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Overcoming Successive Bottlenecks: The Evolution of a Potato Cluster in China

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Summary. — Although the role of industrial policy in economic development is a frequent topic of debate in both the literature and the political arena, most discussions focus on industrial policymaking at the national level. Using a case study of a potato cluster in China, we show that industrial policymaking at the local level contributes greatly to economic development as well. Many of the industrial policies affecting the cluster—including leveling land, developing better varieties, establishing a potato trade association, lobbying for increasing freight car quotas, and attracting processing firms—were implemented at the local level, highlighting the need for discussion of local industrial policymaking as a major determinant of cluster development. As the case study demonstrates, economic development is a continuous process with constantly evolving binding supply-side and demand-side constraints. Often, after a local policy helps remove one binding constraint, a new one emerges that, in turn, may require a new set of policies. Therefore, the success of clusters depends upon local industrial policies that respond to emerging binding constraints at different stages of the cluster's development.

Key words — economic transformation, clusters, comparative advantage, local industrial policy, poverty

1. INTRODUCTION

The literature is home to a lively debate on the usefulness of industrial policy.[1] Skeptics often question bureaucrats' ability to pick the right industries for support. And, in the past, well-intentioned industrial policies, such as import substitution industrialization, have led to price distortions, resulting in inefficient resource allocation across sectors and stagnant economic growth (Baldwin, 1969; Pack & Saagi, 2006). Believers in the efficacy of industrial policymaking argue that many advanced economies, such as United States, Germany, France, and Taiwan, have intervened actively in their domestic economy through such policies during their various stages of development (Chang, 2003, 2009; Evans, 1995; Wade, 2009).

Recent work by supporters of industrial policymaking concentrates on how best to implement such policies. Because individual firms often face externalities in the process of product upgrading and diversification, some scholars reason that governments can play a facilitating role in providing key public goods and services to overcome the externalities. Therefore, the reasoning goes, good industrial policies are always helpful and needed. The real question in these scholars' minds, then, is not *if* industrial policies should be implemented, but rather *how* to best design and implement them (Rodrik, 2009). Similarly, Lin (2010b) argues that previous instances of failed industrial policies should not prevent governments from pursuing such policies at all. Instead, governments should learn from the failures as well as from instances of success. He points out that the violation of a country's comparative advantage is a key reason for policy failure. Lin (2010a) proposes six strategic steps by which a country can identify its comparative advantage and implement industrial policies.[2]

Such views face stiff opposition. Tendulkar (2011) is skeptical that governments can correctly identify and nurture opportunities for structural change and sustained growth through industrial policies. Pack (2011) insists that the amount of information and knowledge required for industrial policymaking goes beyond the scope of capabilities of any developing country's national government. Willem (2011) raises several questions about Lin's six steps: he points out the difficulty of measuring certain export opportunities and the irrelevance of past data due to shifting demand patterns; and he says that institutional or geographic differences between countries may render Lin's first step insufficiently informative.

A common feature in this debate is a lack of distinction between local and national industrial policy. Such a distinction can help clarify some of the arguments. For example, critiques that focus on informational disadvantages in identifying industries for support at the national level may not apply to the local level. In reality, the distribution of industries is often location-specific and different regions may have different set of industries. Consequently, most industrial policies are likely to occur at the local level. Although there exists an emerging but rather limited body of empirical literature on the usefulness of industrial policy, most studies focus on the national level;

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studies of industrial policy at the local level are conspicuously scarce.

Yet local industrial policymaking may be more relevant to local economic development than national industrial policymaking for several reasons. First, even under the same national comparative advantage, there often exists large production differentiation across regions in a country. One region can specialize in one product while a neighboring region specializes in a different one. Consequently, the need for and style of government intervention in each region can be quite different. Because different locales can have different industries, binding constraints on both the supply side and the demand side of the market may differ across regions.

Second, local governments have an informational advantage over the central government by virtue of their proximity to the firm level and corresponding knowledge of the binding constraints for the local industries. As external factors such as market conditions change, the binding constraints evolve as well. Because of proximity to the ground, local governments can respond more quickly and effectively than the central government. It is almost impossible to find a one-size-fits-all national industrial policy for all regions at any given time that adequately addresses these constraints. Third, market failures are often involved during the various stages of the cluster's development, which would necessitate the interventions of the government.

We examine a potato cluster in Anding County, China, and find several industrial policies that have been integral to the cluster's development. Furthermore, nearly all of those industrial policies—including leveling land, developing better varieties, establishing a potato trade association, lobbying for increasing freight car quotas, and attracting processing firms—were implemented at the local level, highlighting the need for discussion of local industrial policymaking as a major determinant of cluster development. As this potato cluster demonstrates, successive bottlenecks in the development process call for local industrial policies that recognize and address continuously emerging supply-side and demand-side binding constraints.

One key reason why the local government has been so keen in fostering the cluster development has something to do with the incentive structure of local governments and officials. Arrangements such as tax revenue sharing between local and national governments provide powerful incentives for local governments to take a more active role in facilitating local economic development. [3] In addition, local officials' promotions are often tied to the performance of local economy. Consequently, local officials place economic development as a top priority. In fact, the cluster-based model is rather ubiquitous in China (Long & Zhang, 2011, 2012) in large thanks to the embedded interest of local officials in promoting local economy.

We should bear in mind the limitation of this study, which is based on only one county and covers only a successful story. There must be some failed local policy interventions as well. More in-depth case studies are needed to understand both successful and failed local industrial policies. Nonetheless, our case study shows that even in a remote area with extremely poor natural endowment like Anding, it is possible to achieve rapid economic growth through a cluster-based development model.

The paper is organized as follows. Section 2 discusses the conceptual model we use to illustrate the role of local industrial policies in our case study. Section 3 describes the location of the potato cluster and includes subsections focusing on specific policies and their effects on supply-side and demand-side constraints. We conclude with a summary and discussion.

