China's pulp and paper sector: an analysis of supply-demand and medium term projections[1]

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SUMMARY

This study summarizes recent trends in China's paper and paperboard sector and projects supply and demand for each of the major grades through 2010. Baseline projections suggest that China's aggregate demand will grow from 48.0 million tonnes in 2003 to 68.5 million tonnes per year in 2010. With domestic production projected to reach 62.4 million tonnes per year, China is expected to dominate global capacity expansion for most major grades. China's annual demand for fibre furnish across all grades is projected to rise from 40.2 million tonnes in 2003 to reach 59.6 million tonnes by 2010. Of this, approximately 58 % will come from recovered paper, 25 % from wood-based pulp, and 17 % from nonwood pulp. This rapid growth has far-reaching implications for forest sustainability and rural livelihoods both within China and throughout the Asia-Pacific region. It will place new strains on China's domestic wood supply and may exacerbate forest conversion and illegal logging in key supplier countries, in addition to providing both threats and potential income opportunities for smallholder tree growers.

Keywords: China, paper and paperboard, pulp, wood fibre, supply-demand trends

INTRODUCTION

China's unprecedented economic growth over the last 15 years has led to a sharp increase in demand for paper and paperboard products. During this period, the country's aggregate consumption of paper and paperboard has grown by 9.6 nearly 10 % per year, rising from 14.6 million tonnes in 1990 to 48.0 million tonnes in 2003. To meet this demand, domestic production of paper and paperboard has grown at a similar pace, expanding from 13.7 million tonnes in 1990 to 43.0 million tonnes in 2003. Accounting for over 50 % of the world's overall growth in paper and paperboard production since 1990, China is now the second largest producer globally, surpassed only by the United States.

There is a general consensus among industry analysts that China's demand for paper and paperboard, as well as domestic production, will continue to expand at a very rapid pace for at least the medium term. However, forecasts of China's consumption for 2010 have varied widely in recent years, ranging from the FAO's projection of 48 million tonnes (Zhang *et al.* 1997a) to projections of 60 million tonnes or more by leading commercial analysts (Jaakko Pöyry 2000, URS Forestry 2002)[2]. Recent market studies also project in recent years have projected that by 2010, China will consume approximately 60 million tonnes of paper and board products annually, and that most of this will be supplied by domestic producers[3]. These projections raise a number of fundamental questions regarding the raw material supply for China's paper and board industry - most notably, ‚How much fibre will be needed to support China's growing demand over the years ahead ?' ‚What types of fibre will the coun-try's paper and board industry consume ?' and

[1] This article has been adapted from Dequan He and Christopher Barr (forthcoming) ‚China's pulp, paper and paperboard sector: an analysis of supply and demand trends and projections to 2010', to be published by the Center for International Forestry Research (CIFOR) and Forest Trends.

[2] It should be noted that even within the FAO literature, estimates of China's future paper and paperboard consumption have varied widely. For instance, the *FAO Provisional Outlook for Global Forest Products Consumption, Production and Trade to 2010* (Zhang *et al.* 1997b) projected that China's total demand would reach between 59.5 million tonnes and 65.6 million tonnes by 2010, depending on the country's general economic growth and other variables. However, this estimate was revised downward quite substantially in the FAO's *Trends and Outlook for Forest Products Consumption, Production and Trade in the Asia-Pacific Region* (Zhang *et al.* 1997a), which used a different set of assumptions to project that China's total demand would reach 48.1 million tonnes in 2010.

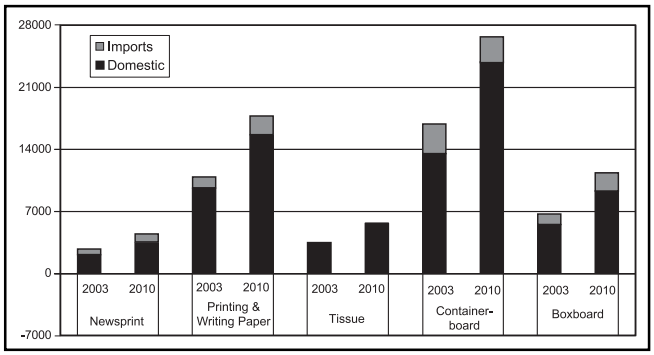
[3] See, for instance, Jaakko Pöyry's 2001 multi-client study entitled *China Forest Industries: Opportunities and Challenges - Pulp and Paper*; and URS Forestry's 2002 multi-client study entitled *The Chinese Pulp and Paper Industry; Present Position - Future Prospects*. A discussion of how these studies' forecasts compare to the projections offered in the present study is provided in He and Barr (forthcoming).

‚Where will the fibre come from ?'

The issue of where China's paper and board industry will get its fibre furnish and in what volumes has direct implications for rural livelihoods, sustainable forest management, and economic development not only within China, but also in Asia-Pacific supplier countries. Given the enormous scale involved, China's growing demand for wood fibre and wood-based pulp, in particular, provides significant income-generating opportunities for rural communities and for forest enterprises throughout the region. At the same time, China's expanding demand also poses potential threats to the livelihoods of forest-dependent people to the extent they may lose access to forests being cleared for pulp fibre or are displaced from lands being converted to pulpwood plantations.

This study represents an initial effort towards determining how much and what types of fibre China's paper and paperboard industry will consume over the medium term. We do so, first, by using an econometric model to project demand, supply, and trade for each of the major grades of paper and board through 2010. Based on these projections, we then use a similar model to estimate demand and supply for each of the major grades of fibre furnish - namely nonwood pulp, recovered paper, and wood-based pulp. It is our hope that this analysis will assist the region's policymakers and planners to anticipate the implications of China's expanding pulp and paper sector for forests and rural livelihoods throughout the Asia-Pacific region.

FIGURE 1 *China's domestic demand and imports for paper and paperboard by grade, 2003-2010 ('000 tonnes)*



Source: Authors' projections based on models developed by China Economic Consulting, Inc.

Our baseline projections suggest that China's aggregate demand for paper and board products is likely to exceed previous estimates and reach 68.5 million tonnes per year in 2010. Similarly, we project that domestic production across all grades is likely to grow by 45 % over 2003 levels to reach 62.4 million tonnes per year in 2010. The most significant volume increases by grade will be seen in containerboard and printing and writing paper (Figure 1). With this considerable growth, we estimate that China's annual consumption of fibre will grow from 40 million tonnes in 2003 to reach nearly 60 million tonnes by 2010. Of this, approximately 58 % will come from recovered paper, 25 % from wood-based pulp, and 17 % from nonwood pulp, made largely from bamboo and agricultural residues.

METHODOLOGY

In this study, we use a proprietary econometric model developed by China Economic Consulting, Inc. to project paper and paperboard demand, supply, and trade over the medium term. This model employs a weighted average index based on real consumer spending, investment, and net trade, together with projected GDP growth, to forecast demand for the major grades of paper and paperboard through 2010. To forecast supply for the various grades, we quantify currently existing capacity and combine this with confirmed capacity expansions at the mill level to estimate future installed capacity. We then multiply the expected installed capacity for each grade by an assumed operating level to project the volume of product that will be supplied by mills located in China. The assumed operating level for any particular grade depends, in part, on when new capacity expansions come online. The net trade is assumed to be the difference between demand and supply.

