogenising prices rather than rely on externally specified prices. However, to ensure the analysis covers those attributes relevant to the mill, the mill may need to assemble its own data regarding product attributes and prices.

4.2 Market integration

Another area of concern to wool textile mills and to the efficiency of the industry as a whole is the extent to which the markets for different wool types are integrated. That is, do prices for a particular type of wool or wool top follow the pattern of another type of wool? A preliminary analysis of this integration was conducted drawing upon data from the Nanjing Wool Market. From the weekly data that Nanjing Wool Market collects from its network of associate members (used in the analysis in Section 4.1.2) as well as from external/overseas sources, Nanjing Wool Market collates average prices for selected wool types as well as constructs various price indices. These are again published on a weekly basis in their magazine. Nanjing Wool Market also collates longer time series of these prices on a monthly basis, which are again made available to registered users on their website. The integration analysis was conducted using both the monthly and weekly data.

4.2.1 Monthly price analysis

The monthly price analysis was carried out on monthly data extending from April 1996 to December 2002. To examine some of the integration relationships, seven price series were used. These included the four main types of wool tops used in China, namely Australian wool combed in China with a count of 60, 64, 66 and 70. Two types of wool tops made from Chinese wool (namely 64- and 66-count) were also included to examine the extent to which the prices for wool tops made from Chinese wool are related to that from Australian wool. Finally, greasy Australian wool of 66-count was included to determine whether wool top of 66-count followed a similar pattern of prices as that of its corresponding greasy wool input.

The graph of the monthly prices in Figure 4.2 suggests that the price series broadly follow the same pattern. The series that appears to move most independently from the other series is the 70-count Australian wool top. The series appear to converge towards the latter part of the period.

The correlation matrix in Table 4.13 confirms the apparent strong correlation between the price series. The particularly strongly correlations are highlighted by the shaded cells in Table 4.13. These include the correlations between the 66-count Australian greasy wool and the Australian 60, 64 and 66 wool tops. Moreover, there is a strong correlation between the Australian 60, 64 and 66 wool top prices. A similar strong correlation exists between the 60- and 64-count Chinese wool tops. However, none of the other price series (66-count Australian greasy wool, 60- to 66-count Australian wool tops and 64- to 66-count Chinese wool tops) are strongly correlated with the 70-count Australian wool tops.

The pairwise Granger causality tests are shown in Appendix 4 and reveal several relationships. The 66-count Australian wool tops influence both 64- and 70-count Australian wool tops. The 64- and 60-count Australian wool tops are closely related, with both appearing to influence each other. The 66-count Chinese wool top influences 64-count Chinese wool top but not vice versa. However, the pairwise causality tests throw up some less obvious or explainable results such as 64-count Chinese top influencing 64-count Australian top, 64-count Australian top influencing 70-count Australian top, and 66-count Australian greasy wool influencing 70-count Australian wool top.

Some of the correlations observed in Table 4.13 may be spurious and require further co-integration analysis to examine the extent of co-integration of the price series.

4.2.2 Weekly analysis

The price series used in Section 4.2.1 were monthly average prices. However, the process of integration may occur on less than a monthly unit basis. Under these circumstances, using average monthly prices may mask integration among the various price series. To examine the extent of integration in a shorter time frame, weekly data for the period January 2000 to June 2002 were used. The analysis also enabled other price series to be examined as part of the co-integration analysis, including Uruguay greasy wool and Australian 80-count wool top.

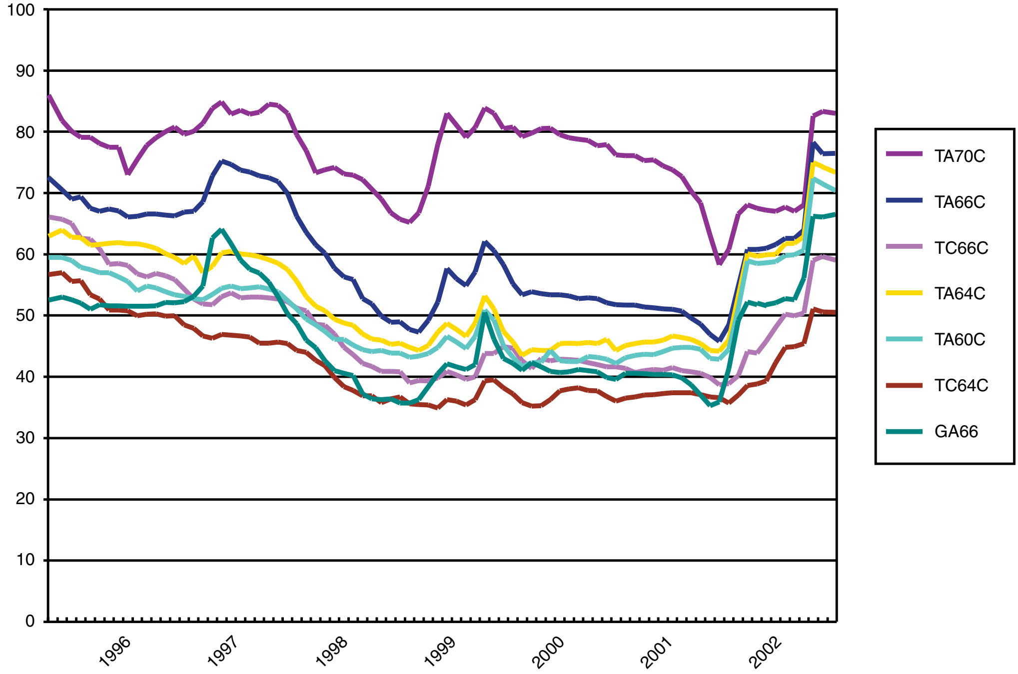

Figure 4.2 Monthly prices (Rmb per kg) for selected wool types

Notes: Prices are in Rmb per kg. The mnemonics for the wool types are first letter represents type ('G' for greasy wool and 'T' for tops). The next letter represents source of wool ('A' for Australian wool and 'C' for Chinese wool). The next two numbers represent the count of the greasy wool or wool top. The final letter for the wool tops indicates whether they have been combed ('A' for Australia and 'C' for China). Thus, 'TA66C' is wool top made from Australian 66s wool that has been combed in China.

Table 4.13 Correlation matrix for monthly prices (1996–2002) for selected wool types

	GA66	TA66C	TA60C	TA64C	TA70C	TC64C	TC66C
GA66	1.000	0.945	0.897	0.927	0.495	0.779	0.780
TA66C	0.945	1.000	0.849	0.911	0.622	0.863	0.877
TA60C	0.897	0.849	1.000	0.981	0.255	0.803	0.803
TA64C	0.927	0.911	0.981	1.000	0.340	0.876	0.873
TA70C	0.495	0.622	0.255	0.340	1.000	0.435	0.482
TC64C	0.779	0.863	0.803	0.876	0.435	1.000	0.990
TC66C	0.780	0.877	0.803	0.873	0.482	0.990	1.000

Notes: Prices are in Rmb per kg. The mnemonics for the wool types are first letter represents type ('G' for greasy wool and 'T' for tops). The next letter represents source of wool ('A' for Australian wool and 'C' for Chinese wool). The next two numbers represent the count of the greasy wool or wool top. The final letter for the wool tops indicates whether they have been combed ('A' for Australia and 'C' for China). Thus, 'TA66C' is wool top made from Australian 66s wool that has been combed in China.

Descriptive statistics for the weekly sample appear in Table 4.14. A graph of these weekly price series appears in Figure 4.3. They highlight the similarity in prices between Australian 66-count wool combed in either Australia or China. They also indicate the much lower prices for tops made from Chinese wool, as well as the higher prices for 70- and 80-count Australian wool tops.

The correlation matrix for these weekly price series appears in Table 4.15. The shaded cells in this matrix highlight the strong correlation between 60- and 64-count Australian wool top and between 70- and 80-count Australian wool top, as well as the strong correlation between 66-count Australian wool top combed in either Australia or China.

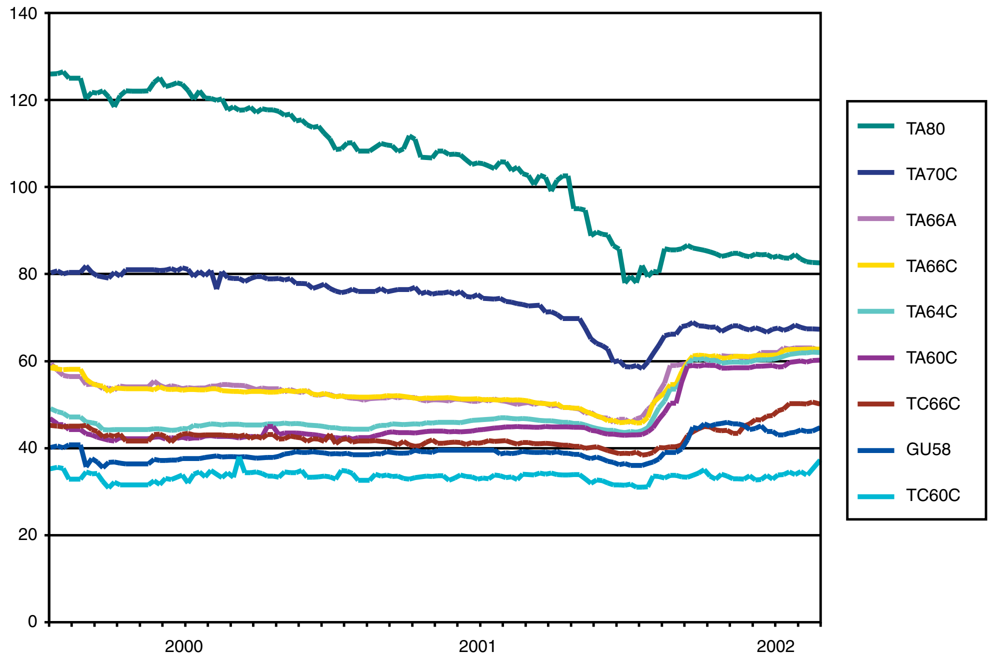

Figure 4.3 Weekly prices (Rmb per kg) for selected wool types — January 2000 to August 2002

Notes: Prices are in Rmb per kg. The mnemonics for the wool types are first letter represents type ('G' for greasy wool and 'T' for tops). The next letter represents source of wool ('A' for Australian wool and 'C' for Chinese wool). The next two numbers represent the count of the greasy wool or wool top. The final letter for the wool tops indicates whether they have been combed ('A' for Australia and 'C' for China). Thus, 'TA66C' is wool top made from Australian 66s wool that has been combed in China.

Table 4.14 Descriptive statistics for weekly price series of selected wool types

	GU58	TA60C	TA64C	TA66A	TA66C	TA70C	TA80C	TC60C	TC66C
Mean	39.39	46.44	48.36	53.88	53.73	73.60	104.50	33.41	42.59
Median	38.85	43.77	45.64	53.47	52.96	75.70	107.51	33.50	41.92
Maximum	45.96	60.21	62.07	63.00	62.79	81.92	126.50	38.01	50.62
Minimum	35.50	41.65	43.61	45.89	45.73	58.25	77.92	30.83	38.41
Std. Dev.	2.63	6.08	5.92	4.40	4.37	6.27	15.10	1.08	2.55
Skewness	1.14	1.49	1.48	0.59	0.62	–0.65	–0.30	0.19	1.35
Kurtosis	3.39	3.45	3.43	2.57	2.73	2.42	1.67	4.82	5.02

Notes: Prices are in Rmb per kg. The mnemonics for the wool types are first letter represents type ('G' for greasy wool and 'T' for tops). The next letter represents source of wool ('A' for Australian wool and 'C' for Chinese wool). The next two numbers represent the count of the greasy wool or wool top. The final letter for the wool tops indicates whether they have been combed ('A' for Australia and 'C' for China). Thus, 'TA66C' is wool top made from Australian 66s wool that has been combed in China.

However, compared to the monthly correlations shown in Table 4.13, analysis of the weekly prices highlighted markedly the lack of correlation between Chinese and Australian wool tops and between the lower and higher count tops (although this was not borne out by the pairwise Granger causality tests reported in Appendix Table 4.4). Indeed the 70- and 80-count tops showed negative correlation with many of the other price series. Compared with the monthly data, the weekly data was over a period where the prices exhibited much greater fluctuation, and where the prices for the higher count tops began to converge with those from lower count tops.

Building economic decision-making capabilities of Chinese wool textile mills
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ACIAR Technical Reports No. 60
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Table 4.15 Correlation matrix for weekly prices (1996–2002) for selected wool types

	GU58	TA60C	TA64C	TA66A	TA66C	TA70C	TA80C	TC60C	TC66C
GU58	1.000	0.910	0.916	0.773	0.817	–0.330	–0.526	0.327	0.668
TA60C	0.910	1.000	0.994	0.818	0.822	–0.516	–0.694	0.212	0.684
TA64C	0.916	0.994	1.000	0.861	0.861	–0.457	–0.646	0.258	0.725
TA66A	0.773	0.818	0.861	1.000	0.980	–0.014	–0.215	0.327	0.853
TA66C	0.817	0.822	0.861	0.980	1.000	0.016	–0.191	0.341	0.882
TA70C	–0.330	–0.516	–0.457	–0.014	0.016	1.000	0.956	0.198	0.073
TA80C	–0.526	–0.694	–0.646	–0.215	–0.191	0.956	1.000	0.090	–0.096
TC60C	0.327	0.212	0.258	0.327	0.341	0.198	0.090	1.000	0.390
TC66C	0.668	0.684	0.725	0.853	0.882	0.073	–0.096	0.390	1.000

Notes: Prices are in Rmb per kg. The mnemonics for the wool types are first letter represents type ('G' for greasy wool and 'T' for tops). The next letter represents source of wool ('A' for Australian wool and 'C' for Chinese wool). The next two numbers represent the count of the greasy wool or wool top. The final letter for the wool tops indicates whether they have been combed ('A' for Australia and 'C' for China). Thus, 'TA66C' is wool top made from Australian 66s wool that has been combed in China.

The pairwise Granger causality tests in Appendix Table 4.4 provide further evidence of these correlations but also throw up some unexpected causal relationships. Once again a full co-integration analysis is required to further understand some of the relationships.

4.2.3 Summary and implications of the integration analysis

The findings of the integration analysis are mixed, partly because of the data used for the analysis and partly because of the complexity of the co-integrating relationships. They also represent only a cursory initial investigation of these price movements, and so a full analysis of the magnitude and nature of these co-integration relationships is warranted. Nevertheless, some consistent findings to emerge from the analysis are:

- Tops made from Australian wool exhibit little co-integration with tops made from Chinese wool.
- Australian wool tops combed in China appear highly co-integrated with the equivalent Australian wool tops combed in Australia.
- Higher count Australian wool tops (70s and above) are not highly co-integrated with tops of lower count.
- Some co-integration, and so substitution, would seem possible between Australian 60s, 64s and 66-count wool tops.
- Greasy wool prices appear related to some wool top prices although in a less than perfect manner.

4.3 Price variation and relativities

To investigate seasonal and inter-year variation in wool prices, the Nanjing Wool Market monthly data for selected wool types for the period 1996 to 2000 were used. In the first instance, seasonal indices were calculated based on the method of additive differences from a moving average. The seasonal indices were then used to seasonally adjusted price series from which average prices in each year for the various wool tops and greasy wool were calculated. The within-year variation, as reflected in the seasonal indices, was then compared with the variation between years.

The seasonal indices for the various wool types are listed in Table 4.16 while the average prices in each year based on the seasonally adjusted series for the same wool types appear in Table 4.17. A comparison of the two tables highlights that the inter-year variation overwhelms the variation within years. That is, variation within years is around Rmb2 per kg compared with a variation between years of just under Rmb20 per kg. The gap between the variation within years and across years is even more pronounced for the Chinese wool.

Prices do not vary much across months and do not vary in a consistent manner across all the wool types. Thus prices for Australian wools tend to be higher in the June to August period while Chinese wools tend to have higher prices in the November to February period. Australian prices tend to be at their lowest in January and April to May, while Chinese prices are also lowest in the April to May period. However, the pattern is not consistent across all wool types and is much lower than the variation experienced across years.

Another notable feature from a comparison of the two tables is that while the premium top considered in the tables, namely Australian 70s tops combed in China, exhibits a much lower inter-year variation in prices than the other types of wool tops, it has the highest variation within years. This may have implications for mills moving from generic to premium tops in that while yearly prices may fluctuate less than for other wool tops, the timing of purchase within year may be more critical than it is for the more generic tops.

Table 4.16 Seasonal (monthly) indices for selected greasy wool and top prices

	GA66	TA60C	TA64C	TA66C	TA70C	TC64C	TC66C
January	–0.88	–0.81	–0.84	–0.58	–0.92	0.07	0.35
February	–0.14	–0.21	–0.03	–0.33	–0.05	0.31	0.44
March	–0.11	0.42	0.20	–0.31	–0.82	–0.17	–0.02
April	–0.32	0.02	–0.06	–0.83	–1.06	–0.32	–0.43
May	–0.24	–0.32	–0.82	–0.78	–0.73	–0.65	–0.37
June	0.80	0.01	–0.51	0.10	0.66	–0.25	–0.07
July	1.37	0.37	0.54	1.39	2.03	–0.01	0.18
August	0.87	0.33	0.48	0.91	1.21	0.01	0.09
September	0.18	–0.14	0.15	0.25	–0.05	0.07	–0.13
October	–0.75	–0.11	0.22	0.04	0.23	0.02	–0.34
November	0.12	0.44	0.54	0.49	0.06	0.52	0.20
December	–0.90	0.01	0.13	–0.36	–0.55	0.39	0.09
minimum	–0.90	–0.81	–0.84	–0.83	–1.06	–0.65	–0.43
maximum	1.37	0.44	0.54	1.39	2.03	0.52	0.44
variation	2.27	1.25	1.38	2.22	3.08	1.17	0.86

Notes: Seasonal indices based on additive differences from moving average. The values are in Rmb per kg. The mnemonics for the wool types are first letter represents type ('G' for greasy wool and 'T' for tops). The next letter represents source of wool ('A' for Australian wool and 'C' for Chinese wool). The next two numbers represent the count of the greasy wool or wool top. The final letter for the wool tops indicates whether they have been combed ('A' for Australia and 'C' for China). Thus, 'TA66C' is wool top made from Australian 66s wool that has been combed in China.

Table 4.17 Yearly variation in selected greasy wool and top prices

	GA66	TA60C	TA64C	TA66C	TA70C	TC64C	TC66C
1996	51.85	56.88	62.09	67.95	78.71	52.85	60.66
1997	56.83	53.87	59.36	70.86	82.30	47.27	53.48
1998	43.09	47.75	51.07	59.83	75.23	40.80	47.02
1999	40.55	45.56	47.37	53.56	75.37	36.44	40.63
2000	41.29	43.00	45.25	53.75	79.41	37.02	42.79
2001	39.09	43.74	45.44	50.13	71.68	36.93	40.79
2002	54.89	60.46	62.35	63.99	70.74	43.25	49.13
minimum	39.09	43.00	45.25	50.13	70.74	36.44	40.63
maximum	56.83	60.46	62.35	70.86	82.30	52.85	60.66
variation	17.74	17.46	17.10	20.73	11.56	16.41	20.03

Notes: Values are average yearly prices in Rmb/kg following seasonal adjustment using the seasonal indices listed in Table 3.1. The mnemonics for the wool types are first letter represents type ('G' for greasy wool and 'T' for tops). The next letter represents source of wool ('A' for Australian wool and 'C' for Chinese wool). The next two numbers represent the count of the greasy wool or wool top. The final letter for the wool tops indicates whether they have been combed ('A' for Australia and 'C' for China). Thus, 'TA66C' is wool top made from Australian 66s wool that has been combed in China.

The analysis above suggests that mills may not have to worry too much about there being peak and off-peak (price) periods within years for purchasing top inputs. Thus, if economies of throughput are large they may offset any price variations across months. Of course, choice of month to purchase will also be determined by the timing of customer orders and by relative product prices. Furthermore, wool top prices may not necessarily reflect availabilities.

Significant variation can occur in wool prices across years. This implies the need for mill management to have decision-making aids to assist them in an environment of fluctuating prices across years. It also means that any mill model needs to be able to accommodate price variability and indeed be structured around being able to provide information for different prices.

5. CAEGWOOL[5]

CAEGWOOL is a *Visual Basic* model embedded in a Microsoft *Excel* spreadsheet that is designed to assist decision making by mill managers and technicians in their managerial accounting and economic evaluation of a wide variety of mill decisions. The model has been developed by researchers from the China Agricultural Economics Group at the University of Queensland and the Chinese Research Centre for Rural Economy in close association with mill managers and technicians from various Chinese wool textile mills and organisations.

This chapter presents a manual to running the model while Appendix 5 provides a simple tutorial example. The manual is divided into three parts. In this first part — Sections 5.1 and 5.2 — a background to the model, the philosophy behind the model and computer programs, the structure of the model, and key parameters and assumptions in the model are described. Readers interested in instructions on how to run the model and how to interpret its output should proceed direct to Part B — Sections 5.3 to 5.7 — of the manual. The third part of the manual — Part C (Sections 5.8 and 5.9) — describes the *Visual Basic* code and the various endogenous parameters in the mode. Reference to this part of the manual is not required for normal usage of the model, but will be of use for more advanced usage or for further model development.

Part A — Overview of the Model

(Sections 5.1 and 5.2)

This part of the manual provides a background to the model, the philosophy behind the model and computer programs, the structure of the model, and key parameters and assumptions in the model. Users interested in following instructions to run the model can move direct to Part B.

5.1 Introduction

The model was developed as part of ACIAR Project ASEM/1998/060 on 'An economic analysis of fibre input/textile product selection and new processing technologies in Chinese wool textile mills'. One part of this project was the development of a whole mill model which could determine the cost and revenue effects of various fibre input/textile product selections as well as evaluate the cost and revenue effects of new processing technologies. The project commenced in 2001 when a detailed understanding of existing mill information and (managerial and financial) accounting systems was obtained along with shortcomings in the system identified by mill managers. In 2002, close collaboration was conducted with technicians and managers from a select group of mills to collect detailed data and ideas for development of the model. The model was validated in 2003 with the select group of mills. A larger group of mills received training in the use of the model in 2004.

The initial focus of the project was on development of a model which could analyse fibre input/textile product selection and new processing technologies. However, the model developed is much broader and is now able to evaluate the economic impact of many other aspects and decisions that impact on mill revenues and costs. The initial phase of the project identified that while many mills devote considerable effort to collecting detailed (and reliable) information, they do not make full use of it in management decisions. This was apparent in 2002 when imported wool prices rose by almost 30% and many mill managers had little information to assist them respond to the volatile input prices.

5.1.1 Model philosophy

Given this background, the intent was to develop a model that is useful to many Chinese wool textile mills, and that could assist managers and technicians with their management decisions. A key aspect of the approach was that the model would draw on existing sources of mill information and could evolve from existing mill decision-making approaches.

[5] The version of the model reported in this manual is not a commercial model but a research model. Although extensive testing has taken place and every effort has been made to ensure the accuracy of the model, no guarantees can be made that it is free of all errors. Thus users should exercise due caution in interpreting results from the model and use only as a guide to decision-making along with other information at their disposal. To the full extent permitted by law, any conditions or warranties imposed under legislation are hereby excluded. The University of Queensland makes no representation that the use of the model provided will not infringe the rights of any third-party, including Intellectual Property rights. The Recipient shall be responsible for the Recipient's use of the model.

5.1.2 Computer philosophy

The model has been developed as a series of *Visual Basic* programs embedded in a Microsoft *Excel* spreadsheet. The reasons for this are as follows:

- Most mills have access to Microsoft *Excel* software and some already use it in simple spreadsheet applications.
- The elementary version of *Visual Basic* is attached to Microsoft *Excel* and has been used for the model.
- Although more sophisticated or specialised programming languages would have handled the model more efficiently, the *Visual Basic* model should be available to all Chinese mills without the need for specialised software.
- Similarly, the *Visual Basic* model has been designed to be as understandable as possible. Some modeling efficiencies have been traded off against a simpler model structure. This involves:
  - Breaking the model down into (mill) recognisable sub-components, such as along the lines of mill workshops
  - Full and detailed description of model variables
  - Comments preceding model sections indicating what is being done
  - Use of simple arrays with mnemonic names rather than more complicated arrays.
- Mill IT staff with a basic understanding of *Visual Basic* should be able to comprehend the model.
- The development of a generic model also enables subsequent development and analysis of specific choices (such as the impact of new processing technologies on the cost and yield coefficients of particular products).
- Chinese researchers or industry officials should be able to develop the model from its simple generic base.

5.2 The model

5.2.1 Uses of the model

The model essentially can be used in two ways.

First, the main intent of the model is to trace out and detail the cost, revenue and physical reconciliation associated with a particular product order. That is, the model inputs details about the amount and type of the product order along with the design of the product (through all of the processing stages), and then evaluates the full financial and physical implications of that product order. In this mode, the model becomes a useful tool for management in terms of the worth of a particular product order, how it should be produced, and what prices/fees should be charged for it.

Second, the model is flexible enough to consider and trace out the financial and physical implications of multiple product orders simultaneously. Although each mill may have many tens of product orders being handled at any time, there may often be around 10 to 20 major orders. The model is flexible enough to evaluate a group of orders. In this mode, mill managers and technicians can assess the profitability of the mill's typical orders (or modifications to these orders) as well as plan, say, input requirements for different wool inputs.

Note that although these two modes are quite distinct, the model does not require notification of the mode being used — this is automatically handled in the data specification process.

5.2.2 Broad structure and assumptions of the model

The model is flexible enough to consider all stages of wool processing from greasy wool purchase through to finished fabric output. Garment making and subsequent textile stages are not included. The model was designed for worsted processing. However, the basic structure of the model means that it would also be possible to adapt it for use with woollen processing. There are seven 'departments' or 'workshops' considered in the model which mimic the structure at many mills. Specifically the workshops are listed below with their outputs in brackets:

- Greasy wool purchase and sorting (re-sorted wool)
- Wool scouring (scoured wool)
- Topmaking (raw tops)
- Dyeing tops and recombing (finished tops)
- Spinning (yarn)
- Weaving (ecru fabric)
- Mending and finishing (finished fabric).

Depending on the type of mill, many of the mills have some or all of these workshops. The workshops are semi-autonomous units receiving inputs from other workshops and in turn supplying inputs to other workshops. They collect their own physical and financial information and also feed information to the entire mill operation.

Some of the key assumptions in the current stage of model development are:

- The model assumes that product can be sold as a final output at all stages (scoured wool, raw tops, finished top, yarn, ecru fabric, finished fabric) except greasy wool purchase and sorting (that is, sale of re-sorted greasy wool).
- Wool inputs can be purchased either as greasy wool, scoured wool, raw tops, finished tops, or yarn. Currently the model does not handle ecru fabric being bought in to be then finished and sold out as finished fabric. (Note this is a very specialised scenario of little relevance to most mills.) That is,

in order for mills to produce finished fabric they must buy in or manufacture yarn that they then weave and mend/finish (the ecru and finished fabric take on the same product number).

5.2.3 Structure of the model

An overview flow chart of *CAEGWOOL* — from a user's perspective — in Figure 5.1 provides a guide to *CAEGWOOL*'s structure. Figure 5.2 also highlights the different calculation modules within *CAEGWOOL* and how they are related.

The model commences by the user specifying a particular product order or multiple outputs. The user then enters the design of the product. From the design of the product, the model generates proformas for the input of the relevant data. In addition, some input values are determined endogenously from the product design, although the user has the ability to override these endogenous values. The model then uses the input data to generate information about the product order in terms of costs, revenues and the flow of physical product.

As mentioned in Section 5.2.2, the broad structure of the model mirrors the structure of the mill by having 'departments' or 'workshops' as the basic organisational unit. The first task of the model is to undertake a physical reconciliation of the fibre inputs at each workshop stage (sale outputs, intermediate outputs, intermediate inputs, purchased inputs) based on the product order, product design and yield co-efficients.

The determination and tracing of the physical amounts required and produced at each workshop stage is a major feature of *CAEGWOOL* and also a reason why the model was run through *Visual Basic* rather than through the spreadsheet formulae.

Based on these physical amounts of fibre inputs required and outputs produced, the model then determines sale revenues and by-product revenues using exogenously specified or endogenously determined product prices. The physical amounts are also combined with the cost coefficients, information on costs, and fibre input prices to determine workshop allocated costs, workshop direct costs-fibre and workshop direct costs-non fibre. Once these workshop costs have been determined, the model then determines intermediate output and input prices by starting from the initial workshop stage. The intermediate prices are used to determine the opportunity cost of manufacturing or purchasing in a particular (intermediate) input as well as determining the value added by each workshop.

To facilitate the calculation of these values, *CAEGWOOL* contains various macro programs and embedded subroutine macro programs. A description of these macro and subroutine programs appears in Section 5.8. The primary macro is the **MAIN** macro which takes the information from the input sheets to determine the relevant physical amounts, costs, revenues, profits, prices and fees. The **MAIN** macro also calls on a series of subroutine macros to generate the relevant output sheets. The other key macro is the **INPUTSHEETS** macro which takes the information from the product design to set up the remaining input sheets as well as calculating various endogeneous prices and cost and yield coefficients. More details of these macros appear in Section 5.8.

Although *CAEGWOOL* has been set up as a simulation rather than optimisation model, it still features the capability to compare the profitability of different model scenarios and to store these results. That is, the subroutine **SAVERESULTS** saves a model run or scenario to a file using a user specified (on ***front page*** worksheet) name. The file contains all the input sheets (to define the scenario) as well as all the generated output sheets. Key indicators from the scenario are then added to a worksheet in a CAEGsummary *Excel* file where the indicators are compared with those from other model runs. (Specifically the model runs are sorted in descending order of profitability with the latest model run highlighted.) In this way, the user is able to compare the profitability of various scenarios and identify the details of the 'best' one. More details of the CAEGsummary file are listed in Section 5.7.

5.2.4 Key model parameters

Treatment and estimation of profit and value added taxes

Wool textile mills face a variety of taxes. Indeed in many cases there can be more than 14 separate taxes. The problem for modelling these taxes in a general model such as *CAEGWOOL* is that many of these taxes are specific to a particular region or mill. Fortunately many of these taxes are relatively minor and have a lump sum nature (that is, unaffected by throughput) and so can be handled as an external (user) input. However, there are two important taxes — namely profit tax and value added tax — that are major cost items for the mill and which are dependent on mill operations.