2. A CONCEPTUAL MODEL OF THE EFFECTS OF LOCAL INDUSTRIAL POLICIES

Before delving into our discussion of the Anding County potato cluster, we first articulate a simple conceptual model to describe the role of local industrial policies in helping to overcome successive demand and supply constraints. Adapted from Sonobe and Otsuka (2006), the model captures the effects of industrial policies on cluster-based development, a commonly observed pattern in developing countries. [4] Figure 1 plots the demand and supply curves. The demand curves are shown as the downward-sloping curves and are labeled with a capital letter D. For a small region, a commodity's price is mainly determined by the extent of the market. The slope of the demand curve may be initially rather flat because the scale of local production is small. However, when local production reaches a certain scale, the market can become saturated, resulting in a sudden drop in price as shown in the steeper part of the demand curve. A better transportation link can help expand the extent of the market, avoiding price collapse associated with rising local supply.

In a small region, local governments find it hard initially to have a direct effect on demand factors. However, local governments do have several options available to facilitate a rightward shift of the supply curve. Using potatoes as an example, the local government can help improve irrigation facilities and breed high-yield, virus-free varieties to shift the supply curve rightward from S_0S_0' to S_1S_1'. The policy interventions result in a welfare gain as measured by the area $S_0E_0E_1S_1$ and a drop in price. However, as farmers see the profit opportunity, they will expand cropping area, leading to a further shift of the supply curve all the way down to S_2S_2'. At the new equilibrium price E_2, it is no longer profitable for anyone to expand into potato production.

At this stage, demand becomes a more binding constraint. Facing deteriorating market conditions, farmers and business communities are likely to be more willing to work with the local government to overcome the demand bottleneck. There are various ways to attract more demand for local products. For instance, a better road can help connect the broader consumer market in remote regions and larger storage facilities will enable farmers to store a portion of their potatoes in the harvest season when the price is low and sell them later when markets

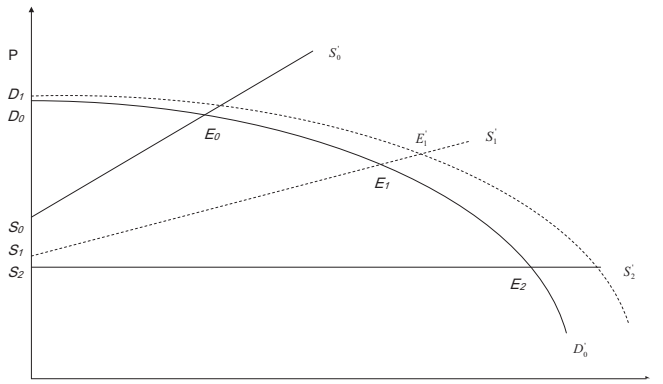

Figure 1. *Market equilibrium in the supply and demand expansion phases as a result of local industrial policy. Note: Policy interventions that shift the supply curve SS′ include improving land quality, breeding better varieties, and so on. Local policies that move the demand curve DD′ up include lobbying for more freight car quotas, building storage capacity, and developing processing industries. Source: Drawn by authors.*

rebound. Such demand-side policy interventions will lift potato price.

This simple diagram illustrates economic development as a continuous process. The types of binding constraints may differ at different stages of development, requiring different responses from the local government to help address the constraints, as illustrated later in the paper. Furthermore, it stands to reason that because the binding constraints are often context- and location-specific, a local government would be more capable of figuring out the best solutions to address them than a higher-level government.

3. CASE STUDY: ANDING COUNTY

Anding County used to be one of the poorest regions in China. It is located in Gansu Province in the Loess Plateau, an area with limited rainfall (380 mm per year). Past agricultural yields have been extremely low and volatile as a result of the limited precipitation. The yield of wheat, a primary crop of the area in the past, averaged only 1,875 kg per hectare (1/6 acre), barely enabling farmers to earn a sustainable level of income. In 1980, the per capita rural income was as low as 114 yuan, or 60% of the national average, and 78% of the farmers lived in poverty. Facing such a hostile natural environment, the region has surprisingly experienced a dramatic transformation into China's "potato capital." Potatoes have replaced wheat as the key crop, accounting for more than 60% of cropping land in Anding County. More than 30% of the rural population are involved in activities related to potato production, marketing, and processing. Additionally, farmers generate 60% of their income from potato production (see Table 1).

The harsh natural environment in Anding County is comparable to, if not worse than, many sub-Saharan African countries. Yet both land and labor productivity in Anding County have improved dramatically over the past three decades. Thus, the successful agricultural transformation of Anding County can provide some useful lessons for other countries at similar stages of development. We discuss several steps taken by the county government and the results of these local industrial policies.

(a) *Improving land quality*

Land is the most basic asset for agricultural production. However, nature did not bestow Anding County with high quality land. Because of the steep slopes that are common to Anding County, most of the land does not hold water during the rainy season as rainfall simply runs off the hills. For hundreds of years, farmers have built terrace fields on their own. In 1956, the Anding County government built a 2-mu (0.133 hectares) terrace field as an agricultural experimentation station. This experimental terrace stored water well, resulting in much higher crop yields. As a result of this success, the government decided to scale up its terrace-building projects. In 1964, the government mobilized 50,000 young laborers to manually build 1,600 hectares of high-quality terrace land. In the early 1980s, the county government once again established terrace building as the main policy tool to improve the natural environment, boost agricultural production, and alleviate poverty. From the early 1980s to the mid-1990s, an average of 3,333 hectares of terrace land were built annually.

In 1996, with a 10-million-yuan loan, the county government purchased 100 Caterpillar bulldozers. The use of machinery greatly improved the terrace-building process. In just one 5-year period, from 1996 to 2001, 20,000 hectares of new terrace plots were constructed. If assuming the new terrace increases land productivity by a modest 5%, this will translate into a cash flow of 3 million RMB additional income per year [5] based on the yield and price level in 1997. In other words, the rate of returns to the 10-million investment is as high as 30%.

