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The Role and Incentives of Chinese Local Governments in Solar PV Overinvestment

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The Role and Incentives of Chinese Local Governments in Solar PV Overinvestment

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Abstract

Local Government's Incentives to Overinvest in the China's PV Industry

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Through an analysis of the political structure, fiscal system, and financing mechanisms at the local level in China, this study seeks to investigate the incentives that prompted local Chinese governments to overinvest in the solar photovoltaics (PV) industry. I find that local governments have several incentives to promote economic development by supporting local industries; their support of China's PV industry illustrates these incentives. Specifically, we find that there are three major incentives for local governments in China to overinvest in the solar PV industry. First, due to the nature of China's tax policy, local governments have supported the PV sector to increase local revenue. Second, as these industries have become significant sources of local employment, it is hard to stop supporting them now that PV companies are having difficulties. Third, local officials seek promotions under the economic indicator system

by gaining higher GDP. PV companies have been very helpful in contributing to local economic growth, thereby advancing the careers of government officials. Farsighted provinces like Jiangsu used the strength of their existing industrial base and favorable geographical location (proximity to ports) to attract visionary innovators and investors for building their PV manufacturing bases. Thanks to the distorted local political and economic incentives in China, this early wave of PV industry investments preceded a flood of imitating local governments that sought to expand their own PV manufacturing. This uncoordinated, irrational exuberance stemming from distorted, bottom-up local incentives has led to the massive PV manufacturing overcapacity in China.

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Introduction

Increasing global interest in and attention to China's solar photovoltaic (PV) industry has intensified, creating the need for deeper analysis of the industry and its relationship to government policies. The solar PV industry's rapid growth in the last decade has received wide attention from scholars and analysts around the world. Several scholars have discussed industry growth, and in particular, the relationship between industry development and national incentive policies, international technology transfer and domestic innovation, and implications for global competitiveness (Bazilian et al, 2012). Liu and Wang et al (2009) presented a comprehensive portrait of solar energy in China, including the PV industry and market development, as well as various solar domestic applications. Huo and Zhang (2012) discussed the lessons learned from China's PV industry by examining national policies designed to increase domestic market demand, which would further create strong incentives to expand domestic manufacturing capacity. They also pointed out problems that impede healthy growth of the industry. Zhao and Shi et al (2011) discussed the status of China's solar PV market, especially its relationship to electricity price. Yu and Luo (2012) demonstrated that the Chinese solar industry innovation model successfully migrated from international technology manufacturer to indigenous innovation after 2007. Wu and Mathews (2012) also underscored the transition of the PV industry from imitation to innovation by researching patents in order to trace knowledge flows. Ng (2011) discusses market and government

policy changes that have enhanced the development of the industry and market following the financial crisis in 2008.

However, none of these or other articles addresses the role of local governments in developing China's solar PV industry. Local governments implement national incentive policies and provide direct support to the industry. Their contributions to the growth of Chinese PV industry cannot be ignored. However, there is a central question that underscores the role of local governments in the solar industry: do they only play the role of executor for the central government or do they have their own incentives to support the industry? To answer this question, a deep understanding of the fiscal system and structure of local governments in China is necessary. Lawrence and Martin (2012) note that fiscal decentralization empowers provincial governments. Gordon and Li (2011) examine the evolution of economic incentives that motivate the actions of local government officials in the absence of organized public input from local residents. Wedeman (1999) describes fiscal decentralization in China specifically highlighting the historical context, the economic and political background, and existing expenditure and revenue assignments. Weingast, Jin, and Qian (2005) explain the relationship between a provincial government's fiscal incentives and provincial market development. Martinez (2006) describes the expenditure responsibilities for local governments in a variety of sectors, including education, healthcare, social welfare, capital investment in infrastructure and agriculture development. Yet, have these incentives driven local governments to support the solar PV industry? This thesis seeks to examine the underlying incentive structure of Chinese local governments to invest in and support solar

PV manufacturing in several provinces. Incentives likely differ among provinces, as a corollary to their varied capabilities and economies.

To achieve this goal, three topics must be addressed: (i) local government's incentives for economic development, (ii) dynamics of the PV industry in China, and (iii) an integrative analysis of the first two topics. Accordingly, Chapter 2 provides an overview of Chinese local governments' structure and fiscal system. Chapter 3 chronicles the Chinese PV industry, particularly the national policies that support the industry and its major investment and market trends. Chapter 4 integrates the discussion in Chapters 2 and 3 to analyze the incentives and different capabilities that motivated local governments to support the PV industry. Finally, Chapter 5 summarizes these issues and provides concluding thoughts.

Chapter 1: Background and Methodology

BACKGROUND

Solar Photovolatics (PV) generate electrical power by converting solar radiation into direct current electricity using semiconductors with no moving parts, PV system operate quietly without emissions and are capable of long-term use with minimal maintenance[1]. In 1954, Bell Labs in the United States introduced the first solar photovoltaic device that could generate at a four percent efficiency and later increased to 11 percent (U.S. Department of Energy). By the late 1950s solar cells were being used in small-scale scientific and commercial applications, such as powering satellites for the U.S. space program, but large-scale commercial use was not started until the late 1990s. The major barrier to widespread diffusion of this technology is the high cost of equipment as compared to conventional fuels. However, with the rapid advances in technology and increasing energy demand, the prices of PV cells have declined from $76.67 per watt in 1977 to $0.74 per watt in 2013 (Figure 1). The annual production of PV cells also has increased dramatically from 48 MW in 1990 to 35000 MW in 2011 (EPIA, 2012).

[1] French scientist Edmond Becquerel discovered the photovoltaic effect in 1839. While experimenting with an electrolytic cell made up of two metal electrodes placed in an electricity-conducting solution, Becquerel found that the cell generated electricity when exposed to light. The German scientist Heinrich Hertz and others observed the PV effect in solids during the 1870's. The first PV cells were built in 1883 with 1-2 percent efficiencies by Charles Fritts, an American inventor.