Following standard Chinese accounting practice, the profit tax is calculated as a set percentage of the net returns, namely of product sales revenues minus workshop costs minus mill overheads minus other taxes (including value added tax mentioned below). Thus, in the profit statement on the ***profit*** worksheet, both a before (profit) tax net revenue or profit and an after (profit) tax net revenue or profit are calculated. The contract prices and service processing commission fees also incorporate a margin for the profit tax. The current version of the model makes provision for

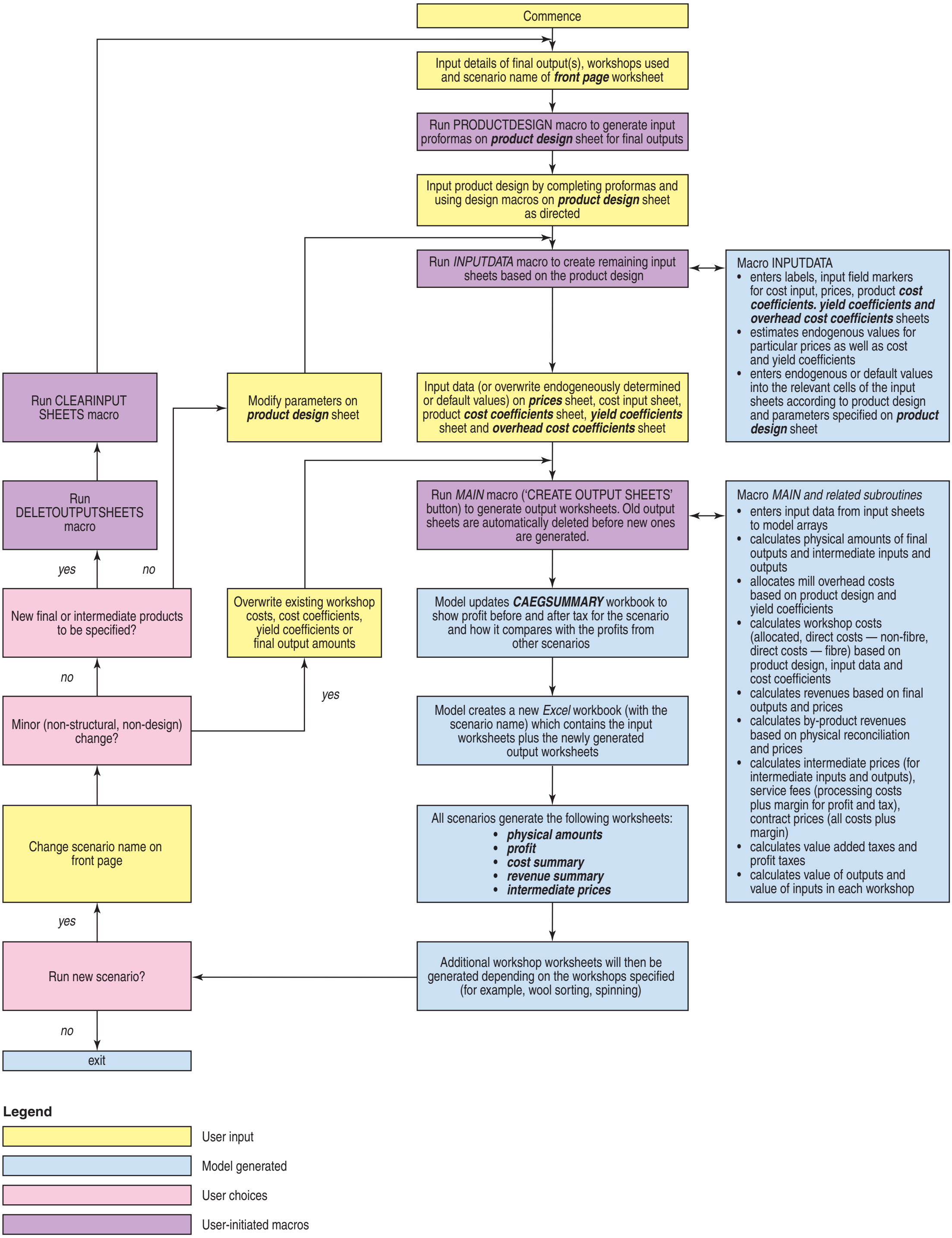

Figure 5.1 CAEGWOOL user flowchart

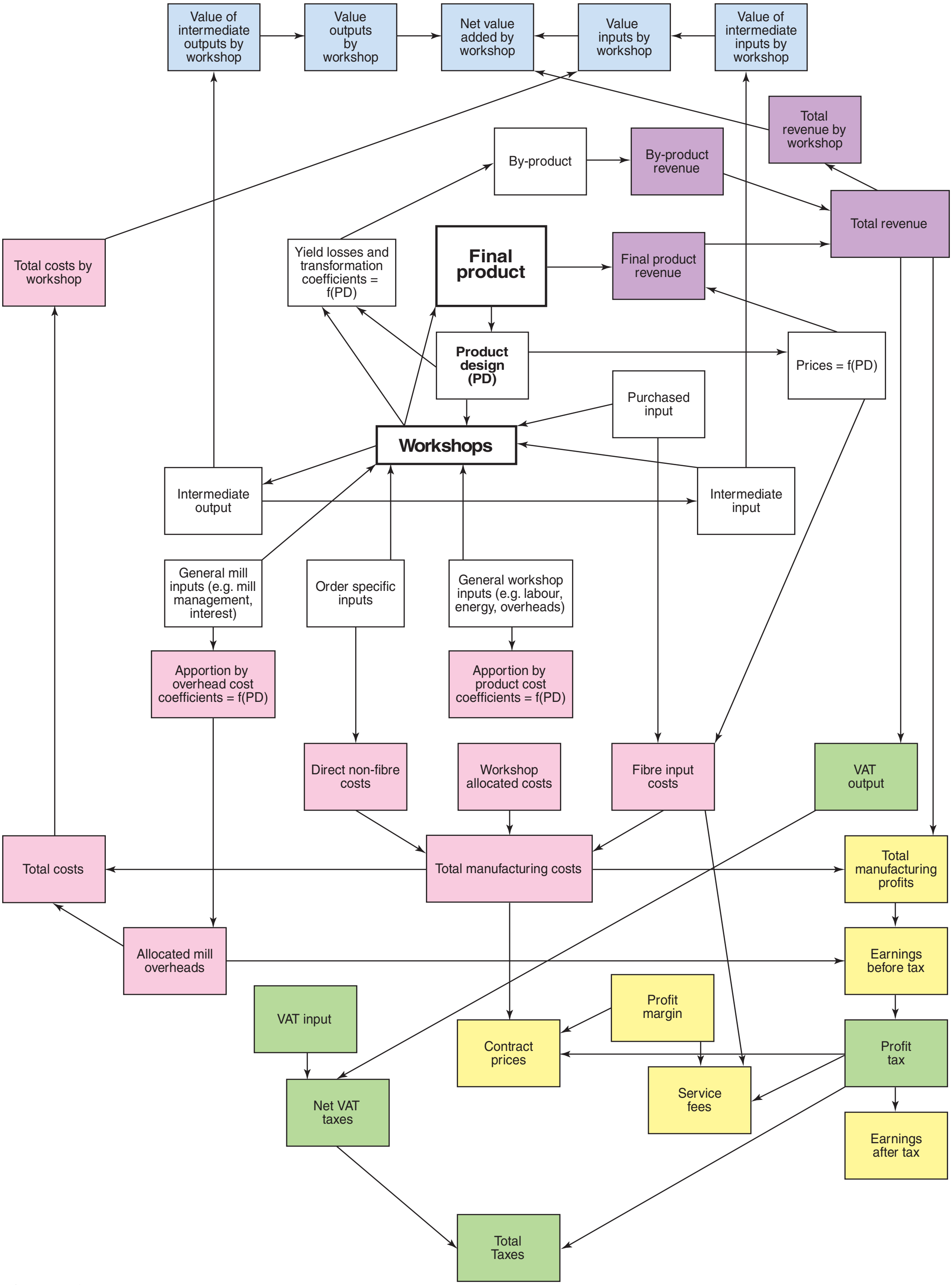

Figure 5.2 CAEGWOOL interrelationships

a single profit tax rate (which is specified as a default value of 33% on the ***cost input*** worksheet. However, in practice, the profit tax rate can vary according to aggregate (as compared with specific order) profits. Thus, the profit tax rate specified by the user should be the rate that normally applies to the mill.

The treatment of value added tax is more problematic. There are two separate components to this tax. A value added tax applies to sales (usually at a rate of 17%). However, a rebate (usually at a rate of 13%) can be claimed for inputs. However, this does not apply to all inputs to the manufacturing process. Specifically the rebate can be claimed on raw material inputs such as fibre inputs as well as other manufacturing inputs. Nevertheless, it cannot be claimed on labour inputs or on mill overheads. The model calculates the value added tax on outputs and rebate on inputs in this manner. That is, the rebate is based on the costs of fibre inputs as well as workshop energy and other costs but excludes labour costs and workshop and mill overheads. Another complication is that the value added rebate rate can vary according to the specific input although the rebate for wool is normally the same rate as for most other inputs. Once again the ***cost input*** worksheet allows the user to input the rates for the value added tax on outputs and the rebate rate for inputs. The model then generates the value added tax amounts for the mill (order) as a whole. Note again that the value added tax is included in mill profits prior to the profit tax described above being applied.

Profits, contract prices and service fees

As mentioned, the model is usually based around a product 'order' although provision does exist to consider multiple orders at the same time. However, the model can present the output either as the profit from that order, as a contract price or as a service fee.

The profit statement which appears on the ***profit*** sheet — and is mirrored in items presented on the specific workshop sheets — sets out the various revenues, costs and taxes and an after tax net revenue or profit. Thus, it determines the profitability of a particular order based on a particular set of product and input prices.

The contract price indicates the product price the mill needs in order to make a specified after tax profit. Specifically, users specify a profit 'margin' which is expressed as a percentage of product costs (including apportioned mill overheads and net value added tax) that users would like to generate as an after-tax profit for that order. The model then uses this profit margin, the product or order costs and the tax rates to determine the price needed to achieve this profit margin. Because the value added tax and the profit tax depend on the final product price, the model needs to determine the contract price, profit tax and value added tax on outputs simultaneously. This is achieved through the equation shown below.

$$P = C\,(1 - T_p + M) / (1 - T_p - T_v - T_v M - T_v T_p)$$

Where P = contract price; C = product costs (including apportioned overheads and value added rebate on inputs); M = profit margin; T_p = profit tax; and T_v = value added tax on outputs.

The service fee covers the case where mills are supplied with the raw wool materials and are asked to process them on commission for a service fee. It is calculated in the same manner as the contract price except that it excludes wool input purchase (or direct fibre) costs.

Intermediate prices and net value added

Many of the outputs from different workshops are not sold but are used as inputs for subsequent processing stages or workshops. Similarly many of the fibre inputs to different workshops are not purchased but come from workshops involved in a previous stage processing. Thus, in order to determine the true value of particular workshops, an accurate tracking and valuation of these intermediate inputs and outputs must be made.

Intermediate prices are tracked through the model based on input requirements (specified in the product design) and allocated workshop and mill overhead costs. The intermediate price includes all costs incurred through the various stages of the mill to produce the intermediate product including input costs (net of any VAT rebate) and apportioned mill overhead costs. The price excludes any profit margin and profit and value added taxes on outputs as mills can elect to produce the intermediate input themselves or alternatively purchase it in from another mill. Both the profits and related taxes are based on overall net revenues and so are indifferent as to whether the input cost is a purchased input or the own costs of producing the intermediate product.

There is also some debate when calculating prices for intermediate inputs as to whether mill overheads should be included. That is, there may be some conjecture that the mill would have incurred the overheads irrespective of whether it produced the intermediate product or purchased it. Thus there may be some debate as to whether the mill overheads should or should not be included in the intermediate price and consideration of opportunity cost. In the ***intermediate prices*** sheet, both intermediate prices with and without overhead costs are calculated and compared with market prices to determine the opportunity costs of self-producing inputs. Note that the decision of whether to self-manufacture or purchase-in the intermediate inputs may well change depending on this treatment of mill overhead costs.

The ***net revenue or value added*** by each workshop is listed in Section C of the ***profit*** sheet as well as in Section 7 of the individual workshop sheets. In these sections, the net revenue added is also broken down into the value of all outputs whether final or intermediate — that is, revenue from final outputs and by-product revenues as well as the value of any intermediate outputs (intermediate price times amount) and the value of all inputs whether purchased or intermediate — that is, workshop allocated costs, apportioned mill overheads, purchased fibre inputs, and the value of any intermediate inputs (intermediate price times amount). Subtracting the value of inputs from the value of outputs results in the net revenue or value added. Section C of the ***profit*** sheet as well as Section 7 of the individual workshop sheets lists two columns of these values — one inclusive of profit and value added taxes and rebates and the other exclusive of profit and value added taxes and rebates.

Apportioning mill overheads

Apart from the fixed (throughput unrelated) costs that may arise directly in a workshop, there are a number of general mill overheads that are not specific to any workshop. These include the costs for the general management of the mill, sales and marketing office, land and other throughput or profit unrelated taxes, effluent treatment and other overheads. In order to determine intermediate prices, contract prices and service fees, some apportioning of these overhead costs to particular workshops and products is required. By its nature (in terms of being a fixed cost), there is no single definitive way that overhead costs can be apportioned. The way in which the model apportions these costs is set out below. However, there may be other ways that mill managers consider that these costs should be apportioned and this may require some changes to the relevant part of the *Visual Basic* code (in the subroutine **OHEADCOSTS**).

In essence the overhead costs are apportioned according to value in a six-step process. In the first step, the mill overheads listed in Section 1 of the ***cost input*** sheet are aggregated. In the second step, the value of all mill outputs is calculated by multiplying the workshop throughputs listed in Section 2 of the ***cost input*** sheet by the relevant product price (usually the price of the first product specified as being manufactured for that workshop). In the third step, the value of all products manufactured as part of the order is calculated and expressed as a proportion of the total value of mill output calculated in step 2. In the fourth step, the proportions calculated in step 3 are modified according to the (endogenously determined or user specified) product specific overhead cost coefficients that appear on the ***overhead cost coefficients*** sheet. That is, these coefficients indicate whether a specific product incurs higher overhead costs (relative to its value) than other products. In the fifth step, the sum of the modified proportions estimated in Step 4 are normalised to a value of 1 to ensure that the apportioned mill overheads by product sum to the total mill overheads for the particular order. Finally, the sixth step applies the modified proportions in step 5.

Part B — Running the Model

(Sections 5.3 to 5.7)

This part of the manual provides details on how to complete the various input sheets, how to run the model, how to interpret the output sheets, and how to navigate around the worksheets in the model. As mentioned in Part A, the model is run from a Microsoft Excel *spreadsheet. Opening the spreadsheet will take the user to the* **CAEGWOOL home** *sheet described in Section 3 below. Note that detailed instructions on how to complete input worksheets or how to interpret output worksheets also appear at the top of each sheet.*

The basic steps in running the model can be summarised as follows:

- Step 1 — Open the **CAEGWOOL Master** (Microsoft *Excel* workbook) file which will automatically open on to the ***CAEGWOOL home*** sheet.
- Step 2 — Use the **FRONT PAGE** navigation button to go to the **front page** sheet and enter information as directed on the name of the model run, the workshops to be included, and details of the final outputs.
- Step 3 — Click on the **PRODUCT DESIGN** macro button, which will send you to the **product design** sheet and create the input proformas for the final outputs.
- Step 4 — Complete the remaining product design interactively as directed before clicking the **CREATE INPUT SHEETS** macro button, which will format the remaining input sheets according to the user specified product design.
- Step 5 — Complete the remaining input worksheets — **cost input, prices, product cost coefficient, yield coefficients,** and **overhead cost coefficients** sheets — as directed. Many of the input cells will contain endogenous or default values which can be used by the user or alternatively simply overtyped. (Users can make changes to the way the model calculates some of these endogenous or default values by changing values on the **endogenous parameters** sheet. However, this must be done prior to clicking the **CREATE INPUT SHEETS** macro button in Step 4.)

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- Step 6 — Once all the input sheets are completed, click on the **CREATE OUTPUT SHEETS** macro button which is located on the **CAEGWOOL home** sheet.
- Step 7 — The **CREATE OUTPUT SHEETS** macro will automatically generate the output sheets, save the file according to the model name specified in Step 2, and open the **CAEGsummary** Microsoft *Excel* workbook to record the model name and net profit before and after tax, and to sort the model runs according to ascending order of profit after tax.
- Step 8 — Exiting the **CAEGsummary** workbook will return the user to the latest model run, where further model runs can be performed as directed by changing input values and clicking on the **CREATE OUTPUT SHEETS** macro button.

5.3 CAEGWOOL Home page — navigating the CAEGWOOL spreadsheet

The first worksheet that appears in the CAEGWOOL model is the CAEGWOOL home sheet. Apart from some basic information about the model, this sheet is used primarily to navigate around the worksheet and to run some of the key program macros. There are three columns of buttons. The first column contains self-titled buttons that hyperlink to all of the input worksheets (e.g. product design sheet). At the bottom of this column is a link to the endogenous parameters sheet accessed for advanced usage of the model. The second column contains buttons that link to the output worksheets common to all model runs (e.g. profit sheet), and to the workshop-specific output worksheets (e.g. spinning sheet). Of course, the sheets in the latter two categories can only be accessed by these macro buttons once they have been generated by the CAEGWOOL model.

Each of the specific worksheets (both the input sheets as well as the model generated output sheets) has an arrow labelled with a 'home' in their top left hand corner (cell A1). Clicking on this arrow will return the user to the CAEGWOOL home sheet.

The third column contains key program macros. The first of these are the two main program macros, namely **CREATE OUTPUT SHEETS** (which runs the model and generates the output sheets) and **CREATE INPUT SHEETS** (which formats the input sheets and inserts model determined values based on the product design). The second set of macro programs, namely **DELETE OUTPUT SHEETS**, and **CLEAR INPUT SHEETS** macro programs are used to clear all input and output sheets in preparation for a completely new product design model run. (A warning is given to highlight that these macro programs will clear all the input.)

5.4 Input sheets

The CAEGWOOL workbook file contains a series of seven input worksheets, namely:
- front page
- product design
- cost input
- price input
- product cost coefficients
- yield coefficients
- overhead cost coefficients.

Instructions to complete the worksheets appear under the title at the top of each one. These instructions are described in more detail below.

The input sheets are completed in sequence and are related. That is, the ***front page*** sheet specifies the product/order being analysed. The ***product design*** sheet then specifies the intermediate inputs needed to produce that product(s). Details entered on the ***front page*** and ***product design*** sheets are used to automatically format the remaining input sheets.

Except where stated, input should be entered in the blue shaded cells.

5.4.1 Front page sheet

The first item to input on the ***front page*** sheet (cell C5) is the path name of the file to which to save summary results from the model (see Section 7 for more details). The initial default name listed in cell C5 is C:\CAEGsummary.xls. However, as indicated in Section 7, users may want to save these summary results in another location or file.

The next item on the ***front page*** sheet (cell B8) is the name of the model run. The name specified will be used to create an output file of the same name. The name can include a directory path, in which case the file will be saved to a specific location. Alternatively, if just a name is given, a file of that name will be saved to the default drive for *Excel* files for the user's computer (see Section 7 for more details). To the right (cell F8), the user is asked to specify whether it is a new design scenario. That is, if there are no output sheets, the user should enter a '1' in this cell, otherwise leave as blank.

Column A of the front page lists various mill workshops or departments. Not all mills have all departments and some products do not use particular departments. The workshops to be considered in the analysis are input into the model by entering a '1' (for yes) in the relevant blue cells in Column B. The workshops not to be included in the analysis should be indicated by entering a '0' in the relevant blue cells in Column B, or by leaving blank (being the default for 0).

Columns C and D are then used to enter the final output(s). These are products sold out of the mill and *not* intermediate products or by-products. Note that final products may be a single final output in the case where a single product/order is being analysed or where they are multiple final outputs. A product label is entered in Column C. The amount is entered in Column D (and the units are specified in Column E. The product label can be any alphanumeric (including Chinese characters, letters or numbers) and so can use any existing mill label for this product. Note that this label will appear on all subsequent input and output sheets.

After completing relevant cells in Columns B, C and D, click on the **PRODUCT DESIGN** macro button at the top of the page. The **PRODUCT DESIGN** macro takes you to the ***product design*** sheet, clears any existing input on this sheet, and generates the input proforma for the final products specified on the ***front page*** sheet. (Thus, re-clicking on the **PRODUCT DESIGN** macro button will delete all existing product design on the ***product design*** sheet.)

5.4.2 Product design sheet

The ***product design*** sheet is perhaps the most crucial data sheet. It would be completed by a production or technical manager(s), and sets the precise specifications for the raw and intermediate products required to produce the final product. In essence, the product design sheet provides proformas or templates which allow the user to input specifications for all final products, intermediate products and inputs.

The ***product design*** sheet is completed from left to right. Proformas for final products specified on the ***front page*** sheet will initially automatically appear — following clicking on the '**PRODUCT DESIGN**' macro button on the ***front page*** sheet. (For instance if a finished fabric with a product label of 'fabric601' is the only final product specified on the ***front page*** sheet, then a single proforma will appear in cells A5 to B18, with the product label 'fabric601' appearing in cell B6. Conversely, if a yarn was specified as a final product, then the proforma would have appeared in cells D6 to E21.) The user completes the proformas for the final product(s), and then clicks on the relevant '**… DESIGN**' macro button for the next processing stage at the top of the input column. (For instance, if the final product is a fabric, then the user clicks on the '**YARN DESIGN**' in cell B4.) This will generate proformas for the intermediate and purchased inputs specified. The user then completes the proformas, clicks on the '**… DESIGN**' button and the process repeats.

The first row in the proformas calls for product labels. These labels are used in the design of the subsequent input sheets generated by the model as well as in the output sheets. These labels can be any alphanumeric label including those commonly used by mills.

Note that some items in the proforma are prefixed with a '**', italicised, and in a coloured font. These items are not used to estimate endogenous parameters in the current version of the model and so are not mandatory to complete. They have been incorporated as they may be useful in subsequent model development and in describing the product on the output sheets. However, users are not required to enter information in the blue shaded cells for these items.

Some products specified in the product design will be manufactured within the mill while others may be purchased in from outside the mill. This is indicated in the proforma (in the 'Manufactured (1) or purchased (0)' row) by specifying a value of '1' in the blue shaded cell if it is manufactured and a value of '0' or left blank if it is purchased. For products specified as being 'manufactured', information is required on what inputs are required to produce that product. This information is entered at the bottom of the proforma for each product. The cells ask for how many inputs are required (for example, cell 'E14' in the case of the first yarn) and then the input labels and proportions of these inputs that go into making the product. For example, if the first yarn ('yn1') required two finished tops ('ftnum2' and 'ft1') made up of 95% of 'ftnum2' and 5% of 'ft2', then the finished top labels would be specified in the blue cells D15 to D16 with the proportions specified in cells E15 to E16. These proportions should be entered as percentages rather than decimal fractions and must add up to 100. If they do not, an 'Error' message will appear when the '**… DESIGN**' is pressed for the next processing stage, and the correct proportions adding up to 100 will have to be entered before the model can proceed.

After the proformas for the final product(s) have been completed, the relevant macro button in row 3 should be clicked (for instance, if the final product was a fabric, click on the '**YARN DESIGN**' macro button in cell B4). Proformas for the intermediate or purchased inputs specified in the final product will then appear. The shaded cells are completed as described above, including specifying inputs and their proportions, and by clicking on the relevant macro button at the top of the column once all the data are entered.

In this way, the user moves from the left to the right of the sheet by completing the empty proformas that automatically appear and then clicking on '**… DESIGN**' at the top of the input columns.

Note that different products (e.g. different yarns) may use the same input (e.g. a particular finished top). For instance, 'yn1' and 'yarn2' may both use finished top 'ft1'. Thus, when the '**… DESIGN**' button is clicked, the model checks whether any of the inputs are the same and will only generate the proformas once for any particular input — that is, for the example listed above, the model will only generate a proforma for 'ft1' once.

Once all product design details have been entered, click on the **CREATE INPUT SHEETS** macro button in the instructions. This will generate the subsequent input data sheets based on details provided on the product design sheet.

Various numbers will appear in row 4 indicating the number of products at each stage, as the input proformas are generated. These are a normal part of the operation of the model and should not be deleted at any stage.

5.4.3 Cost input sheet

This worksheet is divided into three sections, namely information on mill overheads, workshop costs, and costs specific to particular products. These separate components are discussed below. Note that the **CREATE INPUT SHEETS** macro run by clicking on the **INPUT DATA** macro button on the ***product design*** sheet will have generated product labels and blue cells for data entry.

Mill (overhead) costs not allocated to workshop (Section 1 — rows 5 to 17)

These include overhead costs that are across the entire mill and not associated with any specific workshop. Examples include general mill management and expenses associated with a sales and marketing team. Note that care should be exercised to exclude any overhead amounts that are included in the workshop costs (for example, depreciation on capital or workshop manager's salary in, say, a weaving workshop. Whether overhead costs are included in the general mill overheads or in the workshop overheads will primarily depend on how these costs are recorded in mill cost records. If information is available on these costs at a workshop level, then they should be included under 'workshop costs' rather than under 'mill overhead costs not allocated to workshop'). As the data on workshop costs and volumes are typical on a monthly basis, the overhead costs should also be specified as a monthly amount.

There are some overhead costs incurred by virtually all mills that are listed in rows 7 to 11, namely: 'Interest'; 'Non-profit taxes', 'Depreciation'; 'General Mill Expenses'; and 'Sales and Marketing'. (Note that while these overheads are incurred by most mills, it is not mandatory to enter information on them here.) The monthly amounts for these items should be entered in the blue cells D7 to D11. In addition, the input sheet allows provision for the entry of up to five other types of overhead costs to be included. The names of these other overhead costs should be entered in the shaded cells B12 to B16 with their amounts listed in cells D12 to D16.

In relation to some of the listed overhead cost categories, 'non-profit taxes' should not include value added taxes or profit taxes as these are automatically calculated within the model (see Section 2.4.1). The non-profit taxes vary from items such as land tax to welfare taxes, and they can all be aggregated into the one tax. As mentioned above, for items such as 'interest' and 'depreciation' care should be exercised that these do not include any amounts entered under the workshop costs category mentioned below.

Workshop costs (to be allocated by throughput and coefficient) (Section 2 — rows 18 to 29)

This section requires entry of costs of major cost categories for each of the workshops specified on the ***front page*** sheet. These categories are based on existing mill data collection and include 'energy', 'wages', 'overheads' (note these are overhead or fixed costs that are specific to the workshop) and 'other' (which should be used if costs other than energy, wages and overheads are included). In addition to the cost items, Column D also asks for throughput in the workshop (throughputs are specified in metres for the finishing and weaving workshops and in kilograms for all other workshops).

Information on costs and throughputs should be on a representative month basis. That is, the costs and throughputs are used to determine a unit cost. The unit cost can then be applied to a product order (depending on volume) and modified according to cost coefficients that are entered on the following ***product cost coefficient*** sheet. Thus a recent 'normal' month should be used or alternatively a series of months should be averaged to smooth out any abnormal costs (care should be taken, however, that the averaging does not conceal unit cost variations).

Costs directly attributable to a product order (Section 3 — rows 30 on)

Some costs can be easily identified to a particular order such as certain dyes or specific packaging. If this is the case, then these specific costs can be entered in this third section of the worksheet. The **INPUT DATA** macro will generate product numbers, workshops and blue cells. Note that only products that are manufactured by the mill (not bought in) will appear with product labels and blue cells. It is also

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important to note that there may not be any directly attributable costs and so there is no need to enter any data. There is provision for the entry of up to nine separate cost items in each workshop.

If direct costs are entered, then their name should be entered in the relevant blue cells in Column C and the cost (total for product order and not a unit cost) entered in Column D.

Any costs entered in this section should not be included in the costs specified in the previous section (workshop costs to be allocated by throughput and coefficient). For instance, in specifying any direct dye or packaging costs, care should be exercised in ensuring that these dye and packaging costs are not included in the workshop costs to be allocated. In general, if the information is available, it is preferable to enter costs directly in this section rather than in the workshop allocated costs section because the latter will be allocated by general cost coefficients only.

5.4.4 Price input sheet

This sheet requires input of prices of products (final, intermediate and purchased input prices) as well as the prices of the various by-products produced along with margins and tax rates. The sheet is organised into four sections based on these categories.

In Section 1 ('Product prices'), prices for all products (final and intermediate) are entered. Based on the ***front page*** and ***product design*** sheets, the **INPUT DATA** macro will automatically enter the product labels for products requiring price data to be entered. This macro will also list the endogenously determined prices in the shaded cells below the product labels. These prices are a guide, however, and the user may enter their own prices simply by typing over the amounts in the shaded cells. The determination of endogenous prices is described separately in Section 5.9.2. Thus, the sheet is designed to provide information (and specific model values) on prices for particular products, but also allow the user to easily overwrite these endogeneously determined prices if they have more specific knowledge. In addition, managers interested in knowing the impact of variable prices can run alternative scenarios with particular prices.

In Section 2 ('by-product prices'), various by-products and endogenously determined prices appear in cells A28 to B35. Once again, the user can simply overtype the values in the shaded cells if they want to generate scenarios based on a different set of prices.

In Section 3 ('Margin'), the shaded cell (cell B38) is where the user enters a profit margin. The margin represents the percentage mark up over all costs (including taxes) that the mill/user would like to receive or needs to recover. The margin is used in the model to estimate service fees and contract (sales) prices.

In Section 4 ('Tax'), tax rates that are used to endogenously calculate three specific tax items in the model are specified. The first relates to the profit tax rate, the second to the value added tax rate on outputs, and the third to the value added rebate on inputs. Note that all of these rates are specified in percentage terms (e.g. profit tax of 33). Default rates (based on the actual values in 2004) are set in the shaded cells. However, because these rates can and do change, users can overwrite these values.

5.4.5 Product cost coefficients sheet

The ***Product cost coefficients*** sheet is used to enter information on cost coefficients to be used in the allocation of workshop costs. That is, workshop costs may be allocated to products initially based on volumes (that is, unit costs). However, some products may be more expensive to produce in particular workshops (use more labour or energy, etc) than other products. Thus cost coefficients can be used to more accurately assign workshop costs to a particular product. The cost coefficients are an integral part of the model and of the ACIAR project and are discussed in detail in Chapter 2.

The cost coefficients should be specified on the basis that the most common product has a cost coefficient of 1 or that costs are allocated to products on the basis of throughput alone. The specific coefficients for specific products should then be expressed relative to this normal, common or standard product. For instance, a cost coefficient of 1.1 indicates that the unit cost of a particular product is 110% of the unit cost based on throughput alone or of the unit cost for a standard product.

The sheet lists all possible workshops down the page with major cost categories listed (in Column B) for each workshop. (That is, product cost coefficients should be specified not only by product but also by cost category.) However, the **INPUT DATA** macro button ensures that only the workshops and products indicated on the ***front page*** and ***product design*** sheet will appear on the product numbers and as blue shaded cells. As the model requires some input for these coefficients, the shaded cells automatically have a value of 1 (that is, unit costs based on share of throughput alone) or some other endogenously determined cost coefficient based on the product design as described in Chapter 2. Users can type new values over these default or endogenously determined values if they have more specific knowledge of these cost coefficients. Users may also want to investigate various scenarios (such as technology reducing the costs of producing a particular type of product).

5.4.6 Yield coefficients sheet

Products are transformed at each stage of the wool textile processing chain. In some cases this involves distinct changes in units (for example from kilograms of yarn to metres of fabric), while yield losses are also associated with the processing. These by- or co-products, such as noil, spinning wastes, etc., can be sold albeit at a lower price than the original product. Thus the model needs to keep track of the physical amounts of each product at the different stages and to do so needs accurate yield coefficients. A spinning yield coefficient of 0.95, for instance, indicates that only 95% of the weight of finished tops entering the spinning stage is reflected in the weight of the yarn produced. Yield coefficients are assumed to depend not only on output characteristics but also on input characteristics of the product. This is the format reflected in the sheet. Further details about the determination of these yield coefficients are provided in Section 5.9.4.

Initially this sheet will simply have the heading 'Yield coefficients'. However, the INPUTSHEETS macro will generate the products considered in the analysis based on the information on the ***front page*** sheet and ***product design*** sheet. Blue shaded cells will again guide input. As the model requires some input for these coefficients, the blue cells will automatically have a value of 1 (that is, no yield losses) or some other endogenously determined or specified coefficient. Users may input their own yield losses by overtyping these values with their own specific estimates of the yield coefficients. As mentioned, the characteristics of both inputs and outputs can influence yield coefficients and so there is a matrix of yield coefficients specified on the sheet for each workshop/stage, with the output products listed on the columns and the input products specified in the rows. If yield coefficients are assumed to vary only according to the output type, then this can be achieved simply by listing the same values in an output product column.

Note that the yield coefficients are expressed as a decimal fraction rather than as a percentage. Thus, a yield coefficient of 0.93 would have a recombing loss of 7%.

5.4.7 Overhead cost coefficients sheet

The ***Overhead cost coefficients*** sheet is used to enter information on cost coefficients to be used in the allocation of mill overhead costs. Because of the nature of overhead costs, they will normally be allocated to products based on volumes alone (that is, unit costs). However, some products may draw more heavily on overhead cost categories (for instance, require more managerial or sales and marketing input) than other products. Thus, overhead cost coefficients can be used to more accurately assign these general mill costs to a particular product. The coefficients are specified in the same way as the product cost coefficients. For instance, an overhead cost coefficient of 1.1 indicates that the unit overhead cost of a particular product is 110% of the unit cost based on throughput alone. Note that because of their nature and difficulty in determining any variation across products, most model runs may well have overhead cost coefficients all specified as '1'. However, as a general model, it is important to allow for other coefficients or other allocations of overhead costs if specific information is available. These issues and other details about the overhead cost coefficients are discussed in Section 5.9.5.

The sheet lists all possible workshops down the page. However, the INPUT DATA macro ensures that only the workshops and products indicated on the ***front page*** and ***product design*** sheet will appear on the product numbers and as blue shaded cells. As the model requires some input for these coefficients, the shaded cells automatically have a value of 1 (that is, unit overhead costs based on share of throughput alone) or some other endogenously determined cost coefficient based on the product design. Users can type new values over these default or endogenously determined values if they have more specific knowledge of these cost coefficients or if they want to investigate various scenarios (such as technology reducing the costs of producing a particular type of product).

Once the ***Overhead cost coefficient*** sheet has been completed (and all the others) the model is ready to run and generate output. This can be achieved by returning to the ***CAEGWOOL home*** sheet and clicking on the CREATE OUTPUT SHEETS macro button.

5.4.8 Re-entering input data

After the model has been run, data can be re-entered and new scenarios/model runs conducted as highlighted in the flowchart in Figure 5.1. Three types of new scenarios can be considered. First, the impact of slight changes in input data (prices, cost coefficients, etc.) or where different amounts of the final product (of the same design) are of interest. In this case, modify the relevant coefficients, return to the ***front page*** sheet and enter a new model run name, before clicking the CREATE OUTPUT SHEETS macro button on the ***CAEGWOOL home*** sheet which will automatically delete the old output sheets and generate the new output sheets. Note that in this case, the shaded cell for 'new design scenario' should be blank or '0' to indicate that output sheets already exist.

Second, scenarios may involve essentially the same final product order but with slightly different product design requiring a few new (intermediate input) products to be specified on the ***product design*** sheet. In this case, the new product design can be entered by clicking on the relevant reset (**R**) and **… DESIGN** macro buttons and completing the new product proformas. The **INPUT SHEETS** macro can then be rerun, with any additional data entered on the ***price***, ***cost coefficient*** and ***yield coefficients*** sheets.

Third, more fundamentally different scenarios — such as entirely new final products or completely different product design specifications — require a new set of input sheets. In this case, click on the **DELETE OUTPUT SHEETS** macro button as well as the **CLEAR INPUT SHEETS** macro button on the ***CAEGWOOL home*** sheet.