By 2006, a total of 100,000 hectares of high-quality terrace fields had been built in Anding County, or 0.26 hectares per capita, with 93.7% of the land compatible with terrace building having been converted into terraces. As part of a poverty alleviation program, the central government invested heavily in large irrigation projects at the river basin level in the 1960s and 1970s in Anding County. The irrigation facilities built during the planned economy era laid a foundation for the subsequent rapid expansion of potato production several decades later.

(b) *Adopting potato production*

After improving land quality, the next challenge is to find the crops that are most suitable to the local environment. As mentioned earlier, farmers in Anding County previously produced wheat as a primary crop and potatoes as a secondary crop. However, because of frequent drought and soil runoff during the rainy season, average wheat yields were low and varied greatly across years.

During the spring, frequent droughts prevented seeds from fermenting. As the harvest time coincides with the rainy season, the concentrated rainfall often floods crops before harvesting. In 2004, 1 hectare of wheat brought only about

Table 1. *Potato cropping area, yield, price, and farmers' income in Anding*

Year	Total potato cropping area (1,000 hectares)	Total output (1,000 tons)	Yield (ton/hectare)	Price (yuan/ton)	Income from potato (yuan/person)	Net income (yuan/person)	Share of potato income (%)
1997	25.8	247.7	9.6	320	210	899	23.4
1998	25.9	504.4	19.5	300	380	1038	36.6
1999	32.6	506.6	15.5	340	440	1188	37.0
2000	35.8	429.6	12.0	350	306	1258	24.3
2001	42.0	945.0	22.5	160	400	1365	29.3
2002	44.9	471.1	10.5	400	480	1423	33.7
2003	42.7	960.0	22.5	240	604	1484	40.7
2004	49.3	799.9	16.2	425	860	1593	54.0
2005	48.7	800.1	16.4	509	1,050	1683	62.4
2006	56.7	889.1	15.7	540	1,264	1763	71.7
2007	63.3	1120.1	17.7	600	1,500	1868	80.3
2008	68.7	1299.9	18.9	600	1,659	2153	77.1
2009	71.3	1121.4	15.7	900	1,400	2391	58.6

Source: Anding County Agricultural Bureau and Office for Potato Industry.

2,756 yuan of total revenue (1,875 kg/hectare × 1.47 yuan/kg). Compared with wheat, potatoes are more resistant to drought and therefore more suitable for local production. The rainy season, spanning from July to September, coincides with the growth period of potatoes. In addition, the dry climate greatly reduces the use of pesticide. Most important, potato production has a much higher yield (22.5 tons per hectare) than wheat (1.9 tons per hectare). Even at a lower price of 0.3 yuan/kg, merely switching production from wheat to potatoes would double the total gross agricultural income.

After the rural reform in the early 1980s, land use rights were distributed to individual households, allowing farmers to make their own production decisions.[6] Therefore, local leaders could not force farmers to switch their cropping patterns away from wheat to potatoes. Even though farmers had planted potatoes in this area for a long time, they saw them only as a secondary crop to supplement wheat production. Local residents relied on potatoes mainly for survival in the event of famine, earning potatoes a reputation as a "lifesaving crop." Although farmers did have the knowledge and technology necessary to produce potatoes, they were hesitant to switch from wheat to potato farming.

Compared with wheat, many farmers thought potatoes carried a larger market risk. In the 1980s and early 1990s, the government set a guaranteed procurement price for wheat, assuring farmers that they could always sell wheat to the state or market. Without a similar guarantee for potatoes, farmers justifiably feared that if they could not sell their potatoes, the surplus would go rotten at home. Moreover, considering the relative prevalence of wheat in the local diet, the idea of a steady diet of potatoes in the event of lagging sales was not an incentive to grow potatoes.

Facing resistance from farmers, local officials first mobilized village cadres to experiment with large-scale potato production on their land in the early 1990s. Although the farmgate price was rather low, the first potato adopters still made large financial gains because the higher potato yields largely offset the lower price relative to wheat. Having observed the success of cropping potato, more farmers wanted to switch to potato production. Despite the apparently higher financial reward of planting potatoes, many farmers could not afford to buy high-quality seed potatoes. In response to farmers' financial concerns, the local government applied for the poverty alleviation fund from the upper-level government and used the fund to subsidize farmers' purchases of seed potatoes. The demonstration effect of village leaders and seed subsidies played an important role in speeding up the adoption of potato farming in Anding County. As Table 1 shows, in 1997, the total potato cropping acreage was 26,000 hectares, and in 1999 it increased to approximately 26,000 hectares. By 2009, the potato cropping areas surpassed 67,000 hectares.

(c) *Establishing a potato trade association*

The dramatic increase in potato production attracted a large number of traders from Shaanxi, Sichuan, Henan, and Anhui provinces to purchase potatoes in Anding County. Local farmers knew little about the price information in the wholesale markets in big cities as few of them had ever traveled to those cities. Because of this information asymmetry, farmers did not have much bargaining power. Initially, the farmgate price was determined largely by outside traders who captured most of the profit along the supply chain from producers to consumers. As Figure 2 shows, potatoes had to go through the hands of farmers, agents, outside traders, wholesalers, and retailers before reaching the consumer.

Because of the extremely low farmgate price, farmers gradually lost interest in expanding potato cropping areas. At the end of 2002, the potato market hit its nadir, and as a result, some farmers reverted back to wheat production. In 2003, the potato cropping area contracted in size for the first time since 1997. This posed a great challenge to the local government's potato-oriented agricultural development strategy. In response, the county government conducted a market survey on the potato supply chain. Local officials from the agricultural bureau and some townships were sent to survey the behavior of traders, truck drivers, wholesalers, and retailers in several major cities. The numbers shown in Figure 3 were collected from the survey.