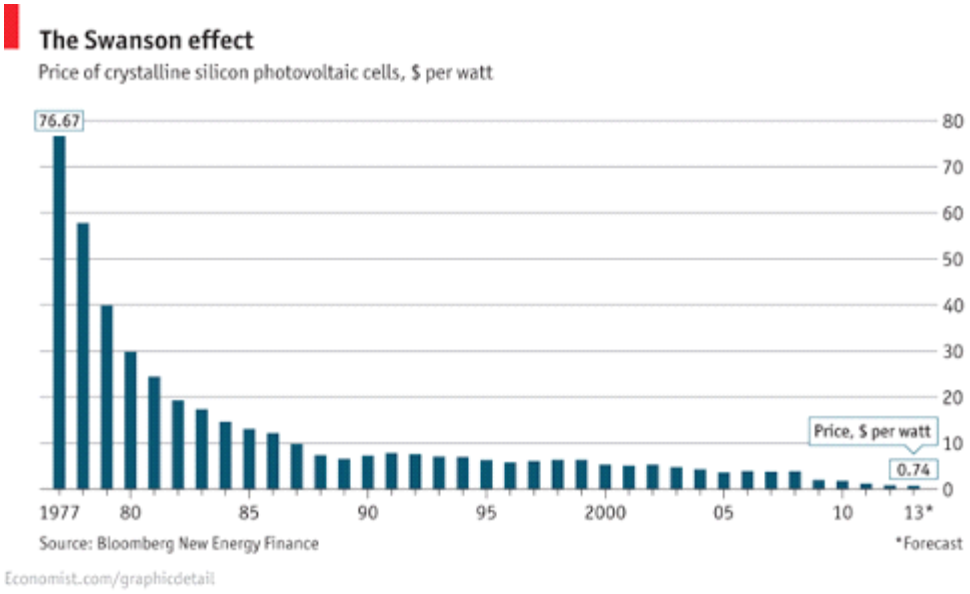

Figure 1: Price of Crystalline Silicon Photovoltaic Cells in U.S. dollars per watt.

Source: The Economist, 2012

China is quite a latecomer to the solar PV's industry compared to some developed counties such as the U.S., Germany, and Japan. China only got into the commercial production game around 2000, starting with local manufacturer Suntech Power. Although China's manufacturing record in PV is pretty short, its contribution to the development of the global solar PV industry is significant. Its eagerness to gain a larger share of the global market and its competitive labor costs has incentivized the increase in PV production while driving down the cost of PV cells (Liu, et al, 2010). In 2007, China first surpassed Japan with 1 gigawatt [GW] production to become the leader of solar cells production around the world. This number continued rising and reached 21 GW in 2011, which represented 60 percent of the global total production (EPIA, 2012). Compared to its rapid growth in manufacturing, China's domestic PV installation capacity is quite

small; the nation only had a cumulative capacity of 2150 megawatt [MW] in 2011. More than 95 percent of its PV products are made for overseas markets. To become a global leader in both manufacturing and the use of PV, the Chinese central government promulgated a series of incentive policies designed to increase domestic PV installations. We discuss these policies and underlying drivers in more detail in Chapter 4.

The rapid growth of Chinese PV industry is a lightning rod for criticism. As mentioned above, China has relied heavily on overseas markets. This reliance rendered the industry fragile and susceptible to changes in domestic policies in major PV-demand countries. The consequences of this arrangement manifested after the financial crisis in 2008 when Germany and other EU countries began eliminating solar incentives and subsidies, which dramatically shrank the global PV market. At the same time, the U.S. government and EU also initiated an anti-dumping and countervailing investigation against Chinese PV manufacturers for receiving excessive government subsidies. On October 10, 2012, the U.S. Department of Commerce imposed sanctions against Chinese PV companies by levying an anti-dumping tax on Chinese PV equipment ranging from 18.32 percent to 249.96 percent, and a countervailing duty ranging from 14.78 percent to 15.97 percent. The EU also indicated it plans to issue a decision on sanctions in June 2013, which potentially could affect the Chinese PV industry far more than the U.S. did. The core issue of this commercial dispute is the unfair subsidies Chinese solar PV firms receive from their government (Omnik New Energy, 2012). However, the Chinese solar PV industry actually received relatively little policy support from the central government compared to other industries. For example, the central government forced wind power

stations to purchase more than 70 percent of their windmills from local manufacturers from 2005 to 2009 (InfraVest). This policy directly led to the rise of many domestic windmill manufacturers such as Goldwind, Sinovel and Shanghai Electric with the central government as a shareholder in each firm. By contrast, almost every major solar PV company in China is private. They prefer to raise funds abroad by listing their stock on foreign stock exchanges, as Suntech Solar first did in 2005. The central government also did not require solar PV companies to purchase their equipment from domestic manufacturers. In fact, it was not until the current Twelfth Five-Year Plan (2011-2015) in which the PV industry was selected as one of the "strategic new industries," along with the wind power industry. Yet, by the time the industry gained "strategic" status, it had already achieved global dominance.

Compared to the central government, local governments have played a more active role, and in some cases even an aggressive role, in supporting the development of the domestic PV industry. Many scholarly papers emphasize the actions that the local governments took to promote the industry (Huo & Zhang, 2012) but not the incentives that motivated them to do so. To understand the underlying incentives behind local government intervention in the PV industry, one first must understand the Chinese government's structure, the relationship between central and local governments, the role of local government in the current fiscal system and local governments' financing methods. Once this structural framework is understood, it is possible to analyze examples of local government interaction with PV firms and investigate the specific incentives that drove local governments to develop the industry.

METHODOLOGY

Since the purpose of this paper is to uncover the incentives local governments have to develop solar PV industry in China, it is necessary to understand the governmental structure and fiscal system first, and then examine more examples to determine which kind of incentives propelled local officials to support the industry. To achieve this goal, I conducted an extensive literature survey and several in-depth, expert interviews. I also include some useful opinions from Chinese articles that I translated into English.

To begin, I collected data on China's governmental structure and fiscal system using Internet searches. To identify the relevant literature for review, I used several search engines such as "Google Scholar", "University of Texas at Austin Library" and "National Knowledge Infrastructure, CNKI". A variety of keyword descriptors were used in searching within these online databases, including "Chinese local governance", "Chinese provincial government", "Chinese fiscal system", "local government finance". and "local land issue". Next, I sought information on the status of Chinese PV industry and local governments' contributions to PV firms by conducting interviews with subject matter experts and searching online databases for keywords. I conducted several on-site interviews with senior officials in Wuxi government (prefecture level) and senior managers in Wuxi-based Suntech Solar that had been arranged during a trip to China in December 2012.[2] I also conducted several telephone interviews with senior officials in Xinyu government (prefecture level) and senior managers in LDK Solar. In addition,

[2] These interviewees requested anonymity within the paper.

information on recent national and local policy-support to PV industry were sourced from the most recent, pertinent academic works, and an exhaustive Internet search of press releases and other relevant public documents.