We use a derived demand approach to model China's demand for nonwood pulp, recovered paper, and paper-grade wood pulp. Based on the projected production levels for each grade of paper and paperboard, we estimate the volumes of the various grades of fibre furnish that are likely to be consumed as inputs through 2010. We forecast production of paper-grade wood pulp by estimating installed capacity and assumed operating levels. For nonwood pulp, our projections of domestic production are based on an assumed annual decrease of 2.5 %, corresponding to the pace at which we expect small and old paper machines are taken off-line. For recovered paper, our projections are based on an assumed 9.0 % annual increase due in part to the government's efforts to boost collection of recycled paper. Again, net trade is assumed to be the difference between demand and supply.

We use these approaches to make lower-bound, upper-bound, and baseline projections for the various grades of paper and board products and of fibre types through 2005 and 2010. For paper and paperboard, our baseline projection is based on the assumption that China's GDP will grow at an average rate of 7.5 % during 2003-2010. Our lower-bound projections assume that GDP growth will decline to 5.5 % for this period, while our upper-bound projections assume that GDP growth will remain at its recent historical levels of 9.5 %. Except where otherwise stated, historical data on pulp and paper demand and production in China have been obtained from the *Almanac of Chi-*

na Paper Industry, published by the China Light Industry Association, and from the China Paper Association.

CHINA'S PAPER AND PAPERBOARD GROWTH, 1990-2003

Paper and paperboard demand in China has expanded rapidly over the last two decades, with an average annual growth rate of 9.6 %, or 2.6 million tonnes per year, between 1990 and 2003 (Table 1). During this period, China accounted for nearly one-third of the world's overall growth in paper and board consumption; and the country currently consumes almost 14 % of global paper supply (Kuusisto 2004, Spencer 2004). Across the different grades, containerboard experienced the most significant volume increase, with demand growing by 12.8 million tonnes during 1990-2003. Printing and writing paper ranked second, with consumption growing by 7.0 million tonnes. Demand for boxboard rose by 5.6 million tonnes, while demand for tissue paper and newsprint grew by 2.6 million and 1.9 million tonnes, respectively.

TABLE 1 *Growth in China's demand and supply of paper and paperboard by grade, 1990-2003 ('000 tonnes)*

	1990	2003	Annual growth	Change in volume
Demand	**14,634**	**48,056**	**9.6 %**	**33,422**
Newsprint	526	2,410	12.4 %	1,884
Printing & Writing	3,313	10,311	9.1 %	6,998
Tissue/Household	647	3,276	13.3 %	2,629
Containerboard	3,193	15,974	13.2 %	12,781
Boxboard	1,118	6,698	14.8 %	5,580
Other paper and board	5,837	9,387	3.7 %	3,550
Net imports	**915**	**5,056**	**14.1 %**	**4,141**
Newsprint	17	340	25.9 %	323
Printing & Writing	43	711	24.1 %	668
Tissue/Household	-32	-194	14.9 %	-162
Containerboard	566	2,474	12.0 %	1,908
Boxboard	244	1,198	13.0 %	954
Other paper and board	77	527	15.9 %	450
Production	**13,719**	**43,000**	**9.2 %**	**29,281**
Newsprint	509	2,070	11.4 %	1,561
Printing & Writing	3,270	9,600	8.6 %	6,330
Tissue/Household	679	3,470	13.4 %	2,791
Containerboard	2,627	13,500	13.4 %	10,873
Boxboard	874	5,500	15.2 %	4,626
Other paper and board	5,760	8,860	3.4 %	3,100

Source: Authors' estimates based on data reported by China Economic Consulting Inc. and China Paper Almanac (2003).

One of the key drivers to the strong increase in China's demand for paper and board has been the sustained high level of GDP growth, together with consumer spending and exports. Between 1990 and 2003, China's real GDP grew at 9.7 % per year, while real consumer spending and merchandise exports increased by 8.8 % and 11.2 % per year, respectively (World Bank 2003). Growing demand for graphic paper has been driven by rising personal incomes, increase in advertising expenditures, and rapid growth in commercial printing. Rising demand for paper packaging, likewise, has been supported by strong growth in merchandise exports and changing distribution systems and packaging methods. Other factors, including China's relatively low consumption base, improvement in living standards and the shift in composition of the industry have also contributed to the strong performance in paper and board demand.

On the supply side, China's paper and board sector has expanded significantly to meet strong demand growth in 1990-2003. As Table 1 shows, China's annual paper and board production rose by 29.3 million tonnes during this period, with an average annual growth rate of 9.2 %, or 2.3 million tonnes. Net imports have filled the gap between demand and supply, growing by approximately 320 000 tonnes per year. The significant increase in production reflects China's solid growth in installed capacity, following the substantial capital investments made in the sector during the 1990s and early 2000s (Jaakko Pöyry 2000; URS Forestry 2002). This expansion came in response to strong demand growth, high levels of imports and lack of high-quality paper and paperboard in China. Since 2000, government pump priming to promote economic growth, loosened monetary policy and the development of China's domestic capital market have also contributed to the rise in paper and board capacity.

The following sections describe recent trends in China's demand, supply, and trade for the major grades of paper and board products, as well as forecasts for each grade through 2010. Appendix A provides a list of major paper and paperboard capacity expansions carried out during 2003, and ongoing and planned expansion projects announced for 2004-2006.

NEWSPRINT

Newsprint is mainly used for the publication of newspapers. Demand for this grade is closely correlated to the performance of gross domestic product. High GDP growth means rising personal incomes, which in turn, make newspapers more affordable. Other factors, such as advertising expenditures, literacy rates, pagination of newspapers and the development of electronic media, also affect demand for newsprint.

In the 1980s, China's demand for newsprint was relatively low as the printing media sector was highly controlled by the government. Newsprint consumption started rising in the early 1990s, however, as the government gradually loosened restrictions on the number of newspapers in circulation and on the advertising space available. Demand for newsprint increased from 526 000 tonnes in 1990 to 2.4 million tonnes in 2003, with an average annual growth rate of 12 %.

Other factors, such as rising consumer purchasing power due to strong GDP growth, rapid increase in advertising expenditures, and high literacy rates also contributed to the sharp growth in newsprint consumption.

On the supply side, only nine state-owned newsprint mills generated most of the newsprint consumed in China until very recently. These mills were protected by the government through controls on domestic newsprint prices and restrictions on foreign investment. In the mid-1990s, the government lifted these restrictions, leading to a considerable surge in newsprint imports during 1997-1998. This persuaded most domestic producers that they would either need to modernize their operations, or face the prospect of collapsing in a competitive market. With government support, many state-owned newsprint producers have taken steps to upgrade their machines or to expand capacity in recent years. In 2003 alone, five more newsprint machines (two of them are swing machines producing both light weight coated paper and newsprint), totaling 820 000 tonnes capacity came online (Table A 1).

