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The Food Industry Center
UNIVERSITY OF MINNESOTA

Working Paper 02-01
University of Minnesota
Printed Copy \$22.50

THE SUPPLY CHAIN OF PORK:

U.S. AND CHINA

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March 2002

This paper was written while Chenjun Pan was a visiting scholar at The Food Industry Center (TFIC). Her work was sponsored by Rabobank and supported by TFIC. The Food Industry Center is an Alfred P. Sloan Foundation Industry Study Center.

ABSTRACT

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Chenjun Pan and Jean Kinsey

Consumers in the United States consume 53 pounds of pork per capita per year. Forty percent of that pork enters the market by way of a contract with a packer or an integrated supply chain arrangement. Chinese consumers consume 37 pounds per capita. Eighty percent of that pork is produced in the backyards of millions of households all over the countryside. The supply chain that brings pork from hog to human is clearly different in these two countries, but both are moving in the same direction.

In the United States, pork breeding produced leaner but heavier hogs by the late 1990's. This was largely in response to consumer demand for leaner meat and processors demand for less waste. Stricter sanitation regulation and quality control by food manufacturers led to a more integrated supply chain. Food companies contract with farmers for hogs with particular characteristics being demanded by consumers and retailers. Half of fresh pork and forty percent of processed pork is sold through foodservice establishments in the U.S. Consumers need for time-saving food is revealed by the portion of pork they eat away from home (42% of \$35 billion sales) and by the mix of fresh (27%) and processed (73%) pork purchased in retail stores. The emphasis in the U.S. supply chain for pork is on delivering consistent quality of safe meat to consumers all the time. There is considerable research into new pork products. The top ten processing plants handle 43 percent of the total output.

China is the largest pork producer in the world slaughtering 526.7 million hogs in 2000, over five times as many as the United States. Although commercial operations and specialized households are growing they provide only about twenty percent of all China's pork. Lower quality and sanitation standards prevent pork produced in backyards from entering the westernized/commercial supply chain but it is an important source of meat in the inland and rural areas of China. Coastal cities have more commercial and imported pork. For example, in Beijing sixty percent of production is from commercial farms.

The advent of retail supermarkets and higher incomes in China foretell an increase in commercial pork operations. Direct foreign investment by key Western food companies and retailers are leading the standards for food safety and handling in the larger cities. Based on current pork consumption at various income levels, it is estimated that pork consumption will grow more than seven percent in Chinese cities and 1.5 percent in the countryside over the next ten years. This translates into an additional 12 million pounds of pork in 2011 with the urban consumption surpassing the rural consumption. The pork industry will be driven to emphasize quality, sanitation, and convenience in China as they already do in the United States. With China entering the World Trade Organization (WTO) more pork imports can be expected. Exports will depend on meeting the quality and safety standards of importing countries.

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The supply chain for pork: the U.S. and China

1. Introduction

Great changes have occurred in the structure of the U.S. pork industry in recent years. Vertical coordination replaced an open market arrangement on an increasing scale, accompanying the industrialization trend at almost every stage of the supply chain. Marketing linkages between producers and processors are tighter. Information about consumption trends is being shared by all the participants in the chain, and becomes an important guide to product development and inventory management.

Dynamic consumption trends and new technologies are primarily responsible for the changes. Consumers have become more concerned about convenience and health, with the rise in income and change of lifestyle. New technologies improved both the industry's productivity, and motivated firms to expand and consolidate to take advantage of economies of scale.

China's pork industry presents a different scenario. With 80% of rural households engaging in hog production, China's industry primarily features extremely small backyard production. Given the facts of overpopulation and land scarcity, backyard hog production has significant value for farmer subsistence, and will not phase out into large-scale production in the foreseeable future. However, specialized farmers and large-scale production, although accounting for a small share of the pork industry, are gradually gaining ground.

Three factors will influence the development of the China's pork industry. First, rapid growth in China's economy will continue to increase income and improve living standards. More and more urban consumers are becoming affluent, and showing similar consumption patterns to the U.S. consumers. Rapidly increasing income and urbanization generates new market opportunities for quality pork products. Second, genetic technologies and new feeding methods are contributing greatly to China's changing pork landscape. Finally, China's pork industry will be challenged by the WTO accession. It is expected to increase pork imports and increase the industrial structure of the pork industry.

Although the production and consumption of pork in the U.S. and China differ in many aspects, using the U.S. pork supply chain as a benchmark provides a case history that could inform the development path of China's pork supply chain in the foreseeable future.