Note that the output from new model runs is stored in a separate *Excel* file depending on the name specified in cell B8 of the ***front page*** worksheet. Thus, it is important to specify a new model run name.

5.5 Common output work sheets

Once the create output sheets macro button has been clicked, a set of output sheets are automatically generated. These include a set of five output sheets that are common to all model runs namely:

- Physical amounts sheet
- Profit sheet
- Cost details sheet
- Revenue details sheet
- Intermediate prices sheet.

In addition, detailed ***workshop*** sheets are generated for each workshop included in the analysis. In Section 5, the common output sheets are described, while Section 6 describes the workshop specific output sheets.

Note that the output work sheets precede the input work sheets in the saved model Excel workbooks. They can also be accessed via the navigation buttons on the ***CAEGWOOL home*** sheet

5.5.1 Physical amounts sheet

The ***physical amounts*** sheet lists all the physical flows of product through the mill based on the final outputs specified and the design of the product. It is divided into two sections — the first section outlines the physical flow of the products specified on the ***front page*** sheet or ***product design*** sheet, while the second section lists the amounts of co- or by-products produced in each of the workshops as part of the processing.

Specifically, Section 1 ('products') reports the amount of each product specified on the ***product design*** sheet (indicated by the product label in Column B) and sorts it into the category of final output (Column C), intermediate input (Column D) or purchased input (Column E). Note that in the input sheets, only the amount of final product is specified. The amount of the other intermediate inputs and purchased inputs is calculated in the model from the final product amount, the product design specifications (products required and proportion), and the yield coefficients.

In Section 2 ('by-products'), the amounts of by-products produced are reported. Once again these are derived through the product design specifications, yield coefficients and final product amount.

The ***physical amounts*** sheet will be of interest to a number of managers within the mill. Workshop production managers will have direct information on how much product they need to produce (as intermediate input) to meet the final order. Similarly mill buyers will know what types and amounts of products they need to purchase for each workshop.

5.5.2 Profit sheet

The ***profit*** sheet contains three separate components, namely: (A) Profit statement; (B) Contract prices and service fees; and (C) Net revenue added by workshop.

Section A. 'Profit statement' sets out a profit statement or statement of costs, revenues and net revenues. These are based on the format of profit statements that mills/Chinese enterprises are familiar with. Item '1' (row 6) is 'total revenue' which is disaggregated in the following two rows into 'final output' revenues and 'by-product' revenues. Item '2' (row 10) specifies 'total manufacturing costs' and reports the total of the costs incurred in the workshops. These are also disaggregated into three categories, namely costs allocated by (product cost) coefficients, direct costs attributable to products (such as a specific dye or packaging but not fibre inputs), and direct fibre input costs.

Subtraction of the total manufacturing costs from the total revenue gives Item '3' (row 15) of 'manufacturing profit'. Item ('4' — row 17) reports 'mill overhead costs' which are then disaggregated into 'interest', 'value added taxes', 'taxes other than profit or value added', 'depreciation', 'general mill expenses', 'sales and marketing' and 'other mill overheads'. These are based on the values entered in the ***Cost input*** sheet as well as the overhead cost coefficients and tax rates. Note that in line with Chinese accounting practices, mill overheads include interest, value-added taxes and non-profit taxes but exclude profit tax.

The mill overhead costs (Item '4') are then subtracted from the manufacturing profit in Item '3' to arrive at Item '5' of Profit before tax (row 26). Item

'6' is a 'profit tax' which is calculated by multiplying the profit tax rate by the profit before tax (Item '5'). Subtraction of the profit tax (Item '6') from the profit before tax (Item '5') results in Item '7' of 'profit after tax'.

Section B. 'Contract prices and service fees' reports contract prices and service fees for the final products specified.

The contract price is calculated as total product costs including taxes plus a profit margin — which is specified on the ***prices*** sheet — divided by the amount of the final product (order). Further details about how this price was calculated are set out in Section 5.9.2. As indicated in Section 5.2.4, because profit tax and value added tax depend on the output price, both these taxes and the contract price need to be determined simultaneously. The contract price indicates the price the mill needs in order to make a specified after tax profit.

The service fee is the same as the contract price except that it excludes wool input purchase (or direct fibre) costs. That is, it covers the case where mills are supplied with the raw wool materials and are asked to process them on commission for a service fee.

Section C. 'Net revenue added by workshop' reports the net revenue added by each workshop as described in Section 5.2.4. Note that these figures include provision for the valuation of both intermediate outputs and inputs. Column E reports these net revenues added excluding value added and profit taxes while Column F reports these net revenues added including value added and profit taxes. As the revenue added at each workshop stage includes provision for profit margins and taxes in Column F, summing the net revenue added of all the workshops in this column should equate (after rounding errors) with the Profit after tax reported as Item '7' in Section A. (Note that the sum of net revenues added in Column E (that is, excluding value added and profit taxes) should equal Item '5' minus the value added taxes reported in Item '4'.) Further details of how these net revenues added by the workshops are calculated, are provided in Section 5.2.4.

5.5.3 Cost details sheet

This sheet provides a complete breakdown of costs, the aggregate amounts of which were listed on the ***profit*** sheet. It comprises five separate sections.

Section 1. 'Workshop allocated costs' reports the allocated workshop costs by workshop and by the cost categories of energy, labour, workshop overheads and other workshop costs. The costs are also aggregated across workshops and across the cost categories.

Section 2. 'Workshop direct costs — non-fibre' reports the direct costs by workshop for the final outputs specified. While these costs come directly from the ***Cost input*** sheet, their presentation in this sheet allows them to be compared with the other cost types. In this section, Column B indicates the type of product (e.g. yarn), Column C the product label, Column D the type of the direct cost, and Column E the cost — which is the cost per order and not a per-unit cost.

Section 3. 'Workshop direct costs — fibre' lists the fibre input costs for each workshop. The workshops (e.g. weaving) are highlighted in bold in Column B, and this first row lists the total for the workshop. Subsequent rows list the type of fibre input in Column B (e.g. yarn), the product name of the fibre input in Column C and the cost in Column D.

Section 4. 'Mill overhead costs' apportions mill overhead costs for the product order(s) to particular workshops and even specific products (final and intermediate products). The columns are the same as for Section 3.

Section 5. 'Taxes' lists details of the key taxes. First, it disaggregates value added taxes into its two components, namely the value added tax on outputs and the value added rebate on inputs. The value added rebate on inputs is actually a revenue. Subtracting this from the value added tax on outputs gives the value listed under 'value-added taxes' in Item 4 of the ***profit*** sheet. The following row reports the profit tax (Item 6 of the ***profit*** sheet), and the next row lists taxes other than for profit and value added (that also appears as a separate line in Item 4 of the ***profit*** sheet).

This worksheet will be of particular interest to mill accountants and managers in being able to better apportion mill costs to particular workshops and so better understand the cost implications of particular product orders.

5.5.4 Revenue details sheet

The ***revenue details*** sheet is a straightforward sheet divided into two sections. The first section — ***'1' ('Value of final outputs')*** — indicates the revenues from the final outputs sold. The type of output is listed in Column B, the product name in Column C, and the revenue in Column D. The second section — ***'2' ('By-product revenues')*** — indicates the revenues from various by-products. These revenues are derived from the physical amounts (calculated within the model and reported on the ***physical amount*** sheet) and the prices (listed on the ***prices*** sheet).

5.5.5 Intermediate prices sheet

The ***intermediate prices*** sheet highlights the prices and values of all of the intermediate inputs specified on the ***product design*** sheet and whose physical amounts are listed in Column D of the ***physical amounts*** sheet. The columns in the sheet are as follows:

- Column A lists the type of intermediate input (e.g. raw top).
- Column B indicates the product label of the intermediate input.
- Column C lists the calculated intermediate price. This intermediate price includes all costs incurred through the various stages of the mill to produce the intermediate product. These include input costs (net of any VAT rebate) and apportioned mill overhead costs, but exclude the profit margin and taxes. More details of how these intermediate values are calculated are provided in Section 5.2.4.
- Column D lists the market price of the intermediate input (that has either been entered exogenously on the ***prices*** sheet or determined endogenously in the model) net of any value added rebate.
- Subtracting Column D from Column C highlights the opportunity cost. That is, if the intermediate price exceeds the market price then there is an opportunity cost for the mill to produce the intermediate input themselves. Intermediate inputs, for which there is a positive opportunity cost (i.e. better to purchase the intermediate input rather than produce it themselves), are highlighted by gold shading. Intermediate inputs which have a negative opportunity cost (i.e. better for the mill to produce itself rather than purchase) are highlighted in green shading.
- Column F lists an intermediate price for the intermediate inputs that does not include mill overhead costs. Column G indicates the opportunity cost when mill overhead costs are excluded (see Section 5.2.4 for a discussion surrounding the issue of whether to incorporate overhead costs). Note that the decision of whether to self-manufacture or purchase in the intermediate inputs may well change depending on this treatment of mill overhead costs.
- Column H lists the contract price and Column I the service fee for the intermediate inputs. These items are calculated in the same way as they were for the final products on the ***profit*** sheet as outlined in Section 5.2.4, namely total costs (intermediate price) plus provision for profit margin, profit tax and value added tax on outputs. As discussed in Section 5.2.4 (B), the service fee excludes purchased fibre inputs. The contract prices for the intermediate inputs enable the mill to ascertain the price it would need to charge before considering selling out some of the intermediate inputs it produces.

Care needs to be exercised in interpreting this sheet. The row shadings should not be the only basis about which intermediate products should be self-manufactured or instead purchased in. An important factor is that conjecture exists about the treatment of mill overheads and non-profit taxes.

5.6 Run-specific (workshop) output sheets

Apart from the output sheets mentioned in Section 5.5 that are common to all model runs, a number of workshop output sheets (***sorting***, ***scouring***, ***topmaking***, ***recombing***, ***spinning***, ***weaving***, ***finishing***) will also be generated, depending on the workshops included in the analysis. The basic format of all of these sheets is the same and the various sections are described below. However, some sheets do vary slightly and may not include particular sections. For instance, the ***finishing*** sheet will not include the section on '3. Fibre input price/costs' as the model assumes that all ecru fabric that comes into the finishing workshop is not purchased in, but instead is produced in, the mill's weaving workshop. Similarly, most workshop sheets will not include the section on '5. Revenues' as they will be producing intermediate outputs rather than final outputs.

The first section of a ***workshop*** sheet — ***Section 1. 'Specifications&amounts'*** — sets out again the specification of each product at this workshop stage (for example, yarn in the spinning workshop) according to information from the ***product design*** sheet. The specifications for each product are set out in separate columns from Column D. For most of the workshop sheets, whether the product is purchased in or manufactured in the workshop is listed at the bottom of the product specification. If the product is purchased in, there are no workshop costs for that particular product. This will be apparent as there will be no cost entries in the rows below this product. The amount required of the product (whether purchased in or manufactured in the workshop) is also indicated at the bottom of this section.

The second section of a workshop sheet — ***Section 2. 'Input/output table'*** — indicates the amount of inputs required to produce each of the products that are manufactured in the workshop. (Products not manufactured in the workshop but purchased in as inputs for subsequent stages appear in the product specifications but do not feature in this input/output section.) The row under the column headings for this section lists the labels for the products produced in the workshop. The labels of the inputs are then listed in subsequent rows in Column D. This gives three sets of columns for each product manufactured in the workshop. The first set of columns specifies the proportion of each input used to produce the workshop product. The second set of columns highlights the yield coefficients. The third set of columns indicates the amount of inputs required to produce each of the manufactured workshop products. This amount is based on the input proportions, the yield coefficients and the amount of workshop product required which is listed in the above Section 1 ('1. Specifications&amounts'). Note that different products manufactured in the workshop may use the same fibre input. Thus, the final column indicates the total amount of each input required to manufacture all of the workshop products needed, and so provides a guide to the workshop production manager about what fibre inputs he needs to source.

The third section of a workshop sheet — ***Section '3. Fibre input prices/costs'*** — sets out the purchase cost for each of the inputs purchased which is calculated from the physical amount in the input/output table and the price of the input which comes from the ***prices*** sheet. This price is also reported in this section in the right-hand column. Note that some workshops that do not purchase in inputs (that is, uses intermediate inputs from other workshops) will not have this section on their workshop sheet.

The fourth section of a workshop sheet is ***Section '4. … workshop costs'***. Each product manufactured in the workshop has a series of cost categories listed in separate columns from Column E. These are: workshop allocated costs by type; workshop direct costs — non fibre; workshop direct costs — fibre costs; and finally total workshop costs with and without allocated mill overheads.

The fifth section of a ***workshop*** sheet — ***Section '5. Revenues'*** — lists the price, amount and revenues from the final outputs from the workshop. Because most workshops will not have final outputs, then this section will not appear in most workshop sheets.

The sixth section of a workshop sheet — ***Section '6. Total … workshop costs and revenues'*** — lists the aggregate revenue and cost categories for the entire workshop, rather than for individual products.

The seventh section of a workshop sheet is ***Section '7. Value added for … '***. It has three rows and two columns. The three rows are for the: value of all inputs to the workshop (purchased or otherwise); value of all outputs from the workshop (sold or otherwise); and the value added (the value of outputs minus the value of inputs. More details about how these values are calculated are set out in Section 5.2.4. The first column (Column E) lists these values excluding value added and profit taxes, while the second column (Column G) lists these values including value added and profit taxes. The values for value added correspond with the items shown in Section C of the profit sheet.

5.7 CAEGsummary file and saving model results

For any particular model run or scenario, the **SAVERESULTS** subroutine macro saves the generated output sheets along with the input sheets in a file with the name specified in cell B8 on the ***front page*** worksheet. Note that this file will be located in the default *Excel* drive location on the user's computer. (Users can change this default location at any time in *Excel* through <<tools>>, <<options>>, <<general>> and specifying a new location in the default file location box.) Alternatively, the name in cell B8 may also include a specific path (e.g. C:\\mill runs\scenario1). The latter option may provide a more secure basis for identifying the exact location of the saved file. The net profit from this scenario along with the name of this model run is then recorded in a separate *Excel* file which is initially named by default as **c:\CAEGsummary.xls**.

When a new model scenario is run, the **SAVERESULTS** subroutine macro automatically enters the name of the model run in Column A, the net profit before tax in Column B, and the net profit after tax in Column C from the new model run into the **CAEGsummary** file. It then sorts the models into descending order of net profit after tax (namely based on the values in Column C). The latest model run is highlighted by shaded (coloured) cells to indicate how it compares with previous model runs. Appendix Figure 5.18 shows the output from an example **CAEGsummary** file indicating these features. Thus, the user is able to quickly identify how the model scenario compares with other scenarios and the 'optimal' scenario (in terms of net profits). The file containing the output and input sheets for this optimal model run can then be easily identified by the model name.

This file will be especially useful when considering alternative fibre input choices to produce a particular output. The user may delete any of the rows (that is, different model runs) without consequence. This is useful if the user wants to compare an entirely different set or group of model scenarios. There is no need to remove the coloured shading if these rows are complete as the **SAVERESULTS** subroutine macro will automatically do this before entering the results for a new model run.

Note that provision exists in cell C5 on the ***front page*** worksheet to change the path and name of the summary results file from the default **c:\CAEGsummary.xls** to another path and filename (both the path and filename must be specified). In this way, users can maintain several summary files which record the results of closely related model runs. It enables the user to direct the file to a specific path or location allowing it to be easily found at a later stage.

Each saved file can exceed 1 megabyte in size. Thus, if a large number of runs are performed and there is limited storage capacity on the system, the size of the files may become an issue. One way to markedly reduce the size of the files is to save and run files without the macros. This can be achieved by copying all worksheets to a new workbook which will effectively save the file without the macros. To run a new model run from the (non-macro) file, click on the macro buttons which will simply use the macros of the same name in the other file. The saved file, as with the original file, will be the smaller file containing no macros. In this way, numerous model runs can be performed with saved files of a much smaller size.

Part C — Advanced Usage

(Sections 5.8 and 5.9)

This part of the manual provides details on how to access the Visual Basic code and how to change some of the endogenous parameters in the model both at run time and in model development. Normal model users will not need to access this section other than as (advanced) specification information on the model. However, it does describe the **endogenous parameters** *sheet which allows users to change endogenous model parameters without recourse to the Visual Basic code.*

5.8 Visual Basic programs

The *Excel* spreadsheet is used primarily as an input and output platform with all of the computations undertaken in *Visual Basic* programs as program macros. The macro programs can be accessed and reviewed by clicking on 'tools' and then 'macros' on the *Excel* main menu bar. In addition to the macro programs, there are also various subroutine programs called by these macros. The macro programs can be classified into various groups which are described below.

5.8.1 Main program macros

The two most important macros in the program are the MAIN macro and the INPUTSHEET macro as described below:

- MAIN: The main program uses information from the input sheets to calculate all of the costs, revenues and physical amounts. It contains a series of subroutines — one for each output sheet — to generate the output. Note that it also deletes the existing output sheets prior to a new model run being generated, which is necessary to avoid *Microsoft Excel* errors being generated in having output sheets of the same name. (Note that the *Windows/Excel* warning message 'Delete output sheet permanently' will appear on a number of occasions as the sheets are being deleted, and just require that OK be clicked.) This macro can be run by clicking a macro button with the label of 'CREATE OUTPUT SHEETS' on either the ***CAEGWOOL home***, ***front page***, or ***overhead cost coefficients*** sheets. Once the output sheets have been created, the value in cell F8 on the ***product design*** sheet is made blank to signify that it is not a new scenario (this avoids any errors for the next time the 'CREATE OUTPUT SHEETS' button is pressed.
- INPUTSHEET: Used to construct/format ***workshop costs***, ***prices***, ***cost coefficient***, and ***yield coefficient*** sheets from the information contained on the ***front page*** and ***product design*** sheets. The main purpose is to simplify the input sheets to the maximum extent possible and to minimise misunderstanding and transcription errors by, for example, including only products from the ***product design*** sheet and highlighting their labels. This macro can be run by clicking a macro button with the label of 'CREATE INPUT SHEETS' on the ***product design*** sheet.

5.8.2 Calculation subroutine programs called by main macro

The main macro program calls various subroutine programs to perform a variety of calculations. These subroutine programs can be accessed at the end of the main macro program. These include:

- OHEADCOST — reads in overhead costs and allocates overhead costs to products and workshops
- ENTERFINALOUTPUTAMOUNTS — reads in final outputs as specified on ***front page*** sheet
- ENTERPRICEDDATA — reads in information from ***prices*** sheet
- ENTERYIELDCOEFFICIENT — reads in yield coefficients from ***yield coefficient*** sheet
- ENTERCOSTCOEFFICIENT — reads in cost coefficients from ***cost coefficient*** sheet
- MODIFYVALUEADD — modifies value of outputs and value of inputs at each stage to allow for value added tax and profit tax
- PHYSICALC — calculates inputs required and intermediate outputs produced based on final outputs, product design and yield coefficients
- ENTERFINALOUTPUTAMOUNTS — reads in final outputs as specified on ***front page*** sheet.

5.8.3 Output worksheet subroutines called by main macro program

After entering input data and calculating physical amounts, the main macro program calls various subroutine programs that generate the output worksheets. Specifically the following subroutine macros (located at the end of the main macro program) generate the worksheets of the same name:

- **PHYSICAL**
- **PROFIT**
- **COSTDETAILS**
- **REVENUEDETAILS**
- **INTERMEDIATE PRICE**
- **FINISHING**
- **WEAVING**
- **SPINNING**
- **RECOMBING**
- **TOPMAKING**
- **SCOURING**
- **SORTING.**

5.8.4 Macros and subroutine macro programs used to save model results and prepare worksheets for new model run

The **SAVERESULTS** subroutine macro that is called from the **MAIN** macro saves the model as a ***Microsoft Excel*** workbook with user specified name on the ***front page*** sheet. The subroutine also records the model name together with the net profit before tax and the net profit after tax on the CAEGsummary workbook which records all model runs, and highlights and sorts the new model run (according to net profit after tax) on this workbook.

The following two macros are important in preparing the model for a new model run and for clearing input sheets to enter a new product design.

- **DELETEOUTPUTSHEETS**: This macro deletes existing output sheets prior to a new model run (necessary to avoid errors being generated in the **MAIN** macro which generates output sheets of the same name). Normally the macro is called as a subroutine from the **MAIN** macro program. However, the macro can also be run independently by clicking on the '**CREATE OUTPUT SHEETS**' on the ***CAEGWOOL home*** sheet of the **MAIN** macro to delete existing output sheets. When the macro is run from the '**DELETE OUTPUT SHEETS**' button on the ***CAEGWOOL home*** sheet, it sets the value in cell F8 on the ***product design*** sheet to '1' to signify that there are no output sheets and that the model is now set up to run a new scenario. 'Delete output sheet permanently' will appear on a number of occasions as the sheets are being deleted, and just require that OK be clicked.
- **CLEARINPUTSHEETS**: Used to clear particular cells on input sheets in preparation for a new product design.

5.8.5 Macros associated with product design sheet

There are a series of macro programs designed to determine what products need to be specified on the product design sheet. A series of subroutines then create the blank proformas for these products on the product design sheet. These macros include:

- **PRODUCTDESIGN**: Clears the ***product design*** sheet and then calls on the program macros below to create the blank proformas for the final outputs recorded on ***front page*** sheet.
- **PDYARN**: Determines what yarn input proformas are required and calls on **YARNPD** macro to create these proformas.
- **PDFTOP**: Determines what finished top input proformas are required and calls on **FTOPD** macro to create these proformas.
- **PDRTOP**: Determines what raw top input proformas are required and calls on **RTOPD** macro to create these proformas.
- **PDSWOOL**: Determines what scoured wool input proformas are required and calls on **SWOOLD** macro to create these proformas.
- **PDGWOOL**: Determines what greasy wool input proformas are required and calls on **GWOOLD** macro to create these proformas.
- **PDGWOOL**: Determines what greasy wool input proformas are required and calls on **GWOOLD** macro to create these proformas.

The macro programs above call specific subroutines described below that create the product proformas. The subroutines can be accessed via the relevant macro program (e.g. access **YARND** through the **PDYARN** macro program).

- **FABRICDESIGN**: Creates a blank proforma/form in Columns A and B of the ***product design*** sheet for inputting data on a specific fabric.
- **YARND**: Creates a blank proforma/form in Columns D and E of the ***product design*** sheet for inputting data on a specific yarn.
- **FTOPD**: Creates a blank proforma/form in Columns G and H of the ***product design*** sheet for inputting data on a finished top.
- **RTOPD**: Creates a blank proforma/form in Columns J and K of the ***product design*** sheet for inputting data on a specific raw top.
- **SWOOLD**: Creates a blank proforma/form in Columns M and N of the ***product design*** sheet for inputting data on a specific scoured wool.
- **GWOOLD**: Creates a blank proforma/form in Columns D and E of the ***product design*** sheet for inputting data on a specific yarn.

Apart from these macros, there are a series of other macros called **FABRICDESIGNRESET**, **YARNDESIGNRESET**, **FINISHEDTOPDESIGNRESET**, **RAWTOPESIGNRESET**, **SCOUREDWOOLDESIGNRESET** and **GREASYWOOLDESIGNRESET**, which are designed to clear or reset the product input proformas on the ***product design*** sheet if an error is made and the user wants to input a completely new design. These reset macros can be run by clicking on the '**R**' macro button at the top of the relevant column on the ***product design*** sheet.

The macros use a large number of variables many of which are common to all macros. Note, however, that a full description of all the variables appears at the start of the **MAIN** macro where all variables are used.

5.9 Endogenous input values and *endogenous parameters* sheet

There are several areas in the model where the values for particular inputs are calculated endogenously. That is, automatic values will appear on the input sheets based on calculations performed within the model and according to specifications/attributes of the product entered on the ***product design*** sheet. These values are not intended to be definitive but rather to provide a useful guide for users of the model as they are entering various input parameters. Indeed, they are based on empirical sector wide analysis and so cannot be expected to relate directly to any one particular mill.

The main inputs for which endogenous values are calculated or could be considered for calculation are: prices; product cost coefficients; yield coefficients; and overhead cost coefficients. The estimation of some of these endogenous values has been based on detailed empirical analysis, which is reported in Chapters 2 to 4. This section outlines how and where the findings from these empirical analyses are included in the model and how they can be modified by the user to account for mill specific analyses.

In essence, the endogenous values are calculated within the **INPUT SHEETS** macro. The endogenous values are based on product attributes specified on the ***product design*** sheet. These values may be estimated by structural equations with the product attributes as independent variables, or alternatively the product attributes may sort the product into a particular group or type which has a particular (endogenous) value associated with it.

The *Visual Basic* code highlights where these values are calculated within the input sheets macro by delineating the sections with asterisks (*****) and through relevant comment lines. The variables in the structural equations or that relate to particular product groups are linked to values on the ***endogenous parameters*** sheet. This sheet — described below — lists key values which the user has the opportunity to enter or modify. Thus, the user has easy access to refining or tailoring the parameters to their specific case if they have the relevant information. However, more fundamental changes — such as different functional forms — may require that the relevant *Visual Basic* code in the highlighted sections of the **INPUT SHEETS** macro be modified.

Note that most users and most model runs will not need to refer or make entries/changes on this ***endogenous parameters*** sheet as they are used only to provide default or guide values on the input sheets and users can still make run-time changes to these input values on the relevant input worksheets. Thus, the ***endogenous parameters*** sheet is designed merely to provide the user with some (easy) control over these endogenous values, especially where these values are likely to vary with changes in the marketing environment or if they are specific to individual mills.

5.9.1 Endogenous parameters sheet

As mentioned, this input sheet is optional and, indeed, in most cases will not need to be completed. The sheet is divided into three sections, namely '**1. Prices**'; '**2. Cost coefficients**'; and '**3. Yield coefficients**'. The three sections are further broken down into the different processing stages (such as 'top making') or products (such as 'yarn'). Each of these processing stage/product rows contains provision for the entry of up to 10 model parameters, which can be changed to endogenously calculate some of the values on the input sheets (such as prices, product cost coefficients, yield coefficients) without having to change them in the source program code in the **INPUT SHEETS** macro.

Each of the parameters on this sheet is defined in a set of three cells. The first cell is a label such as '**A**' or '**B**', the second is a yellow shaded cell, and the third is a blue shaded cell. The label can be altered by the user or model developer to reflect the parameter or category as in the case of '**<60S**' in the spinning row of the cost coefficients in the standard model. The yellow shaded cell is used to specify default values for these parameters, or values that will remain the same for different model runs. (In the case of the '**<60s**' parameter mentioned above, see the value of '0.9' in the yellow cell immediately to the left.) The blue shaded cell allows the user to change the value of the parameter for the particular model run. Note that model developers can also write the structural equations used to estimate the endogenous values, although these are only used to report these equations for the benefit of the user and not used directly by the model to calculate these values.

The values entered in the blue or yellow shaded cells are used to generate the endogenous values that appear in the blue cells on the various input worksheets when the CREATE INPUT SHEETS macro button is clicked. The endogenous values generated are a guide only and users can still enter changes to the specific cost and yield coefficients or prices at run time on the particular input worksheet (e.g. specific yield coefficients can be entered by overtyping the values in the blue cells on the ***yield coefficients*** worksheet).

Furthermore, because these parameters are used in the INPUT SHEETS macro, they need to be entered prior to the CREATE INPUT SHEETS macro button being clicked.

5.9.2 Prices

One area well suited to the estimation of endogenous values in the model is product prices. Individual products — whether they be fabric, yarn, top, scoured wool or greasy wool — contain various traits or attributes. The price that a consumer or user is prepared to pay for a particular product depends on the attributes contained in the product and the value the user places on each of these attributes. Thus, if information is available on product attributes as well as the value of these attributes, the price of the composite product can be estimated. Various studies have used secondary market data and hedonic price analysis or other types of analysis to determine the value or implicit prices of these attributes. Furthermore, mills can use their own historical data on prices received or prices paid to determine these implicit values.

The INPUT SHEETS macro uses the information on product attributes and some postulated relationships between product attributes and product price to estimate endogenous prices in the model. These price relationships or equations are highlighted in the asterisk delineated sections in the INPUT SHEETS macro and are also listed on the ***endogenous parameters*** sheet. As mentioned above, this sheet allows values in these equations to be changed to suit the relationships that exist at a particular mill, and also to be updated with new information and new analysis. One feature of wool product prices is that they can vary significantly across years. Thus, endogenous prices derived from, say, a relationship calibrated against year 2000 prices may bear little relation to prices in, say, 2004. This can be in terms of both the absolute level of prices and also in the differentials that exist between different types/qualities of product. An attempt to address these variations is allowed for in the ‘pbase’ and ‘pvar’ variables listed on the first row of Section 1 (‘1. Prices’) of the ***endogenous parameters*** sheet. As shown, by default these have a value of ‘1’ indicating that the absolute level of prices and the variation across types is the same as in the calibration year (2000). However, if say prices are 30% higher than in the calibration year, then a value of 1.3 should be entered in the blue shaded cell beside the ‘pbase’ variable. Similarly, if the variation between products falls by 20%, then a value of ‘0.8’ should be entered beside the ‘pvar’ variable. The equations on page 52 show how these variables then influence the endogenous prices.

5.9.3 Product cost coefficients

One major feature of the model, and issue of major concern to mills, is the allocation of workshop costs to particular products. Mills do not have much information to determine these coefficients and studies such as those reported in Chapter 2 are an attempt to estimate these coefficients.

The cost coefficients will be a function of the various product attributes, making them amenable to endogenous estimation within the model. Furthermore, given that mills have very little information on which to base their estimates of cost coefficients, there will be a demand and need to report these coefficients. Conversely, because the cost coefficients will be specific to and dependent on mill practices, the value of universally determined, endogenously determined cost coefficients may be limited. Nonetheless, they should provide a guide for mills in specifying mill specific cost coefficients on the ***product cost coefficient*** sheet.

The endogenous product cost coefficients can be found and modified on the ***endogenous parameters*** sheet or in the INPUT SHEETS macro in the same way the endogenous prices were (as described in Section 5.9.2). In the preliminary 2004 version of the model, only coefficients for spinning and weaving have been determined. These are based on products falling within an attribute range rather than based on a structural equation. For more details about the estimation of these product cost coefficients, see Chapter 2.

5.9.4 Yield coefficients

Yield coefficients can again be crucial in determining the relative costs and returns from particular types of product. As indicated in Chapter 3, data issues mean that estimating yield coefficients is more feasible than estimating product cost coefficients. However, because the variation in yield coefficients is less, and because it can depend on non-product characteristics, their endogenous derivation based on attributes specified on the product specifications from the ***product design*** sheet may be more problematic. Thus, in the 2004 preliminary version of the model, yield coefficients are specified on a workshop basis. However, the structure exists both within the ***endogenous***

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parameters sheet and the **INPUT SHEETS** macro to incorporate product specific endogenous yield coefficients or structural equations that determine these coefficients if they can be identified. Further details of the estimation of these endogenous yield coefficients are described in Chapter 3.

5.9.5 Overhead cost coefficients

Because general mill overheads can be a large proportion of overall costs, overhead cost coefficients may be crucial in allocating these large costs to individual products. However, these overhead cost coefficients are less amenable to estimation based on statistical methods observed for the yield and product cost coefficients. It is more likely that users (mill managers) will specify these ***overhead cost coefficients*** directly on the overhead cost coefficients sheet based on their experience or understanding of general mill resources used to service the manufacture of specific products. Thus, the model by defaults sets these values at '1' (that is, overhead costs allocated according to throughput). Nonetheless, if analysis can reveal relationships between product attributes and these overhead cost coefficients, endogenous derivation of these coefficients could be effected through the **INPUT SHEETS** macro.

In the January 2004 standard version of the model, the following relationships are specified:

- *Finished fabric price = 0.1 + 40 * pbase + ((400 – fabric weight) * 0.15 + (wool% – 100)*0.1)*pvar*
- *ECRU fabric price = 0.1 + 25 * pbase + ((400 – fabric weight) * 0.15 + (wool% – 100)*0.1)*pvar*
- *Yarn price = 0.1 + 80 * pbase + ((wool% – 100) * 0.4 + (count-40) * 0.25)*pvar*
- *Finished top price = 0.1 + 50 * pbase + ((22 – micron) * 8 + (length-90) * 0.3 – domwool*–15)*pvar*
- *Raw top price = 0.1 + 45 * pbase + ((22 – micron) * 8 + (length-90) * 0.3 – domwool*–12)*pvar*
- *Scoured wool price = 0.1 + 35 * pbase + ((22 – micron) * 8 + (length-90) * 0.3 – domwool*–10)*pvar*
- *Greasy wool price = 0.1 + 25 * pbase + ((22 – micron) * 8 + (length-90) * 0.3 – domwool*–10)*pvar*

where *pbase* and *pvar* are defined in Section 5.9.2, and where *domwool* is a dummy variable equal to 1 for domestic wool and 0 for Australian wool.

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6. Mill Scenarios

THE CAEGWOOL model presented in Chapter 5 is designed to evaluate the economic impacts for wool textile mills of particular mill decisions or the impacts of changes in the marketing or technological environment. CAEGWOOL has been specifically designed to apply to individual mills rather than a generic broad group of mills by enabling mills to input their own set of data and circumstances. Thus, this chapter presents a series of model runs or scenarios to demonstrate how individual mills can use CAEGWOOL to assess the economic impact of various decisions or changes.