Figure 3 clearly illustrates the rent allocation among different parts of the chain in 2003. Farmers sold their potatoes to agents of outside traders at 0.28 yuan/kg, where their production cost was 0.26 yuan/kg. Farmers earned a meager profit of two cents per kilogram without even counting their own labor cost. After paying the agents a fixed fee of 0.01 yuan/kg, the cost to outside traders equaled 0.29 yuan/kg. The traders then had the potatoes shipped to wholesalers in major cities and sold them at 0.48 yuan/kg. The transportation cost was about 0.1 yuan/kg, enabling the traders to pocket a net profit of 0.09 yuan/kg. Retailers bought the potatoes from wholesalers at a cost of 0.50 yuan/kg and sold them at the retail market at an average spot price of 0.60 yuan/kg. After extracting transportation, rent, and labor costs, the retailers netted a profit of about 0.05 yuan/kg. As the survey results indicated, farmers earned the least along the supply chain despite having to endure backbreaking farming work while local leaders that outside traders claimed a lion's share of the value added along the potato supply chain. They also demonstrated that the general lack of market information and collective bargaining power were the key reasons why the farmgate price was so low.

Considering the impossibility of quickly reallocating the rents along the supply chain through market forces, the local government decided to intervene in the market to reduce the monopoly powers of outside traders. The first initiative, in July 2003, was to establish a potato trade association. The major objective of the association was to train local traders to take the place of outside traders. Many of the association members initially had rather low levels of education. And although many had help from outside traders when purchasing potatoes, they knew little about market operations outside Anding County. To train indigenous traders and resolve this knowledge gap, the government sponsored 50 members to participate in a one-month marketing training in the School of Economics and Management at the Lanzhou University.[7]

The association has three tiers. The top tier exists at the county level, where the main responsibility is to collect market information and have potatoes shipped to the wholesale markets. This part of the association hired informants in major wholesale markets to collect market information and feed the information to its members. It is much more cost effective for the association to gather price information than individual members. The second tier is composed of members at the township level, whose primary task is to set up potato collection stations, purchase potatoes from agents or farmers, and then sell them to the county-level members or to traders from elsewhere. The villages have members who comprise the third tier and act as agents for first-tier and second-tier members. They charge a commission for purchasing, sorting, packaging, and shipping potatoes on behalf of traders at the top level. In support of the association, the Anding County government enacted a regulation banning nonmembers of the potato association from directly purchasing potatoes from farmers,

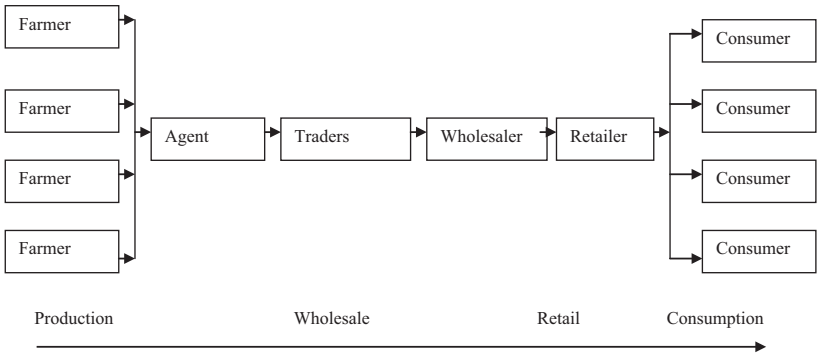

Figure 2. *Potato supply chain prior to 2003. Source: Drawn by authors.*

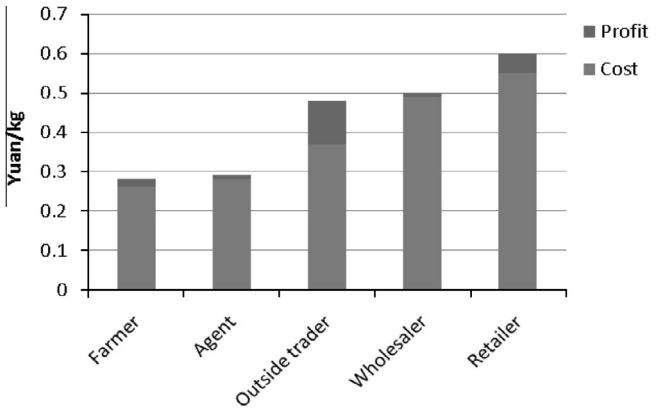

Figure 3. *Potato value chain in 2003. Source: Pan Yanjun, Anding Office for Potato Industry.*

effectively limiting the activities of nonlocal traders and greatly eroding their monopoly power.

The association has grown at a phenomenal rate since its establishment in 2003. At its inception the association had about 30 founding members. By 2009, it had attracted more than 3,000 members, including 467 first-tier members, 1,322 second-tier members, and more than 2,000 third-tier members. The association performed so well that its president, Dajiang Liu, was elected to the National People's Congress.

The association's mission is to promote the potato industry. To do that it tries to ensure that farmers receive a competitive price and thus have the proper incentive to produce potatoes. At one point, some traders in remote locations were buying potatoes from farmers at an unfairly low price, greatly damaging the reputation of the association. Beginning in 2004, the county government and the association worked together to implement a minimal procurement price, and they announced both the market and the minimum guaranteed prices in different media, including local radio, television, and marketplaces. Such a floor reduced fluctuations in the farmgate price and prevented traders from cheating farmers, thereby ensuring a stable potato supply.