This report begins with a description of the recent changes in the US pork industry, followed by an analysis of the forces behind the changes. It will then discuss the trends and problems in China's pork industry, and finally summarize the implications of the U.S. pork supply chain for China's industry.

2. The U.S. pork industry

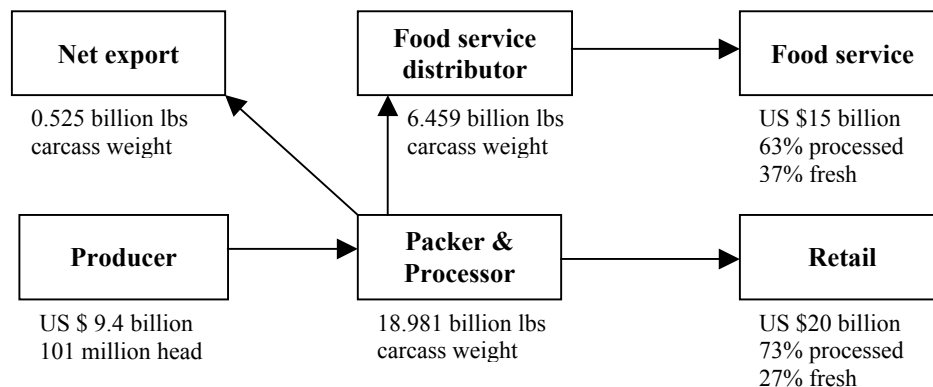
2.1. Changes in the pork supply chain

The US pork supply chain has been shifting towards vertical coordination. New marketing arrangements along the supply chain have been established, replacing traditional open market relationships on an increasing scale. This change is accompanied by a consolidation in the pork industry structure, which has been going on for more than sixty years, but accelerated in the 1980s and 1990s.

Structural changes happened in almost every stage in the chain. In the production sector, the number of pork producers decreased from 670,000 in 1980¹ to 236,000 in 2000, while the pork output increased from 7.5 million tons to 8.3 million tons during the same period. Many small farms have been forced to leave the industry; the survivors are bigger and fewer. Slaughter and processing is more concentrated, with the top ten plants processing 42% of the total output.²

Figure 1 presents a general picture of how value is created through the U.S. pork supply chain.³ It implies that the largest proportion of the value is created at the retail/food service level, as the producers' share in the total value is only 27%. This number was about 50% two decades ago.⁴

Figure 1: Value added chain in the U.S. pork industry⁵



¹ Chris Hurt, Industrialization in the Pork Industry, *Choices*, pp. 9-13, Volume 9, No. 4, 1994.

² Leef, Schrader, Coordination in the United States Hog/Pork Industry, <http://agecon.lib.umn.edu/cgi-bin/view.pl>

³ Herein, marketing is defined as all the activities that take place from the time hogs leave the farm gate. Activities performed prior to that time are considered to be production.

⁴ David J. Schaffner et al. *Food Marketing: International Perspective*, Copyright 1998 by the McGraw-Hill Companies, Inc.

⁵ Brian Buhr, the U.S. Pork Chian Overview, University of Minnesota, buhrx002@umn.edu, March 2000

Vertical coordination between producer and packer

Close relationships between hog producers and slaughtering/processing companies have been established. There are two types of coordination: vertical integration and contracting. Approximately 40% of hog sales to packers were coordinated by contracts and integrated operations in 1998, compared with 11% in 1993 and only 3% in 1980.⁶

Under the contractual relationship, producers manage feeder hog production, farrowing and finishing, while packers provide young hogs, feed, veterinary supplies and management advice. Producers are paid for quality, which might be ignored in the traditional open market system. Since the early 1980s, many producers have utilized production contracts to rapidly expand their output.

Contracts vary by region and firms. Common terms include risk-sharing, price, and time period. Contracts are often used for organizing such items as feed purchases, designation and time of delivery, types of hogs to be delivered, and method of production.⁷ Contracting allows food processors/manufacturers to specify hog characteristics and streamline their production lines for greater efficiencies.

Due to the increase of long-term contract arrangements, the middleman (between producers and packers) has become less and less important. Direct shipment is commonly arranged, replacing independent assembly operation.

Retailers become more important

The retailing sector has grown rapidly, responding to the dynamic market. Supermarket chains, started in the 1930s, dominate the U.S. retailing landscape. Seventy-five percent of food sales are realized through supermarkets. Moreover, retailers have up-front exposure to consumers, and are in a better position to understand consumption trends. Supermarkets are so important that manufacturers have to fight for the limited shelf space.