Chapter 2: Overview of China's local government

POLITICAL STRUCTURE

There are five levels of local government in China: provincial level, prefectural level, county level, township level and village level (Table 1). The fiscal relationship between central government and local governments has changed over time, and can be categorized into three distinct phases: the central controlled phase pre-1979, the transitional phase from 1979 to 1994 and the post-1994 phase (Shen et al, 2008). These phases demonstrate the central government's determination to complete decentralization step by step. Starting in 1994, local revenue was reallocated as revenues were collected from: local taxes, the local portion of shared taxes from all non-state owned enterprises; business tax; and personal income tax (Bahl, 1999). Since then, local governments discovered how to gain their own revenues by supporting profitable industries. Chen and Jin (2011) pointed out that fiscal power has shifted from central government to local governments through decentralization. Although local governments are forbidden to borrow money under China's 1994 budget law, local governments are keen to support local industry by raising capital through direct borrowing and loan guarantees, borrowing from commercial banks, or indirect borrowing. Moreover, Gordon and Li (2011) asserted that fiscal incentives are not the only incentives for local government to increase revenue. They also relied heavily on non-fiscal incentives, such as the economic indicators tied to local officials' job performance.

The People's Republic of China (PRC) officially claims 34 provincial-level governments, which include 23 provinces, five "autonomous regions" with large ethnic minority populations (Tibet, Xinjiang, Inner Mongolia, Ningxia, and Guangxi); four municipalities that report directly to the central government (Beijing, Shanghai, Tianjin, and Chongqing); and the two special administrative regions of Hong Kong and Macau. (The PRC's count of 23 provinces includes Taiwan). Below the provincial level, there are four levels of local governments, including prefectural level, county level, township level and village level. (Table 1)

Local governments in China play an important role in the economy. Local revenue in recent years is approximately eight percent of GDP, extra-budgetary revenue (largely income from land) is another three percent of GDP, budgetary expenditures are close to 14 percent of GDP, and extra-budgetary expenditures comprise another two-and-a-half percent of GDP (Gordon & Li, 2011). Provinces maintain their own revenue streams, and governments at the provincial level and below are responsible for the largest share of the country's public expenditure, including almost all public spending on education, health, unemployment insurance, social security, and welfare (Saich, 2001). Provinces also have the right to pass their own laws and regulations, which may extend national laws and regulations, but may not conflict with them. The central government also gives provinces the right to adopt unique policies based on their own situation and, in recent years, has encouraged them to undertake approved policy experiments (Wang, 2012).

Level	Type	Names
1	**Provincial Level** (33), one claimed (Taiwan).	Provinces (23), Autonomous regions (5), Municipalities (4), Special administrative regions (2).
2	**Prefectural Level** (333)	Prefectures (17), Prefecture-level cities (283), Autonomous prefectures (30), Leagues (3).
3	**County Level** (2858)	Counties (1464), Districts (855), Country-level cities (367), Autonomous countries (117), Banners (49),Autonomous banners (3), Special districts (3), Forestry areas (1).
4	**Township Level** (40859)	Town (19141), Townships (14646), Subdistricts (6686), Ethnic township (1098), Sumu (181), District public offices (2), Ethnic Sumu (1).
5	**Village Level** (informal)	Village committees (623669), Neighborhood committees (80717).

Table 1: Government divisions administered by the People's Republic of China

Source at: Administrative Divisions of the People's Republic of China, 15 June 2005, retrieved 5 June 2010.

FISCAL SYSTEM

To understand China's fiscal system and the relationship between central and local government, a knowledge of the history and phases of China's fiscal decentralization is useful.

1949 -1978: Central Control System

The fiscal relationship between central and local government in the first thirty years of PRC can be described by the words "coordination" and "expenditure." The central government made decisions on finance, planning, and administration for the local governments. It was a system in which all decisions about what people needed were centrally planned. Provincial governments collected most of the revenue generated from within the province. Provinces derived about 80 percent of revenue from taxes and (mostly) profits from state-owned enterprises. The central government devised a spending plan for each province based on their revenues (Oksenberg and Tong 1991, Riskin, 2000).

The tax system was quiet simple: taxes levied on profits from state-owned enterprises (SOE) were the main source of governmental revenue. It was easy to monitor and determine the profit of these SOEs since prices and sales for the operations were planned by the central government. The central government determined the expenditure and budget for local governments by setting spending priorities, approving local budgets according to local spending needs, and determining civil service salary scales, pension and unemployment benefits, educational and health care standards. The central government also took responsibility for determining the national defense budget, and

setting policy for economic development, foreign affairs and industry. Under this system, provincial government was more like a local administrative arm of the central government, rather than an independent government. Local governments had little incentive under this system to support enterprises, which led to a slowing of local economies. This is believed to be the main cause of the slow economic growth in China during these years (Shen et al, 2008). By the late 1970s, a variety of enterprises formed, and with them, changes in the tax system that nearly crashed this fiscal system. A number of different revenue-sharing systems developed in the early 1980s in an effort to mitigate the disadvantages of the old system.

1979 -1993: Fiscal Contracting Systems

The Chinese fiscal system experienced three major changes from 1979 to 1993, all of which were aimed at promoting local economy by giving them more autonomy in various fiscal functions and creating incentives for them to gain their own revenue. This period can be regarded as the start of decentralization in China.

The first fiscal reform happened in 1980 when a revenue-sharing fiscal system was used to replace the old centralized system. Under this system, the revenue collected by local government would be shared by both central and local government, which created incentives for local government to collect more revenue. This arrangement had a vivid nickname: “eating in separate kitchens” (Lou et al., 2008). The central government determined revenue-sharing rules with provincial governments, and provincial governments also determined revenue-sharing rules with prefectural governments. There were three types of revenues: central-fixed revenue, local-fixed revenue and shared

revenue. About 80 percent of the shared revenue was remitted to the central government and local governments retained the remaining funds. Central government maintained the right to determine tax rules (Agarwala, 1992). However, this system relied on unified taxes rates and bases, which resulted in rich provinces becoming richer and poor provinces becoming poorer. To fill this gap, the central government began changing the rules in the mid-1980s.