6.1 Base scenario

To illustrate the capability of CAEGWOOL to consider various mill decisions, a base scenario was developed and the results compared with a range of alternative scenarios.

The case considered is of an integrated spinning/weaving worsted mill that produces finished fabrics from raw tops. The mill has a recombing/dyeing workshop, a spinning workshop, a weaving workshop and a finishing workshop. In the base scenario some of the fibre inputs used at intermediate stages are produced by the mill while others are purchased.

The final output is 4000 metres of finished fabric. The product design to produce the fabric is shown in the product design sheet in Figure 6.1. In essence, the final output draws on blended wool yarns and tops that have been produced within the mill or purchased from outside.

A series of scenarios has been devised and the results presented in Tables 6.1 to 6.6 and discussed in Sections 6.2 to 6.4. The base scenario is labelled as Scenario 1 and is compared with 11 other scenarios. As Chapter 5 revealed, CAEGWOOL presents an extensive and detailed set of output sheets. For space

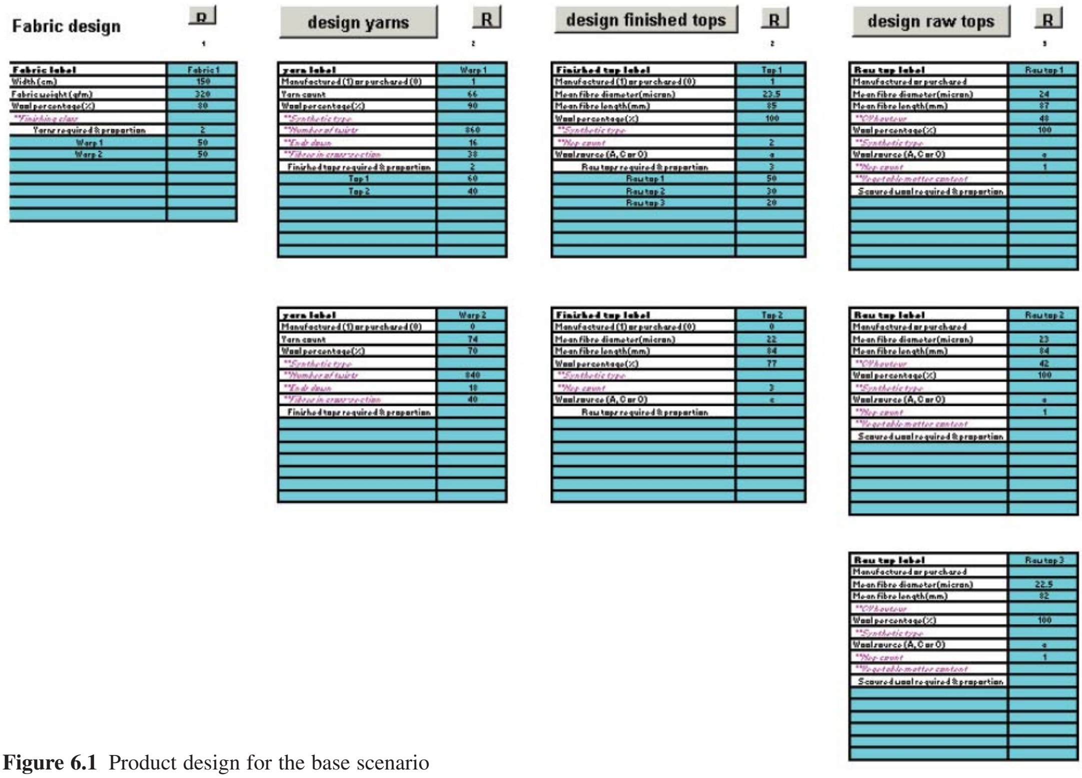

Figure 6.1 Product design for the base scenario

Table 6.1 General price scenarios

Scenario	(1) Base scenario	(2) Prices –25%	(3) Price levels and differentials –25%
Profit Statement (Rmb)			
1 Total revenue	**200 658.22**	**160 658.22**	**150 658.22**
Final output	200 400.00	160 400.00	150 400.00
By-products	258.22	258.22	258.22
2 Total manufacturing costs	**134 146.74**	**111 975.35**	**113 988.21**
Workshop allocated	47 271.62	47 271.62	47 271.62
Direct — non-fibre	6 100.00	6 100.00	6 100.00
Direct — fibre	80 775.12	58 603.73	60 616.58
3 Manufacturing profit (= 1 – 2)	**66 511.48**	**48 682.87**	**36 670.01**
4 Mill overhead costs	**47 484.48**	**44 270.65**	**41 605.88**
Interest	2 965.97	3 042.66	2 966.05
Value-added taxes	20 261.13	16 343.41	14 381.74
Taxes other than for profit or value added	741.49	760.66	741.51
Depreciation	8 474.20	8 693.31	8 474.44
General mill expenses	5 931.94	6 085.31	5 932.11
Sales and marketing	5 296.37	5 433.32	5 296.53
Other mill overheads	3 813.39	3 911.99	3 813.50
5 Profit before tax (= 3 – 4)	**19 027.00**	**4 412.22**	**–4 935.86**
6 Profit tax	**6 278.91**	**1 456.03**	**0.00**
7 Profit after tax (= 5 – 6)	**12 748.09**	**2 956.18**	**–4 935.86**
Contract prices and service fees (Rmb/metre)			
Contract price (Rmb)	**52.38**	**45.75**	**46.12**
Service fee (Rmb)	**27.29**	**27.54**	**27.29**

Table 6.2 Input and output price scenarios

Scenario	(1) Base scenario	(4) Fabric prices –25%	(5) Input prices +25%
Profit Statement (Rmb)			
1 Total revenue	**200 658.22**	**160 658.22**	**200 658.22**
Final output	200 400.00	160 400.00	200 400.00
By-products	258.22	258.22	258.22
2 Total manufacturing costs	**13 4146.74**	**134 146.74**	**156 318.13**
Workshop allocated	47 271.62	47 271.62	47 271.62
Direct — non-fibre	6 100.00	6 100.00	6 100.00
Direct — fibre	80 775.12	80 775.12	102 946.51
3 Manufacturing profit (= 1 – 2)	**66 511.48**	**26 511.48**	**44 340.09**
4 Mill overhead costs	**47 484.48**	**39 537.93**	**43 194.75**
Interest	2 965.97	2 841.05	2 812.63
Value-added taxes	20 261.13	13 461.13	17 378.85
Taxes other than for profit or value added	741.49	710.26	703.16
Depreciation	8 474.20	8 117.29	8 036.08
General mill expenses	5 931.94	5 682.10	5 625.26
Sales and marketing	5 296.37	5 073.31	5 022.55
Other mill overheads	3 813.39	3 652.78	3 616.24
5 Profit before tax (= 3 – 4)	**19 027.00**	**–13 026.45**	**1145.34**
6 Profit tax	**6 278.91**	**0.00**	**377.96**
7 Profit after tax (= 5 – 6)	**12 748.09**	**–13 026.45**	**767.38**
Contract prices and service fees (Rmb/metre)			
Contract price (Rmb)	**52.38**	**51.97**	**58.77**
Service fee (Rmb)	**27.29**	**26.88**	**26.79**

Table 6.3 Contract prices and service fees for different profit margins

	Base Scenario (profit margin 10%)	Profit margin 5%	Profit margin 15%
Contract price (Rmb/metre)	52.38	48.22	56.68
Service fee (Rmb/metre)	27.29	25.12	29.53

Table 6.4 Tax scenarios

Scenario	(1) Base scenario	(6) No VAT	(7) Profit tax 10%
Profit Statement (Rmb)			
1 Total revenue	**200 658.22**	**200 658.22**	**200 658.22**
Final output	200 400.00	200 400.00	200 400.00
By-products	258.22	258.22	258.22
2 Total manufacturing costs	**134 146.74**	**134 146.74**	**134 146.74**
Workshop allocated	47 271.62	47 271.62	47 271.62
Direct — non-fibre	6 100.00	6 100.00	6 100.00
Direct — fibre	80 775.12	80 775.12	80 775.12
3 Manufacturing profit (= 1 – 2)	**66 511.48**	**66 511.48**	**66 511.48**
4 Mill overhead costs	**47 484.48**	**27 223.35**	**47 484.48**
Interest	2 965.97	2 965.97	2 965.97
Value-added taxes	20 261.13	0.00	20 261.13
Taxes other than for profit or value added	741.49	741.49	741.49
Depreciation	8 474.20	8 474.20	8 474.20
General mill expenses	5 931.94	5 931.94	5 931.94
Sales and marketing	5 296.37	5 296.37	5 296.37
Other mill overheads	3 813.39	3 813.39	3 813.39
5 Profit before tax (= 3 – 4)	**19 027.00**	**39 288.12**	**19 027.00**
6 Profit tax	**6 278.91**	**12 965.08**	**1 902.70**
7 Profit after tax (= 5 – 6)	**12 748.09**	**26 323.04**	**17 124.30**
Contract prices and service fees (Rmb/metre)			
Contract price (Rmb)	**52.38**	**46.08**	**50.24**
Service fee (Rmb)	**27.29**	**22.87**	**26.17**

reasons, however, only a concise version of the ***profit*** sheet (namely the profit statement and contract and service prices) are provided for each scenario in order to highlight some of the key variations between the scenarios.

6.2 Varying prices

One of the main challenges for Chinese wool textile mills is dealing with variable output and input prices. In Table 6.1, two variable price scenarios are presented along with the base scenario (Scenario 1). In the first price scenario — Scenario 2 — the prices of both fibre inputs and textile outputs are reduced by 25%. In the second price scenario — Scenario 3 — the price levels for fibre inputs and outputs are reduced by 25%.[6]

Comparing Scenario 2 with the base scenario, the fall in fabric prices of 25% reduces revenue from the order by around Rmb40 000. However, fibre input prices also fall by 25% and, being a large part of overall costs, reduce direct fibre costs by around Rmb22 000. After taking into account lower value-added taxes, net revenues before profit tax falls by around Rmb15 000 and by about Rmb10 000 after profit taxes.

In Scenario 3, a reduction in quality price differentials of 25% accompanies the fall in price levels of 25%. Given the nature of the product, the product design, and the existing price differentials

[6] These scenarios are easily handled in the CAEGWOOL input sheets by inputting values (0.75) in the blue shaded cells for 'Pbase' and 'Pvar' at the top of the ***endogenous parameters*** sheet.

Table 6.5 Cost scenarios

Scenario	(1) Base scenario	(8) Overheads –25%	(9) Labour costs +25%
Profit Statement (Rmb)			
1 Total revenue	**200 658.22**	**200 658.22**	**200 658.22**
Final output	200 400.00	200 400.00	200 400.00
By-products	258.22	258.22	258.22
2 Total manufacturing costs	**13 4146.74**	**134 146.74**	**140 264.53**
Workshop allocated	47 271.62	47 271.62	53 389.41
Direct — non-fibre	6 100.00	6 100.00	6 100.00
Direct — fibre	80 775.12	80 775.12	80 775.12
3 Manufacturing profit (= 1 – 2)	**66 511.48**	**66 511.48**	**60 393.69**
4 Mill overhead costs	**47 484.48**	**40 678.64**	**47 484.48**
Interest	2 965.97	2 224.48	2 965.97
Value-added taxes	20 261.13	20 261.13	20261.13
Taxes other than for profit or value added	741.49	556.12	741.49
Depreciation	8 474.20	6 355.65	8 474.20
General mill expenses	5 931.94	4 448.95	5 931.94
Sales and marketing	5 296.37	3 972.28	5 296.37
Other mill overheads	3 813.39	2 860.04	3 813.39
5 Profit before tax (= 3 – 4)	**19 027.00**	**25 832.84**	**12 909.21**
6 Profit tax	**6 278.91**	**8 524.84**	**4 260.04**
7 Profit after tax (= 5 – 6)	**12 748.09**	**17 308.00**	**8 649.17**
Contract prices and service fees (Rmb/metre)			
Contract price (Rmb)	**52.38**	**49.95**	**54.57**
Service fee (Rmb)	**27.29**	**24.86**	**29.48**

Table 6.6 Technology scenarios

Scenario	(1) Base scenario	(10) Yield coefficients +0.01 *(1 percentage point)*	(11) Weaving cost coefficients –25%; Workshop depreciation +50 000	(12) Micron –1; Hauteur –10 mm
Profit Statement (Rmb)				
1 Total revenue	**200 658.22**	**200 556.79**	**200 658.22**	**200 658.22**
Final output	200 400.00	200 400.00	200 400.00	200 400.00
By-products	258.22	156.79	258.22	258.22
2 Total manufacturing costs	**134 146.74**	**131 743.49**	**130 347.09**	**135 586.36**
Workshop allocated	47 271.62	46 894.26	43 471.97	47 271.62
Direct — non-fibre	6 100.00	6 100.00	6 100.00	6 100.00
Direct — fibre	80 775.12	78 749.23	80 775.12	82 214.74
3 Manufacturing profit (= 1 – 2)	**66 511.48**	**68 813.30**	**70 311.13**	**65 071.86**
4 Mill overhead costs	**47 484.48**	**47 551.11**	**47 695.53**	**46 992.01**
Interest	2 965.97	2 944.16	2 965.97	2 932.70
Value-added taxes	20 261.13	20 527.89	20 472.18	20 073.98
Taxes other than for profit or value added	741.49	736.04	741.49	733.18
Depreciation	8 474.20	8 411.90	8 474.20	8 379.15
General mill expenses	5 931.94	5 888.33	5 931.94	5 865.41
Sales and marketing	5 296.37	5 257.44	5 296.37	5 236.97
Other mill overheads	3 813.39	3 785.35	3 813.39	3 770.62
5 Profit before tax (= 3 – 4)	**19 027.00**	**21 262.19**	**22 615.60**	**18 079.86**
6 Profit tax	**6 278.91**	**7 016.52**	**7 463.15**	**5 966.35**
7 Profit after tax (= 5 – 6)	**12 748.09**	**14 245.67**	**15 152.45**	**12 113.50**
Contract prices and service fees (Rmb/metre)				
Contract price (Rmb)	**52.38**	**51.65**	**51.10**	**52.72**
Service fee (Rmb)	**27.29**	**27.19**	**26.01**	**27.18**

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between product types, an overall loss for the order of Rmb4935 arises. The main reason for the loss is the lower fabric price which results in a revenue of Rmb40 000 lower than the base scenario and Rmb10 000 lower than Scenario 2.

The scenarios in Table 6.1 assume that the prices for wool inputs and wool textile outputs follow the same patterns. Although a relationship between wool prices and wool textile prices can be expected, they also operate in quite distinct markets and are subject to different sets of supply and demand forces. For instance, wool prices are markedly affected by supply conditions and relative livestock product prices in the major wool-growing countries, while wool textile prices are governed primarily by consumer demand for apparel and other goods made from wool textiles. Thus, there have been numerous instances of wool textile prices moving independently of wool prices and vice versa. Scenarios 4 and 5 in Table 6.2 attempt to reflect these independent price movements.

In Scenario 4, fabric prices fall by 25% but fibre input prices remain the same. Compared with Scenario 2, the impact is quite marked. That is, revenues fall by Rmb40 000 but are not compensated for by a fall in fibre input costs. Consequently, the overall impact is a loss on the order of Rmb13 026. Scenario 5 reflects the situation that arose in 2002 where fabric prices remained virtually the same while wool input prices rose by 25%. The results in Table 6.2 indicate that direct fibre costs rise to Rmb102 947 and result in a virtual break-even profit after tax of Rmb767.

6.3 Contract prices and service fees

The bottom section of Tables 6.1 and 6.2 lists 'contract prices' and 'service fees' determined by CAEGWOOL. These two items were defined in Section 5.2.4. Effectively the contract price is the price the mill needs to price the product in order to make a specified after tax profit or profit margin. In the base scenario, along with all the other scenarios in Tables 6.1 to 6.2 and Tables 6.4 to 6.6, this margin is set at 10%. Thus, in arriving at the contract price, all costs including apportioned mill overheads and net value added tax are taken into account along with the profit margin. The service fee is calculated in a similar manner to the contract price except that direct fibre costs are excluded. That is, it presumes that the mill customer supplies the fibre input and that the service fee represents all other costs for processing these fibre inputs including the specified profit margin.

Table 6.3 presents contract prices and service fees (as determined by CAEGWOOL) for the base scenario for the standard 10% profit margin as well as for profit margins of 5% and 15%.[7] Table 6.3 reveals that changing the profit margin can have a marked impact with contract prices varying from Rmb48.22 to Rmb56.68 and service fees from Rmb25.12 to Rmb29.53. The ability to identify or determine new contract prices or service fees as product design or other conditions change is a key output from the CAEGWOOL model and powerful tool for mill managers.

6.4 Varying taxes

The next set of scenarios considered and reported in Table 6.4 concerns varying taxes. There are a plethora of taxes that impact on the profitability of wool textile enterprises but the main taxes are the profit tax and the value added tax. As a key model parameter in CAEGWOOL, the treatment of these taxes in the model is described in more detail in Section 5.2.4. In general, a value added tax applies to sales at a rate of 17% with a rebate able to be claimed on specified inputs at a rate of 13%. A profit tax rate of 33% normally applies to pre-(profit) tax net revenues. However, in some circumstances usually related to products exported, an exemption to value added tax can apply. Similarly, although the profit rate of 33% is widely applied, the rate is dependent on aggregate enterprise (as opposed to individual order) profits, and can be varied in other circumstances. Thus, there is a need to examine the sensitivity of the model results to changes in these key tax parameters.[8]

Scenario 6 in Table 6.4 presumes that no VAT on outputs or rebate on inputs applies. The impact in Table 6.4 is shown in Section 4 ('Mill overhead costs') of the Profit Statement where combined value added taxes (tax on outputs minus rebate on inputs) is shown. Compared with the base scenario, the reduction in value added taxes increases profit before (profit) tax by around Rmb20 000. However, as profit taxes are calculated after consideration of value added taxes, the increase in profit after tax is less at around Rmb13 600.

In Scenario 7, profit taxes are reduced from the standard 33% to 10%. This may reflect the case of temporary tax relief support to a mill in a restructuring or transition phase. As shown in Table 6.4, the impact of this tax change is much less than the non-application of the value added taxes with taxes reduced (and profits increased) by around Rmb4400.

[7] The alternative scenarios were run by simply changing the default value on the relevant blue shaded input cell (cell B38) on the ***price input*** sheet.

[8] Provision is made on the ***price input*** sheet of the CAEGWOOL model to change these default value added and profit tax rates.

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6.5 Cost scenarios

One of the major factors of concern to mill managers is the control of costs. This is a major reason behind the detailed disaggregation of costs by workshop and type in the CAEGWOOL output reporting. Thus, there are numerous cost scenarios that could be considered, while the profit statement in Table 6.5 does not reveal the extent of cost disaggregation available in CAEGWOOL. However, to illustrate how some of these alternative costs may impact on mill profitability, two cost scenarios are compared with the base scenario.

In Scenario 8, overhead costs are reduced by 25%.[9] This may occur in a restructuring situation where an individual mill is brought into a group structure and where there may be cost economies for particular overheads.[10] The impact manifests itself in Table 6.5 in Section 4 of the profit statement with profits rising in this particular case by around Rmb4600.

Scenario 9 involves an increase in (non-managerial) labour costs of 25%. This may reflect growing economic opportunities and rise in wages for unskilled labour for wool textile mills in industrial east coast regions.[11] Because labour costs are a major proportion of all workshop allocated costs, the impact of the rise in labour costs in this particular case is similar to that of the change in overheads except in the opposite direction — namely profits around Rmb4000 lower than the base scenario.

6.6 Technical scenarios

Wool textile mills have sought to improve their profitability through the uptake of new technology and equipment and an improvement in operational practices. New technologies can impact in a number of ways: by reducing manufacturing costs; by increasing yields; or by combinations of increasing costs and increasing yields. Many new technologies involve substantial investments and have a number of impacts, making an economic assessment complicated. CAEGWOOL is designed to assist managers with this economic assessment.

Many different technical decisions warranting an economic assessment and of interest to mill managers could be identified. However, Table 6.6 provides a sample of just three scenarios. In Scenario 10, processing yields for all stages were increased by one percentage point.[12] As shown in Table 6.6, the higher yields reduce both the direct fibre costs (less fibre inputs are required to produce the order) as well as workshop allocated costs (as less fibre input has to be processed). Furthermore, mill overhead costs for the order are also reduced as the order now takes proportionately less of overall mill activity with the rising yields.

Scenario 11 presents the case of new equipment which may lower manufacturing costs but increase depreciation costs associated with the purchase of the new equipment.[13]

Scenario 12 relates more to fibre input/textile product selection than to technology per se. That is, there are a number of fibre input combinations that can produce a particular wool textile output. Spinning prediction models and ACIAR research such as that carried out in project AS1/1997/70 are designed to assist mills identify some of these combinations. Mills also draw on experience and other sources to identify the different product designs. The CAEGWOOL model can then assess the profitability and cost implications associated with the different product design. In the hypothetical case used in Scenario 12, product design was changed by having tops that were 1 micron finer to compensate for their hauteur being reduced by 1 cm.[14] Although the profit statement in Table 6.6 highlights the impact of this change, the full CAEGWOOL output is needed to observe the full range of impacts that this change in product design would have.

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[9] This scenario was set up by changing the values in the blue shaded cells on the ***overhead cost coefficients*** sheet to 0.25.

[10] Not all restructuring will reduce overheads. Situations of cumbersome management and governance structures combined with a desire to cross-subsidise losses within the group may potentially lead to overheads for some mills to increase.

[11] The rise in wages may be more than 25% as improved labour productivity and efficiency may partly offset rising wages.

[12] This was achieved by entering the new yields in the relevant blue shaded cells in Section 3 of the ***endogenous parameters*** sheet.

[13] This scenario was achieved by entering new values for the cost coefficients in the relevant blue shaded cells in Section 2 of the ***endogenous parameters*** sheet while at the same time increasing the overheads for weaving in Section 2 of the ***cost input*** sheet.

[14] The scenario was achieved by changing the parameters on the product design sheet, re-running the **CREATE INPUT SHEETS**, and then running the **CREATE OUTPUT SHEETS.**

7. Conclusions

CHINESE wool textile mills find themselves in the midst of a transition that includes changing ownership and governance structures, upgrading equipment and technology, and improving managerial and operational practices and analytic capabilities. Many mills are only now addressing the latter phase of transition and are seeking ways to effectively go about the process.

The remarkable ability of the Chinese economy and industry to adapt and change means that many of the current problems besetting the industry will undoubtedly be resolved in the future and a more robust and sophisticated industry can be expected. However, this does not mean that the transformation will be quick or smooth, or that enterprises cannot be assisted within this extremely dynamic environment.

In this rapidly changing environment, the presentation of one-off findings may be of limited value. Changing relative prices and cost structures can quickly outdate a static analysis. Furthermore, Chinese wool textile mills exhibit enormous diversity in sizes, structures, technology and operational practices. Thus, the series of analyses and models discussed in this report have been designed to be flexible and to be tailored to individual mills. Much of the emphasis has been on describing or illustrating the approach so that mills can apply the approach or model to their own set of circumstances.

To facilitate the adoption of the approaches by individual enterprises, the data requirements and output reporting associated with these approaches have been based around the information and processing systems that mills are familiar with now. However, as technology, processes and information systems change and become more sophisticated, there is also the need for these operational systems and decision-making aids to evolve. The emphasis in the report on explaining the approach is to encourage and enable participants within the Chinese wool textile industry to refine, adapt, and develop these approaches as conditions and systems change in the future. The intention has also been to provide a sufficiently general and flexible framework to facilitate the development of these models and analyses.

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Appendix 1
Abstract for ACIAR Project ASEM/1998/60

RECENT economic reforms and market developments pose major challenges for the viability of the vast majority of Chinese wool textile mills. To ensure their long-term future, Chinese mills must adapt to the changing market and policy environment and improve the efficiency of their operations.

The primary goal of this project, ASEM/98/60, is to improve the long-term viability of Chinese wool textile mills. Ways to improve viability are to be identified through an economic analysis of mill fibre-input/textile-product selection and effluent treatment technologies. The analysis will adopt a whole-mill approach that takes the entire operation of the mills into account including the source of their fibre inputs and the markets for their textile products. A modelling framework, designed to experiment with various alternative mill management strategies, will incorporate findings from the processing prediction and effluent treatment research of Projects AS1/97/70 and AS1/97/69. However, the modelling framework will also draw upon a detailed synthesis of other operations of the mills, and a thorough analysis of their cost and revenue structures.

Project ASEM/98/60 is structured around this whole-mill approach. The core of the analysis is the *development of an economic modelling framework that synthesises operations of the mill*, and this forms the basis of ***Sub-project 1***. The modelling framework will be of sufficient detail to determine the impact of fibre-input/textile-product selection, effluent treatment, and other management decisions on mill profitability. Specific mills will be used as case studies to develop the economic models. Mills associated with Projects AS1/97/70 and AS1/97/69 will first be considered to maximise the synergies between the suite of ACIAR wool textile projects. However, other mill case studies will be needed to generalise the models and analysis to a broad range of mill types in China.

Mill managers seeking to tailor their manufacturing systems to improve mill profitability *require a thorough understanding of what their users want in terms of the relative value and importance that they place on particular attributes of the mill's products*. This is the basis of Sub-project 2. The emphasis in ***Sub-project 2*** is on the derived demand for intermediate textile products (such as yarns and fabrics). Mills need to determine their immediate manufacturing strategies in the full knowledge of end-user requirements. However, in the longer term, the derived demand for intermediate textile products will reflect changes in consumer preferences for final textile products. A detailed survey of consumer preferences is beyond the scope of this project. Nevertheless, information about the long-term trends in final consumer tastes and preference is crucial to the long-term viability of the wool textile mills. Consequently, Sub-project 2 will include a detailed review of all available information on trends in consumer tastes and preferences.

Mill managers can use the processing prediction research embodied in projects such as AS1/97/70 to identify the fibre inputs best suited to manufacture the textile products that are in greatest demand or that attract the highest prices. However, the profitability for mills of these higher-value products depends on the relative cost of fibre-inputs used to manufacture them. Furthermore, to take advantage of the processing prediction research, mills must have access to sufficient supplies of accurately described fibre inputs. Project ASEM/98/60 will *examine the supply pathways to these mills*. ***Sub-project 3*** analyses the supply pathways for domestic wool, while ***Sub-project 4*** examines the pathways for imported wool.

Investigation of the supply pathways will reveal the costs and availabilities of particular fibre inputs to mills to feed information into the economic modelling to be conducted as part of Sub-project 1. Both the domestic and imported supply chains for wool have impediments to mills receiving accurately specified wool on a reliable basis at least cost, and in a form that they could take advantage of the processing prediction research. For instance, existing supply pathways for Chinese domestic wool mean that mills often receive heterogeneous, poorly sorted raw wool for a price averaged over the different qualities. The analysis, therefore, will also have a normative focus in examining how administrative structures and contractual arrangements can be improved to minimise the transaction costs of getting the appropriate type and form of wool from suppliers to the mills.

Thus Project ASEM/98/60 involves direct collaboration with managers of selected mills, as well as Australian and Chinese scientists involved in the

ACIAR/CSIRO wool textile science projects. However, the project also calls for discussions and collaboration with many other groups in the wool textile marketing chain. The Research Centre for Rural Economy (RCRE) attached to the Ministry of Agriculture, as the Chinese collaborator on Project ASEM/98/60, will play a crucial role in facilitating and co-ordinating fieldwork and research across the various parts of the Project. The RCRE has a well-deserved reputation for academic excellence and the necessary connections to facilitate the fieldwork and to disseminate the findings. Agro-industrialisation, including natural fibre processing, is high on its research agenda.

Project ASEM/98/60 has had a long gestation, with many organisations such as the CSIRO Wool Technology Group, AFFA, IWS, Agriculture Victoria and the CRC for Premium Wool Production interested in some or all of the issues of the project. As the lead organisation on Project ASEM/98/60, the China Agricultural Economics Group at the University of Queensland has liaised, and will continue to liaise, extensively with these other interested parties. In addition, a 'China Wool Group' (involving researchers on projects AS1/97/70, AS1/97/69 and ASEM/98/60, the ACIAR program co-ordinators on these projects, as well as interested IWS and AFFA and other Australian government and wool industry officials) was established in September 1999. This forum provides a useful conduit for the exchange of information between the suite of ACIAR wool textile projects in China and associated organisations.

Australia is the main overseas supplier of wool to China, while China is Australia's largest wool export market. The long-term viability of Chinese mills is central to the interests of the wool and wool textile industries in both countries. The CSIRO/ACIAR wool textile science projects have the potential to improve the technical efficiency with which Chinese wool textile mills undertake particular operations. Project ASEM/98/60 takes the next two crucial steps of showing (a) how the output from these CSIRO/ACIAR projects can best be used to improve overall mill profitability; and (b) the measures needed in the textile-product and wool-supply chains to facilitate the application of these technologies and processes. Both a demonstration of how these technologies and processes can assist mill profitability and how the domestic and imported raw material supply chains can be improved, are important steps towards ensuring the adoption of these new technologies by Chinese wool mills.