In terms of market outlook, our baseline projection shows that Chinese newsprint demand will increase by about 7.2 % per year through 2010, translating to annual growth of 220 000 tonnes (Table 2). Newsprint production is forecast to grow by approximately 7.5 % per year, representing an increase of 200 000 tonnes during the same period. As a result, China will continue to import small amounts of newsprint to meet its demand. Even if our lower bound forecast plays out, China will still need to import about 24 000 tonnes of newsprint per year through 2010.

PRINTING AND WRITING PAPER

Printing and writing papers are mainly used for publication of magazines, catalogues and books (textbooks, notebooks and exercise-books). Demand growth for this grade is highly correlated to overall economic activities, especially the performance of advertising, commercial printing and educational printing and writing. China's consumption of printing and writing paper grew by 9.1 %, or 540 000 tonnes per year in 1990-2003, exceeding 10 million tonnes for the first time in 2002. Several factors have contributed to strong demand growth for this grade, including increasing levels of economic activity, a relatively low per capita consumption base, and a relatively high rate of literacy and educational demand.

Printing and writing papers can be further broken down into coated and uncoated papers. As shown in Figure 2, average annual growth in demand for coated paper was about 21 % in 1990-2003, while average annual growth for uncoated paper was 7 % during the same period. This divergence largely stems from how these two grades are utilized in the end-use market. In China, a large portion of uncoated paper is used to produce textbooks, exercise books and notebooks. Prices for these products have been highly regulated by the government, so that these books would be rela-

TABLE 2 *Projected growth in China's demand and supply for paper and paperboard, 2005-2010 ('000 tonnes)*

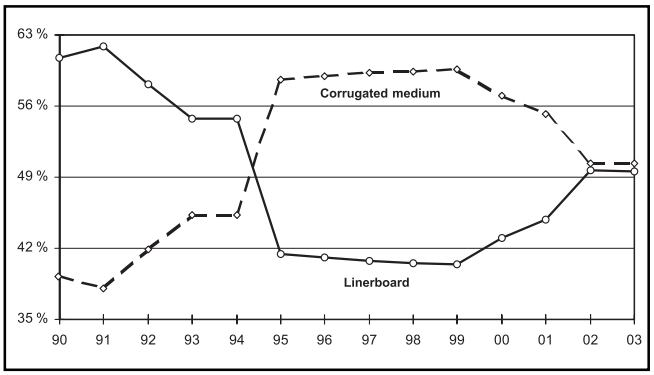
	2003	2005			2010		
		Lower bound	Baseline	Upper bound	Lower bound	Baseline	Upper bound
Demand	**48,056**	**51,094**	**52,922**	**54,185**	**61,593**	**68,528**	**75,129**
Newsprint	2,410	2,598	2,688	2,781	3,447	3,928	4,461
Printing & Writing	10,311	11,941	12,353	12,784	15,062	17,161	19,490
Tissue	3,276	3,717	3,845	3,979	4,957	5,647	6,414
Containerboard	15,974	17,907	18,598	18,802	24,227	25,920	27,311
Boxboard	6,698	7,233	7,474	7,595	9,470	10,825	11,721
Other	9,387	76,990	7,965	8,243	4,430	5,047	5,732
Net imports	**5,056**	**4,640**	**4,807**	**4,911**	**5,429**	**6,058**	**6,731**
Newsprint	340	256	265	274	443	505	674
Printing & Writing	711	1,326	1,372	1,419	1,367	1,557	1,769
Tissue	-194	-97	-100	-103	-30	-34	-38
Containerboard	2,474	1,851	1,922	1,943	1,913	2,047	2,156
Boxboard	1,198	917	948	963	1,341	1,533	1,660
Other	527	387	400	414	395	450	511
Production	**43,000**	**46,454**	**48,115**	**49,274**	**56,164**	**62,470**	**68,398**
Newsprint	2,070	2,342	2,423	2,507	3,004	3,423	3,787
Printing & Writing	9,600	10,615	10,981	11,365	13,695	15,603	17,722
Tissue	3,470	3,813	3,945	4,083	4,987	5,681	6,453
Containerboard	13,500	16,056	16,676	16,859	22,315	23,874	25,154
Boxboard	5,500	6,315	6,526	6,632	8,129	9,292	10,061
Other	8,860	7,312	7,565	7,829	4,035	4,597	5,221

Source: Authors' projections based on models developed by China Economic Consulting, Inc.

tively affordable, especially for people with lower income in rural areas. As a result, profit margins have been relatively low for publishers of textbooks and producers of exercise and notebooks.

In contrast, most coated paper is used for commercial publishing of books, magazines, catalogues, brochures and calendars. The commercial printing market has not been heavily regulated by the government. In addition, the relocation of export-oriented printing operations from Hong Kong to neighboring Guangdong Province in recent years has given a boost to the printing sector. Finally, consumers have become increasingly quality conscious, resulting in publishers substituting high quality coated paper for uncoated grades.

FIGURE 2 *Share of linerboard and corrugated medium as portion of total containerboard demand, 1990-2003 (percentage)*



Source: Authors' projections based on models developed by China Economic Consulting, Inc.

Will this trend continue ? Several factors suggest that it will. First, demand for coated papers will continue to enjoy rapid growth in export-oriented printing operations in China. With China's entry into the World Trade Organization (WTO), commercial printing operations will also benefit from strong growth in merchandise exports and foreign direct investment in telecommunications, banking and investment management. Finally, high quality coated paper will continue to be substituted for uncoated grades due to rising quality demands for consumers. We project that growth for coated grade will average 11 % (470 000 tonnes) per year during 2003-2010, while growth for uncoated grade will average 6 % (510 000 tonnes) per year during the same period.

On the supply side, production of printing and writing paper grew from 3.3 million tonnes in 1990 to 9.6 million tonnes in 2003. This was largely due to a series of major capacity expansions in late-1990s, several of which were made by leading international producers such as Asia Pulp & Paper (APP), Asia Pacific Resources International Ltd (APRIL), and Daewoo Paper. Further expansion of China's production of printing and writing paper is expected, with at least 1.7 million tonnes of new capacity scheduled to come online between 2004 and 2006 (Table A 2).

In spite of the fact that domestic production will not fully meet China's continuing growth in demand for printing and writing paper over the medium term, it is likely that a significant number of small producers will be pushed out of the market during the next several years. In the past, these small mills have survived through a combination of tariff protection, ties to local governments, and production of low-quality, but cheaper products that satisfy their customers' needs. However, the competitiveness of lower-quality products is rapidly disappearing with China's entry into the WTO and growing consumer demand for higher quality paper.

Our baseline forecast shows that China's net imports for this grade will increase from 710 000 tonnes in 2003 to 1.6 million tonnes in 2010, with a 12.4 % average annual growth rate. Even our lower bound projection indicates that net imports for printing and writing paper in China will grow by 10 % per year, or 100 000 tonnes, while our upper bound projection shows that net import growth will average 14 % per year, or 160 000 tonnes.