(d) *Building local wholesale markets*

With the rapid increase in market share, the local government and the potato trade association decided in 2005 to build wholesale markets in Anding County, since local wholesale markets would help discover pricing information in a much cheaper, timelier, and more accurate way than collecting the information from wholesale markets all over China. The county government earmarked 10 hectares of land for developing the wholesale market. The wholesale marketplace is a shareholding company financed through a public–private partnership. The marketplace has experienced two phases of development. The first phase started in April 2005 with a total investment of 46 million yuan. The national government contributed 2.7 million yuan, the county government invested 8.34 million, and the association raised 35 million from its members. The total construction area is 38,600 square meters, including a 15,000-square-meter marketplace for potato sales. The government formally approved the second phase in 2007. The total investment of 27 million yuan for that phase came from various sources, including the central government's policy subsidies (5 million), the local government's matching fund (2 million), bank loans (10.35 million), and the shareholding company's self-financing (9.8 million). The second phase involved updating the inspection, information, and electronic fund transfer systems. The market turned out to be a big success. It quickly became China's largest potato distribution center, price formation center, and information distribution center. In response to the increasing trade, the market was further expanded to 100 hectares in 2009.

The secondary wholesale markets also grew rapidly. As Table 2 shows, in 1995 there was only one secondary wholesale market. By 2005, that number had increased to seven and land area had risen to 0.14 million square meters. By 2010, 10 more secondary wholesale markets had been built, and total land area had increased to 0.37 million square meters. Additionally, 63 village collection points had been set up across the county, up from only two in 1995. The primary outcome of these results is that strong spatial market coverage greatly reduces transaction costs and increases the transparency of price information, making it harder for any traders to unfairly compensate farmers.

Figure 4 shows how, as of 2010, the producers are linked to consumers. Comparing this with Figure 2, we see that the supply chain has completely changed in just seven years.

(e) *Expanding market access*

As Figure 5 shows, China has four major potato production regions. Prior to 2000, each production region primarily served the markets in nearby provinces due to the high cost of transporting the crop across regions. Anding County followed a similar pattern, and potatoes were initially sold primarily to Sichuan and Hubei provinces. As the total production area expanded, the potato market in the nearby provinces became saturated, resulting in a measurable price drop in 2003.

Table 2. *Market development in Anding*

Year	Secondary township wholesale markets			Village collection points		
	No. of wholesale markets	Market space (m^2)	Storage (metric ton)	No. of wholesale markets	Market space (m^2)	Storage (metric ton)
1995	1	10,000	4,000	2	4,800	2,200
2000	1	10,000	4,000	6	18,370	13,070
2005	7	139,760	344,800	23	74,220	29,780
2010	17	366,943	1,082,700	63	174,941	161,385

Source: Anding County Agricultural Bureau and the Office for Potato Industry.

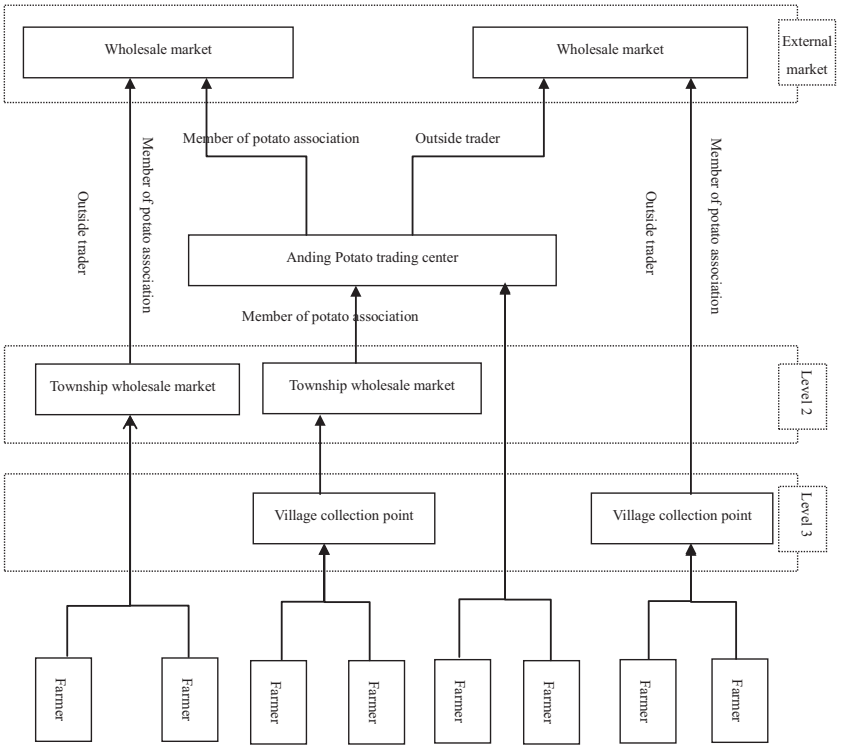

Figure 4. *Market structure of potato supply chain in 2011. Source: Drawn by authors.*

Figure 5. *China's four major potato production centers prior to 2003. Source: Drawn by authors.*

Although the demand for potatoes was still high in the large city centers on the coast, Anding County is far away from major coastal cities (1,600, 1,755, and 2,380 km from Beijing, Shanghai, and Guangdong, respectively). For example, the cost of transporting potatoes by road from Anding County to Shanghai was as high as 0.45 yuan/kg. Despite the rather low cost of production, when potatoes were shipped to Shanghai, their price was no longer competitive with those produced in Shandong. But if the potatoes were transported to Shanghai via rail, the transportation cost would amount to only half of that by road. However, the Ministry of Railway controlled the number of rail freight cars allocated to Anding County, and because Anding County was a rather poor region, the demand for freight cars used to be low, and consequently it received a smaller freight car quota. As potato output grew, so did demand for more freight cars. The limited quota of freight cars thus prevented Anding potatoes from reaching the coastal markets.