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Appendix 2
Programs and regressions to estimate cost coefficients

Appendix 2.1 Macro to categorise orders and determine aggregate throughputs

```
Sub weavingcost3unit()
'
' weavingcost3unit Macro
' Macro recorded 5/28/2003 by Colin Brown
' sorts records into 3 weaving classes
' 1-pure wool (100%)
' 2-mid wool blend fabrics (70 to 99 % wool)
' 3-low wool blend fabrics (<70%)
'

 Dim wcount(800)
 Dim wwoolp(800)
 Dim wden(800)
 Dim wyield(800)
 Dim wtput(800)
 Dim wmonth(800) As Integer
 Dim class(800) As Integer
 Dim amount(12, 12)

 For i = 1 To 12
 For j = 1 To 6
 amount(i, j) = 0
 Next j
 Next i

 rcount = 2
 For i = 1 To 439
 wcount(i) = Cells(rcount, 4)
 wwoolp(i) = Cells(rcount, 8)
 wden(i) = Cells(rcount, 9)
 wtput(i) = Cells(rcount, 6)
 wmonth(i) = Cells(rcount, 1)
 wyield(i) = Cells(rcount, 7)
 If wwoolp(i) = 100 Then
 If wcount(i) > 69 Then
' If wden(i) > 299 Then
 class(i) = 1
 Else
 class(i) = 2
 End If
 Else
 If wwoolp(i) > 69 Then
 class(i) = 3
 Else
 class(i) = 4
 End If
 End If

' class(i) = 2
' End If
' Else
' class(i) = 2
' End If
' Else
' If wwoolp(i) > 56 Then
' class(i) = 3
' Else
' class(i) = 4
' End If
' End If
' If wcount(i) > 71 Then
' If wden(i) > 299 Then
' class(i) = 1
' Else
' class(i) = 5
' End If
' Else
' If wden(i) < 300 Then
' class(i) = 2
' Else
' class(i) = 5


' End If
' End If
' Else
' If wwoolp(i) < 56 Then
' If wden(i) < 300 Then
' class(i) = 4
' Else
' class(i) = 5
' End If
' Else
' If wcount(i) < 71 Then
' If wden(i) > 299 Then
' class(i) = 3
' Else
' class(i) = 5
' End If
' Else
' class(i) = 5
' End If
' End If
' End If
 Cells(rcount, 13) = class(i)
 Sum = amount(wmonth(i), class(i))
 amount(wmonth(i), class(i)) = amount(wmonth(i),
 class(i)) + wtput(i)
 amount(wmonth(i), 6 + class(i)) = amount(wmonth(i),
 6 + class(i)) + wtput(i) * wyield(i)
```


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```
 rcount = rcount + 1
 Next i

 For i = 1 To 12
 For j = 1 To 4
 amount(i, 6) = amount(i, 6) + amount(i, j)
 If (amount(i, j) = 0) Then
 Else
 amount(i, 6 + j) = amount(i, 6 + j) / amount(i, j)
 End If
 Next j
 Next i

 Sheets.Add.Name = ‘summary7’
 Sheets(‘summary7’).Select
 rcount = 5
 For i = 1 To 12
 Cells(rcount, 1) = i
 For j = 1 To 4
 Cells(rcount, j + 1) = amount(i, j)
 Cells(rcount + 14, j + 1) = amount(i, 6 + j)
 Next j
 Cells(rcount, 5) = amount(i, 6)
 rcount = rcount + 1
 Next i

 rcount = 5
 For i = 1 To 12
 For j = 1 To 4
 Cells(rcount, 6 + j) = amount(i, j) / amount(i, 6) * 100
 Next j
 rcount = rcount + 1
 Next i