TISSUE AND HOUSEHOLD PAPERS

China's demand for tissue and other household paper grades grew by an average of 13 % per year during 1990-2003, rising from 647 000 tonnes to 3.3 million tonnes (Table 1). Strong economic growth in concert with rising personal incomes, low per-capita consumption levels and rising health concerns, have contributed to the double-digit growth for this grade in recent years.

China's market for tissue products has been increasing year by year, but large regional disparities are clearly seen due to the different levels of disposable income and cultural practices. For example, China's more affluent coastal regions have the highest demand for household tissue products. Inland cities support the next highest level of demand, followed by rural areas. Some disparities are also seen in demand for different levels of quality for the same product type. More affluent segments of the population consume higher quality products, while other sectors of the population utilize those of middle and lower quality.

Over the last 15 years, China's domestic producers have supplied all of the country's increased demand for tissue and household papers, following significant investments in this grade. In fact, trade data show that tissue is the only grade where China is a net exporter. Before 1997, China's gross exports for tissue were in the range of 25 000 - 55 000 tonnes per year, and they mainly went to Hong Kong. However, China exported approximately 120 000 tonnes of tissue in 2001. Gross exports continued to rise to 160 000 tonnes in 2002 and reached 230 000 tonnes in 2003.

Looking forward, our baseline projection shows that demand growth for tissue and household papers will average 8.0 % per year, or 340 000 tonnes annually

through 2010 - or about 5 percentage-points lower than the 13 %-per-year achieved since 1990. This healthy growth will translate into another 2.4 million tonnes of demand by 2010 (Table 2). Production is projected to grow by 7.3 % per year during the same period, translating into an aggregate increase of 2.2 million tonnes of tissue paper. As the gap between demand and supply narrows, net exports of tissue are fo-recast to decline from 195 000 tonnes in 2003 to 34 000 tonnes in 2010.

One of the main risks for this projection is GDP growth in China, especially growth in consumer spending. Higher GDP growth would mean higher disposable income and, therefore, higher demand for tissue paper. Our upper bound projection calls for demand for this grade to grow at 10% per year to reach 6.4 million tonnes in 2010, while the lower bound projection indicates that demand for this grade will grow at around 6 % per year, reaching 5.0 million tonnes by 2010.

CONTAINERBOARD

Containerboard, including linerboard and corrugated medium, is mainly used to make fibre boxes to pack a variety of durable and nondurable goods. Demand for this grade is highly correlated with the performance of economic activities, such as industrial production and consumer spending. China's successful reforms have led to rapid economic growth, especially in the segments of merchandise exports and consumer spending, which in turn, have resulted in strong demand growth for containerboard.

In the decade following 1978, when China started making its transition to a market economy, domestic demand for containerboard more than doubled, rising from less than 1.0 million tonnes to 2.3 million tonnes by 1988. Since then, demand for containerboard has continued to experience very rapid growth, reaching 16.0 million tonnes in 2003. Chinese consumers are now buying processed food, beverages, clothing, footwear and durables that were unavailable during the pre-reform decades, and most of these are packed in fibre-based boxes. In addition, the open economy of the reform era has been driven, in part, by high levels of merchandise exports, such as footwear and toys. The exporting sectors are demanding quality packaging with added strength and better printability required to achieve competitiveness in the foreign markets.

Continued growth in containerboard continues to appear likely over the medium and long term, primarily due to the favorable outlook for China's merchandise exports and consumer spending. Our baseline projection shows that demand growth for containerboard will average 7.2 %, or 1.4 million tonnes per year from 2003 to 2010 (Table 2). This growth rate is about 6 percentage points lower than the 13 %-per-year achieved in the previous decade. The growth in containerboard demand will add about 10.0 million tonnes to the grade's total consumption by 2010, pushing it up to 25.9 million tonnes.

We attribute this significant increase to: 1) healthy growth in industrial production for durable and nondurable goods; 2) rising exports of merchandise goods resulting from China's WTO membership, which in turn, demand more packaging materials; 3) changing distribution systems and packaging methods; and 4) the increasing popularity of large-scale retail outlets in China relative to traditional open markets. Demand growth for containerboard could be even stronger if fibre boxes do not meet significant competition from alternative packaging materials (particularly plastics) in some end uses.

TABLE 3 *Growth in China's demand and supply nonwood pulp, recovered paper and wood pulp 1990-2003 ('000 tonnes)*

	1990	2003	Annual growth	Change in volume
Demand	**12,823**	**40,166**	**9.2 %**	**27,343**
Nonwood pulp	6,799	11,741	4.3 %	4,942
Recovered paper	4,172	19,199	12.5 %	15,027
Paper grade wood pulp	1,851	9,226	13.2 %	7,375
BHKP	235	2,919	21.4 %	2,684
BSKP	510	2,822	14.1 %	2,312
UKP	486	1,589	9.5 %	1,103
MEC	451	1,696	10.7 %	1,224
Other	169	200	1.3 %	32
Net imports	**739**	**15,149**	**26.2 %**	**14,410**
Nonwood pulp	3	41	21.0 %	38
Recovered paper	422	9,381	26.9 %	8,959
Paper grade wood pulp	314	5,726	25.0 %	5,413
BHKP	25	2,309	41.6 %	2,284
BSKP	210	1,962	18.7 %	1,752
UKP	36	659	25.1 %	623
MEC	6	723	43.9 %	716
Other	36	73	5.6 %	37
Production	**12,084**	**25,036**	**5.8 %**	**12,952**
Nonwood pulp	6,796	11,700	4.3 %	4,904
Recovered paper*	3,750	9,818	7.7 %	6,068
Paper grade wood pulp	1,538	3,518	6.6 %	1,980
BHKP	210	610	8.5 %	400
BSKP	300	860	8.4 %	560
UKP	450	930	5.7 %	480
MEC	445	973	6.2 %	528
Other	133	145	0.7 %	12

* Production of recovered paper means collection.
Source: Authors' estimates based on data reported by China Economic Consulting Inc. and Almanac of China Paper Industry (2003).

There are two major subgrades for containerboard: linerboard and corrugated medium. Linerboard includes kraftliner (made of unbleached kraft pulp) and testliner (made of waste paper). Recently, kraft-top testliner, which contains at least 25 % unbleached kraft pulp, has gained in popularity as the strength and burst are similar to kraftliner and the cost normal-

ly is lower. Corrugated medium includes semi-chemical mechanical medium and recycled medium. The former is made from semi-chemical mechanical pulp, while the latter is made of recycled paper.

Historically, the share of demand for linerboard was relatively high due to the lower quality of corrugated medium produced in China. For example, the share of demand for linerboard was about 60 % in 1990-1994, while the share for medium was about 40 % during the same period (Figure 2). However, there has been a major shift in the share of these two grades in recent years, primarily due to: 1) improvement in the quality of both domestically produced liner and medium; and 2) an increase in larger and faster corrugators, which require more higher-quality medium sheets.