In 1985, the State Council of China redesigned revenue-sharing arrangements by varying schedules based on provinces' budget balances in previous years. The financially weak provinces were allowed to retain more revenues, but the wealthier regions, like Beijing, Shanghai, Jiangsu, and Zhejiang, were required to remit more revenues to the center. This modified system could help poor provinces to eliminate deficits, but it also created problems for the rich provinces (Lou et al, 2008). The high level of remittance curbed local incentives for these richer provinces to expand their tax bases, which led to stagnant revenues in these regions.

To overcome these disadvantages, the central government implemented the fiscal contract system in 1988. Under this system, each level of government would sign a contract with its direct leader to meet revenue and expenditure goals. There were several revenue-sharing methods adopted by different provinces based on their own economic conditions. The most popular one was "contracted sharing rate with fixed yearly growth rate of revenue" (Agarwala, 1992) The central-local revenue sharing rate and the yearly growth rate of local revenues were based on the revenue performance of the province within recent years and were negotiated by the central and provincial governments. If the

real growth rate was greater than the contracted rate, the province could keep the surpluses. If the real growth rate was lower than the contracted rate, then the province had to offset the gap.

In this transition period from 1979 to 1993, these three fiscal reforms signaled the intent of the central government to begin fiscal decentralization and build a solid foundation for the tax-sharing system implemented in 1994. Local government started to gain control over much of their own tax revenues and, at the same time, the central government devolved its responsibility of financing many public infrastructure projects to the local governments. However, these reforms also created some problems such as fiscal decline, distortion in the private sector, increasing fiscal disparities among provinces and growing distrust between central and local governments (Montinola et al., 1995). To address these problems, the central government made great efforts to find an alternative approach. Thus, they implemented the tax-sharing system in 1994.

Post-1994 Tax-Sharing System

The most intensive and far-reaching fiscal reform happened in 1994 with the implementation of a tax-sharing system. It created a clear framework for the relationship between central and local governments, which made the central-local revenue sharing more transparent and easy to monitor (Lou et al, 2008). It also successfully addressed some problems, such as the continuous fiscal decline before 1994, the complicated and disparate tax structure, and the lack of revenue provided to the central government.

Tax assignment

The core of this fiscal reform was the introduction of a tax assignment system, which specifies the way revenues are shared between the central and provincial governments. Under this new system, local revenue was defined as revenues from local taxes and the local portion of the shared taxes (Bahl, 1999). The major local taxes were the income taxes from all enterprises other than central government enterprises, business tax from the sales of services, and personal income tax. A new kind of tax named Value Added Tax (VAT) at a uniform rate of 17 percent was introduced and became the most important shared tax between central and provincial governments. VAT is a form of consumption tax on the value added to a product, material, or service by the stage of its manufacture or distribution. These reforms also eliminated the variations of the revenue sharing rules from the 1980-1993 phase. The current unified sharing rule can be seen in Table 2. Among the most profitable shared taxes such as VAT, company income tax, personal income tax and business (China Statistical Yearbook, 2006), only the business tax was shared more than 50 percent by the provincial government, which gave the central government the larger portion than the provincial governments. In addition to the budgetary revenue, another category of revenue called extra-budgetary revenue was institutionalized after the reform, which consists of tax surcharges and user fees levied on local industries by central and local government agencies, as well as some earnings from SOEs. Unlike the budgetary local revenues, the extra-budgetary local revenues are not required to be shared with the central government, which creates an strong incentive for

local government by developing more local industries and further promoting local economy (Wong, 1995).

Taxes	Central	Local
Central Tax		
Tariffs	100	0
Consumption Tax	100	0
Shared Tax		
VAT	75	25
Business Tax	3	97
Stamp Tax on Security Exchange	97	3
Personal Income Tax	60	40
Company Income Tax	60	40
Local Tax		
Resource tax	0	100
Urban Maintenance and Development Tax	0	100
Urban Land Using Tax	0	100
Agriculture and Related Tax	0	100
Tax on Contracts	0	100

Table 2: Tax Assignment

Source: Shen, 2008.

Expenditure assignment

The 1994 reform did not change the assignments of expenditure responsibility used before 1994, which was described specifically in Table 3 below. As shown, the central government was responsible for nationwide services such as national defense, foreign affairs, foreign aid and scientific research. The local governments were mainly focused on public goods and services, the development of the local economy, and the operation of various institutions. For example, sub-national governments accounted for 92 percent of education and 97 percent of the health care expenditure. The actual division of expenditure responsibilities among sub-provincial governments was determined at each level of government, since there were no specific laws or regulations to guide them (Martinez et al., 2006). Basically, the provincial governments decided the expenditure assignment for prefectural governments and the latter determine the expenditure assignment for lower-level county and village governments.

Benefits of tax-sharing system

1. Central revenue increased since the reform. Before the 1994 fiscal reform, the revenue of the central government continued to fall because of two major reasons. First, the revenue assignment was not highly detailed which allowed the local government to escape from several tax remittances to the central government (Shen et al., 2012). Second, the central government relied on the local governments to collect taxes, but local government could easily grant tax exemptions without the permission from the center. After implementation of the tax-sharing system in 1994, the situation changed dramatically. As shown in Figure 2, the portion of the central government's increased

Expenditures	Central	Provincial	Prefecture	County
Total	30	18	22	30
Capital Investment	44	23	22	11
Agriculture Expenditure	12	46	11	30
Education	8	15	18	60
Scientific Research	63	23	9	5
Health Care	3	22	32	43
Social Security	11	39	32	18
Government Administration	19	11	22	48
Expenditure for Public Security Agency, Procuratorial Agency and Court of Justice	5	25	34	35
National Defense	99	1	0	0
Foreign Affair	87	13	0	0

Table 3: Actual division of main expenditure responsibilities

Source: China Statistical Book, 2006.

from 22 percent in 1993 to about 56 percent in 1994. This success is attributed to two main factors: 1) central collection of VAT, which ended the situation of the central government relying on local remittances (Shen et al., 2012), and 2) the ban on local governments approving tax exemptions or reductions in the new tax system.