’
End Sub
```


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Appendix 2.2 2-Categorisation weaving regressions

Appendix Table 2.2.1 Total weaving cost (2-type)

Dependent Variable:	TCOST
Method:	Least Squares
Date:	11/12/04 Time: 23:08
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	166186.0	29639.46	5.606919	0.0000
PURE	1.072551	0.148193	7.237519	0.0000
BLEND	1.346794	0.113860	11.82854	0.0000

R-squared	0.769538	Mean dependent var	496700.6
Adjusted R-squared	0.759295	S.D. dependent var	112047.7
S.E. of regression	54972.50	Akaike info criterion	24.72751
Sum squared resid.	1.36E+11	Schwarz criterion	24.84447
Log likelihood	–590.4604	F-statistic	75.12993
Durbin-Watson stat.	1.459408	Prob(F-statistic)	0.000000

Appendix Table 2.2.2 Variable weaving cost (2-type)

Dependent Variable:	VNDCOST
Method:	Least Squares
Date:	11/12/04 Time: 23:14
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	102624.4	22202.03	4.622295	0.0000
PURE	0.842133	0.111007	7.586299	0.0000
BLEND	1.145320	0.085289	13.42872	0.0000

R-squared	0.807848	Mean dependent var	375526.9
Adjusted R-squared	0.799308	S.D. dependent var	91918.57
S.E. of regression	41178.26	Akaike info criterion	24.14967
Sum squared resid.	7.63E+10	Schwarz criterion	24.26662
Log likelihood	–576.5921	F-statistic	94.59504
Durbin-Watson stat.	1.519351	Prob(F-statistic)	0.000000

Appendix Table 2.2.3 Labour weaving cost (2-type)

Dependent Variable: LCOST
Method: Least Squares
Date: 11/12/04 Time: 23:16
Sample: 1 48
Included observations: 48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	105593.1	17050.49	6.192962	0.0000
PURE	0.405683	0.085250	4.758733	0.0000
BLEND	0.524663	0.065499	8.010202	0.0000

R-squared	0.602706	Mean dependent var	
Adjusted R-squared	0.585049	S.D. dependent var	
S.E. of regression	31623.66	Akaike info criterion	
Sum squared resid.	4.50E+10	Schwarz criterion	
Log likelihood	–563.9198	F-statistic	
Durbin-Watson stat.	1.840320	Prob(F-statistic)	

Appendix Table 2.2.4 Electricity weaving cost (2-type)

Dependent Variable: ELCOST
Method: Least Squares
Date: 11/12/04 Time: 23:12
Sample: 1 48
Included observations: 48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	–12843.55	14932.73	–0.860094	0.3943
PURE	0.444359	0.074662	5.951644	0.0000
BLEND	0.533594	0.057364	9.301913	0.0000

R-squared	0.677211	Mean dependent var	120372.0
Adjusted R-squared	0.662865	S.D. dependent var	47699.36
S.E. of regression	27695.83	Akaike info criterion	23.35641
Sum squared resid.	3.45E+10	Schwarz criterion	23.47336
Log likelihood	–557.5539	F-statistic	47.20506
Durbin-Watson stat.	0.622071	Prob(F-statistic)	0.000000

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Appendix 2.3 3-Categorisation weaving regressions

Appendix Table 2.3.1 Total weaving cost (3-type)

Dependent Variable:	TCOST			
Method:	Least Squares			
Date:	11/13/04 Time: 00:26			
Sample:	1 48			
Included observations:	48			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	148113.5	29390.32	5.039533	0.0000
HIGH	1.203424	0.152604	7.885925	0.0000
MEDIUM	1.128251	0.144447	7.810816	0.0000
LOW	1.735011	0.200819	8.639691	0.0000

R-squared	0.794270	Mean dependent var	496700.6
Adjusted R-squared	0.780243	S.D. dependent var	112047.7
S.E. of regression	52525.98	Akaike info criterion	24.65566
Sum squared resid.	1.21E+11	Schwarz criterion	24.81159
Log likelihood	–587.7358	F-statistic	56.62427
Durbin-Watson stat.	1.221855	Prob(F-statistic)	0.000000

Appendix Table 2.3.2 Variable weaving cost (3-type)

Dependent Variable:	VNDCOST			
Method:	Least Squares			
Date:	11/13/04 Time: 00:28			
Sample:	1 48			
Included observations:	48			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	92657.09	21540.56	4.301517	0.0001
HIGH	0.926898	0.111846	8.287303	0.0000
MEDIUM	0.955588	0.105867	9.026272	0.0000
LOW	1.414975	0.147183	9.613730	0.0000

R-squared	0.828965	Mean dependent var	373871.1
Adjusted R-squared	0.817303	S.D. dependent var	90066.18
S.E. of regression	38497.00	Akaike info criterion	24.03420
Sum squared resid.	6.52E+10	Schwarz criterion	24.19014
Log likelihood	–572.8209	F-statistic	71.08573
Durbin-Watson stat.	1.313346	Prob(F-statistic)	0.000000

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Appendix Table 2.3.3 Labour weaving cost (3-type)

Dependent Variable:	LCOST
Method:	Least Squares
Date:	11/13/04 Time: 00:30
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	93334.45	16505.75	5.654661	0.0000
HIGH	0.494454	0.085703	5.769372	0.0000
MEDIUM	0.376425	0.081122	4.640217	0.0000
LOW	0.787990	0.112781	6.986919	0.0000

R-squared	0.661983	Mean dependent var	232931.8
Adjusted R-squared	0.638937	S.D. dependent var	49092.32
S.E. of regression	29498.86	Akaike info criterion	23.50175
Sum squared resid.	3.83E+10	Schwarz criterion	23.65768
Log likelihood	–560.0419	F-statistic	28.72370
Durbin-Watson stat.	1.618754	Prob(F-statistic)	0.000000

Appendix Table 2.3.4 Electricity weaving cost (3-type)

Dependent Variable:	ELCOST
Method:	Least Squares
Date:	11/13/04 Time: 00:31
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	–12551.34	15671.13	–0.800921	0.4275
HIGH	0.442243	0.081370	5.434992	0.0000
MEDIUM	0.537128	0.077020	6.973841	0.0000
LOW	0.527317	0.107078	4.924610	0.0000

R-squared	0.677247	Mean dependent var	120372.0
Adjusted R-squared	0.655241	S.D. dependent var	47699.36
S.E. of regression	28007.24	Akaike info criterion	23.39797
Sum squared resid.	3.45E+10	Schwarz criterion	23.55390
Log likelihood	–557.5513	F-statistic	30.77573
Durbin-Watson stat.	0.622967	Prob(F-statistic)	0.000000

Appendix 2.4. 4-categorisation (count) regressions

Appendix Table 2.4.1 Total weaving cost (4-type, count)

Dependent Variable:	TCOST
Method:	Least Squares
Date:	11/13/04 Time: 00:07
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	150306.0	29595.70	5.078644	0.0000
PWOOLHC	1.304314	0.193673	6.734605	0.0000
PWOOLLC	1.024911	0.259803	3.944960	0.0003
MWOOL	1.124283	0.144979	7.754803	0.0000
LWOOL	1.751103	0.202340	8.654263	0.0000

R-squared	0.797673	Mean dependent var	496700.6
Adjusted R-squared	0.778852	S.D. dependent var	112047.7
S.E. of regression	52691.96	Akaike info criterion	24.68065
Sum squared resid.	1.19E+11	Schwarz criterion	24.87556
Log likelihood	–587.3355	F-statistic	42.38188
Durbin-Watson stat.	1.230857	Prob(F-statistic)	0.000000

Appendix Table 2.4.2 Variable weaving cost (4-type, count)

Dependent Variable:	VNDCOST
Method:	Least Squares
Date:	11/13/04 Time: 00:10
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	94940.19	21504.49	4.414900	0.0001
PWOOLHC	1.031954	0.140725	7.333134	0.0000
PWOOLLC	0.741014	0.188775	3.925388	0.0003
MWOOL	0.951455	0.105343	9.031983	0.0000
LWOOL	1.431731	0.147022	9.738215	0.0000

R-squared	0.834676	Mean dependent var	373871.1
Adjusted R-squared	0.819297	S.D. dependent var	90066.18
S.E. of regression	38286.43	Akaike info criterion	24.04191
Sum squared resid.	6.30E+10	Schwarz criterion	24.23683
Log likelihood	–572.0059	F-statistic	54.27367
Durbin-Watson stat.	1.276941	Prob(F-statistic)	0.000000

Appendix Table 2.4.3 Labour weaving cost (4-type, count)

Dependent Variable: LCOST
Method: Least Squares
Date: 11/13/04 Time: 00:12
Sample: 1 48
Included observations: 48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	94214.18	16689.39	5.645154	0.0000
PWOOLHC	0.534934	0.109215	4.897996	0.0000
PWOOLLC	0.422828	0.146506	2.886082	0.0061
MWOOL	0.374833	0.081755	4.584808	0.0000
LWOOL	0.794447	0.114102	6.962599	0.0000

R-squared	0.664837	Mean dependent var	232931.8
Adjusted R-squared	0.633659	S.D. dependent var	49092.32
S.E. of regression	29713.66	Akaike info criterion	23.53493
Sum squared resid.	3.80E+10	Schwarz criterion	23.72985
Log likelihood	–559.8384	F-statistic	21.32397
Durbin-Watson stat.	1.585825	Prob(F-statistic)	0.000000

Appendix Table 2.4.4 Electricity weaving cost (4-type, count)

Dependent Variable: ELCOST
Method: Least Squares
Date: 11/13/04 Time: 00:16
Sample: 1 48
Included observations: 48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	–9898.333	15219.99	–0.650351	0.5189
PWOOLHC	0.564320	0.099599	5.665905	0.0000
PWOOLLC	0.226242	0.133607	1.693343	0.0976
MWOOL	0.532326	0.074557	7.139817	0.0000
LWOOL	0.546789	0.104056	5.254751	0.0000

R-squared	0.704739	Mean dependent var	120372.0
Adjusted R-squared	0.677273	S.D. dependent var	47699.36
S.E. of regression	27097.55	Akaike info criterion	23.35061
Sum squared resid.	3.16E+10	Schwarz criterion	23.54552
Log likelihood	–555.4146	F-statistic	25.65852
Durbin-Watson stat.	0.815537	Prob(F-statistic)	0.000000

Appendix 2.5 4-categorisation (density) regressions

Appendix Table 2.5.1 Total weaving cost (4-type, density)

Dependent Variable:	TCOST
Method:	Least Squares
Date:	11/13/04 Time: 00:17
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	149822.2	30120.17	4.974148	0.0000
PWOOLHD	1.152166	0.216501	5.321751	0.0000
PWOOLLD	1.267538	0.244777	5.178331	0.0000
MWOOL	1.117251	0.149526	7.471931	0.0000
LWOOL	1.729645	0.203495	8.499685	0.0000

R-squared	0.794813	Mean dependent var	496700.6
Adjusted R-squared	0.775726	S.D. dependent var	112047.7
S.E. of regression	53063.12	Akaike info criterion	24.69468
Sum squared resid.	1.21E+11	Schwarz criterion	24.88960
Log likelihood	–587.6724	F-statistic	41.64120
Durbin-Watson stat.	1.215746	Prob(F-statistic)	0.000000

Appendix Table 2.5.2 Variable weaving cost (4-type, density)

Dependent Variable:	VNDCOST
Method:	Least Squares
Date:	11/13/04 Time: 00:20
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	91458.85	22077.95	4.142543	0.0002
PWOOLHD	0.962843	0.158695	6.067274	0.0000
PWOOLLD	0.881939	0.179421	4.915482	0.0000
MWOOL	0.963302	0.109602	8.789077	0.0000
LWOOL	1.418737	0.149161	9.511443	0.0000

R-squared	0.829378	Mean dependent var	373871.1
Adjusted R-squared	0.813506	S.D. dependent var	90066.18
S.E. of regression	38895.03	Akaike info criterion	24.07345
Sum squared resid.	6.51E+10	Schwarz criterion	24.26837
Log likelihood	–572.7629	F-statistic	52.25473
Durbin-Watson stat.	1.316526	Prob(F-statistic)	0.000000

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Appendix Table 2.5.3 Labour weaving cost (4-type, density)

Dependent Variable:	LCOST
Method:	Least Squares
Date:	11/13/04 Time: 00:22
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	95300.34	16843.99	5.657824	0.0000
PWOOLHD	0.435481	0.121073	3.596838	0.0008
PWOOLLD	0.568217	0.136886	4.151026	0.0002
MWOOL	0.363769	0.083619	4.350313	0.0001
LWOOL	0.781817	0.113800	6.870104	0.0000

R-squared	0.665725	Mean dependent var	232931.8
Adjusted R-squared	0.634629	S.D. dependent var	49092.32
S.E. of regression	29674.29	Akaike info criterion	23.53228
Sum squared resid.	3.79E+10	Schwarz criterion	23.72720
Log likelihood	–559.7748	F-statistic	21.40913
Durbin-Watson stat.	1.626656	Prob(F-statistic)	0.000000

Appendix Table 2.5.4 Electricity weaving cost (4-type, density)

Dependent Variable:	ELCOST
Method:	Least Squares
Date:	11/13/04 Time: 00:23
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	–18385.26	15187.15	–1.210580	0.2327
PWOOLHD	0.617249	0.109164	5.654329	0.0000
PWOOLLD	0.223347	0.123421	1.809629	0.0773
MWOOL	0.574686	0.075394	7.622433	0.0000
LWOOL	0.545636	0.102606	5.317775	0.0000

R-squared	0.712148	Mean dependent var	120372.0
Adjusted R-squared	0.685371	S.D. dependent var	47699.36
S.E. of regression	26755.41	Akaike info criterion	23.32519
Sum squared resid.	3.08E+10	Schwarz criterion	23.52011
Log likelihood	–554.8046	F-statistic	26.59563
Durbin-Watson stat.	0.780940	Prob(F-statistic)	0.000000

Appendix 2.6 Weaving regressions — alternative approach

Appendix Table 2.6.1 Total weaving cost — alternative approach

Dependent Variable:	UTCOST
Method:	Least Squares
Date:	11/13/04 Time: 23:40
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.703461	99.88515	0.057100	0.9547
WARPCOUNT	0.070262	0.104577	0.671872	0.5054
WEFTCOUNT	–0.108846	0.047609	–2.286271	0.0275
WEFTDENSITY	0.018743	0.020748	0.903359	0.3716
WEIGHT	–0.001291	0.024185	–0.053386	0.9577
WOOLP	–0.053635	0.041993	–1.277219	0.2087
YIELD	–0.032418	1.003493	–0.032305	0.9744

R-squared	0.144277	Mean dependent var	2.178942
Adjusted R-squared	0.019050	S.D. dependent var	1.889735
S.E. of regression	1.871649	Akaike info criterion	4.225555
Sum squared resid.	143.6259	Schwarz criterion	4.498438
Log likelihood	–94.41332	F-statistic	1.152120
Durbin-Watson stat.	2.226963	Prob(F-statistic)	0.350380

Appendix Table 2.6.2 Variable weaving cost — alternative approach

Dependent Variable:	UVNDCOST
Method:	Least Squares
Date:	11/13/04 Time: 23:54
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	15.11064	81.27781	0.185913	0.8534
WARPCOUNT	0.030866	0.085095	0.362727	0.7187
WEFTCOUNT	–0.080677	0.038740	–2.082544	0.0436
WEFTDENSITY	0.019522	0.016883	1.156317	0.2542
WEIGHT	–0.005476	0.019680	–0.278230	0.7822
WOOLP	–0.047460	0.034170	–1.388926	0.1724
YIELD	–0.116660	0.816555	–0.142869	0.8871

R-squared	0.139002	Mean dependent var	1.733430
Adjusted R-squared	0.013002	S.D. dependent var	1.532983
S.E. of regression	1.522985	Akaike info criterion	3.813259
Sum squared resid.	95.09878	Schwarz criterion	4.086142
Log likelihood	–84.51821	F-statistic	1.103193
Durbin-Watson stat.	2.223160	Prob(F-statistic)	0.377079

Appendix Table 2.6.3 Labour weaving cost — alternative approach

Dependent Variable:	ULCOST
Method:	Least Squares
Date:	11/14/04 Time: 00:01
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.789177	50.16934	0.155258	0.8774
WARPCOUNT	0.037969	0.052526	0.722858	0.4739
WEFTCOUNT	–0.059386	0.023912	–2.483489	0.0172
WEFTDENSITY	0.010716	0.010421	1.028279	0.3098
WEIGHT	–0.000671	0.012148	–0.055269	0.9562
WOOLP	–0.029417	0.021092	–1.394693	0.1706
YIELD	–0.068487	0.504025	–0.135881	0.8926

R-squared	0.168905	Mean dependent var	1.038922
Adjusted R-squared	0.047281	S.D. dependent var	0.963118
S.E. of regression	0.940074	Akaike info criterion	2.848321
Sum squared resid.	36.23328	Schwarz criterion	3.121204
Log likelihood	–61.35970	F-statistic	1.388747
Durbin-Watson stat.	2.221661	Prob(F-statistic)	0.242233

Appendix Table 2.6.4 Electricity weaving cost — alternative approach

Dependent Variable:	UELCOST
Method:	Least Squares
Date:	11/13/04 Time: 23:57
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.015107	24.57906	0.285410	0.7768
WARPCOUNT	–0.010695	0.025734	–0.415618	0.6799
WEFTCOUNT	–0.013044	0.011715	–1.113450	0.2720
WEFTDENSITY	0.008523	0.005106	1.669362	0.1027
WEIGHT	–0.004646	0.005951	–0.780645	0.4395
WOOLP	–0.015370	0.010333	–1.487387	0.1446
YIELD	–0.051128	0.246933	–0.207054	0.8370

R-squared	0.104232	Mean dependent var	0.506445
Adjusted R-squared	–0.026856	S.D. dependent var	0.454500
S.E. of regression	0.460563	Akaike info criterion	1.421303
Sum squared resid.	8.696843	Schwarz criterion	1.694186
Log likelihood	–27.11127	F-statistic	0.795130
Durbin-Watson stat.	2.159147	Prob(F-statistic)	0.579176

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Appendix 2.7 Spinning regressions

Appendix Table 2.7.1 Total spinning cost

Dependent Variable:	TCOST			
Method:	Least Squares			
Date:	11/16/04 Time: 14:47			
Sample:	1 48			
Included observations:	48			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	111807.0	32208.73	3.471326	0.0012
LESS60	6.018358	1.048105	5.742135	0.0000
S60	6.178667	0.819196	7.542355	0.0000
S70	8.169573	0.902733	9.049820	0.0000
OVER80	8.780686	0.748319	11.73388	0.0000

R-squared	0.869290	Mean dependent var	621570.5
Adjusted R-squared	0.857131	S.D. dependent var	154108.4
S.E. of regression	58249.89	Akaike info criterion	24.88120
Sum squared resid.	1.46E+11	Schwarz criterion	25.07612
Log likelihood	–592.1489	F-statistic	71.49321
Durbin-Watson stat.	1.814161	Prob(F-statistic)	0.000000

Appendix Table 2.7.2 Variable spinning cost

Dependent Variable:	VNDCOST			
Method:	Least Squares			
Date:	11/16/04 Time: 14:55			
Sample:	1 48			
Included observations:	48			

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	77780.06	28913.30	2.690113	0.0101
LESS60	5.613067	0.940868	5.965840	0.0000
S60	6.179077	0.735380	8.402561	0.0000
S70	7.638379	0.810370	9.425789	0.0000
OVER80	7.726683	0.671755	11.50223	0.0000

R-squared	0.872787	Mean dependent var	546985.6
Adjusted R-squared	0.860953	S.D. dependent var	140229.2
S.E. of regression	52290.07	Akaike info criterion	24.66533
Sum squared resid.	1.18E+11	Schwarz criterion	24.86025
Log likelihood	–586.9680	F-statistic	73.75377
Durbin-Watson stat.	1.976424	Prob(F-statistic)	0.000000

Appendix Table 2.7.3 Labour spinning cost

Dependent Variable:	LCOST
Method:	Least Squares
Date:	11/16/04 Time: 14:56
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	43588.82	18762.14	2.323233	0.0250
LESS60	1.939840	0.610539	3.177259	0.0028
S60	2.425868	0.477196	5.083590	0.0000
S70	3.751636	0.525858	7.134319	0.0000
OVER80	3.539876	0.435909	8.120681	0.0000

R-squared	0.773352	Mean dependent var	250784.4
Adjusted R-squared	0.752268	S.D. dependent var	68173.10
S.E. of regression	33931.56	Akaike info criterion	23.80041
Sum squared resid.	4.95E+10	Schwarz criterion	23.99533
Log likelihood	–566.2099	F-statistic	36.68034
Durbin-Watson stat.	1.679874	Prob(F-statistic)	0.000000

Appendix Table 2.7.4 Electricity spinning cost

Dependent Variable:	ELCOST
Method:	Least Squares
Date:	11/16/04 Time: 14:58
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3342.221	20264.08	0.164933	0.8698
LESS60	3.483806	0.659413	5.283190	0.0000
S60	4.208989	0.515396	8.166515	0.0000
S70	4.015287	0.567953	7.069748	0.0000
OVER80	4.280636	0.470804	9.092185	0.0000

R-squared	0.817787	Mean dependent var	274147.6
Adjusted R-squared	0.800837	S.D. dependent var	82119.15
S.E. of regression	36647.83	Akaike info criterion	23.95443
Sum squared resid.	5.78E+10	Schwarz criterion	24.14935
Log likelihood	–569.9063	F-statistic	48.24704
Durbin-Watson stat.	1.459224	Prob(F-statistic)	0.000000

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Appendix 2.8 Spinning cost regressions — alternative approach — 2 variable

Appendix Table 2.8.1 Total spinning cost — alternative approach

Dependent Variable:	UTCOST
Method:	Least Squares
Date:	11/16/04 Time: 15:07
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.710332	2.440003	1.520626	0.1353
WARPCOUNT	0.091551	0.034635	2.643290	0.0113
WOOLP	–0.013091	0.019336	–0.677043	0.5018

R-squared	0.137938	Mean dependent var	9.485186
Adjusted R-squared	0.099624	S.D. dependent var	1.116631
S.E. of regression	1.059551	Akaike info criterion	3.014028
Sum squared resid.	50.51914	Schwarz criterion	3.130978
Log likelihood	–69.33668	F-statistic	3.600197
Durbin-Watson stat.	1.721762	Prob(F-statistic)	0.035450

Appendix Table 2.8.2 Variable spinning cost — alternative approach

Dependent Variable:	UVNDCOST
Method:	Least Squares
Date:	11/16/04 Time: 15:10
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.728175	1.972074	1.890485	0.0651
WARPCOUNT	0.064527	0.027993	2.305111	0.0258
WOOLP	–0.003052	0.015628	–0.195316	0.8460

R-squared	0.117896	Mean dependent var	8.322512
Adjusted R-squared	0.078691	S.D. dependent var	0.892179
S.E. of regression	0.856356	Akaike info criterion	2.588201
Sum squared resid.	33.00058	Schwarz criterion	2.705151
Log likelihood	–59.11683	F-statistic	3.007186
Durbin-Watson stat.	1.937506	Prob(F-statistic)	0.059457

Appendix Table 2.8.3 Labour spinning cost — alternative approach

Dependent Variable:	ULCOST
Method:	Least Squares
Date:	11/16/04 Time: 15:11
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.090862	1.453975	0.750262	0.4570
WARPCOUNT	0.057223	0.020639	2.772582	0.0081
WOOLP	–0.016375	0.011522	–1.421210	0.1621

R-squared	0.147331	Mean dependent var	4.004982
Adjusted R-squared	0.109434	S.D. dependent var	0.669045
S.E. of regression	0.631377	Akaike info criterion	1.978633
Sum squared resid.	17.93864	Schwarz criterion	2.095583
Log likelihood	–44.48719	F-statistic	3.887716
Durbin-Watson stat.	1.614080	Prob(F-statistic)	0.027706

Appendix Table 2.8.4 Electricity spinning cost — alternative approach

Dependent Variable:	UELCOST
Method:	Least Squares
Date:	11/16/04 Time: 15:13
Sample:	1 48
Included observations:	48