Consolidation in the retailing sector resulted in the emergence of mega retailers at the expense of small stores. From the mid-1990s to 2000, the market share held by the nation's top four food retailers soared from 17% to 34%. This number is dramatically higher in the nation's 100 largest cities, reaching nearly 72% in 1998.⁸

While the packers and retailers are growing larger, the role of independent distributors is declining. Due to the expansion of scale and improvement in warehouse management, more and more packers distribute products directly to retail stores, bypassing traditional distributors. In the

⁶ Steve W. Martinez, Vertical Coordination in the Pork and Broiler Industries, ERS, USDA, Agricultural Economic Report No. 777, Washington, April 1999.

⁷ James B. Klibenstein, John D. Lawrence, Contracting and Vertical Coordination in the United States Pork Industry, Staff Paper No. 265, Iowa State University, July 1995.

⁸ Alan Barkema et al. The New US Meat Industry, Economic Review from Federal Reserve Bank of Kansas City, Second Quarter 2001, Volume 86.

meantime, however, the remaining distribution market is more and more concentrated in the hands of a few mega-distributors. For example, Sysco, the largest food service distributor, and Supervalu, the largest supermarket wholesaler, gross over US\$20 billion annually and operate all across the country.

Unlike the relationship between hog producers and packers, the relationship between packers and retailers is relatively loose. This is partially because some retailers attempt to do meat cutting by themselves, to satisfy their particular customer demands. It's also because there is lack of trust between retailers and packers. Therefore, most transactions of fresh meat are based on day-to-day negotiations, while for branded processed products, packers/processors offer the products on a "take it or leave it" basis. The trend in larger supermarkets to purchase only "case ready" meat puts further demands on processors to cut, package, and label fresh meat before it can be sold to retail stores. This can lead to more branded fresh meat.

2.2 Reasons for the changes in pork chain

2.2.1 Swiftly changing consumer demand

It has been widely suggested that discriminating consumers are primarily responsible for the changes in the pork supply chain. Their demands for extremely detailed product specifications have overwhelmed the traditional market system.⁹

Although the quantity of pork consumption has remained constant since 1985, in the range of 22 kg to 24 kg (53 lbs.) per capita (retail weight), pork consumption patterns changed towards greater variety and more value-added products. For example, Hormel, one of the largest food companies that specialize in pork products, introduced 183 new products in 2000 (<http://hormel.com>). Branded meat products are increasing.

Away-from-home eating has been boosted. Pork purchased from the foodservice sector has reached 50% (Table 1). Pork used in foodservice grew at 17% in the past three years, more than doubling the 8% overall growth experienced by the U.S. foodservice industry.

⁹ Frances Antonovitz et al. Vertical Integration Incentives in Meat Product Markets, Staff Paper p.96-13, Applied Economics Department, University of Minnesota, Aug 1996.

Table 1: percentage of pork meat reported eaten by food source in 1996 ¹⁰

Source	Pork
Grocery store	28%
Fast food	10%
Restaurant	20%
Cafeteria	20%
Other food source	22%

In the retail markets, ham, including lunchmeat and entrées, represented 30% of all pork consumed. Both fresh pork and bacon accounted for 16% of pork purchases, followed closely by sausage (15%), other lunchmeats (12%) and hot dogs (10%).

The changes in pork consumption patterns are mainly due to the changes in demographics and lifestyle. In the American demographics, ethnic populations have increased faster than the average growth rate of the total population. The increase in Asians and Hispanics between 1990-2000 accounted for nearly half (48.7%) of all U.S. population change during that period. While the overall U.S. population increased by 13.2%, the Hispanic population increased by 57.9% and the Asian population increased by 40.8%. Together, African-Americans, Asians, and Hispanics account for 30% of the population. This implies that a greater variety of pork products will be consumed.

Lifestyles have changed dramatically. Women's increased participation in the labor force has shifted meal preparation at home to an increase use of convenience food or eating out. Nearly three-fourths of the women aged 25-54 are now in the work force, compared with about half 20 years ago.

2.2.2 Technology

Enormous improvements in technology have driven the pork industry to change. New production technology has provided an impetus for pork companies to grow, since it leads to cost savings, mostly through capturing economies of scale. Information technology facilitated communication among various participants in the pork industry, and helped them respond quickly to the changing market demand. New demands for tracking meat cuts back to particular animals and farms are challenging the supply chain information systems and will lead to greater coordination. Specific products have been delivered through improvement breeding. By altering animal genetics, scientists produce leaner hogs to cater to the consumers' wants.

¹⁰ Brian Dietz, Jean Kinsey, Where and when do we eat meat? (unpublished paper) 2001, dietz013@umn.edu, Jkinsey@apcc.umn.edu.