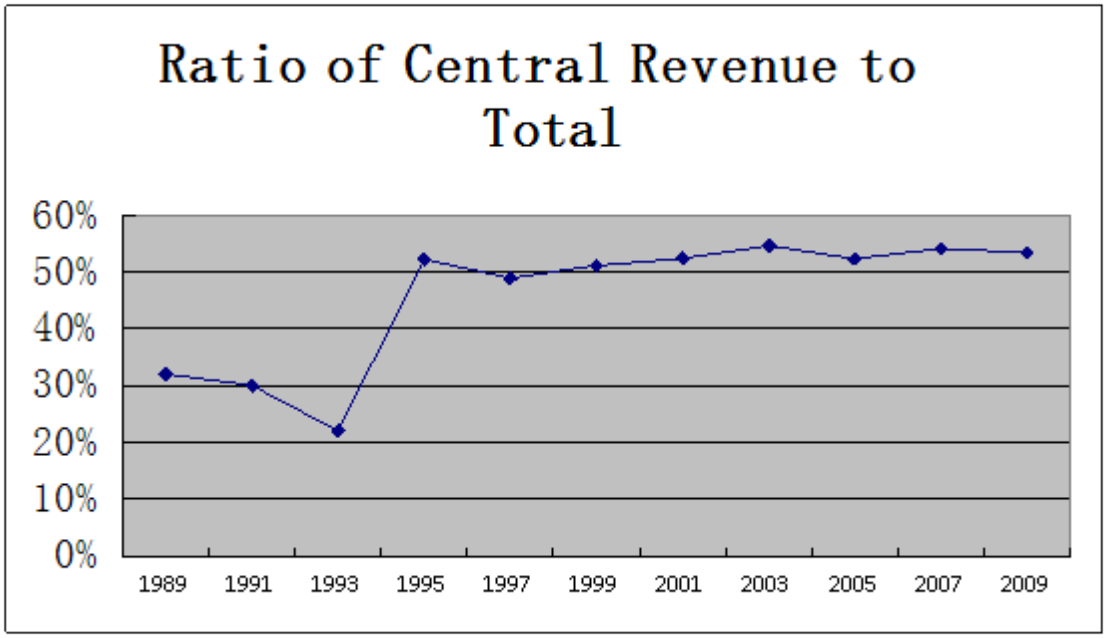

Figure 2: Ratio of central revenue to total.

Source: China Statistic Book, 2010.

2. *Create fiscal incentives for local government.* As a result of the fiscal decentralization through the reforms in the 1980s, local governments enjoyed economic autonomy, which created a strong fiscal incentive for these local governments to make their own economic decisions. For example, localities started to sell or rent arable land for industrial uses to gain more revenue (Li, 1999). Second, this new tax-sharing system reformed the tax structure by abolishing several unreasonable taxes such as the

production tax. The more revenue local government gained, the more they retained. The reforms also put an end to the enduring misappropriation of revenues between the central and local governments at the same time (Shen et al., 2012). For example, the excise taxes were assigned to the local government and the business taxes to the local government after the 1994's reform, which eliminated incentives for local governments to over-develop certain enterprises with high tax-returns such as tobacco companies (Zhang and Martinez-Vazquez, 2003). Further, the local government can retain all the extra-budgetary revenue they gained. Although that had long existed, it was first institutionalized after the 1994's reform.

3. *Increase the central control.* The central government established the National Tax Services Bureau to provide tighter control over taxes collection. The interference of local governments in tax administration and collection of shared revenues was substantially restrained. Local governments were not allowed to grant tax reductions or exemptions to local enterprises. Any new tax exemptions had to be approved by the center and reported in a separate schedule of the tax return (Shen et al., 2012).

Local finance

The imbalance between local government expenditures and revenues is stark in China currently. As shown in Table 3, the local government expenditure increased from RMB 333 billion in 1993 to 6,104 billion in 2009, at the rate of growth of more than 42 percent per year, which is faster than the growth of the national fiscal expenditure. Local government expenditures made up 70 percent of the overall fiscal expenditure (Martinez et al., 2006). At the same time, local revenues increased from RMB 339 billion in 1993 to

3260 billion in 2009, at the rate of growth of 33 percent per year, which is slower than the growth rate of national revenue. The ratio of local expenditure to local revenue increased from 0.98 to 1.87 during 1993 to 2009, which meant the local revenue cannot afford local expenditure currently. In the next sections, I will describe the local expenditure and revenues first, and then the strategies being adopted by local governments to fill the gap between them.

Local revenues in China are mainly comprised of five shared taxes, Value-Added Tax, Business Tax, Company Income Tax, Personal Income Tax, and Stamp Tax, and local taxes such as Tax on Real Estates, Agricultural Tax, Tax on the Use of Urban Land, Land Value-Added Tax.(Table 2). Among all these taxes, Business Tax accounts for 32 percent, VAT 22 percent, Company Income Tax 17 percent, Personal Income Tax seven percent and Urban Maintenance and Development Tax six percent (Chinese Statistics Book, 2006). Thus, the local portion of shared taxes, especially business tax and VAT, are the major financial income for local governments.

The specific expenditure responsibilities for local governments can be seen in Table 3 above, but it is not fixed yet; changes can be made to suit the new economic environment. For example, although local expenditures for education account for 92 percent of the total expenditure, it still lags far behind compared to developed market economies such as the United States, which leads to a poor educational attainment in China (Ruth & Stephanie, 2011). In addition, environmental and resource protection, climate change and other related problems are very important to a nation's sustainable development. Although not significant in the current budgetary scheme, these fiscal

expenditures likely will increase in the future (Ruth & Stephanie, 2011). Local expenditures also increased when facing some extreme situations, such as the 2008 global financial crisis. The central government typically will enact new economic plans to stimulate the economy, which will increase local expenditure. For example, after the worldwide financial crisis in 2008, the central government released large-scale plans to stimulate the economy, which meant that local governments had to provide massive financial support (Yu, 2009). In short, the current trend of increasing local government spending is unlikely to change in the foreseeable future.

Four financial methods

Since the imbalance of local governments in fiscal expenditure and revenue is expanding continuously these years, the local governments have tried various financing methods to meet the enormous demand for local funds. At present, four financing approaches are commonly used by the localities. They are: 1) financial allocation by the central government, 2) land financing, 3) platform financing and 4) local bonds financing.