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.729607	1.211197	2.253644	0.0291
WARPCOUNT	0.008463	0.017193	0.492252	0.6249
WOOLP	0.008917	0.009598	0.928997	0.3578

R-squared	0.038343	Mean dependent var	4.122987
Adjusted R-squared	–0.004397	S.D. dependent var	0.524800
S.E. of regression	0.525952	Akaike info criterion	1.613249
Sum squared resid.	12.44816	Schwarz criterion	1.730199
Log likelihood	–35.71797	F-statistic	0.897122
Durbin-Watson stat.	1.098082	Prob(F-statistic)	0.414908

Appendix 3 Yield regressions

Appendix 3.1 Finishing yield regressions

Appendix Table 3.1.1 Finishing yield regression: 2003 and for product throughputs greater than 1000

Dependent Variable:	YIELD
Method:	Least Squares
Date:	11/11/04 Time: 23:37
Sample (adjusted):	2 2954 IF THROUGHPUT >1000
Included observations:	1100
Excluded observations:	3 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	96.49633	0.457636	210.8583	0.0000
THROUGHPUT	1.21E-05	1.31E-05	0.924663	0.3553
WEIGHT	–0.002932	0.001497	–1.958356	0.0504
WOOLPER	–0.003706	0.002991	–1.238742	0.2157
TYPE2	–0.112253	0.122178	–0.918766	0.3584
TYPE3	0.355498	0.178883	1.987326	0.0471

R-squared	0.016451	Mean dependent var	95.40030
Adjusted R-squared	0.011956	S.D. dependent var	1.615602
S.E. of regression	1.605915	Akaike info criterion	3.790704
Sum squared resid.	2821.386	Schwarz criterion	3.817994
Log likelihood	–2078.887	F-statistic	3.659621
Durbin-Watson stat.	1.413489	Prob(F-statistic)	0.002739

Appendix 3.2 Weaving yield regressions

Appendix Table 3.2.1 Weaving yield regression: 2000

Dependent Variable:	YIELD
Method:	Least Squares
Date:	10/24/03 Time: 12:53
Sample (adjusted):	1165 1710 IF YEAR2000=1
Included observations:	546 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	97.92729	0.157957	619.9619	0.0000
SAMEWARPWEFT	–0.117327	0.055084	–2.129950	0.0336
WARPCOUNT	–0.004713	0.002261	–2.084409	0.0376
WEFTCOUNT	0.004498	0.001595	2.819950	0.0050
WEFTDEN	–0.000530	0.000477	–1.109742	0.2676
WEIGHT	–0.001069	0.000447	–2.390427	0.0172
WOOLPER	0.001040	0.000947	1.098329	0.2726

R-squared	0.037681	Mean dependent var	97.42070
Adjusted R-squared	0.026969	S.D. dependent var	0.418157
S.E. of regression	0.412480	Akaike info criterion	1.079479
Sum squared resid.	91.70527	Schwarz criterion	1.134641
Log likelihood	–287.6977	F-statistic	3.517565
Durbin-Watson stat.	0.094181	Prob(F-statistic)	0.002010

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Appendix Table 3.2.2 Weaving yield regression: 2001

Dependent Variable:	YIELD
Method:	Least Squares
Date:	10/24/03 Time: 13:00
Sample (adjusted):	1 434 IF YEAR2001=1
Included observations:	433 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	96.68807	0.319921	302.2244	0.0000
SAMEWARPWEFT	0.048119	0.114020	0.422020	0.6732
WARPCOUNT	0.008286	0.003538	2.341944	0.0196
WEFTCOUNT	–0.001338	0.003272	–0.408895	0.6828
WEFTDEN	–0.001087	0.000810	–1.341498	0.1805
WEIGHT	0.001712	0.000787	2.175898	0.0301
WOOLPER	–0.000701	0.001669	–0.420099	0.6746

R-squared	0.026379	Mean dependent var	97.31894
Adjusted R-squared	0.012666	S.D. dependent var	0.564835
S.E. of regression	0.561247	Akaike info criterion	1.698721
Sum squared resid.	134.1890	Schwarz criterion	1.764530
Log likelihood	–360.7731	F-statistic	1.923667
Durbin-Watson stat.	1.882387	Prob(F-statistic)	0.075648

Appendix Table 3.2.3 Weaving yield regression: 2002

Dependent Variable:	YIELD
Method:	Least Squares
Date:	10/29/03 Time: 10:22
Sample (adjusted):	435 1164 IF YEAR2002=1
Included observations:	729 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	97.16534	0.389169	249.6738	0.0000
SAMEWARPWEFT	0.136422	0.136629	0.998489	0.3184
WARPCOUNT	0.000532	0.004700	0.113219	0.9099
WEFTCOUNT	–0.000931	0.004518	–0.205992	0.8369
WEFTDEN	0.000650	0.000762	0.853821	0.3935
WEIGHT	–0.000896	0.000999	–0.897489	0.3698
WOOLPER	0.001076	0.001673	0.642992	0.5204

R-squared	0.005328	Mean dependent var	97.24246
Adjusted R-squared	–0.002938	S.D. dependent var	0.813264
S.E. of regression	0.814458	Akaike info criterion	2.436969
Sum squared resid.	478.9331	Schwarz criterion	2.481059
Log likelihood	–881.2750	F-statistic	0.644517
Durbin-Watson stat.	1.839478	Prob(F-statistic)	0.694608

Appendix Table 3.2.4 Weaving yield regression: 2003

Dependent Variable:	YIELD
Method:	Least Squares
Date:	11/29/04 Time: 11:27
Sample (adjusted):	1711 3484 IF YEAR2003=1
Included observations:	1772 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	97.46085	0.038797	2512.045	0.0000
SAMEWARPWEFT	–0.011834	0.011904	–0.994142	0.3203
WARPCOUNT	0.000142	0.000427	0.332865	0.7393
WEFTCOUNT	0.000123	0.000342	0.358639	0.7199
WEFTDEN	–0.000104	9.06E-05	–1.147844	0.2512
WEIGHT	9.95E-05	0.000114	0.874331	0.3821
WOOLPER	–0.000419	0.000201	–2.081719	0.0375

R-squared	0.003720	Mean dependent var	97.43143
Adjusted R-squared	0.000333	S.D. dependent var	0.135673
S.E. of regression	0.135651	Akaike info criterion	–1.153527
Sum squared resid.	32.47789	Schwarz criterion	–1.131879
Log likelihood	1029.025	F-statistic	1.098348
Durbin-Watson stat.	0.026263	Prob(F-statistic)	0.360908

Appendix 3.3 Spinning yield regressions

Appendix Table 3.3.1 Spinning yield regression: 2000

Dependent Variable:	YIELD
Method:	Least Squares
Date:	10/24/03 Time: 13:32
Sample (adjusted):	1036 1402 IF YEAR2000=1
Included observations:	367 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	94.96660	1.417050	67.01712	0.0000
THROUGHPUT	0.000107	4.07E-05	2.637922	0.0087
WOOLP	–0.008304	0.005177	–1.603844	0.1096
WARPCOUNT	0.000455	0.018539	0.024556	0.9804
WARPTWIST	0.002884	0.003196	0.902551	0.3674
WEFTCOUNT	–0.015711	0.008079	–1.944667	0.0526
WEFTTWIST	–0.000622	0.001694	–0.367387	0.7135
ZSZTWIST	0.199308	0.263033	0.757733	0.4491

R-squared	0.057375	Mean dependent var	95.65886
Adjusted R-squared	0.038995	S.D. dependent var	1.763479
S.E. of regression	1.728754	Akaike info criterion	3.954236
Sum squared resid.	1072.904	Schwarz criterion	4.039367
Log likelihood	–717.6024	F-statistic	3.121612
Durbin-Watson stat.	2.131353	Prob(F-statistic)	0.003274

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Appendix Table 3.3.2 Spinning yield regression: 2001

Dependent Variable:	YIELD
Method:	Least Squares
Date:	10/24/03 Time: 13:36
Sample (adjusted):	1 379 IF YEAR2001=1
Included observations:	379 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	100.2910	0.821955	122.0152	0.0000
THROUGHPUT	–6.83E-06	3.90E-05	–0.175092	0.8611
WOOLP	–0.012938	0.005281	–2.449856	0.0148
WARPCOUNT	–0.076482	0.013520	–5.656842	0.0000
WEFTCOUNT	0.005001	0.007702	0.649285	0.5166
WARPTWIST	0.001162	0.001501	0.774251	0.4393
WEFTTWIST	–0.000196	0.001319	–0.148937	0.8817
ZSZTWIST	0.240376	0.304630	0.789075	0.4306

R-squared	0.220668	Mean dependent var	94.58011
Adjusted R-squared	0.205963	S.D. dependent var	1.864331
S.E. of regression	1.661282	Akaike info criterion	3.873939
Sum squared resid.	1023.907	Schwarz criterion	3.957053
Log likelihood	–726.1114	F-statistic	15.00692
Durbin-Watson stat.	1.965080	Prob(F-statistic)	0.000000

Appendix Table 3.3.3 Spinning yield regression (2 variable): 2001

Dependent Variable:	YIELD
Method:	Least Squares
Date:	10/29/03 Time: 11:39
Sample (adjusted):	1 379 IF YEAR2001=1
Included observations:	379 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	100.5577	0.705691	142.4954	0.0000
WOOLP	–0.012580	0.004863	–2.586858	0.0101
WARPCOUNT	–0.065465	0.006389	–10.24568	0.0000

R-squared	0.218472	Mean dependent var	94.58011
Adjusted R-squared	0.214315	S.D. dependent var	1.864331
S.E. of regression	1.652522	Akaike info criterion	3.850367
Sum squared resid.	1026.792	Schwarz criterion	3.881535
Log likelihood	–726.6445	F-statistic	52.55433
Durbin-Watson stat.	1.968008	Prob(F-statistic)	0.000000

Appendix Table 3.3.4 Spinning yield regression: 2002

Dependent Variable:	YIELD
Method:	Least Squares
Date:	10/24/03 Time: 13:41
Sample (adjusted):	380 1035 IF YEAR2002=1
Included observations:	656 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	97.67034	0.990909	98.56636	0.0000
THROUGHPUT	0.000159	4.95E-05	3.208602	0.0014
WOOLP	–0.021313	0.005707	–3.734241	0.0002
WARPCOUNT	–0.023188	0.012586	–1.842333	0.0659
WEFTCOUNT	0.000430	0.009115	0.047230	0.9623
WARPTWIST	0.000769	0.001239	0.620645	0.5351
WEFTTWIST	–0.000567	0.001264	–0.448580	0.6539
ZSZTWIST	0.352890	0.303640	1.162199	0.2456

R-squared	0.049185	Mean dependent var	94.49848
Adjusted R-squared	0.038914	S.D. dependent var	2.135233
S.E. of regression	2.093276	Akaike info criterion	4.327458
Sum squared resid.	2839.410	Schwarz criterion	4.382167
Log likelihood	–1411.406	F-statistic	4.788640
Durbin-Watson stat.	1.735156	Prob(F-statistic)	0.000029

Appendix Table 3.3.5 Spinning yield regression: 2003

Dependent Variable:	YIELD
Method:	Least Squares
Date:	11/23/04 Time: 15:12
Sample (adjusted):	1403 2832 IF YEAR2003=1
Included observations:	1428 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	90.24032	3.089796	29.20591	0.0000
THROUGHPUT	0.000432	0.000136	3.173745	0.0015
WOOLP	–0.013692	0.010425	–1.313302	0.1893
WARPCOUNT	–0.024832	0.038399	–0.646675	0.5179
WEFTCOUNT	–0.014147	0.018429	–0.767661	0.4428
WARPTWIST	0.015273	0.007905	1.932099	0.0535
WEFTTWIST	–0.005440	0.003624	–1.500807	0.1336
ZSZTWIST	1.399714	0.839649	1.667022	0.0957

R-squared	0.019285	Mean dependent var	94.27591
Adjusted R-squared	0.014450	S.D. dependent var	5.841274
S.E. of regression	5.798916	Akaike info criterion	6.358806
Sum squared resid.	47750.95	Schwarz criterion	6.388296
Log likelihood	–4532.187	F-statistic	3.989009
Durbin-Watson stat.	1.876560	Prob(F-statistic)	0.000249

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Appendix 3.4 Recombing/dyeing regressions

Appendix Table 3.4.1 Recombing/dyeing yield regression: 2000

Dependent Variable:	YIELD
Method:	Least Squares
Date:	10/24/03 Time: 15:24
Sample (adjusted):	1160 1647 IF YEAR2000=1
Included observations:	487 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	96.91227	0.801353	120.9358	0.0000
THROUGHPUT	8.53E-05	2.18E-05	3.918584	0.0001
WOOLPER	0.000847	0.005659	0.149678	0.8811
COUNT	–0.001197	0.011503	–0.104042	0.9172

R-squared	0.031147	Mean dependent var	97.09959
Adjusted R-squared	0.025129	S.D. dependent var	2.263105
S.E. of regression	2.234489	Akaike info criterion	4.454082
Sum squared resid.	2411.591	Schwarz criterion	4.488483
Log likelihood	–1080.569	F-statistic	5.175878
Durbin-Watson stat.	1.430573	Prob(F-statistic)	0.001578

Appendix Table 3.4.2 Recombing/dyeing yield regression: 2001

Dependent Variable:	YIELD
Method:	Least Squares
Date:	10/24/03 Time: 15:26
Sample (adjusted):	689 1159 IF YEAR2001=1
Included observations:	469 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	98.30391	0.315321	311.7578	0.0000
THROUGHPUT	6.69E-06	1.00E-05	0.668377	0.5042
COUNT	–0.007066	0.004505	–1.568348	0.1175
WOOLPER	–0.000418	0.002113	–0.197894	0.8432

R-squared	0.008595	Mean dependent var	97.77350
Adjusted R-squared	0.002198	S.D. dependent var	0.795620
S.E. of regression	0.794745	Akaike info criterion	2.386900
Sum squared resid.	293.7028	Schwarz criterion	2.422300
Log likelihood	–555.7281	F-statistic	1.343696
Durbin-Watson stat.	1.366054	Prob(F-statistic)	0.259524

Appendix Table 3.4.3 Recombing/dyeing yield regression: 2002

Dependent Variable:	YIELD
Method:	Least Squares
Date:	10/24/03 Time: 15:28
Sample (adjusted):	1 688 IF YEAR2002=1
Included observations:	687 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	97.92801	0.272105	359.8902	0.0000
THROUGHPUT	7.75E-06	1.50E-05	0.516235	0.6059
COUNT	–0.002567	0.003874	–0.662625	0.5078
WOOLPER	0.000152	0.002213	0.068730	0.9452

R-squared	0.001234	Mean dependent var	97.76185
Adjusted R-squared	–0.003153	S.D. dependent var	0.934757
S.E. of regression	0.936229	Akaike info criterion	2.711892
Sum squared resid.	598.6665	Schwarz criterion	2.738281
Log likelihood	–927.5350	F-statistic	0.281355
Durbin-Watson stat.	1.798365	Prob(F-statistic)	0.838878

Appendix Table 3.4.4 Recombing/dyeing yield regression: 2003

Dependent Variable:	YIELD
Method:	Least Squares
Date:	11/29/04 Time: 16:21
Sample (adjusted):	1646 2832 IF YEAR2003=1
Included observations:	1185 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	98.13913	0.268985	364.8492	0.0000
COUNT	0.003544	0.003606	0.982860	0.3259
WOOLPER	–0.006094	0.002027	–3.006705	0.0027
THROUGHPUT	2.40E-05	1.47E-05	1.635054	0.1023

R-squared	0.009324	Mean dependent var	97.89857
Adjusted R-squared	0.006808	S.D. dependent var	1.129498
S.E. of regression	1.125646	Akaike info criterion	3.077962
Sum squared resid.	1496.421	Schwarz criterion	3.095101
Log likelihood	–1819.692	F-statistic	3.705181
Durbin-Watson stat.	1.767232	Prob(F-statistic)	0.011363

Appendix 4 Price analyses

Appendix Table 4.1 Hedonic price analysis of Australian wool combed in China

Dependent Variable:	price
Method:	least squares
Date:	05/12/03 Time: 17:06
Sample (adjusted):	310 2499 if Micron<25 And Length>60 and D2000=1
Included observations:	965 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	–253.3983	10.31421	–24.56787	0.0000
Micron^–1	6205.667	132.3069	46.90358	0.0000
Length	0.315752	0.067835	4.654707	0.0000
Amount	–0.117209	0.023406	–5.007605	0.0000

R-squared	0.745014	Mean dependent var	54.55544
Adjusted R-squared	0.744218	S.D. dependent var	26.13748
S.E. of regression	13.21901	Akaike info criterion	8.005325
Sum squared resid.	167927.2	Schwarz criterion	8.025520
Log likelihood	–3858.569	F-statistic	935.9438
Durbin-Watson stat.	1.767666	Prob(F-statistic)	0.000000

Appendix Table 4.2 Hedonic price analysis of China wool top

Dependent Variable:	price
Method:	least squares
Date:	05/12/03 Time: 17:26
Sample (adjusted):	431 2753 if D2000=1 and Micron<25 And Length>60
Included observations:	1097 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	–73.2992	2.721483	–26.9335	0
Micron^–1	2063.243	47.00774	43.89156	0
Length	0.236115	0.018972	12.44552	0
Amount	–0.00969	0.010494	–0.92376	0.3558

R-squared	0.650643	Mean dependent var	38.7711
Adjusted R-squared	0.649684	S.D. dependent var	5.829396
S.E. of regression	3.450273	Akaike info criterion	5.318424
Sum squared resid.	13011.5	Schwarz criterion	5.336656
Log likelihood	–2913.16	F-statistic	678.5347
Durbin-Watson stat.	1.846364	Prob(F-statistic)	0

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Appendix Table 4.3 Regression analysis of 2002 China wool auction

Dependent Variable:	price
Method:	least squares
Date:	05/19/03 Time: 13:33
Sample (adjusted):	1 54
Included observations:	53
Excluded observations:	1

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	47.16873	4.850372	9.724767	0
Micron^–1	–1.05636	0.226834	–4.65696	0
Length	0.151765	0.01839	8.252527	0
Yield	0.079728	0.028288	2.818406	0.007
Bales	0.001664	0.002253	0.738369	0.4639

R-squared	0.743369	Mean dependent var	41.53774
Adjusted R-squared	0.721983	S.D. dependent var	1.931144
S.E. of regression	1.01824	Akaike info criterion	2.963617
Sum squared resid.	49.76705	Schwarz criterion	3.149494
Log likelihood	–73.5359	F-statistic	34.75974
Durbin-Watson stat.	1.413246	Prob(F-statistic)	0

Appendix Table 4.4 Granger Causality tests for monthly wool price data

Pairwise Granger Causality Tests
Date: 05/15/03
Time: 09:03
Sample: 1996: 01 2002: 12
Lags: 2

Null Hypothesis:		Obs	F-Statistic	Probability
TA66C does not Granger Cause GA66	1	82	3.2589	0.04379
GA66 does not Granger Cause TA66C	2		15.9368	1.60E-06
	3			
TA60C does not Granger Cause GA66	4	82	3.3108	0.04175
GA66 does not Granger Cause TA60C	5		8.25491	0.00056
	6			
TA64C does not Granger Cause GA66	7	82	4.29432	0.01706
GA66 does not Granger Cause TA64C	8		8.72083	0.00039
	9			
TA70C does not Granger Cause GA66	10	82	4.98212	0.00923
GA66 does not Granger Cause TA70C	11		1.8659	0.16169
	12			
TC64C does not Granger Cause GA66	13	82	2.86981	0.06279
GA66 does not Granger Cause TC64C	14		6.34442	0.00281
	15			
TC66C does not Granger Cause GA66	16	82	3.45239	0.03665
GA66 does not Granger Cause TC66C	17		14.0217	6.40E-06
	18			
TA60C does not Granger Cause TA66C	19	82	2.92259	0.05979
TA66C does not Granger Cause TA60C	20		3.8685	0.02507
	21			
TA64C does not Granger Cause TA66C	22	82	3.61074	0.0317
TA66C does not Granger Cause TA64C	23		5.01427	0.00897
	24			
TA70C does not Granger Cause TA66C	25	82	4.72241	0.01163
TA66C does not Granger Cause TA70C	26		0.79851	0.45369
	27			

TC64C does not Granger Cause TA66C	28	82	2.76508	0.06923
TA66C does not Granger Cause TC64C	29		0.93127	0.39845
	30			
TC66C does not Granger Cause TA66C	31	82	2.92133	0.05986
TA66C does not Granger Cause TC66C	32		5.58083	0.00545
	33			
TA64C does not Granger Cause TA60C	34	82	1.46845	0.23666
TA60C does not Granger Cause TA64C	35		1.6805	0.19304
	36			
TA70C does not Granger Cause TA60C	37	82	8.1082	0.00064
TA60C does not Granger Cause TA70C	38		2.22782	0.11466
	39			
TC64C does not Granger Cause TA60C	40	82	2.16878	0.12125
TA60C does not Granger Cause TC64C	41		7.39906	0.00115
	42			
TC66C does not Granger Cause TA60C	43	82	5.22929	0.00742
TA60C does not Granger Cause TC66C	44		13.9523	6.70E-06
	45			
TA70C does not Granger Cause TA64C	46	82	7.37295	0.00118
TA64C does not Granger Cause TA70C	47		1.91957	0.15362
	48			
TC64C does not Granger Cause TA64C	49	82	1.98498	0.14435
TA64C does not Granger Cause TC64C	50		6.92073	0.00172
	51			
TC66C does not Granger Cause TA64C	52	82	4.69126	0.01195
TA64C does not Granger Cause TC66C	53		14.9999	3.20E-06
	54			
TC64C does not Granger Cause TA70C	55	82	2.69208	0.07412
TA70C does not Granger Cause TC64C	56		2.37686	0.09962
	57			
TC66C does not Granger Cause TA70C	58	82	2.78575	0.06791
TA70C does not Granger Cause TC66C	59		3.62422	0.03132
	60			
TC66C does not Granger Cause TC64C	61	82	0.55837	0.57444
TC64C does not Granger Cause TC66C	62		4.15878	0.01927

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Appendix Table 4.5 Granger Causality tests for weekly wool price data

Pairwise Granger Causality Tests
Date: 05/15/03
Time: 10:39
Sample: 1/07/2000 8/09/2002
Lags: 2

Null Hypothesis:		Obs	F-Statistic	Probability
TA66A does not Granger Cause GU58	63	134	3.06558	0.05004
GU58 does not Granger Cause TA66A	64		0.64976	0.52387
TA66C does not Granger Cause GU58	65	134	8.42225	0.00036
GU58 does not Granger Cause TA66C	66		1.02107	0.3631
TA70C does not Granger Cause GU58	67	134	4.11919	0.01844
GU58 does not Granger Cause TA70C	68		1.53278	0.21984
TA80C does not Granger Cause GU58	69	134	3.07788	0.04945
GU58 does not Granger Cause TA80C	70		0.282	0.75474
TC60C does not Granger Cause GU58	71	134	0.32711	0.7216
GU58 does not Granger Cause TC60C	72		2.95642	0.05554
TC66C does not Granger Cause GU58	73	134	2.72638	0.06923
GU58 does not Granger Cause TC66C	74		6.48956	0.00206
TA64C does not Granger Cause TA60C	75	134	4.30493	0.01549
TA60C does not Granger Cause TA64C	76		6.45423	0.00213
TA66A does not Granger Cause TA60C	77	134	2.09133	0.12769
TA60C does not Granger Cause TA66A	78		7.23628	0.00105
TA66C does not Granger Cause TA60C	79	134	6.10784	0.00292
TA60C does not Granger Cause TA66C	80		5.88975	0.00357
TA70C does not Granger Cause TA60C	81	134	7.38114	0.00092
TA60C does not Granger Cause TA70C	82		5.25802	0.00638
TA80C does not Granger Cause TA60C	83	134	4.63678	0.01136
TA60C does not Granger Cause TA80C	84		2.32033	0.10233
TC60C does not Granger Cause TA60C	85	134	0.61455	0.54246
TA60C does not Granger Cause TC60C	86		1.16885	0.31399
TC66C does not Granger Cause TA60C	87	134	3.41027	0.03604
TA60C does not Granger Cause TC66C	88		15.4791	9.40E-07
TA66A does not Granger Cause TA64C		134	0.97335	0.38057
TA64C does not Granger Cause TA66A	89		17.1236	2.50E-07
TA66C does not Granger Cause TA64C	90	134	11.6121	2.30E-05
TA64C does not Granger Cause TA66C			7.68502	0.0007
TA70C does not Granger Cause TA64C	91	134	11.5451	2.40E-05
TA64C does not Granger Cause TA70C	92		9.19002	0.00019
TA80C does not Granger Cause TA64C	93	134	5.17125	0.00691
TA64C does not Granger Cause TA80C	94		3.21574	0.04336
TC60C does not Granger Cause TA64C	95	134	1.80918	0.16792
TA64C does not Granger Cause TC60C	96		2.90684	0.05824

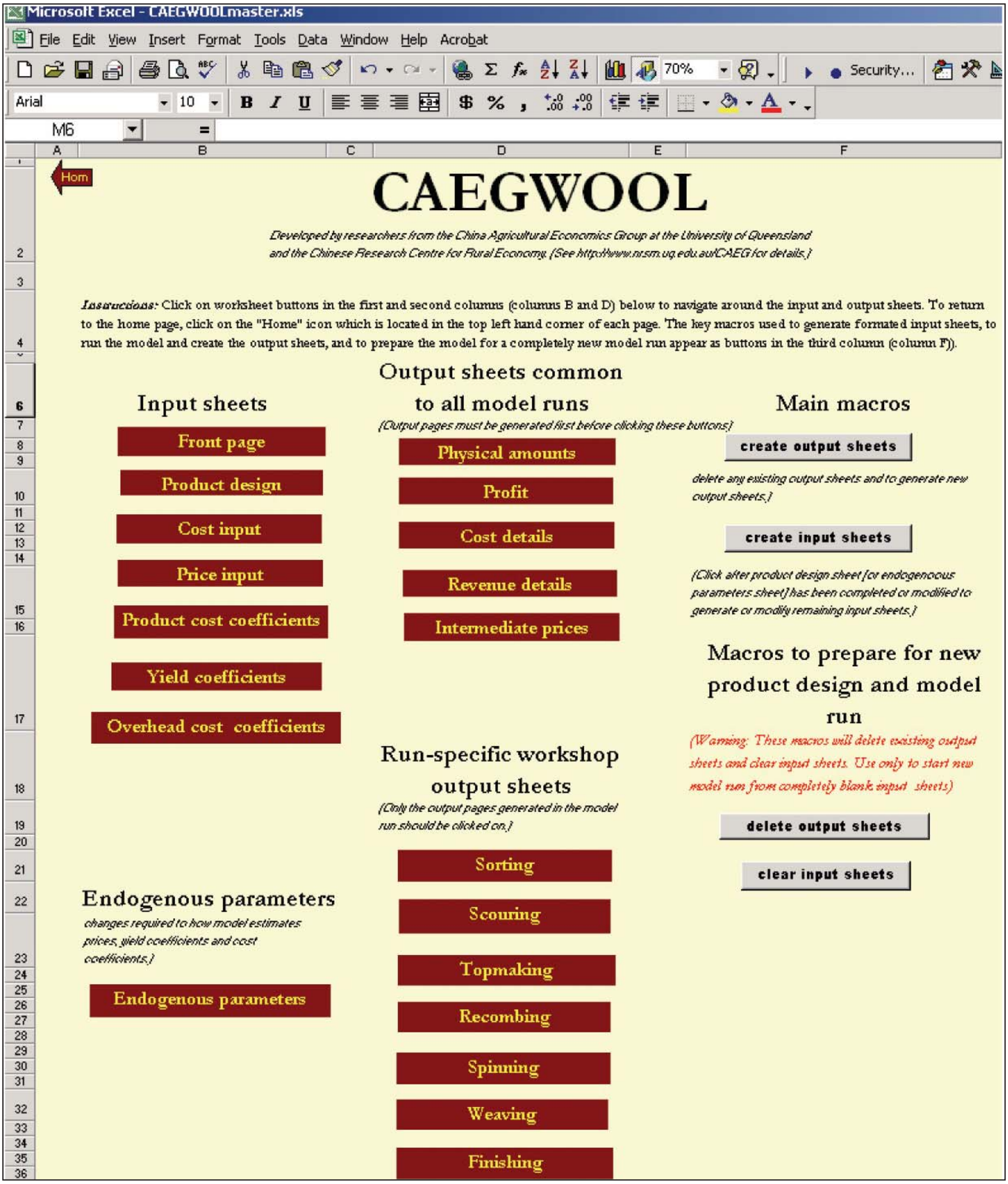