Going forward, however, the increase in China's domestic capacity which has occurred over the last three years - and which is likely to continue through at least 2005 - can be expected to dampen the prospects for containerboard imports (Table A 2). Our baseline forecast projects domestic containerboard supply to climb from 13.5 million tonnes in 2003 to 23.9 million tonnes in 2010. We project that imports for corrugated medium will decline from 1.3 million tonnes in 2003 to about 620 000 tonnes in 2010, while imports for linerboard will increase only slightly from 1.1 million tonnes in 2003 to 1.5 million tonnes in 2010. Thus, on aggregate China will need to import about 2.1 million tonnes of containerboard annually to meet its demand growth.

TABLE 4 *Projected growth in China's demand and supply for nonwood pulp, recovered paper and wood pulp, 2005-2010 ('000 tonnes)*

	2003	2005			2010		
		Lower bound	Baseline	Upper bound	Lower bound	Baseline	Upper bound
Demand	**40,166**	**43,480**	**44,853**	**46,245**	**53,085**	**59,632**	**65,235**
Nonwood pulp	11,741	11,056	11,441	11,591	8,250	9,881	10,246
Recovered paper	19,199	22,244	22,869	23,715	31,437	34,646	38,304
Paper grade wood pulp	9,226	10,180	10,543	10,939	13,398	15,105	16,685
BHKP	2,919	3,333	3,523	3,662	5,136	6,134	6,973
BSKP	2,822	3,172	3,231	3,352	3,952	4,301	4,627
UKP	1,589	1,754	1,799	1,849	2,069	2,229	2,404
MEC	1,696	1,796	1,836	1,896	2,191	2,331	2,541
Other	200	125	155	180	50	110	140
Net imports	**15,149**	**17,431**	**17,897**	**18,603**	**22,737**	**25,193**	**27,944**
Nonwood pulp	41	56	61	71	20	36	51
Recovered paper	9,381	11,079	11,387	11,912	15,306	16,869	18,740
Paper grade wood pulp	5,726	6,296	6,449	6,620	7,411	8,288	9,153
BHKP	2,309	2,448	2,513	2,527	2,491	2,949	3,363
BSKP	1,962	2,247	2,286	2,387	2,832	3,111	3,347
UKP	659	749	774	804	901	991	1,096
MEC	723	818	818	848	1,178	1,178	1,283
Other	73	34	59	54	9	59	64
Production	**25,036**	**26,054**	**26,970**	**27,646**	**30,352**	**34,453**	**37,295**
Nonwood pulp	11,700	11,000	11,380	11,520	8,230	9,845	10,195
Recovered paper	9,818	11,166	11,482	11,803	16,131	17,777	19,564
Paper grade wood pulp	3,518	3,888	4,108	4,323	5,991	6,831	7,536
BHKP	610	885	1,010	1,135	2,645	3,185	3,610
BSKP	860	925	945	965	1,120	1,190	1,280
UKP	930	1,005	1,025	1,045	1,168	1,238	1,308
MEC	973	978	1,018	1,048	1,013	1,153	1,258
Other	145	95	110	130	45	65	80

Source: Authors' projections based on models developed by China Economic Consulting, Inc.

Over the last two decades, China has imported significant volumes of linerboard and corrugated medium to meet the country's growing demand for packaging materials. For example, China's total imports of linerboard and medium were about 630 000 tonnes in 1990, of which linerboard imports accounted for 550 000 tonnes and corrugated medium imports about 80 000 tonnes. Imports of both linerboard and medium have risen significantly since then. In 2003, imports of linerboard reached 1.1 million tonnes, while imports of corrugated medium were about 1.3 million tonnes.

BOXBOARD

Boxboard is mainly used to make carton boxes, which are widely utilized for packaging of lighter weight products, such as footwear, food, wine, cigarettes, and a wide range of consumer luxury goods. Similar to containerboard, demand for this grade is also closely correlated to industrial production and consumer spending. Since 1978, China's policy of economic liberalization has led to strong growth in merchandise exports, which has partially contributed to impres-

sive performance of industrial production. In addition, the successful economic reforms have unleashed strong consumer demand. Consumers in China are now buying beverages, clothing, footwear and cosmetics, which were unavailable during pre-reform years. Most of these are wrapped and packaged, which in turn, has boosted demand for carton boxes and, therefore, boxboard.

Demand for boxboard was less than 500 000 tonnes in 1978, when China started implementing its economic reforms and open door policy. By 1988, demand for this grade had more than doubled to 1.0 million tonnes. Since then, demand for boxboard has continued to show rapid growth, reaching 6.2 million tonnes in 2003, with an average annual growth rate of 14 %.

Historically, imports supplied a large portion of the boxboard consumed by China. Customs statistics show that on average imports accounted for 41 % of total demand during 1990-2000. However, this share fell to 22 % in 2001-2003, primarily due to the rapid increase in domestic production in recent years. Domestic boxboard production grew from approximately 1.0 million tonnes in 1991 to 5.5 million tonnes in 2003. The two largest machines for this grade are located at the Ningbo Zhonghua Paper mill, owned by APP. These two machines came online in 1996-1997, with a combined total capacity at 600 000 tonnes.

We expect that future demand growth in this grade will remain strong through 2010, primarily due to projections of significant growth in merchandise exports, rising personal incomes and increasing production for processed food. Our baseline projection shows that boxboard demand will increase from 6.7 million tonnes in 2003 to 10.8 million tonnes in 2010, with an average annual growth rate of 7.1 % (Table 2). We anticipate that aggregate boxboard supply will increase by 70 % during the same period to reach 9.3 million tonnes in 2010. Much of this increase can be attributed to the fact that eight machines, with a total capacity of 2.4 million tonnes per year, are scheduled to come online during 2003-2004 (see Tables A 1 and A 2). Although most of China's demand for boxboard will be met by domestic production, net imports for boxboard are also projected to grow by 28 % to reach 1.5 million tonnes per year in 2010.

CHINA'S PROJECTED GROWTH IN GLOBAL CONTEXT

On aggregate, our baseline forecast estimates that China's paper and paperboard demand will grow by an average of 2.9 million tonnes annually through the remainder of this decade to reach 68.5 million tonnes in 2010 (Table 2). Significantly, it is expected that China will account for over 30 % of the world's overall growth in consumption of paper and board products during this period (Asprem *et al.* 2004). Across all grades, China's demand will increase most significantly for containerboard and for printing and writing paper - the latter of which relies, more than any other grade, on the use of virgin wood fibre.

In spite of this very substantial increase, China rapidly growing demand is not likely to place significant strains on global supplies of most grades of paper and paperboard products. Rather, over the medium term, China is expected to supply the vast majority of the paper and paperboard it consumes through domestic production (see Figure 2). Our baseline forecast estimates that domestic production will grow by 2.8 million tonnes per year to reach a total of 62.4 million tonnes in 2010 - at which point domestic producers are projected to supply roughly 90 % of China's aggregate demand. Again, the largest increases in new capacity will be in containerboard and printing and writing paper, which will expand by 10.3 million tonnes and 6.0 million tonnes, respectively.