Financial allocation by the center means the special financial allocation for local governments from the center and national debt fund transfers to local governments. The special financial allocation from the center generally has to meet strict requirements and the fund also has a specific application range. The national debt fund transfers to the local government has become more and more popular in the past few years.

Land financing means the local governments obtain funds by selling or leasing the right to use local lands through auction and publicly granting land use rights. Since the speed of industrialization has increased dramatically over the decade or so, large amounts

of land are required to catch up with the speed of development. This source of funding provides the local governments who control the local land-use market a chance to gain huge sums of land grant fee. In some provinces, it even has become the only source of local revenue. It has increased from RMB 589 billion in 2001 to RMB 2700 billion in 2010 at an annual growth rate more than 40 percent. The proportion of land grant fees to local government revenue also increased to 49 percent in 2009, which means many local governments in China may be over-relying on land financing at present (Luo, 2010). However, many problems such as the over-use of arable land and unreasonable compensation also exist in this method, which needs serious supervision to increase efficiency.

Local platform financing is a new way for local governments to deal with finance problems by using a platform such as locally-owned enterprises or Trust and Investment Companies. It is an innovative measure under the current system to fill the financing gap. Under this financing method, local governments use the revenue collected from selling or renting land, stated-owned assets and other funds to form a platform replacing local governments to undertake construction projects, financing and other tasks (Luo, 2010). However, there are many problems with this method; for instance, loan repayment capacity cannot be guaranteed and debt risks potentially increases continuously. A standard of how to create and run these platforms is yet to be established to regulate local governments.

Local bonds financing means the local governments finance themselves by issuing local bonds. The interest rate of local bonds depends on the overall bond market,

but it is typically a little bit higher than treasury bills from the central government. The funds collected by these bonds are listed in the local budget and are under clear regulation and strict supervision. It is mainly used in livelihood field, education and some central projects.

Land issues

As discussed earlier, land revenue has become a major income source for most provinces in China, but it also has caused several serious problems such as over expropriation of rural land and, at the same time, extremely low compensation for the land. The central government established the Land Administration Bureau in 1986 and promulgated the Land Management Law in 1988 to regulate the land development in China. This land law is focuses on land survey and statistics, land use plans, construction projects and how to conserve arable land for each administrative level (Deng, 2003). However, it was not a detailed law and left several undefined areas, which rendered implementation extremely varied among different provinces (Cartier, 2001). Although the central government enacted the New Land Management Law in 1998, which removed municipal and county governments' rights to approve arable land expropriation and increased compensation fees, problems still existed. The term "selling land to gain financial reward" contained in the law act as an encouragement for local governments to emphasize short-term economic benefits and ignore the long-term benefits. As for the compensation fee paid by the local government to arable landowners, it remains far below the market value of land (Xie, 2002).

Since the municipal and county governments have the power to make their own financial decisions on local land, they choose not to charge land taxes on local enterprises at the starting period to provide them a good financial environment. After these local enterprises later gain success, the local governments can retain more business tax, VAT and company income tax. Local governments also refuse to share land-leasing fees with the central government. They argue that land can be leased because of the local investment giving the land market value (Zhang, 2002). The local governments also may divide the land revenue into different categories, having only a small part as land conveyance premium to share with the central government. To attract more investment, especially foreign investment, the local governments at all levels provide investors with cheap land by setting up special development zones or industrial parks. All these special development zones are located in rural areas, which exacerbated expropriation problem. It also creates an unfair competition between enterprises in or outside the zones (Zhu, 2008).

NON-FISCAL INCENTIVES FOR LOCAL GOVERNMENTS TO PROMOTE LOCAL ECONOMY

Besides the fiscal incentives created by decentralization, other incentives contribute to the development of local economies. Since there is no public election above the village level in China, officials do not fear being voted out if they cannot satisfy public demands. Chinese citizens are subject to the hukou system, which means individuals cannot move to other cities without special reasons such as receiving high-level education, making any migration difficult. Thus, the central government's oversight of local government itself can function as an incentive by influencing the decisions of

local officials (Xu, 2010). However, the central government cannot monitor every single locality in practice because of limitations of time and money. Only the worst or the best will be noticed, making the local officials careless of the central oversight.

To create stronger incentives, the central government set up the economic indicator system, which is linked to the evaluation and promotion of local government officials. The system is intended to increase the efficiency and effectiveness of officials in administering local and central policies. Under this system, the central government uses GDP as an economic indicator to evaluate local officials' performance. If they can complete or even exceed the quota in the given time, they get a chance to be promoted. This policy has created a much stronger incentive for local officials to grow their local economies by reaching the quota. Some scholars even argue that it is the most important incentive, even surpassing the incentives created through decentralization measures (Zhou, 2010). However, it still has its own problems (Yang, 2010). First, local officials use GDP as the only indicator to measure economic growth and do not necessarily prioritize residents' preference. For example, local residents are concerned more about social participation, standards of living in the city, income per capita and even hospital beds per capita. These, however, are not included in the current economic indicator system. Only a few officials will respond to these social indicators (Yang, 2010). Second, local officials only focus on indicators that can be examined, and pay no attention to those not in the scope of examination or those that are difficult to measure. The GDP competition even leads some officials to engage in "vanity projects", which wastes resources, and even may encourage officials to misrepresent economic growth figures.

This situation is particularly common in the backward areas of China where there is a lack of economic resources and opportunities (Yang, 2010). Third, some officials even violate the law to achieve their quota. For example, they sell or lease the land at a half price in order to attract investment (Zhou, 2010). All these disadvantages make the economic indicator system a double-edge sword for promoting local economies.

The above section summarizes the political structure, fiscal systems, local financial methods and local land selling/leasing rules. Two kinds of incentives are found through the research, including fiscal incentives created by the decentralization and non-fiscal incentives created by the economic indicator system. Unless we understand changing dynamics in finance and incentives of local governments in China, we can't fully understand the current situation of overinvestment and indebtedness in the China's solar PV industry, which will be explained in the next section.