TC66C does not Granger Cause TA64C	97	134	4.29743	0.0156
TA64C does not Granger Cause TC66C	98		14.8679	1.50E-06
TA66C does not Granger Cause TA66A	99	134	12.2629	1.30E-05
TA66A does not Granger Cause TA66C	100		23.4554	2.00E-09
TA70C does not Granger Cause TA66A	101	134	11.9724	1.70E-05
TA66A does not Granger Cause TA70C	102		4.45905	0.01341
TA80C does not Granger Cause TA66A	103	134	9.42692	0.00015
TA66A does not Granger Cause TA80C	104		3.62346	0.02944
TC60C does not Granger Cause TA66A	105	134	2.58827	0.07905
TA66A does not Granger Cause TC60C	106		3.12611	0.04723
TC66C does not Granger Cause TA66A	107	134	2.54316	0.08255
TA66A does not Granger Cause TC66C	108		14.18	2.70E-06
TA70C does not Granger Cause TA66C	109	134	8.15265	0.00046
TA66C does not Granger Cause TA70C	110		9.60244	0.00013
TA80C does not Granger Cause TA66C	111	134	4.34007	0.01499
TA66C does not Granger Cause TA80C	112		2.71328	0.0701
TC60C does not Granger Cause TA66C	113	134	0.85424	0.428
TA66C does not Granger Cause TC60C	114		2.85339	0.06129
TC66C does not Granger Cause TA66C	115	134	2.77739	0.06592
TA66C does not Granger Cause TC66C	116		25.6626	4.10E-10
TA80C does not Granger Cause TA70C	117	134	1.23149	0.29526
TA70C does not Granger Cause TA80C	118		4.91008	0.00881
TC60C does not Granger Cause TA70C	119	134	0.40682	0.66662
TA70C does not Granger Cause TC60C	120		0.78937	0.45631
TC66C does not Granger Cause TA70C	121	134	1.91014	0.15222
TA70C does not Granger Cause TC66C	122		3.68907	0.02767
TC60C does not Granger Cause TA80C	123	134	1.29561	0.27727
TA80C does not Granger Cause TC60C	124		0.3597	0.69858
TC66C does not Granger Cause TA80C	125	134	1.61763	0.20237
TA80C does not Granger Cause TC66C	126		3.78199	0.02534
TC66C does not Granger Cause TC60C	127	134	2.23904	0.11069
TC60C does not Granger Cause TC66C	128		1.37263	0.25712

Appendix 5
CAEGWOOL tutorial example

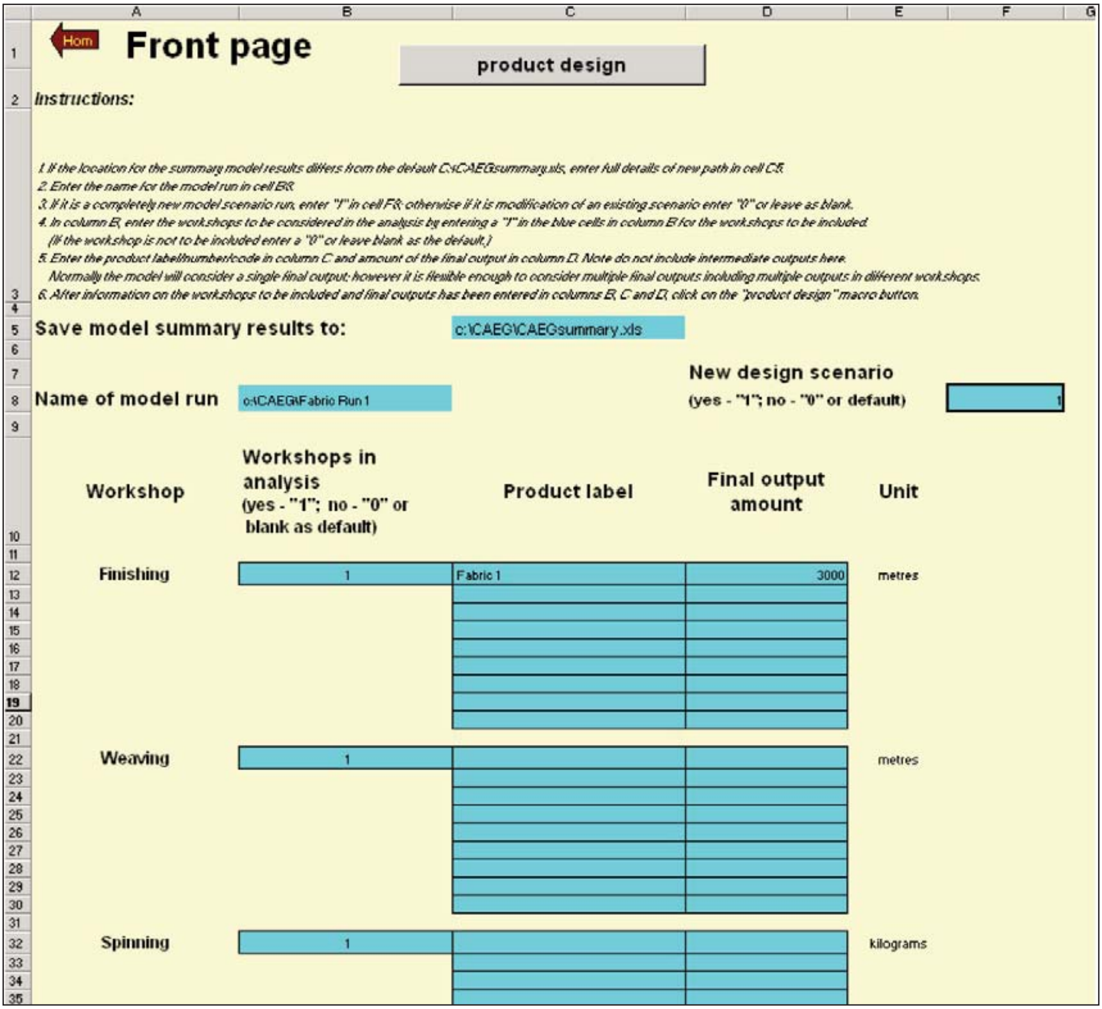
1. Create a new folder on your C drive called 'CAEG', that is C:\CAEG. (Alternatively, if you do not have a C drive, create the CAEG folder on another drive).
2. Copy the CAEGWOOLmaster.xls and CAEGsummary.xls files into this C:\CAEG folder.
3. Open the CAEGWOOLmaster.xls file. It will open onto a worksheet called 'CAEGWOOL home' as shown in Appendix Figure 5.1.
4. Click on the 'Front Page' button in the first column of buttons and it will bring you to a sheet called 'front page' as shown in Appendix Figure 5.2.
5. Enter the information shown in the blue cells in Appendix Figure 5.2. That is, in cell C5 for name of summary file enter 'c:\CAEG\CAEGsummary.xls'. Then enter 'C:\CAEG\Fabric run 1' in cell B8 for the name of the model run. Enter a '1' in the blue shaded cells in Column F8 for the finishing, weaving and spinning workshops. Finally to record the final outputs, list the name 'Fabric 1' in cell C12 and 3450 in cell D12 for the amount of the final product in metres.
6. Once all the information has been entered click on the 'product design' macro button at the top of the 'front page' sheet shown in Appendix Figure 5.2.
7. The 'product design' macro will take you to the 'product design' sheet and create a fabric design proforma for fabric 'fabric 1' as shown in Appendix Figure 5.3. Fill in the blue input cells in this proforma with the values shown in Appendix Figure 5.3.
8. Once the information for 'fabric 1' has been entered, click on the 'design yarns' button in cell D3. This will create yarn design proforma for the two yarns specified namely 'warp1' and 'weft1' as shown in Appendix Figure 5.4.
9. Fill in the design information shown in Appendix Figure 5.4 for the two yarns and then click on the 'design finished tops' macro button. This will create the proforma for the two finished tops as shown in Appendix Figure 5.5. (Note that as this example only specified finishing, weaving and spinning workshops both of these finished tops will be purchased rather than manufactured.)
10. Complete the design information for the two finished tops as shown in Appendix Figure 5.5.
11. All of the product design has now been entered (see Appendix Figure 5.6 for the full completed sheet). Return to the 'CAEGWOOL home' sheet by going to the top left hand corner of the 'product design' page (cell A1) and click on the arrow labelled 'Home'.
12. On the 'CAEGWOOL home' sheet, click on the 'Create input sheets' button which will format the remaining input sheets.
13. Click on the 'Price input' button. It will take you to the 'Price input' sheet as shown in Appendix Figure 5.7. Note that the sheet contains blue shaded input cells for the prices of the products specified on the product design sheet. Furthermore, these blue cells contain model determined values for these prices based on the product design. For now, leave these endogenous values as they are specified and return to the 'CAEGWOOL home' sheet by again clicking on the 'Home' arrow in the top left hand corner.
14. Click on the 'Product cost coefficient' button which will take you to the product design sheet as shown in Appendix Figure 5.8. Once again note that blue shaded input cells have been generated for the products specified on the 'product design' sheet and that model determined values have automatically been entered into these cells. Once again leave these model determined values unchanged for the moment and return to the 'CAEGWOOL home' sheet by again clicking on the 'Home' arrow in the top left hand corner.
15. In the same manner as step 13 and 14, click on both the 'Yield coefficients' and 'Overhead cost coefficients' buttons as shown in Figures A5.9 and A5.10 and return to the 'CAEGWOOL home' sheet.
16. Click on the 'Cost input' button which will take you to the 'Cost input' sheet as shown in Appendix Figure 5.11. Enter the information in the blue cells in Sections 1, 2 and 3 of this sheet as shown in Appendix Figure 5.11. Return to the 'CAEGWOOL home' sheet.

Building economic decision-making capabilities of Chinese wool textile mills
edited by Colin Brown, Scott Waldron, John Longworth and Zhao Yutian
ACIAR Technical Reports No. 60
(printed version published in 2004)

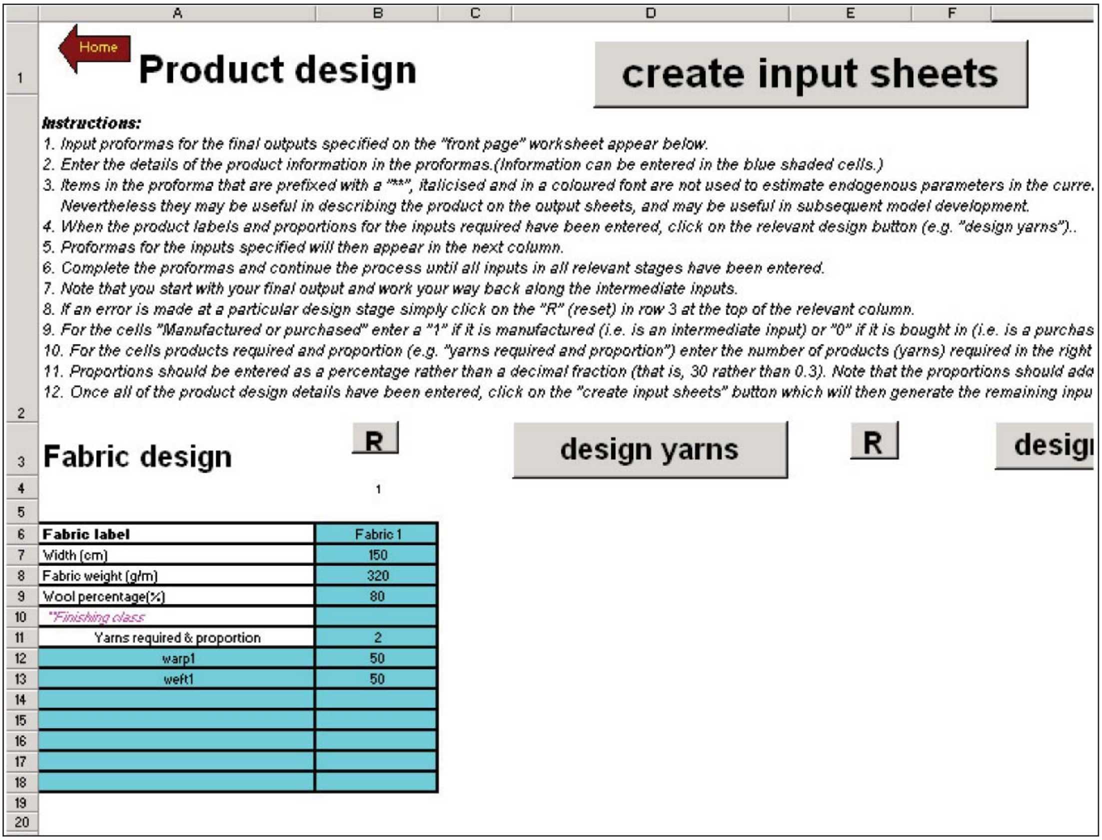
17. Now all of the input information has been entered, so click the 'Create output sheets' button in the third column of buttons. This starts the macro or program that deletes any existing output sheets, performs the calculations, and then generates the new output sheets. You will see the screen flicker as the new sheets are being generated.
18. Finally the screen will come to rest in the CAEGsummary.xls file as shown in Appendix Figure 5.12. As you will see, this sheet records the model name, and both the before and after tax profit. It also sorts the model runs into descending order of profit and highlights the current run with gold shading across the row. However, as this is the first model run only a single row for this model run will appear.
19. Close and save this CAEGsummary.xls file which will then take you to the open 'C:\CAEG\Fabric run 1.xls' file which is the model run.
20. Click on the 'Physical amount' button to take you to the 'physical amounts' sheet as shown in Appendix Figure 5.13. Check out the physical reconciliation between purchased inputs, intermediate inputs and final outputs (based on product design and yield and transformation coefficients) before returning to the 'CAEGWOOL home' sheet via the 'Home' arrow in the top left hand corner of the sheet.
21. Click on the 'Profit' button to take you to the 'profit' sheet as shown in Appendix Figure 5.14. Check out the profit statement (Section 1), contract prices and service fees (Section 2), and net revenue added by workshop (Section 3) before returning to the 'CAEGWOOL home' sheet.
22. Check out one of the workshop specific sheets by clicking on the relevant button in the second series of buttons in the second column of buttons. For instance clicking on the 'Spinning' button will bring you to the 'spinning' sheet as shown in Appendix Figure 5.15.
23. Check out the other output sheets, namely 'cost details', 'revenue details', intermediate prices', 'finishing' and 'weaving' in the same manner.
24. Click on the 'front page' button to go to the 'front page' sheet and change the name of the model run from 'c:\caeg\Fabric Run 1' to 'c:\caeg\Fabric Run 2 low prices'. Then return to the 'CAEGWOOL home' sheet.
25. Click on the 'Price input' sheet to go to the 'Price input' sheet and change the prices in the blue cells for the finished fabric and the ecru fabric as shown in Appendix Figure 5.16. Return to the 'CAEGWOOL home' sheet.
26. Click on the 'Create output sheets' button to run the model again with the new (lower) fabric prices. As this program deletes the existing output sheets, the automatic *Microsoft Excel* warning message for deleting worksheets as shown in Appendix Figure 5.17 will appear. Click on 'OK' as this message appears for the various output sheets.
27. After re-performing the calculations and generating the new output sheets, the screen will come to rest on a revised CAEGsummary.xls file as shown in Appendix Figure 5.18. Compare this sheet with the one shown in Appendix Figure 5.12. Note that the latest model run ('c:\caeg\Fabric Run 2 low prices.xls') is highlighted and is also on the bottom row as its profit is lower than that for 'C:\CAEG\Fabric run 1.xls'.
28. Close and save this CAEGsummary.xls file which will then take you to the open 'C:\CAEG\Fabric Run 2 low prices.xls' file which is the model run.
29. Click on the 'Profit' button to take you to the 'Profit' sheet to show you the new profit statement for this model run with lower fabric prices (as shown in Appendix Figure 5.19). Return to the 'CAEGWOOL home' sheet.
30. Click on the 'Intermediate prices' button to take you to the 'Intermediate prices' sheet as shown in Appendix Figure 5.20. Note that because the market price (net of VAT input rebate) is now lower than the cost of producing the ecru fabric in the mill, that the row for this ecru fabric is now highlighted in gold instead of in green (as it was in the previous model run).
31. Check out the other output sheets via the 'CAEGWOOL home' sheet.
32. Consider undertaking new model runs. If you would like to finish the session, simply close the current file ('C:\caeg\Fabric Run 2 low prices.xls').
33. New sessions can be started by opening the original 'C:\CAEGWOOLmaster.xls), file if a completely new product design is being considered; or alternatively by opening the 'C:\caeg\Fabric Run 2 low prices.xls' file if modifications to the previous model run are being considered.



Appendix Figure 5.1 'CAEGWOOL home' sheet

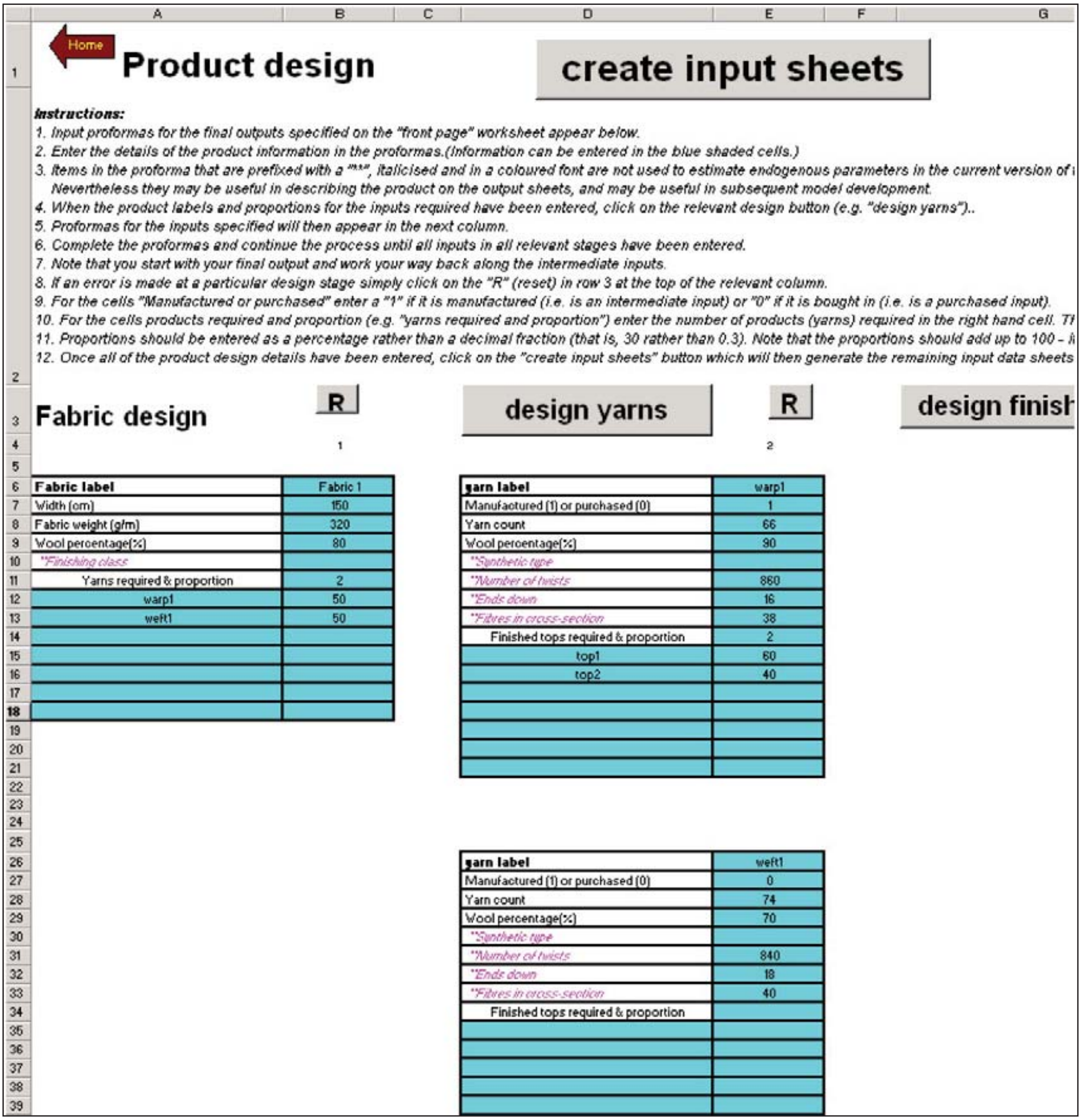


Appendix Figure 5.2 'Front page' sheet

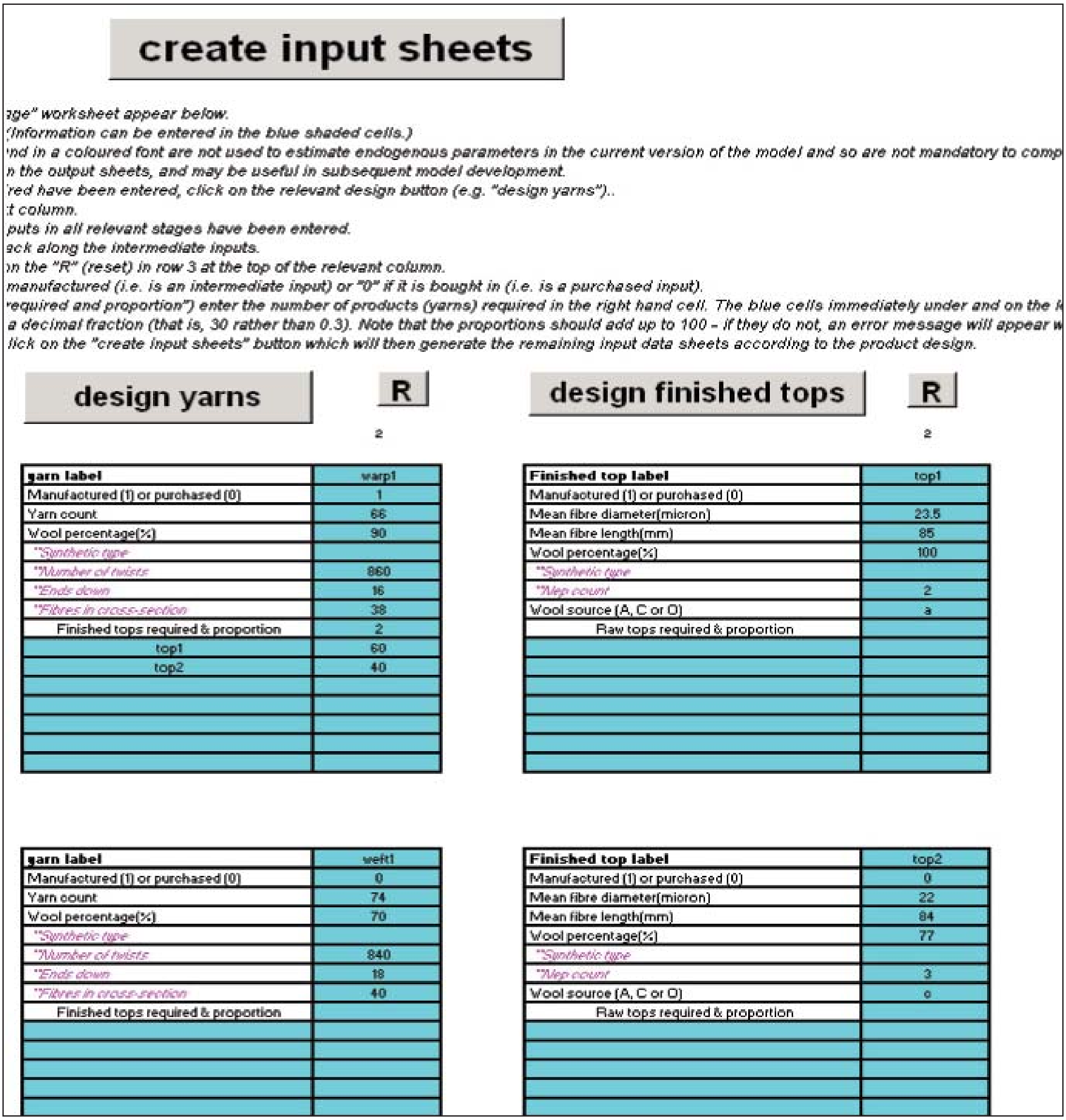


	A	B	C	D	E	F
1	Home **Product design**			**create input sheets**		
2	***Instructions:*** *1. Input proformas for the final outputs specified on the "front page" worksheet appear below.* *2. Enter the details of the product information in the proformas.(Information can be entered in the blue shaded cells.)* *3. Items in the proforma that are prefixed with a "**", italicised and in a coloured font are not used to estimate endogenous parameters in the curre* *Nevertheless they may be useful in describing the product on the output sheets, and may be useful in subsequent model development.* *4. When the product labels and proportions for the inputs required have been entered, click on the relevant design button (e.g. "design yarns")..* *5. Proformas for the inputs specified will then appear in the next column.* *6. Complete the proformas and continue the process until all inputs in all relevant stages have been entered.* *7. Note that you start with your final output and work your way back along the intermediate inputs.* *8. If an error is made at a particular design stage simply click on the "R" (reset) in row 3 at the top of the relevant column.* *9. For the cells "Manufactured or purchased" enter a "1" if it is manufactured (i.e. is an intermediate input) or "0" if it is bought in (i.e. is a purchas* *10. For the cells products required and proportion (e.g. "yarns required and proportion") enter the number of products (yarns) required in the right* *11. Proportions should be entered as a percentage rather than a decimal fraction (that is, 30 rather than 0.3). Note that the proportions should add* *12. Once all of the product design details have been entered, click on the "create input sheets" button which will then generate the remaining inpu*					
3	**Fabric design**	**R**		**design yarns**	**R**	**desig**
4		1				
5						
6	**Fabric label**	Fabric 1				
7	Width (cm)	150				
8	Fabric weight (g/m)	320				
9	Wool percentage(%)	80				
10	*"Finishing class*					
11	Yarns required & proportion	2				
12	warp1	50				
13	weft1	50				
14						
15						
16						
17						
18						
19						
20						

Appendix Figure 5.3 'Product design' sheet—fabric design proforma



Appendix Figure 5.4 'Product design' sheet—yarn design proforma



create input sheets

ıge" worksheet appear below.
(Information can be entered in the blue shaded cells.)
ınd in a coloured font are not used to estimate endogenous parameters in the current version of the model and so are not mandatory to comp
n the output sheets, and may be useful in subsequent model development.
red have been entered, click on the relevant design button (e.g. "design yarns")..
t column.
puts in all relevant stages have been entered.
ack along the intermediate inputs.
on the "R" (reset) in row 3 at the top of the relevant column.
manufactured (i.e. is an intermediate input) or "0" if it is bought in (i.e. is a purchased input).
required and proportion") enter the number of products (yarns) required in the right hand cell. The blue cells immediately under and on the l
a decimal fraction (that is, 30 rather than 0.3). Note that the proportions should add up to 100 – if they do not, an error message will appear w
lick on the "create input sheets" button which will then generate the remaining input data sheets according to the product design.

design yarns R 2

design finished tops R 2

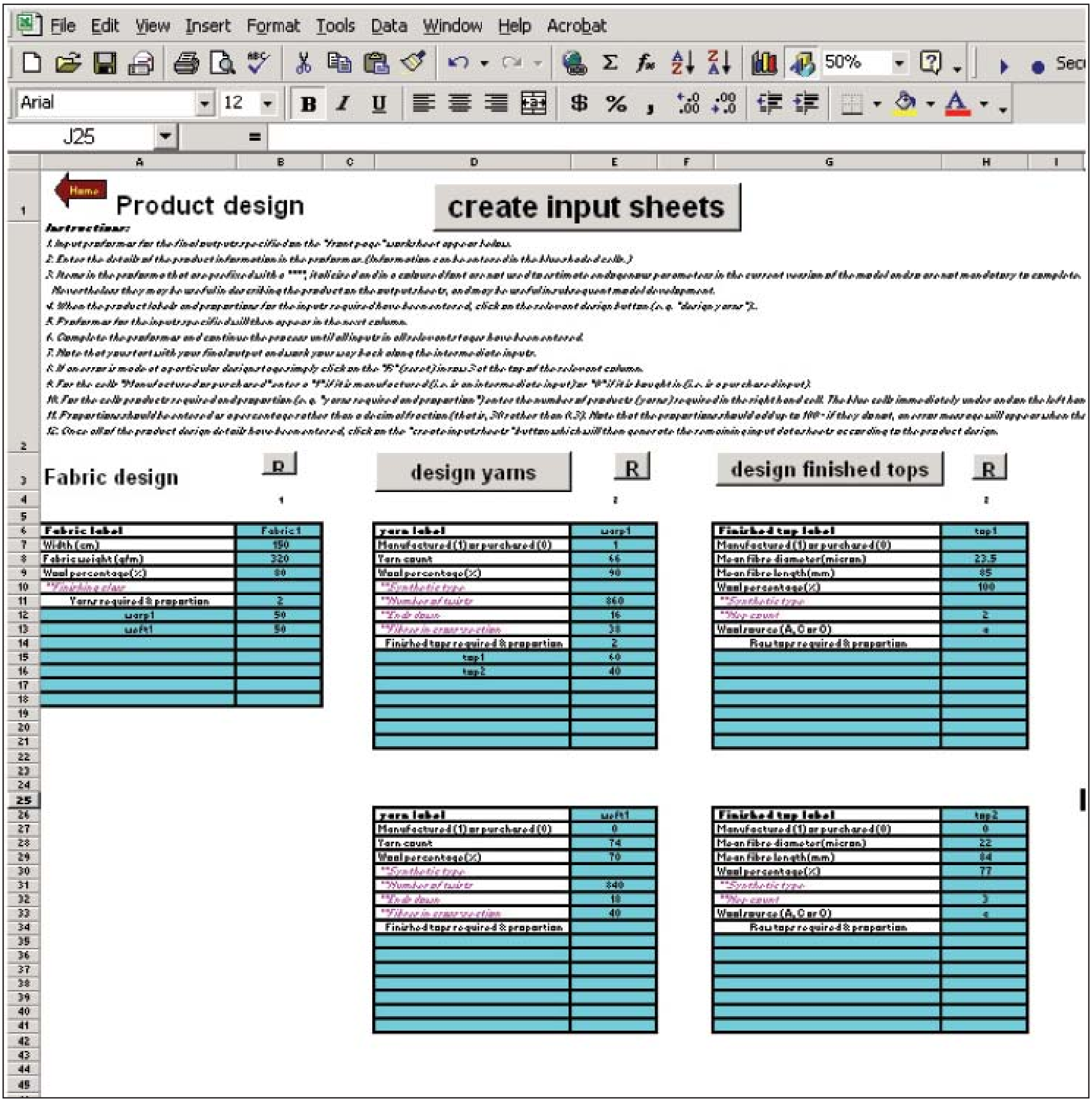
yarn label	warp1
Manufactured (1) or purchased (0)	1
Yarn count	66
Wool percentage(%)	90
**Synthetic type	
**Number of twists	860
**Ends down	16
**Fibres in cross-section	38
Finished tops required & proportion	2
top1	60
top2	40

Finished top label	top1
Manufactured (1) or purchased (0)	
Mean fibre diameter(micron)	23.5
Mean fibre length(mm)	85
Wool percentage(%)	100
**Synthetic type	
**Nep count	2
Wool source (A, C or O)	a
Raw tops required & proportion	

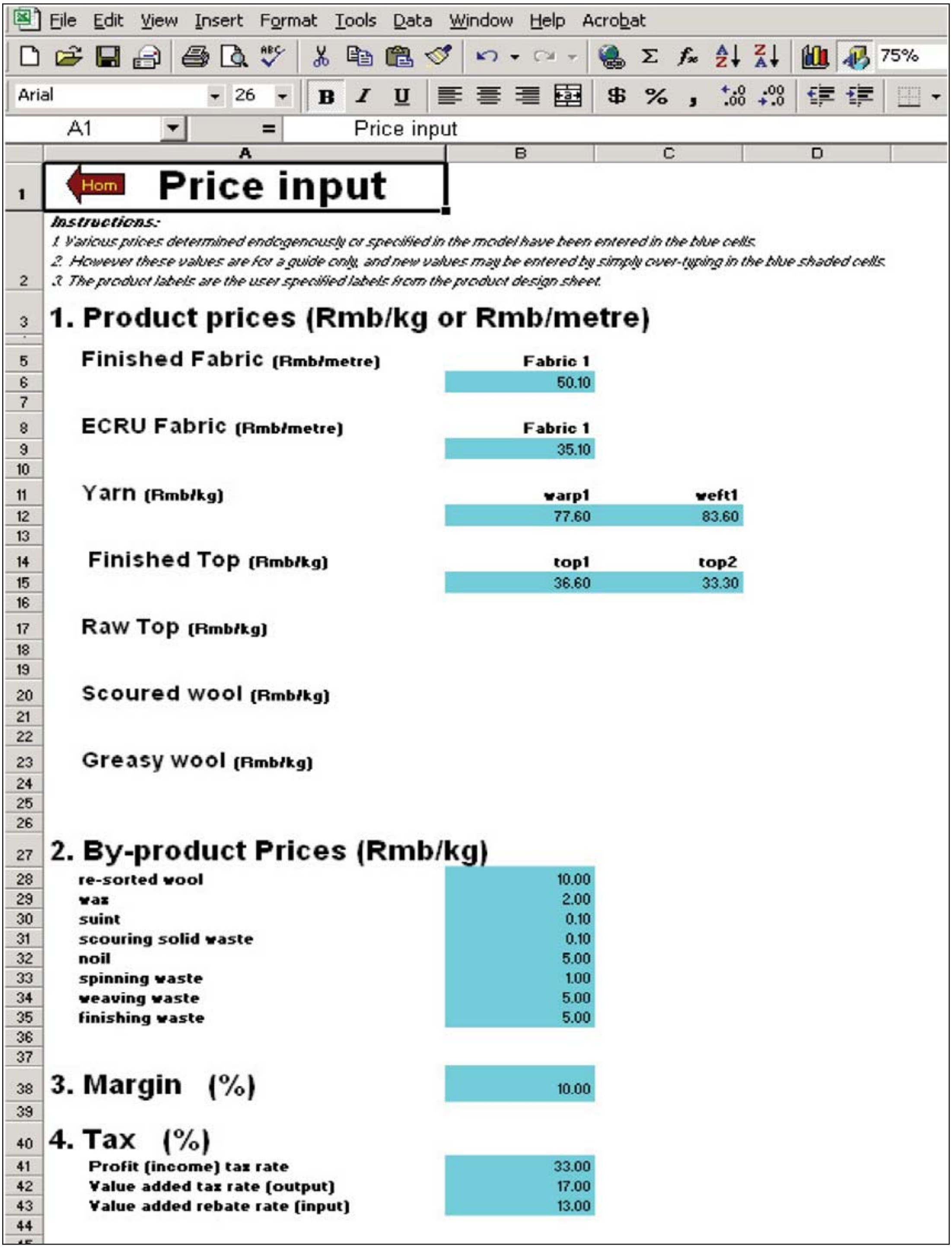
yarn label	weft1
Manufactured (1) or purchased (0)	0
Yarn count	74
Wool percentage(%)	70
**Synthetic type	
**Number of twists	840
**Ends down	18
**Fibres in cross-section	40
Finished tops required & proportion	

Finished top label	top2
Manufactured (1) or purchased (0)	0
Mean fibre diameter(micron)	22
Mean fibre length(mm)	84
Wool percentage(%)	77
**Synthetic type	
**Nep count	3
Wool source (A, C or O)	c
Raw tops required & proportion	

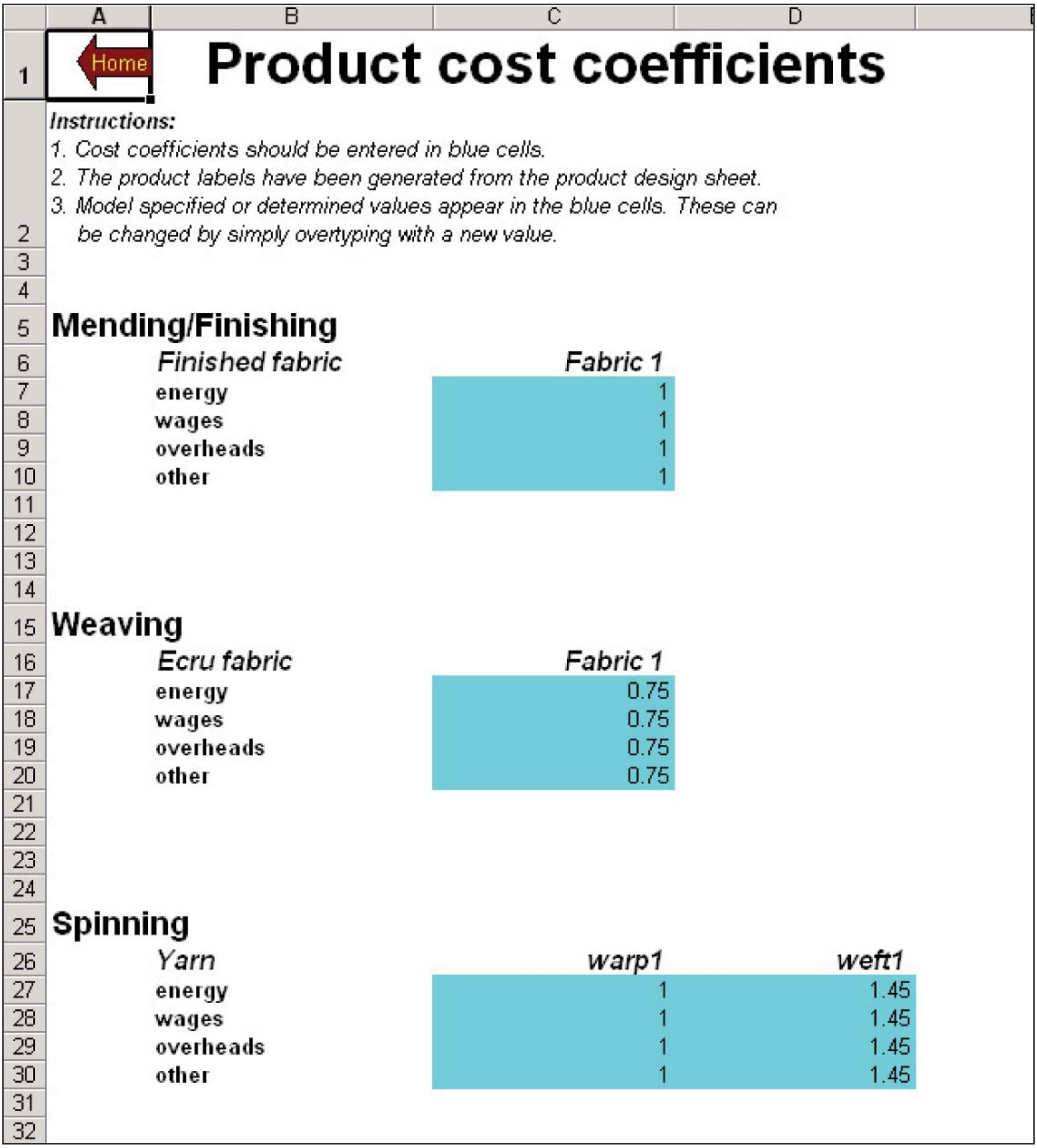
Appendix Figure 5.5 'Product design' sheet—finished top design proforma



Appendix Figure 5.6 'Product design' sheet—completed form



Appendix Figure 5.7 ‘Price input’ sheet



Home

Product cost coefficients

Instructions:
1. Cost coefficients should be entered in blue cells.
2. The product labels have been generated from the product design sheet.
3. Model specified or determined values appear in the blue cells. These can be changed by simply overtyping with a new value.

Mending/Finishing

Finished fabric	*Fabric 1*
energy	1
wages	1
overheads	1
other	1

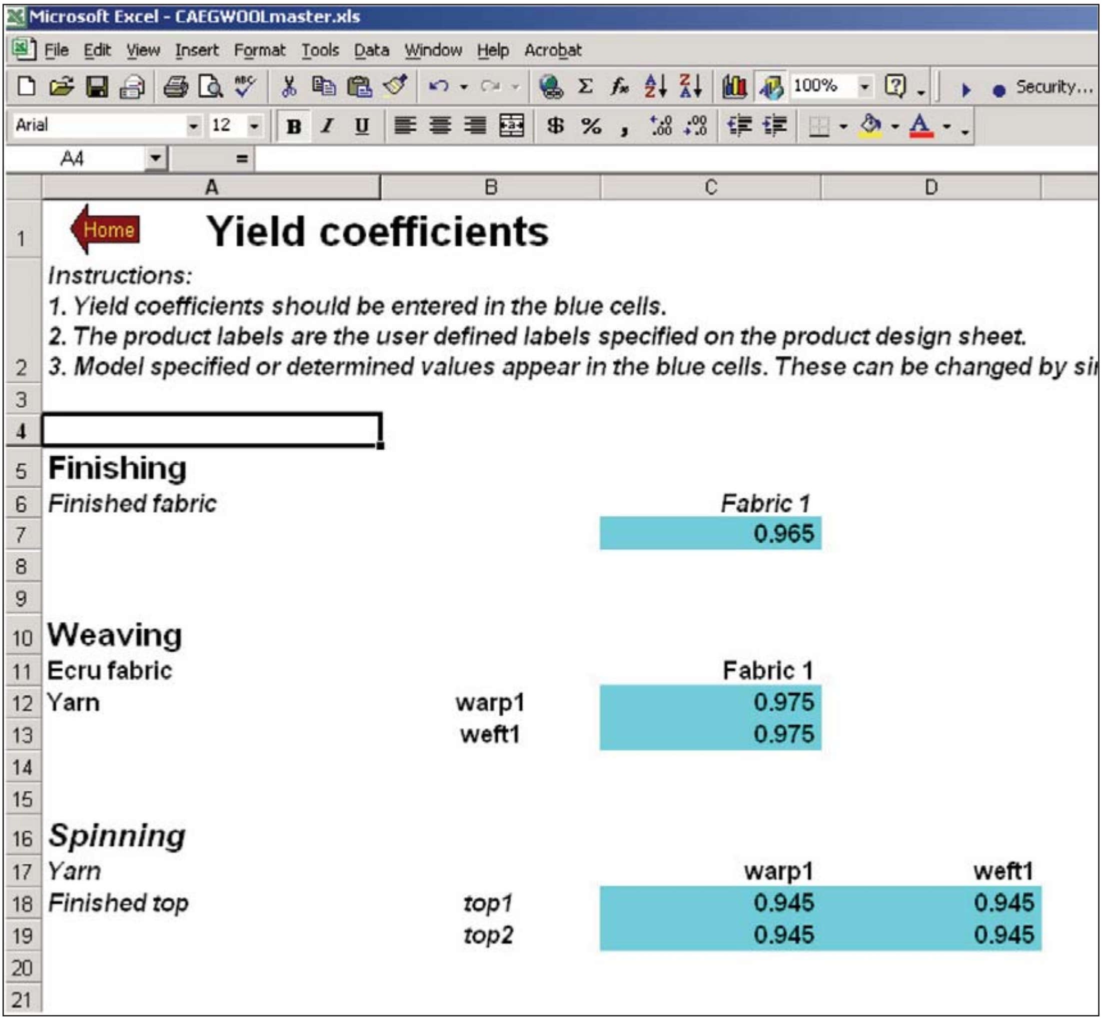
Weaving

Ecru fabric	*Fabric 1*
energy	0.75
wages	0.75
overheads	0.75
other	0.75

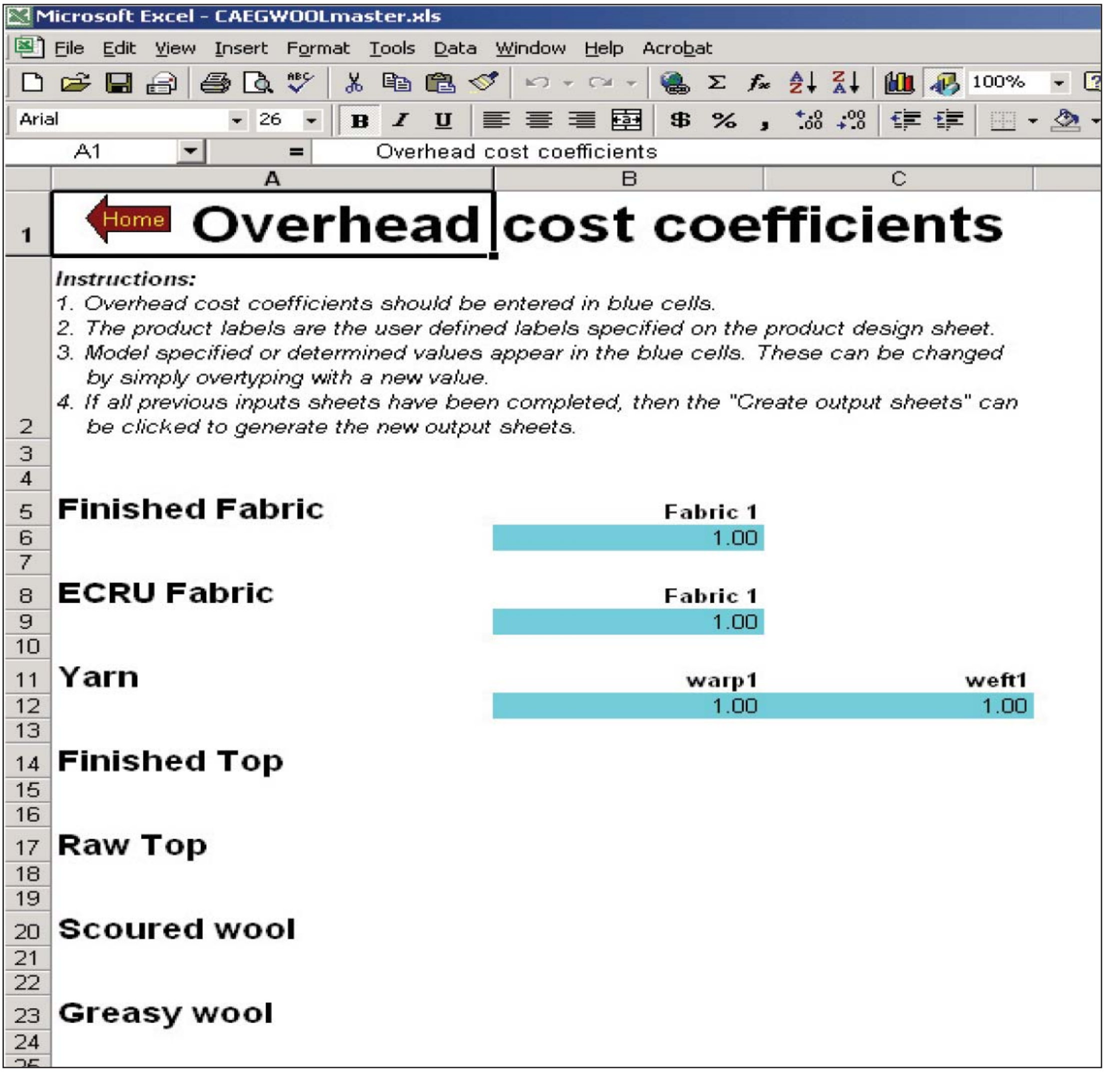
Spinning

Yarn	*warp1*	*weft1*
energy	1	1.45
wages	1	1.45
overheads	1	1.45
other	1	1.45

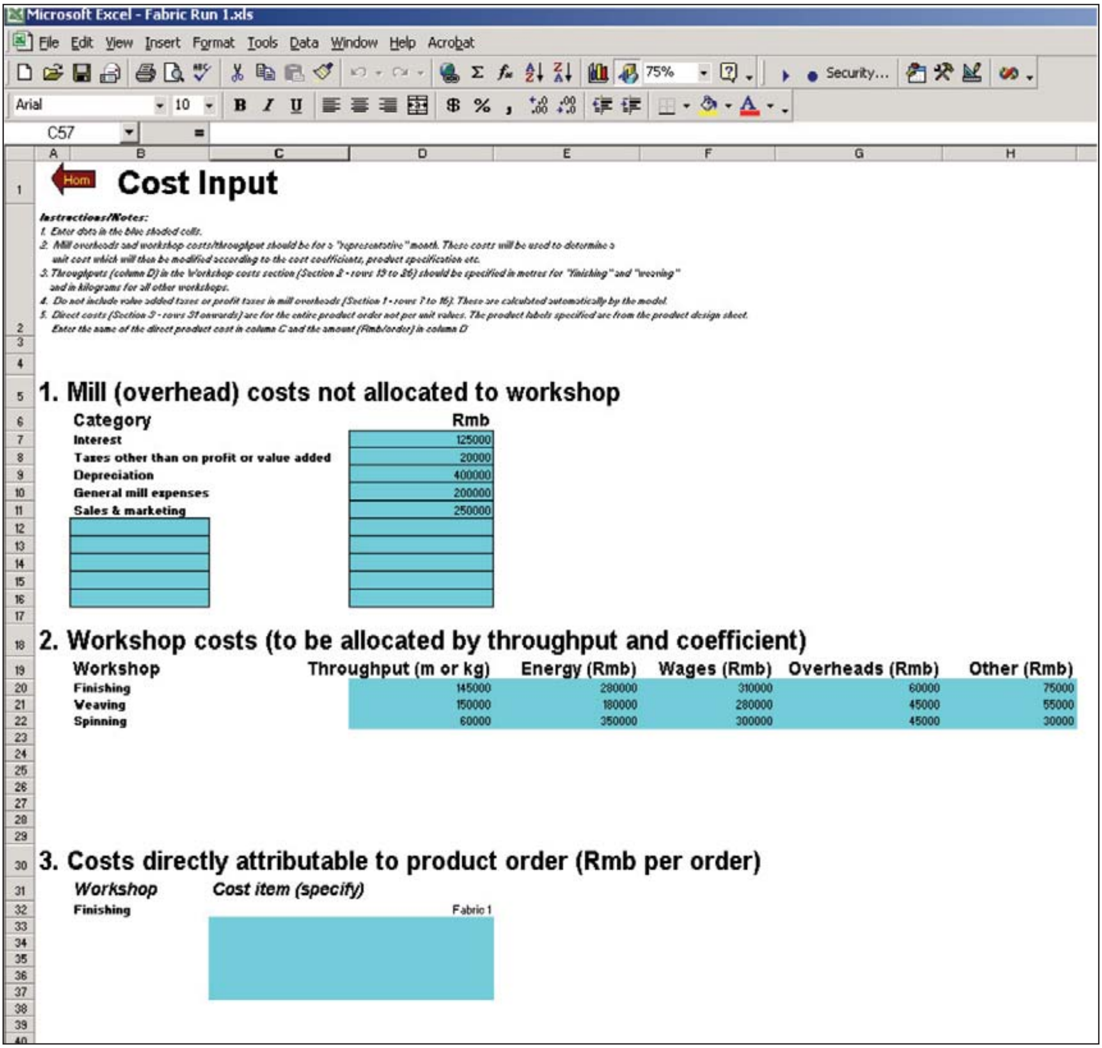
Appendix Figure 5.8 ‘Product cost coefficient’ sheet



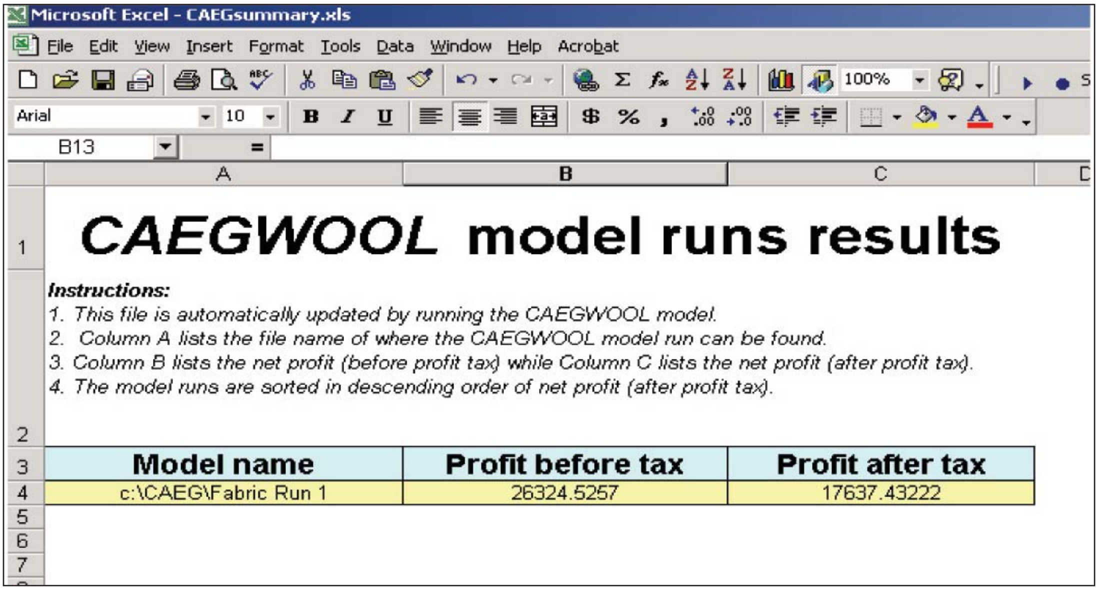
Appendix Figure 5.9 'Yield coefficient' sheet



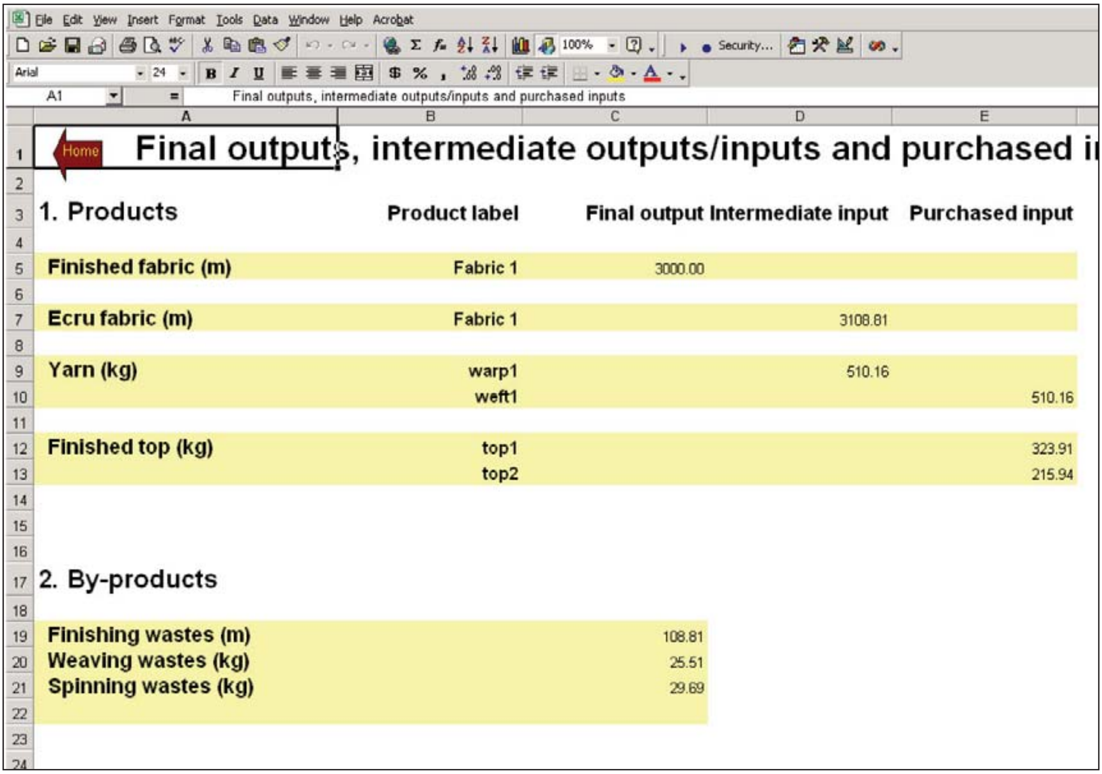
Appendix Figure 5.10 ‘Overhead cost coefficient’ sheet



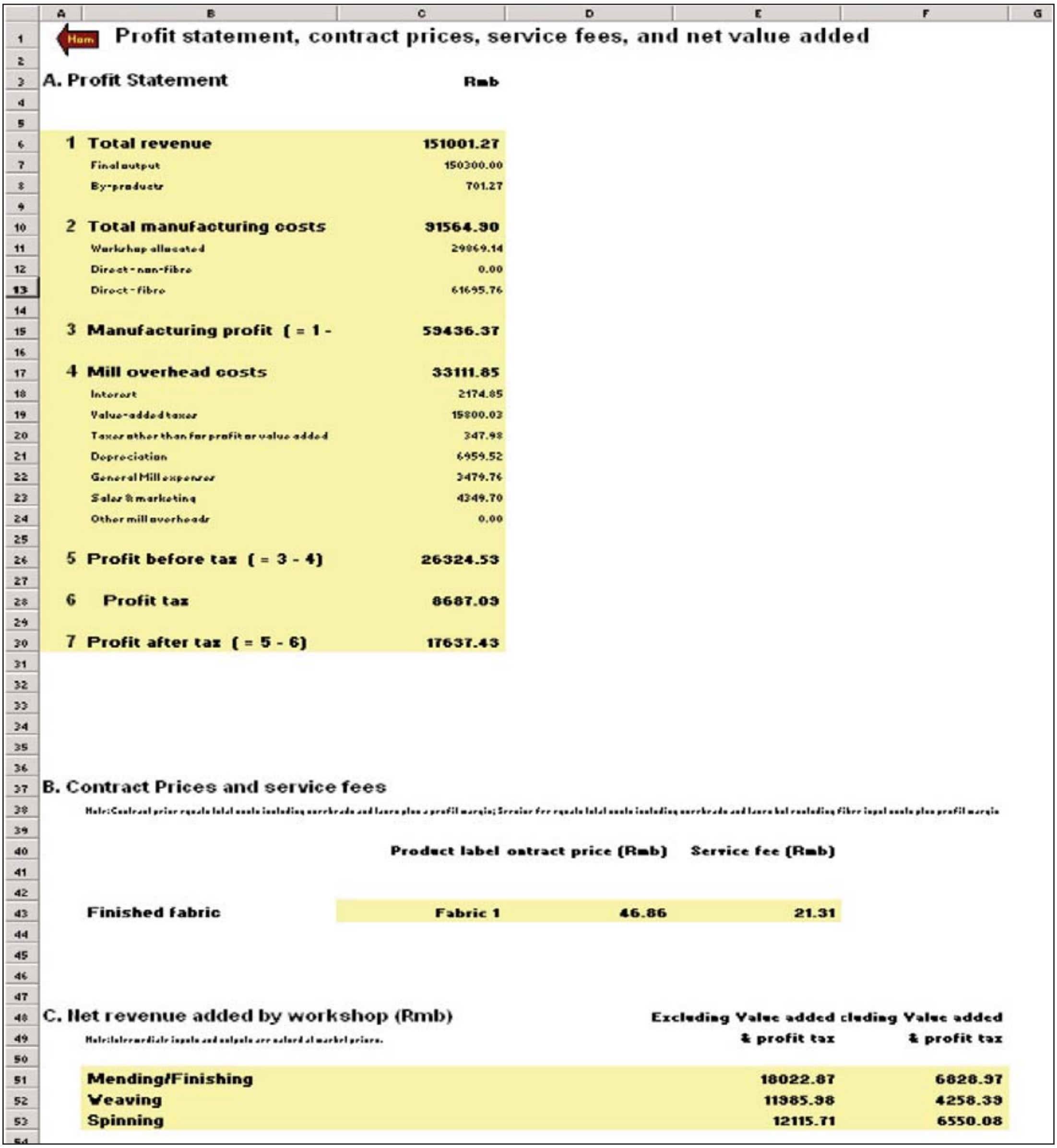
Appendix Figure 5.11 'Cost input' sheet



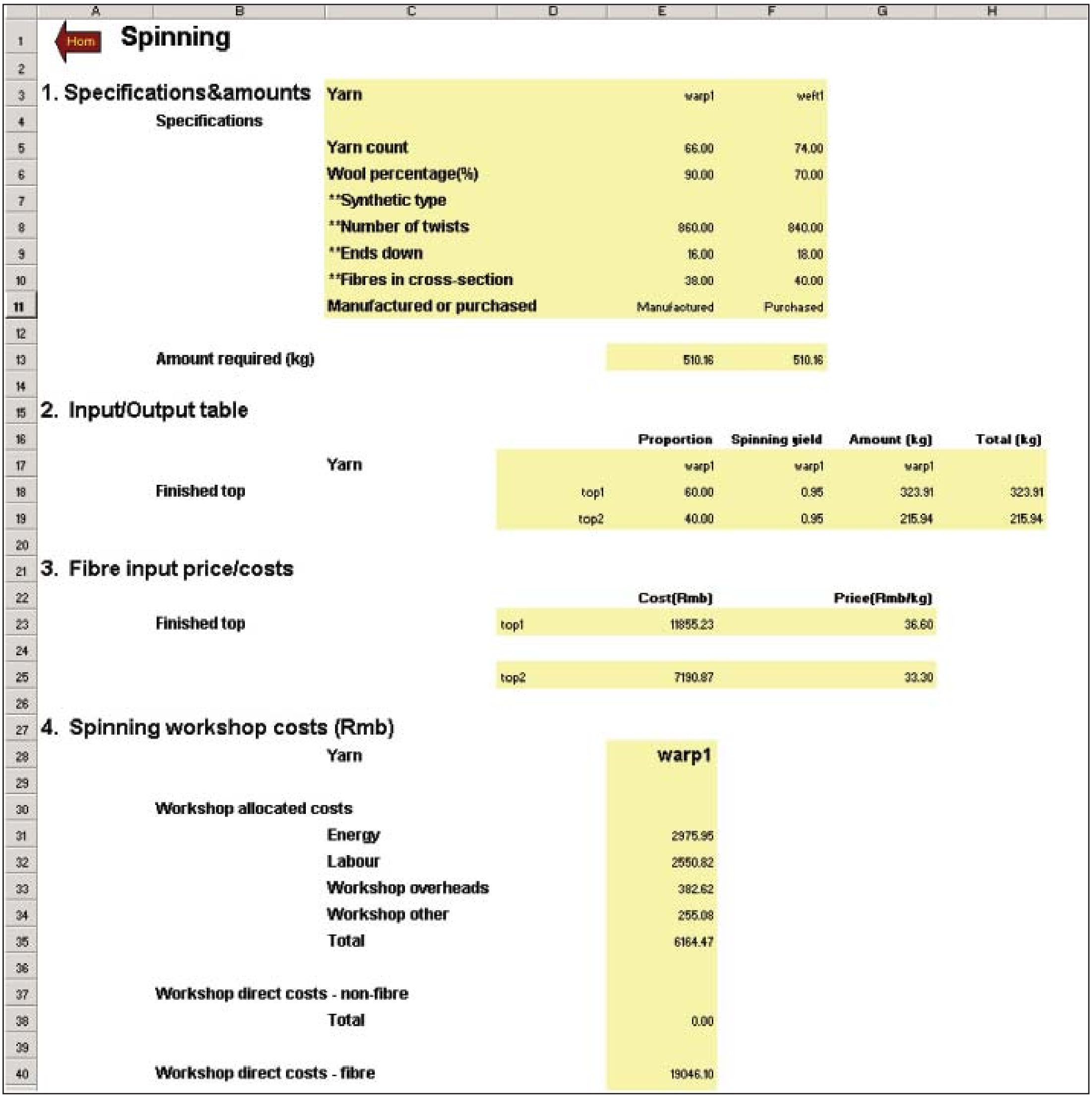
Appendix Figure 5.12 ‘CAEGsummary.xls’ file



Appendix Figure 5.13 ‘Physical amount’ sheet

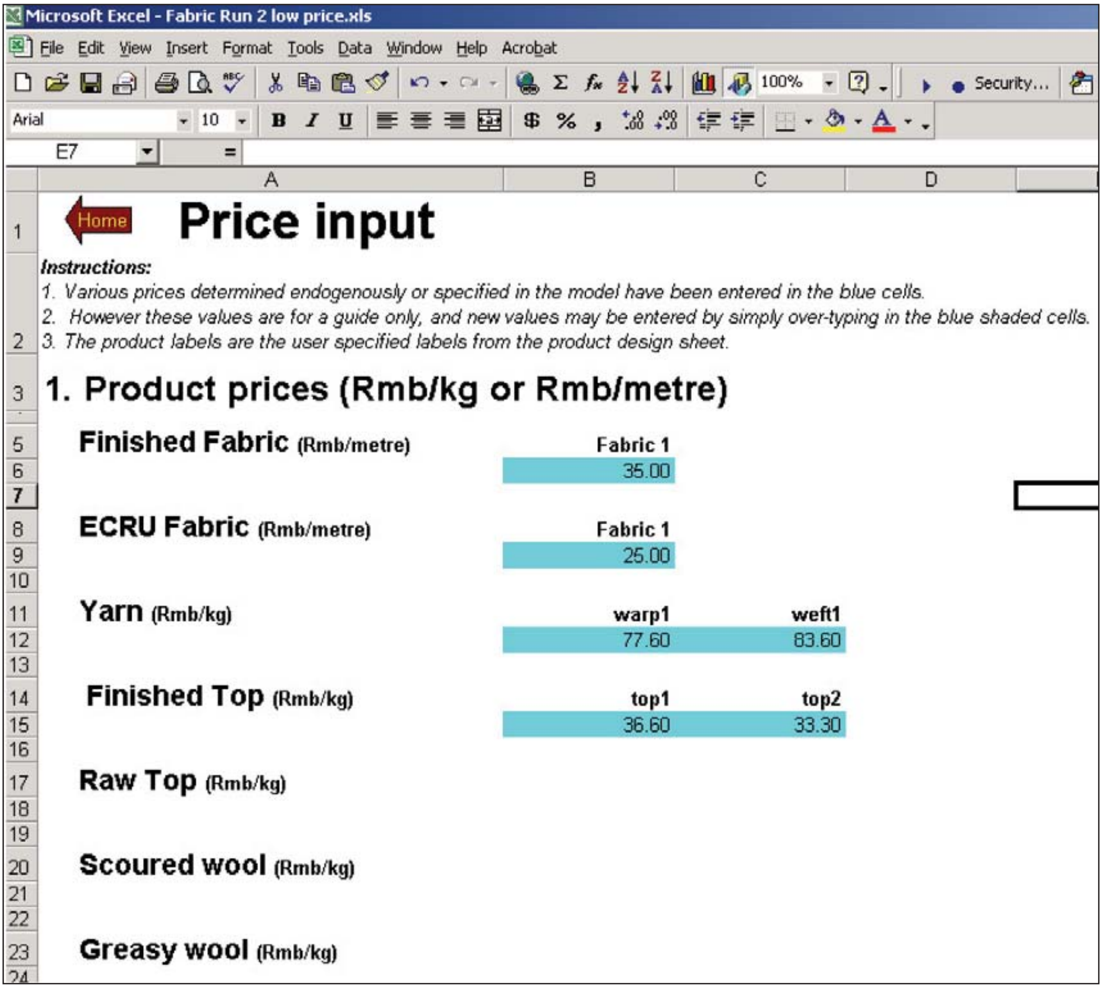


Appendix Figure 5.14 ‘Profit’ sheet

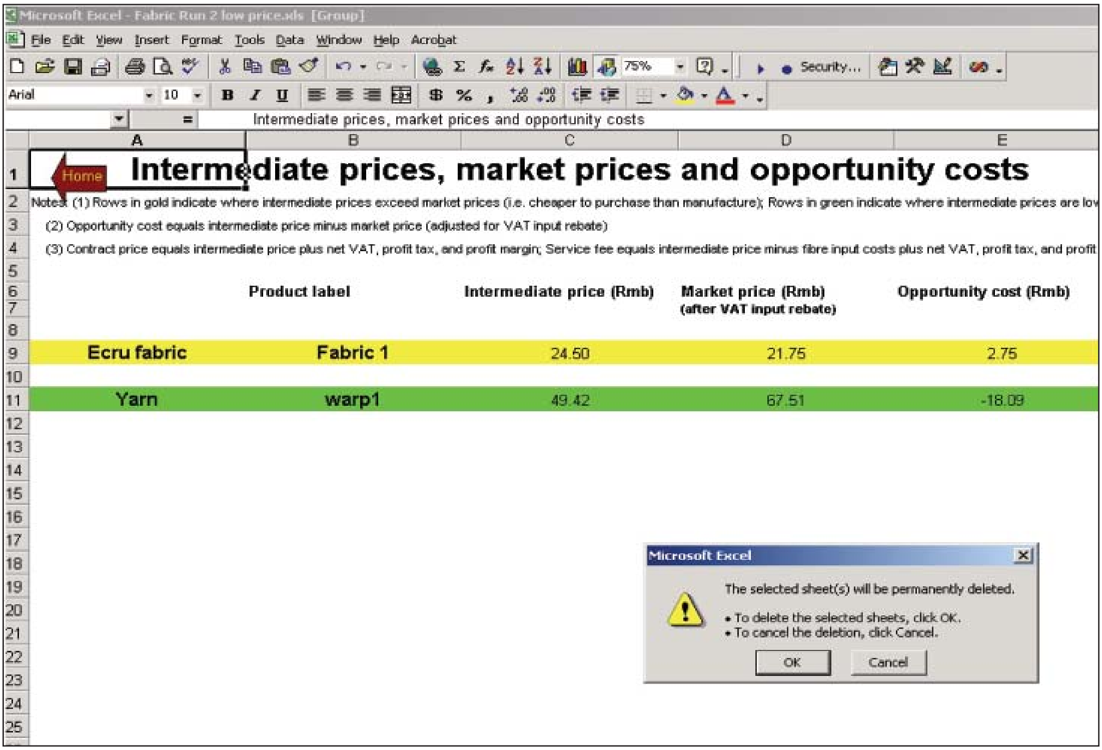


	A	B	C	D	E	F	G	H
1	Hom	Spinning						
2								
3	1. Specifications&amounts		Yarn		warp1	weft1		
4		Specifications						
5			Yarn count		66.00	74.00		
6			Wool percentage(%)		90.00	70.00		
7			**Synthetic type					
8			**Number of twists		860.00	840.00		
9			**Ends down		16.00	18.00		
10			**Fibres in cross-section		38.00	40.00		
11			Manufactured or purchased		Manufactured	Purchased		
12								
13		Amount required (kg)			510.16	510.16		
14								
15	2. Input/Output table							
16					Proportion	Spinning yield	Amount (kg)	Total (kg)
17			Yarn		warp1	warp1	warp1	
18		Finished top		top1	60.00	0.95	323.91	323.91
19				top2	40.00	0.95	215.94	215.94
20								
21	3. Fibre input price/costs							
22					Cost(Rmb)		Price(Rmb/kg)	
23		Finished top		top1	11855.23		36.60	
24								
25				top2	7190.87		33.30	
26								
27	4. Spinning workshop costs (Rmb)							
28			Yarn		warp1			
29								
30		Workshop allocated costs						
31			Energy		2975.95			
32			Labour		2550.82			
33			Workshop overheads		382.62			
34			Workshop other		255.08			
35			Total		6164.47			
36								
37		Workshop direct costs - non-fibre						
38			Total		0.00			
39								
40		Workshop direct costs - fibre			19046.10			

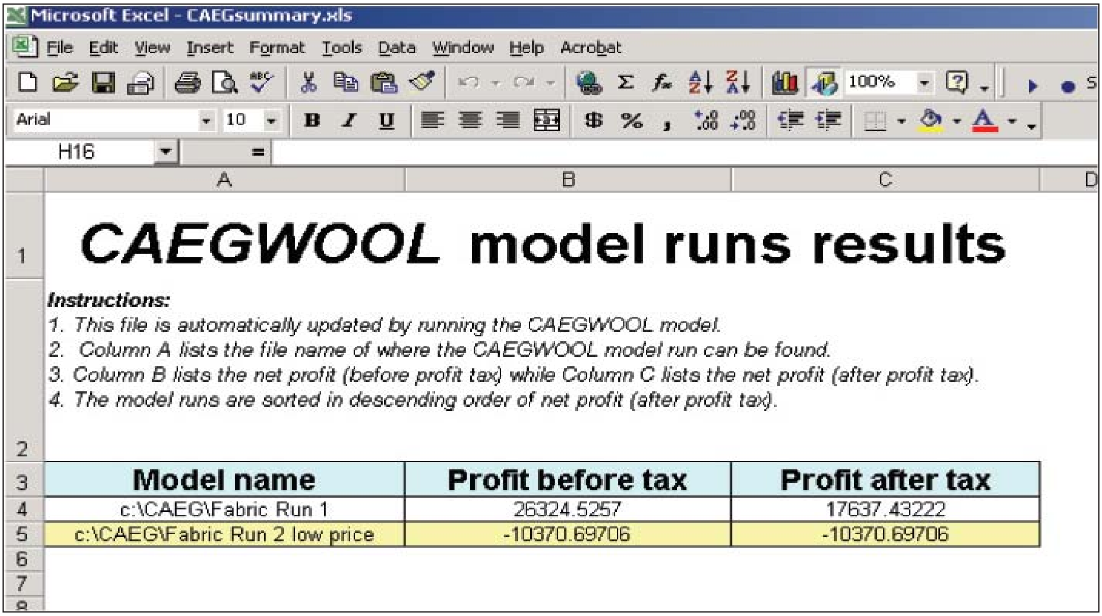
Appendix Figure 5.15 ‘Spinning’ sheet



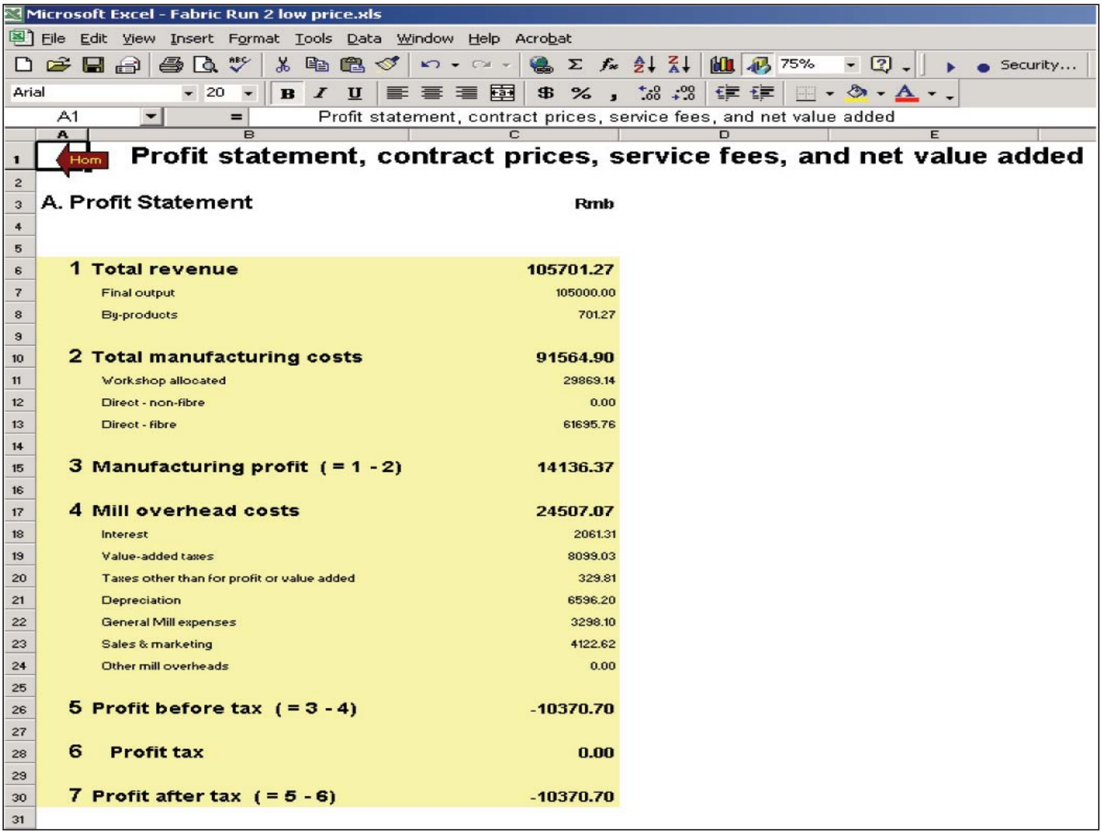
Appendix Figure 5.16 Modified 'Price input' sheet (for 'Fabric Run 2 low price')



Appendix Figure 5.17 Microsoft excel warning message for deleting existing (output) worksheets



Appendix Figure 5.18 Updated CAEGsummary.xls file showing results for ‘Fabric Run 2 low price’



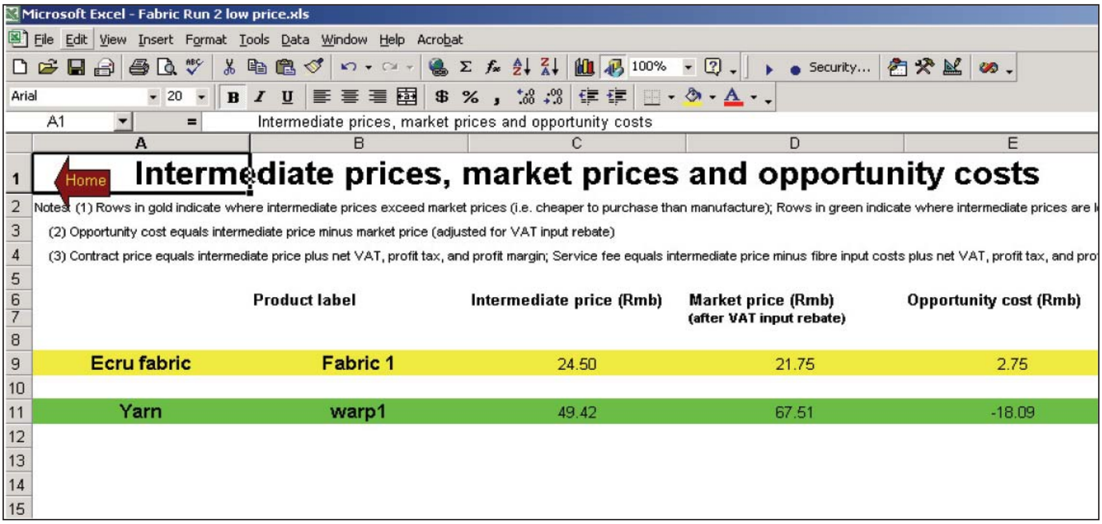
Microsoft Excel - Fabric Run 2 low price.xls

Profit statement, contract prices, service fees, and net value added

A. Profit Statement

		Rmb
1	**Total revenue**	**105701.27**
	Final output	105000.00
	By-products	701.27
2	**Total manufacturing costs**	**91564.90**
	Workshop allocated	29869.14
	Direct - non-fibre	0.00
	Direct - fibre	61695.76
3	**Manufacturing profit (= 1 - 2)**	**14136.37**
4	**Mill overhead costs**	**24507.07**
	Interest	2061.31
	Value-added taxes	8099.03
	Taxes other than for profit or value added	329.81
	Depreciation	6596.20
	General Mill expenses	3298.10
	Sales & marketing	4122.62
	Other mill overheads	0.00
5	**Profit before tax (= 3 - 4)**	**-10370.70**
6	**Profit tax**	**0.00**
7	**Profit after tax (= 5 - 6)**	**-10370.70**

Appendix Figure 5.19 'Profit' sheet for 'Fabric Run 2 low price'



Microsoft Excel - Fabric Run 2 low price.xls

Intermediate prices, market prices and opportunity costs

Notes (1) Rows in gold indicate where intermediate prices exceed market prices (i.e. cheaper to purchase than manufacture); Rows in green indicate where intermediate prices are l

(2) Opportunity cost equals intermediate price minus market price (adjusted for VAT input rebate)

(3) Contract price equals intermediate price plus net VAT, profit tax, and profit margin; Service fee equals intermediate price minus fibre input costs plus net VAT, profit tax, and pro

	Product label	Intermediate price (Rmb)	Market price (Rmb) (after VAT input rebate)	Opportunity cost (Rmb)
Ecru fabric	Fabric 1	24.50	21.75	2.75
Yarn	warp1	49.42	67.51	-18.09

Appendix Figure 5.20 'Intermediate price' sheet for 'Fabric Run 2 low price'