Besides technology, reducing transaction costs and risk sharing are other motivations for coordination between producers and marketing firms. Transaction costs involved in livestock industries include many applications, such as grading, quality of inputs, food safety, middleman costs, etc. In most cases, it appears that transaction costs can be reduced enormously through a coordinated system. Under the open-spot market system, producers take the risk of market fluctuation, while packers have no guarantee of adequate and consistent supply. These risks can be largely avoided under the coordinated relationship.

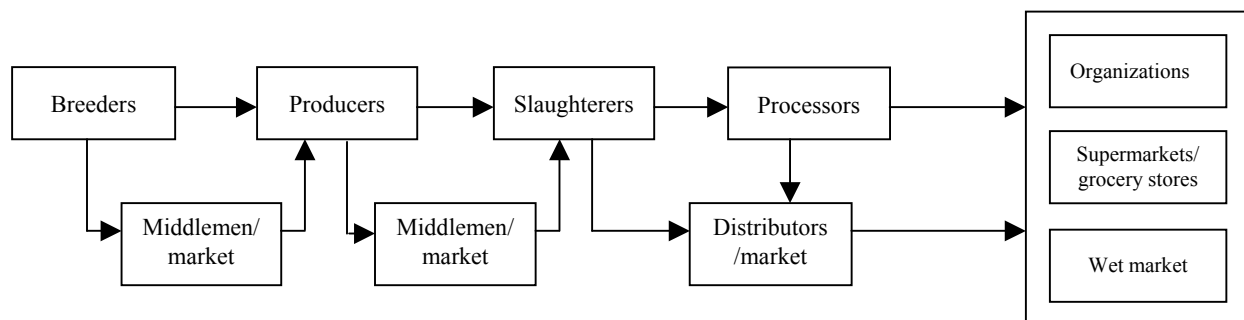
3. China's pork industry

3.1 Current pork supply chain

The pork industry in China grew quickly after the government removed state procurement quotas and price controls in 1985. China is the largest pork producer in the world, with an output of 40.3 million tons in 2000. Slaughtered heads reached 526.7 million in 2000, up from 198 million heads in 1980.

In contrast with the United States, China's leading position in terms of production is accomplished in numerous fragmented individual backyards. Figure 2 presents a general picture of the pork supply chain in China. It indicates that, to a considerable extent, pork products flow through an open market system.

Figure 2: China's pork supply chain



Source: Rabobank Database

Hog production

Hog production is now conducted by three categories of producers: backyard farms, specialized households, and commercial farms. At present, about 80% of China's pork output comes from backyard feeding, 15% from specialized households, and 5% from large-scale commercial operations. This compares with about 95% of hogs raised by rural households in the mid-1980s (Table 3).

Table 3. Shares of Hog Output by Three Types of Producers (%)

Year	Backyard	Specialized	Commercial
1985	94.6	2.9	2.5
1993	88.3	8.2	3.5
1996	80.7	14.6	4.7

Source: Zhang, X. et al. 1998. "China's Livestock Feed Use Relationships: Preliminary Results from a Survey in Seven Provinces." Selected Paper for WRAC Workshop, January 12-13, 1998. Honolulu, Hawaii, USA.

Backyard farming operations are extremely small. Many backyard households raise only 1 to 5 hogs in simple housing. Feed comes mostly from tubers, crop residue, table scraps, and forage. Manufactured compound feed or concentrate feed is used as a supplement.

Although backyard production represents low quality and low sanitation, it is still necessary, from the viewpoint of the whole economy. Hog production adds value to subsistence farming, because 83% of household farms have 0.6 hectares of land or less, not enough for sufficient crop production to support a family. Labor supply is abundant but non-farming employment opportunities are very limited. Moreover, in subsistence farming, crop plantation and animal raising are complementary. Hog manure is a natural and cheap fertilizer for crops, and crop residue can be fully utilized in hog production. Many farmers consider hog production a savings bank. They don't expect to make a profit, but to obtain a small income when in need.

These factors result in low-cost production. Hog prices in China could be 50% of the international average although feed prices could be 200%. For the same reason, backyard hog production suffers the least during the bottom of an economic cycle. Farmers can outwait a price decline and sell next season by slowing the growth rate of their hogs.

However, because millions of small farms react to free market signals, this hog market is more volatile than that under coordinated arrangements. Fragmented structures make hog production a risky business. From 1998 on, an oversupply of hogs dominated the market and the real pork retail price dropped to a historical low in 1999, recovering fully only by 2001.