Chapter 3: PV in China

DEVELOPMENT OF PV INDUSTRY IN CHINA

Although the story of PV in China goes as far back as 1958 (Liu et al., 2010), when the first crystalline silicon PV cell was developed, the real growth of China's PV industry only began around 2000, after Suntech Power company built a PV cell manufacturing line capable of producing solar modules with power generation capacity up to 10 MW per year. Prior to that event, the total manufacturing capacity in China was only 2.7 MW annually. In 2004, the German government changed their energy strategy to focus more on solar energy. This move provided Chinese PV companies with a great chance to increase manufacturing capacity and production (Liu et al., 2010). In 2007, China surpassed Japan to become the global leader of solar cell production (1GW). This number reached 21 GW in 2011, which represented 60 percent of global PV production capacity (Figure 3; Xu, et al, 2011). The export value reached $22.67 billion (EPIA, 2012). PV production has increased at an average growth rate of 49.5 percent since 2002. At the same time, several world-class companies such as Suntech, Yingli and Trina Solar were established and were listed among five largest PV manufacturers among the world in 2010 (Ren, 2011). There are 16 solar PV companies whose stock is publicly traded overseas, and another 16 companies listed on China's stock exchange. The total value of the industry in China reached about $50 billion at the end of 2010 (Ren, 2011).

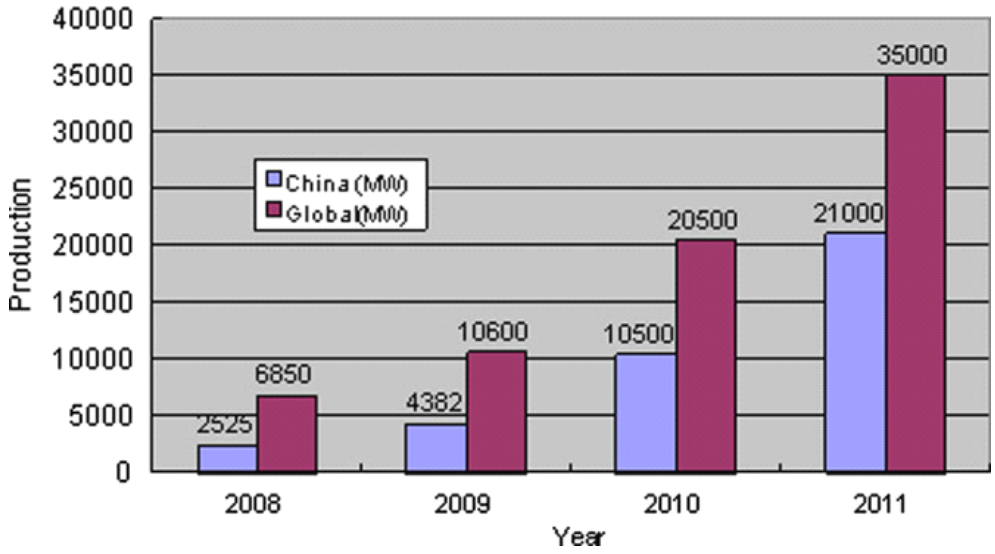

Figure 3: Production of PV cell during 2008-2011: China and global (MW)

Source： Xu et al, 2011.

DEVELOPMENT OF PV TECHNOLOGY

There are five stages in the PV industry chain, including (1) purification the silicon to get polycrystalline silicon; (2) shaping the polycrystalline silicon into ingot and cut it into slices to get wafers; (3) cutting the wafer into the desired shape and making solar cells; (4) connecting the solar cells together to form solar modules; and (5) assembling the solar modules in arrays and connecting them with an electricity system to form an integrated PV system (Zhang & He, 2013). The first two stages are capital and energy-intensive, they form the upstream of the whole industry (Zhang & He, 2013). China entered the upstream market in 2006 and recently gained technological breakthroughs in upstream. The production of polycrystalline silicon in 2010 reached 45,000 tons, which could supply 50 percent the total domestic demand compare to 10 percent in 2007. However, it still remains the weakest part of the whole industry not only

because of the insufficient production but also relatively low quality compare to those produced from U.S., Japan and EU. The third and fourth stages form the downstream sector of industry. Currently it is dominated by Chinese companies since it is both energy and labor intensive. Chinese companies entered the last stage and the installation market after 2010 with strong support from the government (Liu & Goldstein, 2013).

Another way to measure the development of technology is through patents (Keller, 2004). The global patents for PV technology grew very quickly in the last decade, but it was not until 2007 that Chinese companies began catching up with the developed countries. The total number of Chinese patents including upstream and downstream increased from 1868 in 2007 to 7534 in 2010. The ratio of China's patents to total patents around the world also increased from 2.9 percent in 2007 to 17.6 percent in 2010 (Figure 4A & 4B). Silicon purification, ingot and wafer, the weakest part in China's PV industry, also experienced a huge increase in patents. For example, the global share of Chinese patents for silicon purification increased from four to 36 percent after 2007. Patent quality also improved with a rapid growth of invention patents while utilities and design patents remain stable (Yu & Luo, 2012).

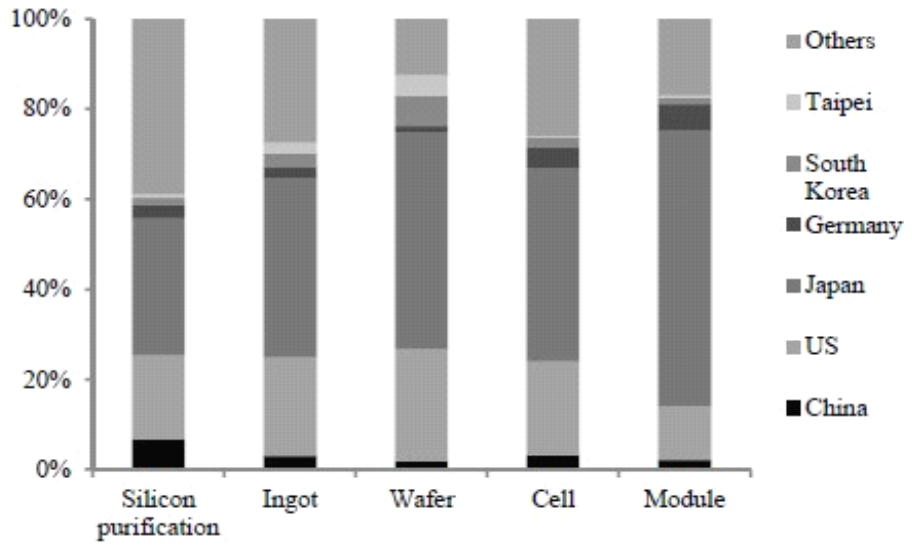

Figure 4A: Patent of Crystalline Technology before 2007

Source: Yu & Luo, 2012.