China's continued dominance of global growth in these grades is demonstrated by the fact that China accounts for 55 % of world capacity expansions for containerboard and 65 % of expansions for uncoated printing and writing paper that have been confirmed for 2004-2007 (Roberts 2004). In addition, China accounts for 100 % of confirmed global capacity expansions for newsprint; 83 % for boxboard; 52 % for uncoated printing and writing paper; and 10% for tissue and household paper during 2004-2007 (Roberts 2004).

It should be noted that a number of potential risks to our baseline projection can be found on both the upside and downside. As China's economy is still in the early stages of development, it has the potential to continue to grow at a very fast rate as the country seeks to catch up with the world's highly industrialized economies. As a result, our upper bound forecast assumes that China's GDP will grow at 9.5 % per year in the next seven years, similar to the growth rates experienced over the last 14 years. However, consumer spending and merchandise exports are likely to contribute more to GDP growth. If this scenario plays out, growth in paper and board demand will average 6.6 % per year, or 3.9 million tonnes annually. Net imports will also grow faster (at 4.2 %, or 240 000 tonnes annually) as domestic producers will be unlikely to keep up with the pace of demand growth.

Our lower bound forecast assumes that China's GDP will grow at 5.5 % per year, or much more slowly than most analysts currently predict. This could occur, for instance, if the Chinese government fails in its current efforts to reform the country's banking system or is unable to manage a soft landing to the economic overheating that is now occurring. In the event such a scenario were to play out, we estimate that growth in paper and board demand will average 3.6 % per year, or 1.9 million tonnes annually. Net imports will grow at only 1.0 %, or 53 000 tonnes annually. Given the current uncertainties in the Chinese economy, we feel that it is critical for policymakers and planners to take both the downside and upside risks into account when making decisions based on projections for the pulp and paper sector.

FIBRE DEMAND - RECENT TRENDS AND PROJECTIONS TO 2010

What will China's rapidly growing demand for paper and paperboard mean in terms of fibre consumption ? Available data suggest that China's aggregate consumption of fibre furnish across major grades, namely nonwood pulp, recovered paper, and wood-based pulp, increased from 12.8 million tonnes in 1990 to 40.2 million tonnes in 2003 (Table 3). Using a derived demand model based on forecasted production levels for the various grades of paper and paperboard, we project that China's annual demand for recovered paper and pulp fibre will reach 59.6 million tonnes by 2010 under our baseline scenario (Table 4). Fibre demand could be as high as 65.2 million tonnes depending on the sector's overall growth.

In contrast to the relatively neutral effect that China is expected to have on world paper and paperboard markets, this sharp growth in fibre demand will undoubtedly mean that China plays an increasingly significant role in the regional and global fibre trade. Indeed, Chinese companies - often with government support - have already taken steps to secure large volumes of recovered paper, wood pulp, and wood chips in world markets in order to supply domestic paper production (Wright 2004). In this regard, China is moving aggressively to achieve self-sufficiency in most grades of paper and paperboard, in addition to promoting wood pulp production, while relying heavily on imports to meet these industries' raw materials needs. The following sections describe China's projected supply and demand for the various grades of fibre furnish through 2010.

NONWOOD PULP

In 1990, nonwood pulp - principally made from bamboo, bagasse, reeds, wheat straw and other agricultural residues - accounted for over one-half of the 12.8 million tonnes of fibre consumed by domestic paper producers. Since then, however, the government has taken steps to close several thousand small-scale nonwood pulp mills because they have been a major source of water pollution, which poses problems for agricultural intensification (Roberts 2004)[4]. At the same time, the government is now seeking to promote the development of domestic wood pulp production to meet the needs of China's increasingly modern paper and board industries.

Data that are available on China's nonwood pulp industry can be described as sketchy at best. However, best estimates suggest that in spite of the government's recent effort to close mills, consumption of nonwood fibres grew by nearly 5 million tonnes on aggregate during 1990-2003. This expansion has, nevertheless, lagged well behind the sector's overall growth, and nonwood fibres accounted for less than one-third of the fibre furnish utilized by Chinese paper producers in 2003.

According to our baseline projections, China's demand for nonwood fibres will experience a moderate decrease in aggregate terms and a sharp decline in proportional terms over the next several years. Consumption of nonwood pulp will likely drop from 11.7 million tonnes in 2003 to approximately 9.9 million tonnes in 2010. By 2010, nonwood fibres are projected to account for less than 17 % of the industry's total fibre furnish. To a significant degree, the accuracy of these projections will depend on how actively and effectively the government continues to pursue its current policy of closing small-scale nonwood pulp mills, and on whether future technological innovations provide cost-effective ways of reducing the amount of pollution created by such mills.[5]

RECOVERED PAPER

Of the overall growth in China's fibre demand during the last 15 years, approximately 55 % has been supplied by recovered paper. In 1990, China's paper and board producers consumed 4.2 million tonnes of recovered paper, which then accounted for nearly one-third of the industry's total fibre demand. By 2003, the industry utilized some 19.2 million tonnes of recovered paper to account for 47 % of China's total fibre consumption. Roughly one-half of this came from imports, while the remainder was sourced domestically.

Over the medium term, our baseline forecast indicates that China's demand for recovered paper will grow from 19.2 million tonnes in 2003 to 34.6 million tonnes in 2010, at which point recovered paper will supply 58 % of the industry's total fibre furnish. During this period, recovered paper will account for no less than three-quarters of the new growth in China's overall fibre demand. Indeed, with the exception of printing and writing paper, most of the new paper and paperboard capacity that will come online in China over the next several years will rely heavily on recovered paper. The rationale for this is two-fold: on the one hand, recycled paper is cheaper than virgin wood fibre; and on the other hand, the investment

[4] Reliable data on how many nonwood pulp mills have been closed do not exist in the public domain. One widely-cited source estimates that over 4,000 small-scale nonwood pulp mills were closed during 1996-97; however, this figure has never been independently confirmed (Jaakko Pöyry 2000). Anecdotal reports have also indicated that at least a portion of the mills that have been ‚closed' have subsequently continued to operate informally.

[5] Some analysts anticipate that China will soon adopt new technologies which allow nonwood pulp to be processed efficiently and in environmentally sound way to produce high quality fibre. Ilkka Kuusisto of Jaakko Pöyry Consulting, for instance, projects that in spite of recent declines, the widespread use of such technologies will mean that China's nonwood pulp production increases over the medium-term, reaching 14 million tonnes in 2015 (Kuusisto 2004).

costs associated a paper or paperboard mill that utilizes recovered paper are considerably lower than those that involve pulp production (Roberts 2004).