Specialized households and commercial farms are gaining importance, albeit at a slow pace. Both types of producers often employ more advanced management practices, better swine genetics, and more grain and protein feeds. Lean pork is the main product from commercial farms; hogs raised by backyard farms tend to have higher fat ratios.

In terms of geographic distribution, backyard farming is less important in the coastal areas than in the middle and western areas. Hog production in developed areas (coastal region) is more concentrated and specialized. For example, in the Beijing area, commercial farms account for 60% of local production.

Slaughtering/processing

The slaughtering sector was monopolized by state-run slaughtering houses before 1985. Since then (when the pork market was liberalized with the abolishment of hog procurement quotas), individual butchers have entered and dominated the slaughtering market with a share of more than 80%. Liberalization helped to promote the production, but also caused a significant amount of contaminated meat through illegal slaughtering. As a result, the Hog Slaughtering Act was issued on January 1, 1998, stipulating that all hogs should be slaughtered at designated slaughtering plants, which comprise meat-processing plants, specific slaughtering plants and pork wholesale markets. However, given the fact that backyard production is fragmented, it is a tough task to eliminate illegal slaughtering.

Although the total capacity of designated slaughtering plants is less than half of the total slaughtered hogs per year, overall utilization of the capacity can be as low as 15%. This is because commercial firms can't compete with the low costs of individual butchers. Of the large plants, many are large export-oriented plants, which were established from year 1985 to 1995 when pork exports were increasing. Those plants were heavily impacted later because they couldn't keep up with the sanitary standards of importing countries.

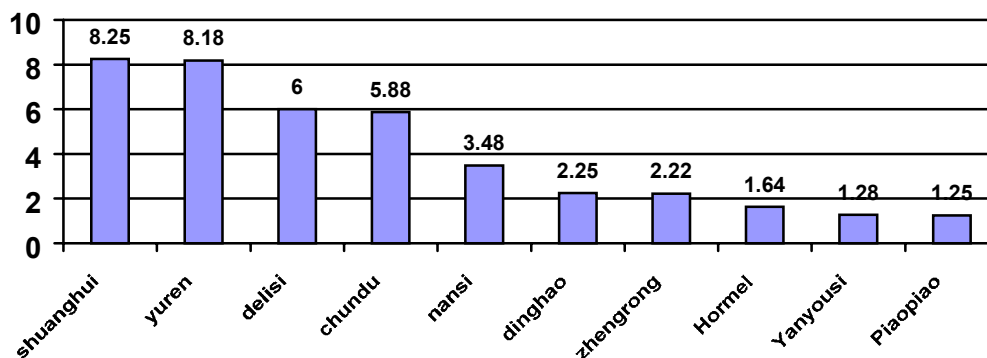
The meat-processing sector improved with the introduction of foreign equipment and processing technologies. Traditional processing lines have gradually been equipped with modern machinery. Along the way, traditionally flavored meats were replaced more and more by Western-flavored ones, especially in the large cities. It was reported that Western-flavored meats accounted for half of the total cooked pork in 1986, and the ratio increased to 64.6% after only one year. However, because some manufacturers used inferior ingredients in the processing, and also because the processing of traditionally flavored meats has been upgraded, Western-flavored meats lost part of its share to traditionally flavored meats. In Shanghai market, for example, the market share of Western-flavored meats decreased from 75.8% in 1993 to 40% in 1998, while the remaining share was recaptured by traditionally flavored meats.

Despite the development of a processing sector, only 15% of pork is processed into packaged cuts and chilled meat, with the rest sold as fresh and frozen meat in the retail market. Out of that 15%, less than 27% is cooked meat¹¹, including traditional ham, cured meat, Western flavored ham, sausage, bacon, etc.

Unlike other food processing industries, local producers are the main players in the pork-processing sector. Although some international players began production in China very early, their shares in the market are not influential. This is mainly because local competitors adopted a cost-driven strategy, which was more successful in a mass market. Figure 3 shows the market share of top ten brands in cooked meat market in 1999. In the top ten, Hormel is the only foreign brand, with 1.64% market share.

¹¹ Han Gaoju, "Hog Production Situation and Policy Suggestion". from China Animal Husbandry Bulletin, June, 1999. By Ministry of Agriculture.

Figure 3. Market Share (%) of Top Ten Cooked Meat Products, 1999¹²



Distribution, logistics and transportation

There are two market channels through which finished hogs are delivered to slaughtering houses. In backyard production, hogs are sold directly to slaughtering houses or individual butchers, or are collected in villages at the procuring booths owned by large slaughtering houses. Hogs raised by specialized households are mostly delivered to commercial farms and slaughtered there, usually by contract. On most commercial farms, slaughtering is one part of integrated production.