In 2004, facing the inevitable freight car bottleneck during the harvest season, the Anding County government urgently requested help from the provincial government. Xiankui Wang, a deputy provincial party secretary, used to work at the Ministry of Railway prior to his current position. Using his influence, Wang lobbied the Ministry of Railway to allocate 3,650 freight cars in 2004 to transport potatoes from Anding, a sharp increase from 1,507 freight cars in 2003 (see Table 3 for the number of freight cars over the years). When the freight trains full of Anding potatoes arrived in Shanghai, Nanjing, and other big cities in the coastal region, many traders from the production centers in Inner Mongolia and Shandong were scared away. The Anding potato price immediately began to act as the determinant of the national potato price. Consequently, Anding potatoes were able to reach a larger market.

To help the potato industry in Anding County, the Ministry of Railway made an exception and allowed the Anding County government to determine its quota based on actual demand. By 2009, Anding County's allocation of freight cars had risen to 6,145, with each freight car able to carry 60 metric tons. This resulted in 0.37 million tons of potatoes, or about one-third of total local output, being transported by rail.

(f) *Improving storage capacity*

The seasonal nature of potato production presented another constraint. In northern China the harvest season lasts from late September to December. Naturally, the price tends to be low in this period as fresh potatoes flood the markets. After late December, the price is more likely to go up as potatoes become more scarce close to the Chinese New Year. Given the V-shaped price pattern, farmers were reluctant to dump all their potatoes onto the market in the fall even if the transportation conditions allowed. Instead, they preferred to store the potatoes a little longer and sell them later at a better price. Seeing this need for storage, in 2004 the county government came up with a new policy to encourage farmers to build potato storage facilities by offering a 200-yuan subsidy. It even provided free land for members of the potato association or enterprises to build larger-scale storage facilities. Thanks to the dry environment, even the indigenous storage facilities in Anding County can keep potatoes fresh for up to six months. Based on our household survey in 2010, we found that on average each household has more than one potato storage facility.

Table 4 documents the rapid development of storage facilities over time. In 2004, the total storage capacity was 250,000 tons; by 2010 that number had risen to 600,000 tons. The storage system in Anding County comprises four levels. First, at the county level, the Anding Wholesale Market itself has eight large electric-powered centrally controlled storage facilities with a total capacity of 45,000 tons. Second, at the lower, township level, 68 storage caves with natural draft ventilation have been built, providing 65,000 tons of total capacity. Third, the village collection points are equipped with 2,200 caves with a total storage capacity of up to 130,000 tons. Fourth, individual farmers have dug 246,000 microcaves, each averaging less than 10 tons of storage capacity, at home or near their land. These small caves can store up to a combined 360,000 tons of potatoes.

Suppose the storage campaign results in an increase in sale price and profit (one cent per kg), the total net profit for an average cave of 10 tons capacity would amount to 100 RMB. Given a one-time 200 RMB subsidy, the rate of returns is as high as 50%. This is definitely better than providing direct cash transfers to the poor year over year, which will incur a much greater fiscal burden to the government in the long run.

The larger storage capacity helps farmers manage uncertainty in the market. For instance, in the fall of 2008, the potato price bottomed out due to a nationwide bumper harvest. In mid-October, the wholesale price at Guangzhou had dropped to 800 yuan/ton. At that price, farmers could not earn a sufficient income. However, as a result of the readily available storage facilities, farmers could put a significant portion of their potatoes into storage. By early 2009 and before the Chinese New Year, the potato price bounced back to a significantly higher level, enabling farmers to sell their stored potatoes at a more profitable price of 0.6 yuan/kg. Using the increased storage capacity, the average farmer earned 1,600 yuan of income from potato production despite the unfavorable market conditions during the previous fall.

(g) *Breeding better varieties*

With an increasing supply of potatoes and rising income, consumers demanded tastier and better-looking varieties. In response to market demand, the local government took steps to develop new and better varieties to improve the competitiveness of potatoes produced in Anding County.

The agricultural extension station in Anding County tested several varieties to local conditions, and two such varieties were selected and widely adopted. The first is Lingshu #3, developed by Gansu Academy of Agricultural Science. It is renowned for its high yield, drought resistance, short growth period (only 105 days), and long storage life. The average yield per hectare of this variety is as high as 27 to 53 tons. It contains 21.2% starch and 0.13% sugar. Since consumers do not find this variety especially palatable due to the rather low sugar content, it is mainly used for processing starch.

In the early 2000s, the Anding agricultural extension station rented land from Ran Zhen, a farmer in Daping Village, Qinglan Township, to experiment with breeding new potato

Table 3. *Number of freight cars allocated to Anding for potato transportation by Ministry of Railway*

Year	2003	2004	2005	2006	2007	2008	2009
No. of freight cars	1,507	3,650	3,956	3,303	5,735	5,462	6,145

Note: Surveyed by authors. Each freight car can carry up to 60 metric tons of potatoes.

Table 4. *Storage capacity in Anding*

Year	Centrally air conditioned		Natural draft ventilation		Storage caves (>300 metric tons)		Household caves (<10 metric tons)		Total storage capacity (1,000 tons)
	No.	Capacity (1,000 tons)	No.	Capacity (1,000 tons)	No.	Capacity (1,000 tons)	No.	Capacity (1,000 tons)	
2004	–	–	4	4	16	5	100,000	241	250
2005	1	10	12	12	50	15	120,000	263	300
2006	4	33	52	52	240	70	150,000	295	450
2007	5	36	60	60	300	92	160,000	312	500
2008	5	36	60	60	300	92	160,000	312	500
2009	5	36	60	60	300	92	160,000	330	518
2010	8	45	68	65	2,200	130	246,000	360	600

Source: Anding Statistical Bureau.
Note: Tons refer to metric tons.

varieties. However, after a few years, the experiment was called off due to budget cuts, and the station simply returned the land full of different varieties to Ran Zhen. To save money, the farmer used the seed potatoes from her land to plant potatoes. At the time of harvest, to her surprise, the potatoes in one parcel of her land looked extremely good and tasted delicious as well. She picked a few potatoes and had them tested in the Anding agricultural extension station. This variety turned out to be superior to other popular varieties at the time in both taste and resistance to disease. Its sugar content is as high as 0.32%. Not surprisingly, it enjoys a 30% to 40% price premium in the market *versus* other conventional varieties, although its yield is slightly lower.