Through at least 2010, we anticipate that China will continue to source approximately one-half of its recovered paper needs from external sources. The projected growth of China's recovered paper imports from 9.3 million tonnes in 2003 to 16.8 million tonnes will undoubtedly have a profound impact on the global market. In 2003, world exports of recycled paper - mainly from the United States, and to a lesser extent, Western Europe and Japan - totaled 16.5 million tonnes, and China imported 57 % of this (Roberts 2004). Many analysts believe that recovery rates in the US, Western Europe, and Japan are already near their peak, and any increases in paper recovery will largely be absorbed by internal demand within those markets (Roberts 2004, Kuusisto 2004). China's own domestic collection of recycled paper can be expected to increase by approximately 8 million tonnes through 2010; however, this will account for roughly 50 % of the projected growth in demand for this grade.

This suggests that China's substantial and rapidly expanding demand for recovered paper will almost certainly cause the world market to tighten, leading to sharp price increases for recycled paper and supply difficulties in many regions. Depending on how far prices rise, this could undermine the competitiveness of paper producers utilizing recovered paper compared to those using wood-based pulp (Roberts 2004).

WOOD-BASED PULP

With China producing an increasing volume of higher grade paper and board products, demand for wood-based pulp has been the fastest-growing segment of the industry's overall fibre furnish, averaging 13 % per annum since 1990. Consumption of wood pulp, however, still lags well behind recovered paper in terms of volume. In 1990, China's paper and board producers consumed only 1.8 million tonnes of mechanical and chemical wood pulp, which then accounted for less than 15 % of the industry's fibre furnish. By 2003, demand for wood pulp had reached 9.2 million tonnes to account for over 22 % of total fibre consumption. Bleached hardwood kraft pulp (BHKP) and bleached softwood kraft pulp (BSKP) each account for approximately 30 % of the various grades of wood pulp currently consumed by Chinese paper producers.

We project that China's demand for various grades of wood pulp will continue to increase at a rapid pace through 2010 – although in aggregate terms, the volumes of wood pulp consumed will continue to be far exceeded by recovered paper. According to our baseline forecast, China's annual demand for wood pulp will grow by nearly 65 % through the end of the decade, rising from 9.2 million tonnes in 2003 to 15.1 million tonnes in 2010. At that point, various grades of wood-based pulp will account for approximately one-quarter of the total fibre furnish utilized by China's paper and board producers.

BHKP will likely be the fastest-growing segment of wood pulp demand, effectively doubling from 2003 levels to reach 6.1 million tonnes in 2010. To a significant degree, this stems from the rapid growth of printing and writing paper production in China, which utilizes a relatively high proportion of virgin wood fibre compared to other grades. We anticipate that by 2010, pulp producers located in China will supply just over 50 % of the country's demand for BHKP, while the remainder will need to be imported. Demand for BSKP is projected to increase from 2.8 million tonnes in 2003 to 4.3 million tonnes in 2010. At that point, over 70 % of China's demand for BSKP is likely to be supplied by imports.

These projections suggest that China will continue to play a dominant role in world pulp markets over at least the medium term, and probably well beyond. According to data published by Hawkins Wright, China accounted for 55 % of the global increase in demand for market pulp during 1997-2003 (Wright 2004). Through 2008, Hawkins Wright projects that world demand for market pulp will grow from 44.8 million to 51.0 million tonnes per year and that China will account for just under 50 % of this demand. At the same time, global pulp capacity is expected to expand at an even faster pace, growing from 47.9 million tonnes in 2003 to 56.4 million tonnes in 2008. This imbalance is likely to put substantial downward pressure on world pulp prices, which in turn may sharply undermine the competitiveness of domestic pulp production within China, where pulp production costs are already high compared to countries such as Indonesia and Brazil.

IMPLICATIONS FOR SUSTAINABILITY AND LIVELIHOODS

The rapid growth of China's pulp and paper sector has far-reaching implications for forest sustainability and rural livelihoods. Given the enormous scale of China's projected demand, it is inevitable that the impacts of this growth, both positive and negative, will be felt not only within China but throughout the Asia-Pacific region, and perhaps beyond. For policymakers, civil society groups, and donor agencies that are concerned with such impacts, it will be important to take the following issues into account.

First, our projections estimate that by 2010, China's domestic supply of wood pulp will increase by 3-4 million tonnes over current levels, and domestic supply of paper and paperboard will increase by roughly 20-25 million tonnes. This implies that approximately 5-8 new pulp production lines, each with an annual capacity of 500 000 - 600 000 tonnes, and perhaps as many as 40-50 new paper and paperboard production lines will need to begin operating by the end of the decade. Some of this growth can undoubtedly be achieved by expanding the capacity of existing processing facilities; however, much of the new capacity will require

the construction of greenfield mills. Such projects require access to large volumes of water, substantial amounts of power, extensive infrastructure - and for integrated pulp production - a sizeable land base. Does China have a sufficient number of sites available for expansion of the pulp and paper industry on the scale that is projected ? If these mills are not built in China, where else might the new capacity be brought online ?

Second, the projected increase in China's demand for wood-based pulp from approximately 9 million tonnes in 2003 to 15 million tonnes by 2010 will mean substantial growth in the country's annual consumption of wood fibre. If it is assumed that on average, across all grades, 4.3 m^3 of roundwood (overbark) are needed to produce 1.0 air-dried tonne of pulp, then the volume of wood consumed annually by China in the form of wood pulp - whether produced domestically or externally - will rise from just under 40 million m^3/yr in 2003 to 65 million m^3/yr in 2010. The fact that roughly one-half of the wood pulp consumed by China over the medium term is expected to be produced domestically suggests that this will place considerable new pressures on the country's internal wood supply. The extent of such pressures will largely depend on how much new pulp capacity actually comes online domestically and whether the country's ambitious plantation development plans are successful. However, as Cossalter (2004) has noted, the development of fast-growing plantations in southern China continues to face numerous challenges - including land scarcity and limited genetic diversity - which may sharply constrain their productivity and yields for quite some time.

Third, it seems inevitable that China will obtain a substantial portion of its wood pulp and wood fibre from external sources, particularly from forested countries in the Asia-Pacific region. Most analysts expect that China will source the bulk of its softwood fibre imports from the Russian Far East and New Zealand, while much of its hardwood fibre will come from Brazil and Indonesia (Wright 2004, URS Forestry 2002). Given the weak forest governance that exists in some of these countries, it is likely that China's growing demand will exacerbate current pressures on natural forests and provide added incentives for illegal logging. Already, China imports close to 1.0 million tonnes of BHKP from Indonesia annually, with much of this being made from ‚mixed tropical hardwoods' harvested from natural forests (Barr 2001). Moreover, there are growing signs that some China-based pulp producers are seeking to obtain wood fibre from countries in the Mekong region, where forest law enforcement is also notoriously weak (Lang 2002). Recent reports of Chinese producers making investments in Laos and Cambodia, for instance, certainly raise questions about whether increased volumes of illegally harvested wood fibre will soon be flowing from those countries (Greenpeace 2004).