Logistics and transportation has remained fairly underdeveloped. While import/export activities and some freight forwarding have traditionally been undertaken by state-owned players like Sinotrans (China National Foreign Trade Transportation Corporation) or Cosco (China Ocean Shipping Company), part of domestic logistics and goods transport needs have been met by the pork industry's companies themselves. They have historically owned and operated their own trucks to deliver goods downstream to distributors and wholesalers. For backyard-produced pork, wholesalers play an important role. They buy the slaughtered pork, or do the slaughtering themselves, and move the meat to consumers through a highly antiquated and fragmented retail trade.¹³

Trains and trucks are the two main modes of transporting frozen meat in China. Although the rail system has improved greatly, priority is given to passengers and critical commodities. The trains limited capacity and lack of genuine service orientation makes trucks the most common method for transporting meat.

¹² Information Center of National Bureau of Internal Trade, 2000, contact person: Mrs. Gao Huanxin, tel: 86-10-66095472.

¹³ Stephen Shaw and Frank Wang, China's Evolving Logistics Landscape, McKinsey & Company, Greater China Office, Tel: 852-2868-1188, July 2001.

Due to the inefficiency of transportation, many manufacturers tend to focus on a regional market. In addition, fresh meat is sold most commonly in rural areas, due to a lack of cold storage capacity.

Retail market

Significant changes are occurring to the China's food retail market. Supermarkets and chain stores started to grow substantially from the early 1990s. Big foreign names, such as Wal-Mart, Carrefour, Makro and Metro, appear in many cities and provide models and stimulus to Chinese counterparts. A few Chinese supermarket chains now expanded from their home city/province to become regional networks, and are moving towards becoming national chains. The attributes of convenience, comfortable open spaces, quality consistency, and one-stop shopping fit modern Chinese lifestyles better than wet markets, old department stores, and grocery stores.

However, it should be recognized that wet markets and grocery stores remain the most important retail outlets for food sales. Many regions, primarily rural areas, are out of reach of supermarkets and chain stores. While supermarkets demonstrate a clear price advantage for a broad line of products, the prices of fresh products tend to be higher. Furthermore, many Chinese supermarkets have been handicapped by a poorly managed fresh produce sections. Though packaged food might be successful, fresh meat has not been an important proportion of sales for many supermarkets.

3.2 Forces reshaping the landscape

3.2.1 Mixed pork consumption demand

China has achieved far-reaching economic growth since the economic reform in the late 1970s. GDP saw a two-digit growth rate for most of the 1980s and 1990s, and remains above 7% in recent years. As the economy has prospered, income and living standards have increased considerably. The real average annual income in urban areas has grown nearly fourfold since 1980, reaching \$757 per capita in 2000.¹⁴ The increase in rural residents' income is even larger during the same period, though it slowed somewhat in recent years. Rising income in urban and rural areas has resulted in changed dietary patterns, which are shifting away from staple grains and starches in favor of animal proteins and fish.

Chinese consumers are fond of pork meat. While the market share of other kinds of meat, such as poultry, beef and mutton, are rising, pork is still the leading meat in China. As seen in Appendix 1, pork still makes up more than 67% of all meat consumed, but that is down from 94% in 1983.

China's pork consumption can be described as: 1) mixed consumption patterns; 2) great potential for growth in the coming years.

¹⁴ Source: China Statistics Yearbook, 2001.

Mixed consumption demand

As economic development is uneven among the regions, disparity is an increasingly important issue. Generally, economic development in eastern areas is more advanced than in western areas, and the urban economy is more prosperous than the rural economy. The average annual income in rural areas is only 36% of that in urban areas. In cities, economic disparity has increased too, as unemployment rose when the state-owned enterprises reformed.

These disparities result in food consumption patterns differing from region to region. Generally, pork consumption patterns can be divided into three groups: 1) consuming at a low level due to a lack of both supply and purchasing power; 2) meeting basic requirements for pork and consuming in a traditional way; 3) looking for brand and premium pork products. Consumers in rural areas are basically in the first group, with the exception of eastern coastal villages. There, the average per capita consumption of pork is 70% less than the urban areas. Low and middle class urban consumers are roughly in the second group. They can afford to purchase pork from wet markets and food stores, but seldom from supermarkets. They have sufficient food budgets, and can afford eating out occasionally. The first and second groups constitute about 90% of the population.¹⁵ The third is a rapidly growing group, made up of upper class and white-collar workers. They are more concerned about nutrition and food safety, and want convenience. Dining out has become frequent for them.