As a root crop with asexual reproduction, potatoes are prone to virus attack. As such, it is critical that farmers have access to virus-free seedlings in order to avoid diseases and other consequences of possible virus attacks. In the mid-1990s, the county government set up a potato detoxification center and promoted virus-free seedlings. The center has 140 employees, including 18 senior and 31 junior scientists, and is equipped with the leading potato detoxification and reproduction technologies available in China. The center also has the capacity to quickly detect potato viruses and inspect quality. In collaboration with various partners, it currently produces 20 million seedlings and 30 million pedigrees per year which are virus free.

The large-scale expansion of reproducing the seedlings is primarily undertaken by other, mostly private firms. In 1989, Anding had only one state-owned drought agricultural research center that could produce virus-free seed potatoes. Since 2000, however, six private enterprises have begun to produce seedlings. All of these firms are located in Dingxi Drought Agricultural Science and Technology Demonstration Park, which is one of 21 national agricultural science and technology demonstration sites. The impact of this growth in research has two distinct yet complementary characteristics. On the one hand, the high-quality seedlings provide a foundation for the sustainable growth of potato production in Anding County. On the other hand, the rapid expansion of potato cropping areas demands more seedlings, inducing development of the local potato breeding industry. By 2010, Anding County had become the largest breeding center of virus-free potato seedlings in China.

(h) *Developing the processing industry*

Because the consumer demand for potatoes is rather inelastic, a rapid increase in supply will saturate the market, drive down prices, and make it difficult to expand potato production further. By comparison, the demand from processing industries has more growth potential. Whereas consumers are picky about the shape and taste of potatoes, those factors are of less concern to the starch industries. After the price drop in 2003, the local government realized the importance of developing the potato processing industry. If there were enough processing plants, they could absorb the low-quality potatoes left over from the consumer market and provide a floor price for those low-quality potatoes. This would bring additional income to farmers and generate tax revenues for local government.

Before 2003, there were a limited number of family workshops producing low-quality starch and noodles by processing merely 5% of total potato output. In 2003, the local government intensified its effort to attract investment in the potato processing sector by offering a package of incentives to investors. First, it provided them with land at a discount price to build factory buildings. Aside from land, other complementary infrastructure, such as electricity and water supply, was also guaranteed. Additionally, by working with banks, the government helped secure loans for the investors. Perhaps more important, the local government promised to provide a stable and adequate supply of potatoes with high starch concentrations. To ensure the balanced need for the consumer market and input use in the processing industries, the county drafted a potato cropping plan according to soil and water endowment in different regions. According to the plan, the northern part would focus on high-starch potatoes, the south would specialize in edible potatoes for vegetable use, and the Chuanshui district would target potato production mainly for French fries and chips. Such a plan assured investors that the processing plants would have access to a stable supply of potatoes.

The key reason why the local government wanted to subsidize the first mover is because it carries a much big business risk and its discovery cost may not be fully recovered. After some trial and errors, if the business succeeds, the information will quickly spread out, likely attracting more investors. As discussed in Hausmann and Rodrik (2003), the first mover normally totally cannot capture the total gains of its search cost because the followers can easily imitate it. If the externality is too large, then it is possible that no investors want to make the first move. In this case, Anding's industrial policy to subsidize the earliest potato processing plants can be justified.

In 2003, the county successfully attracted investment in two processing plants. As a result of the new plants, in total the county processed 40,000 tons of potatoes and output 8,000 tons of starch (see Table 5). In 2004, two more processing plants were established, increasing the county's total starch production capacity to 40,000 tons. In 2005, Anding County

attracted eight more processing plants, raising the total starch processing capacity to as high as 100,000 tons. In total, these firms processed 250,000 tons of potatoes, or more than 30% of the total output that year.

In 2006, the 12 firms invested more than 50 million yuan to expand the scope of their product, including a 9,000-tons potato flour production line, a 10,000-tons modified starch production line, and a 3,000-tons frozen French fry production line. Additionally, some firms started to produce potato chips. Four dedicated unit trains of starch were shipped from Anding County to Tianjin. All together, more than 300,000 tons of fresh potatoes were locally processed, absorbing one-third of total output. In 2007, three more production lines for potato flour, noodles, and specialized starch for textile industry use were put into place, and that year the plants processed a total of 350,000 tons of potatoes. In 2008, these firms invested in a few more production lines, including one for potato chips, and processed a total of 400,000 tons of fresh potatoes. In 2009, firms in Anding County produced 2,500 tons of French fries and potato chips to meet the increasing demand of fast food restaurant chains such as McDonald's. Furthermore, some of the products have been exported to countries in Southeast Asia and the Middle East.

The county government has put great effort into helping enterprises upgrade product quality. For instance, the local government helped the firms secure research-and-development grants from the upper-level government, register patents, and apply for national or provincial "well-known brands." In 2010, Anding County hosted the China Potato Exhibit for the sixth time. This well-known potato industry promotion attracts traders to come from all over China to Anding County and place orders for fresh potatoes and processed potato products.

Since 2005, the government has promoted the business model of "dragon head enterprises" or leading, large-scale enterprises. Under such a model, a company signs a contract with a producer association prior to the cropping season, wherein the producer association promises to serve as a production base for the company. The association then coordinates with farmers to plant the designated potato varieties. This is a win–win arrangement facilitated by the production association. On the one hand, the contract reduces farmers' market risk and enables them to concentrate on their production. On the other hand, the company secures a stable supply of potatoes. With just one year's experimentation, the area of contracted farming jumped from 6,000 hectares in 2005 to 17,333 hectares in 2006. As Table 1 shows, despite the rapid expansion of potato cropping area, the potato price has not declined. In contrast, it has shown an upward trend. Accordingly, potato production has contributed to a steady rise in income for farmers.