Fourth, China's growing demand for pulpwood fibre is likely to pose both threats and new opportunities for rural communities throughout the region. On the one hand, the conversion of natural forests for pulpwood plantations has often involved the displacement of local peoples. In Indonesia, for instance, the government has allocated several million hectares of forestland to plantation companies since the late-1980s with little regard for the tenure rights or livelihoods of communities living in those areas (Harwell 2003; Barr 2001). On the other hand, the large volume of fibre that China is expected to consume will undoubtedly create opportunities for income generation that did not previously exist. It is possible that smallholder farmers and community groups would be able to earn substantial amounts of cash income by growing pulpwood fibre, either for the open market or through out-grower schemes linked to particular pulp mills (Wenming *et al.* 2002). Past experience with such schemes, however, suggests that they often carry high levels of risk for participants (Nawir 2003, Mayer and Vermeulen 2002). To work on any significant scale, the households and communities involved would need to have secure land tenure, as well as improved access to credit and markets.

Finally, China's efforts to downsize the country's nonwood pulp industry and to promote the expansion of wood-based kraft pulp production is likely to have unintended negative consequences for employment in some parts of the country. Historically, nonwood pulp has been produced by thousands of small- and medium-scale mills that utilize agricultural residues and other types of nonwood fibres. These mills are widely distributed across China, and they employ large numbers of people, in addition to providing an important source of income for farmers who supply them with agricultural residues. Our projections that annual production of nonwood pulp will decline by 1.5-3.5 million tonnes by 2010 suggests that as many as 700 mills with a capacity of 5 000 tonnes/yr - or an even larger number of smaller mills - could be closed (in addition to the large number that have already reportedly been closed in recent years). While the government's campaign to close small-scale nonwood pulp mills is largely aimed at reducing pollution of watersheds, these efforts could put several tens of thousands of people out of work and remove a significant source of income for large numbers of farmers. In aggregate terms, these job losses may be offset by the large investments now being made in kraft pulp production facilities that utilize wood fibre. However, it is important to recognize that large- and mega-scale kraft pulp mills are highly-capital intensive, and those planned for China will be heavily concentrated in the country's relatively affluent coastal regions.

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APPENDIX A: CHINA'S MAJOR PAPER AND PAPERBOARD CAPACITY EXPANSION PROJECTS

TABLE A 1 *Major paper and paperboard capacity expansions in China, 2003 ('000 tonnes)*

Company	Ownership	Location	Capacity	Grade	Startup
Guitang Group	Private	Guitang, Guangxi	15	Tissue	Q1:2003
Jilin Paper	SOE	Jilin	90	Newsprint	Q1:2003
Wangda Group	Private	Changshu, Jiangsu	180	Containerboard	Q1:2003
Wan Li Da	Private	Zengcheng, Guangdong	150	Recycled Medium	Q1:2003
Yinhe Paper	Private	Shandong	100	Recycled Medium	Q1:2003
Jindaxing Paper	Private	Guangxi	70	Newsprint	Q2:2003
Jinzhou Paper	Private	Dongguan, Guangdong	250	Recycled Medium	Q2:2003
Wangda Group	Private	Xinhui, Guangdong	170	Containerboard	Q2:2003
Bohui Paper	Private	Huatai, Shandong	300	Boxboard	Q3:2003
Guitang Group	Private	Guitang, Guangxi	15	Tissue	Q3:2003
Huatai Paper	Private	Dongying, Shandong	280	LWC/newsprint	Q3:2003
Ji Teng	SOE	Hebei	100	Containerboard	Q3:2003
Long Chen Longda	JV	Wuxi, Jiangsu	200	Containerboard	Q3:2003
Taishan Paper	Private	Laiwu, Shandong	140	LWC	Q3:2003
Dongguan Nine Dragons	WFOE	Dongguan, Guangdong	450	Boxboard	Q4:2003
Guangxi Lipu Paper	Private	Guangxi	50	Linerboard	Q4:2003
Lee & Man	WFOE	Changshu, Jiangsu	250	Linerboard	Q4:2003
Mindu	Private	Fujian	100	Boxboard	Q4:2003
Nine Dragons Paper	WFOE	Yaicang, Jiangsu	450	Kraft-top liner	Q4:2003
Sun Group	Private	Yanzhou, Shandong	200	Boxboard	Q4:2003
Yalujiang Paper	SOE	Dandong, Liaoning	180	Newsprint	Q4:2003
Yueyang Paper	SOE	Yueyang, Hunan	180	LWC/newsprint	Q4:2003

Note: Private = Chinese privately-owned company; SOE = state-owned enterprise; JV = joint venture; WFOE = wholly foreign-owned enterprise.
Source: Almanac of China Paper Industry (1999, 2002 and 2003) and China Economic Consulting, Inc.

TABLE A 2 *Major paper and paperboard capacity expansions in China, 2004-2006 ('000 tonnes)*

Company	Ownership	Location	Capacity	Grade	Startup
Jianhui Paper	Private	Donguan, Guangdong	300	Boxboard	Q2:2004
Chaohu Jinhe Paper	Private	Chaohu, Anhui	150	Boxboard	Q3:2004
Lee & Man	WFOE	Changshu, Jiangsu	250	Recycled medium	Q3:2004
Cheng Loong	WFOE	Pudong, Shanghai	300	Containerboard	Q4:2004
Foshan Huaxin Packages	JV	Foshan, Guangdong	150	Boxboard	Q4:2004
Jiangxi Chenming Paper	Private	Jiangxi	400	LWC/newsprint	Q4:2004
Ningbo Zhonghua Paper	JV	Ningbo, Zhejiang	700	Boxboard	Q4:2004
Sun Paper	Private	Yanzhou, Shandong	160	Uncoated woodfree	Q4:2004
RGM International	WFOE	Xinhui, Guangdong	450	Uncoated woodfree	Q4:2004
Gold East Paper (APP)	WFOE	Dagang, Jiangsu	700	Coated woodfree	Q1:2005
Chenming Paper	Private	Shouguang, Shandong	400	Boxboard	Q1:2005
Lee & Man	WFOE	Changshu, Jiangsu	350	Linerboard	Q1:2005
Beiya Industrial	JV	Leshan, Sichuan	50	Uncoated woodfree	Q2:2005
Nippon Paper Industries	JV	Chengde, Hubei	75	Newsprint	Q3:2005
PanAsia Paper	WFOE	Zhaoxian, Hebei	330	Newsprint	Q3:2005
UPM-Kymmene	WFOE	Changshu, Jiangsu	450	Uncoated woodfree	Q3:2005
Ningxia Meili	Private	Zhongwei, Ningxia	300	Boxboard	Q1:2006
Oji Paper	WFOE	Natong, Jiangsu	600	Coated woodfree	Q4:2006

Note: Private = Chinese privately-owned company; SOE = state-owned enterprise; JV = joint venture; WFOE = wholly foreign-owned enterprise.
Source: Almanac of China Paper Industry (1999, 2002 and 2003) and China Economic Consulting, Inc.

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