Great potential for growth in consumption

Three factors reveal a great potential for pork consumption to grow in the near future. First, with 70% of the 1.2 billion population in rural areas, with very low levels of pork consumption, strong economic growth promises an increase in their pork consumption over the coming decades. Secondly, population growth remains one of the most important factors in shaping Chinese pork consumption. Although China has successfully slowed the population growth rate to 0.9%, this still translates into roughly 12 million additional people each year. Thirdly, urbanization and policies aimed at reducing rural unemployment are reinforcing the trend towards more pork consumption. This is because people tend to shift their dietary habits when they move to cities, and because a greater variety of food products are available in urban markets.

Consumption trends are projected on the basis of historical data. The trends below reflect the assumptions that income and population growth rates will remain constant over the next ten years.

Based on pork consumption across seven income groups in 1997 (appendix 2), income elasticity of pork consumption is approximately 0.427, i.e. 10%, income growth will cause pork demand to increase by 4.27%. Annual growth rate of average urban income is 6.8%, and annual rural income is 4.5% in the past two decades. Hence, pork consumption should grow by 2.9% per

¹⁵ Dermot. J. Hayes, Roxanne Clemens, The Chinese Market for U.S. Pork and Pork Variety Meats. March 1997, <http://www.card.iastate.edu/publications/texts/97bp14.pdf>.

year in urban areas and 1.9% in rural areas over the next ten years, based on income growth alone.

Despite the relatively small proportion, urban population has grown more quickly than rural population due to immigration and urbanization. The annual growth rate in urban populations in the last decade is 4.2%, while rural population actually decreased by 0.413% during the same period¹⁶. Population growth causes an increase in pork consumption at about the same speed as it grows.

Adding up the effect of increases in income and numbers of people, the annual growth rates of pork consumption in urban and rural areas are projected to be 7.1% and 1.5% respectively over the next ten years.

Official statistics show that urban market for pork is 7.65 million tons, and rural market size is 9.3 million tons in 2000 (appendix 2 and 3). At the growth rate of 7.1% and 1.5%, urban and rural market size will increase to 15.2 million tons and 15.14 million tons respectively in ten years. In other words, total urban consumption will surpass rural areas at that time. That implies that the demand for high quality, safe, tasty, and convenient pork products will likely grow faster than the mass-market demand.

3.2.2 New technology application

The development of the feed industry is one of the primary reasons that China's pork production has increased over the past two decades. Not until the late 1970s was manufactured feed introduced on a significant scale. Manufactured feed, associated with new feeding methods, greatly improved the feed-to-pork conversion rate from 4:1 to 3.2:1. It is worth noting that although manufactured feed only accounts for 25-30% of feed consumption, concentrate feed, (a mainly protein intermediate product for compound feed), has been widely used as a supplement by backyard farmers to make their own compound feed. The utilization of concentrate feed represented a big improvement in backyard hog production.

Since the 1980s, China has imported quality hog breeds from England, Denmark, Canada, USA, Brazil, and Taiwan in order to enhance the lean meat yield. The main breeds imported include Yorkshire, Landrace, and Duroc. They produce more lean meat with a shorter grow-up period and a higher feed conversion rate. Now they are the main genetic breeding stock in commercial breeding farms for producing purebred, two-way crossbreeds, three-way crossbreeds, and hybrids with local breeds. The introduction of foreign breeds sets a new standard and advances the modernization of the Chinese hog sector.

3.2.3 WTO accession

China became a member of WTO on Dec 11, 2001. The event has significance for China's agricultural sector, which is lacking competitiveness relative to the world market but will have to

¹⁶ China Statistical Yearbook, various issues.

participate soon. For the pork industry, two factors appear to have the potential for profound impact. First, the reduction of pork import tariffs, from 20% to 12% in 5 years, is expected to increase pork imports to China's domestic market. Second, foreign companies are allowed to have full trading and distribution rights since the WTO accession, including rights in retailing, wholesaling, warehousing, and transportation. This area was restricted to domestic companies before.

Will pork imports increase considerably in the near future? Some experts believed they will because land is relatively scarce, and because China doesn't have a comparative advantage in feed crops and hence livestock production. Full implementation of livestock tariff reductions will also bring considerable increase in livestock product imports.

However, there are three factors which might negatively influence pork imports. First, backyard production, which delivers a lower price, will continue to be the main force in the foreseeable future. Secondly, Chinese consumers prefer fresh to frozen pork. This limits the market for the import of frozen pork. Thirdly, the distribution of imported pork necessarily relies on how quickly the logistics and marketing system develops. New systems will benefit not only imports, but also the players within China, who can reduce their own marketing costs considerably.