4. CONCLUSIONS

This paper narrates the successful story of the development of the potato cluster in Anding County, Gansu Province, China. Anding County used to be one of the poorest places in China; its people could hardly feed themselves. Within a few decades, however, the county has seen the formation of a comprehensive potato industry cluster (see Figure 6). Anding County has subsequently become one of the largest potato production, distribution, and processing centers in China. The local government has enthusiastically fostered the cluster's emergence and growth. However, its policies vary according to stage of development. As the cluster grows, the binding constraints evolve over time as well. This requires the local government to be sensitive to the needs of farmers and entrepreneurs and come up with endogenous and timely solutions,

Table 5. *Development of Anding potato processing industry*

Year	Starch (metric ton)	Potato flour (metric ton)	Fries and chips (metric ton)	Value added (1,000 yuan)	Taxes (1,000 yuan)
2002	3,000		100	3,000	450
2003	8,000		200	8,220	1,370
2004	13,000		500	14,650	1,960
2005	26,000		800	30,960	2,720
2006	36,600	3,500	1,500	62,000	2,910
2007	27,000	2,600	1,200	45,000	3,650
2008	48,000	4,000	1,500	120,000	2,830
2009	25,300	2,000	2,500	46,800	1,100

Source: Anding Bureau of Economy and Trade.

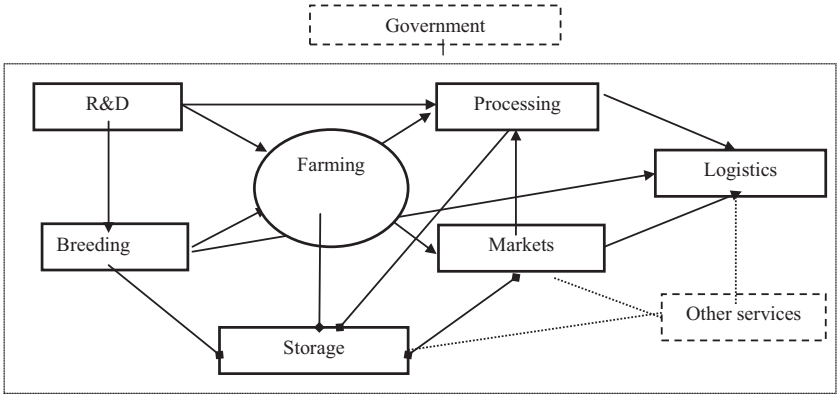

Figure 6. *Anding potato cluster. Source: Drawn by authors.*

especially in the face of the opportunities presented by crises (Ruan & Zhang, 2010).

The potato cluster is not a special case. For example, a cluster in a neighboring county specializes in Chinese medical herbs, and another one is renowned for the Chinese art of paper cutting. As shown in Long & Zhang, 2011, 2012, China's industrialization over the past several decades has been largely cluster based. Our paper explores the connection between this process of industrialization and the implementation of local industrial policy in developing regional specialization within China. Supporting evidence for this case study can be found in many other clusters.

This case study also has relevance for agricultural development in other developing countries. Because of differences in terrain, soil, water, and temperature, the comparative advantage in producing agricultural products is likely to vary greatly across regions. Therefore, it is hard for a central government or donor to prescribe a unified national agricultural development strategy that applies to all locations at any given time. In comparison, local governments have better access to information about the binding constraints faced by firms and therefore are in a better position to come up with practical solutions. Not only local governments play an active role fostering cluster development in China, they are also instrumental in many developed countries. For example, municipal and regional governments in Italy constructed industrial parks, set up vocational schools, built roads, and ran research centers to promote cluster development (Pirore & Sabel, 1984).

However, many local governments in developing countries lack the necessary incentives to develop their local economy due to the institutional arrangements with their respective upper-level governments. If they do not keep a keen eye on the development challenges themselves, they may find that merely relying on the upper-level government or donors to help out proves fruitless.

NOTES

1. Rodrik (2004) defines industry policy as measures to stimulate specific activities and promote structure change.

2. The six steps include: (1) Identify those dynamically growing tradable goods and service in other countries which are slightly more developed than the home country. They likely represent the country's latent comparative advantage. (2) Among the above list, identify those that domestic private firms have already spontaneously entered and diagnose any binding constraints that may inhibit firm from entering and growing. (3) For those industries that are new domestically, the government should provide some incentives to encourage the entry of private domestic firms in these industries. (4) Take advantage of unexpected opportunities that may arise from the country's comparative advantage or from new technological breakthrough. (5) In countries plagued with poor infrastructure and business environment, set up special economic zones or industrial parks to attract foreign firms coming in a bundle. (6) Provide first innovators with time-limited tax incentives, co-financing of investment, or access to foreign exchange to compensate for the first movers for their positive externality on other firms.

3. Since 1994, China has implemented a tax sharing scheme between local and central governments. For example, for value added tax, the central government and local governments receive 75% and 25%, respectively. Local governments keep all the business taxes. This tax sharing arrangement provides local governments a strong incentive to develop the local economy. But it may also widen regional inequality (Zhang, 2006).

4. There are of course industrial policies which are not specific to cluster-based model. This is beyond the scope of our paper. Here we limit our discussion to cluster-based development model.

5. Estimated using 20,000 hectare × 9.6 tons/hectare × 320 RMB/ton × 5%.

6. See Du (2010) for details about the course of rural reforms.

7. The training has paid off, as many of the trainees have become leading traders in the potato industry nationwide.

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