Therefore, capital investment opportunities rather than trade expansion, will likely provide the greater market potential for foreign companies.

3.3 Implications for the development of China's pork supply chain

Comparing the U.S. with China's pork chain highlights that the gaps in China's pork system lie in an inefficient marketing system, low sanitary standards, and risky production.

The establishment of an efficient marketing system is urgently required. This efficiency will depend on improved relationships among all stages of the supply chain, more sophisticated logistics and further development of retail sector.

While both vertical integration and contracting are expected to increase in the years ahead, contracting is likely to gain ground. This is because backyard production will (and should) continue to exist, and it will demonstrate strong competitiveness towards integrated production. Contractual relationships in the U.S. pork chain provide a good model for China's industry. In the U.S., 85% of hogs are raised under long-term contracts or commitments to meat processors. This system ensures a supply of high quality hogs to processing plants, decreases the volatility in raw material cost, and rewards the risks shared by processors and producers over the long term. Through contracts, processors are able to obtain larger outputs while economizing on capital and labor, and producers can reduce risks and obtain financial support. Sanitary standards can also be improved, since the delivery of quality products is important for processors to establish and sustain market image.

Contracting is not new to China's livestock sector. The government is promoting the idea of so-called "dragon head" companies. Large companies contract with hundreds of individual farmers in a region, and procure, process, and market agricultural products from farmers. Under the contract, farmers provide labor and land, while companies provide breeds, feed, veterinary supplies, and technologies. Farmers have less control over the marketing process, but they also have less market risk than they did through traditional open markets.

It should be recognized that, under the present legal system, individual farmers are vulnerable to a contractor's default of contract. Therefore, corrections in the legal system need to be in place as soon as possible to protect farmers.

While underdeveloped logistics and distribution systems are causing inefficiency in pork marketing, they offer great opportunities for both domestic and foreign players who can develop and utilize them the earliest. Independent distributors or logistic service providers can take advantage of the increasing demand for sophisticated, well-equipped logistic services. Some large companies have observed imminent competitive pressure and are about to establish their own logistics networks.

Projection of China's pork demand presents that urban market size will surpass rural market size in ten years. That indicates the potential pork demand will grow, and the pork industry will be driven to emphasize quality, sanitation, and convenience. New consumption trends require tighter coordination in the supply chain, which offers great market opportunities for both foreign and domestic companies.

Appendix 1: Pork output and its share in total meat (1,000 tons) in China

Year	Total meat	Pork meat	Pork share in total meat
1996	45840	31580	68.9%
1997	52688	35963	68.3%
1998	57238	38837	67.9%
1999	58207	38907	66.8%
2000	61246	40314	65.8%

Sources: *China's Statistical Yearbook*, various issues. All statistics after 1996 have been corrected by the National Bureau of Statistics according to China's Agricultural Census results.

Appendix 2: Official Statistics of per capita income and pork consumption in Chinese urban areas

Year	Per capita income in urban areas (\$)	Per capital pork consumption (kg)
1992	244.2	17.7
1993	310.5	17.4
1994	421.2	17.12
1995	516.0	17.24
1996	583.0	17.07
1997	621.7	15.3
1998	653.6	15.9
1999	705.3	16.9
2000	756.6	16.7

Source: China Statistics Yearbook, various issues.

Appendix 3: Pork consumption in different income groups in 1997 in China

Income groups	Per capita annual income (US \$)	Pork consumed (kg)
Lowest income households	281.08	11.79
Low income households	348.80	13.33
Lower middle income households	412.89	14.31
Middle income households	489.64	15.56
Upper middle income households	580.96	16.64
High income households	687.83	17.75
Highest income households	881.20	19.25

Source: China Statistical Yearbook 1998.

Appendix 4: Some discussions on official pork consumption statistics

Official statistics shows that per capita pork consumption in urban areas has been constant over the past decade (Appendix 2). The great discrepancy between consumption and output growth caused some experts' attention. It has been widely believed that consumption data are deflated. Lu Feng¹⁷ suggested that there were two important factors missed in the collection of consumption data: food given by work units and dining out. According to the sample survey conducted by the Urban Social Economic Survey Team of SSB in 1995, food obtained by working staffs from their work units averaged at 3.2 kg of meat and 1 kg of fish per capita for the whole urban population. Expenditure of dining out has increased rapidly. In 2000, per capita dining out in urban areas reached \$34.7, or 14.7% of total food expenditure, compared to 8.4% in 1994.

¹⁷ Lu Feng, Output Data on Animal Products in China: How Much Are They Overstated, Aug 1998, fenglu@pku.edu.cn