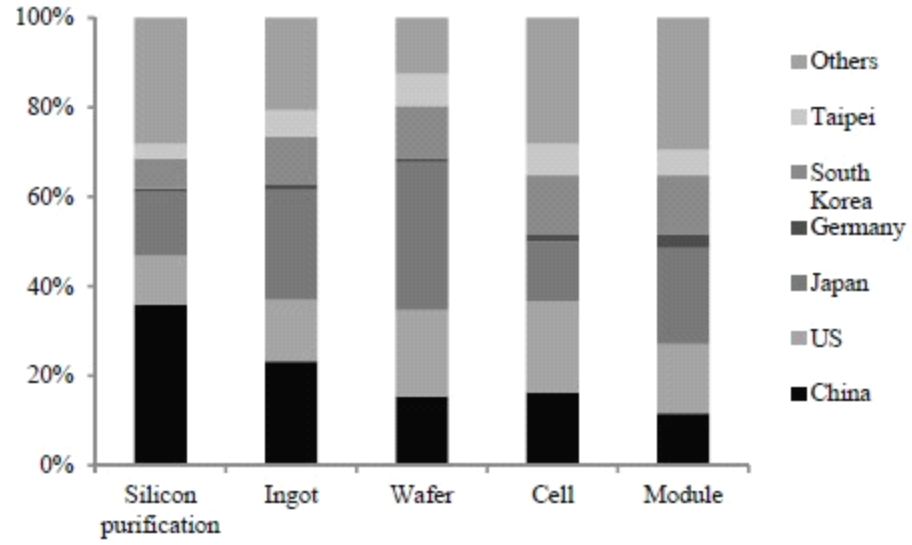

Figure 4B: Patent of Crystalline Technology after 2007

Source: Yu & Luo, 2012.

PV MARKET IN CHINA

China is rich in solar energy resources. According to the China Meteorological Administration, the annual solar radiation varies a lot in different regions, roughly between 3350 megajoule of energy [MJ/m^2] to 8400 MJ/m^2, with an average at 5860 MJ/m^2 (Figure 5; Luo, 2005). Basically, the west and northwest parts of China have more abundant sunlight than the eastern area (Figure 5). For example, Qinghai-Tibet Plateau and Midwest of Inner Mongolia have the richest solar resources compared to anywhere else in China. That region could reach 9250 MJ/m^2 annually. However, these regions are relatively economically poor and have less electricity demand compared to China's eastern coastal areas, which also creates a challenge for transporting excess solar generated electricity to the east.

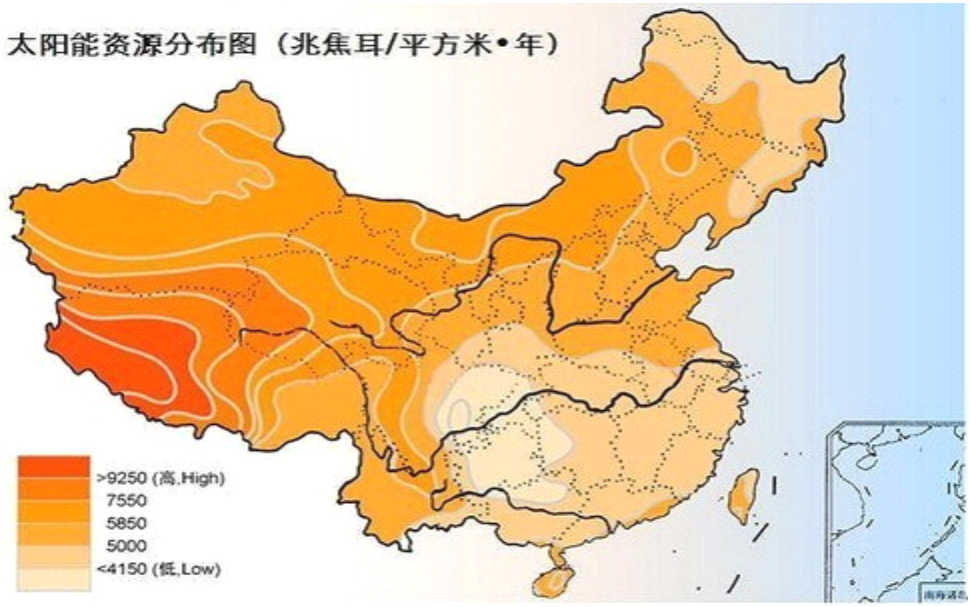

Figure 5: Annual solar radiation distribution in China (MJ/m^2)

Source: China Meteorological Administration, 2010.

Despite its abundant sources of solar radiation and its huge share of the global PV market domestic PV installation in China is very small. In 2010, total PV cells production reached 10.5 GW with only 500 MW installed inside the country. It is the high cost of PV and lack of enough policy support, which has restricted the growth of PV penetration in China (Zhang & He, 2013). There are five basic kinds of PV power applications in China: off-grid solar PV in rural areas; off-grid solar PV for other industries such as transportation and telecommunications; off-grid solar PV for lights, chargers and other commercial products; on-grid solar PV for buildings; on-grid large scale solar PV (IEA, 2011). Before 2009, the Chinese solar PV market was concentrated on the off-grid rural electrification projects, which only led to a very small number of PV installations. With the dramatic price decline of PV cells starting in 2009, the domestic PV market experienced fast growth during these years. In addition, the National Development and Reform Commission introduced a national feed-in tariff (FIT) for solar PV generated electricity at 1.15RMB/kWh ($0.18 /kWh) in 2011. That policy created a strong incentive for the expansion of the domestic PV market. The PV installations reached a record high of 2.5 GW that year, increasing by about 400 percent compared to 2010, and brought China's cumulative capacity to 3.3 GW, which represented 4.95 percent of global cumulative installed capacity (Wang, 2012). These numbers are likely to keep rising with the implementation of the 12th Five Year Plan, which will be explained below.

NATIONAL POLICY SUPPORT

The rapid growth of the PV industry and market in China are linked closely to the government's incentive policies, including the Brightness program in 1996, the Township

Electrification Program in 2002, the Renewable Energy Law in 2006, the Rooftop Subsidy Program, the PV Concession Program and Golden Sun Demonstration Program in 2009, the national Feed-in Tariff (FIT) scheme in 2011 and the latest 12th Five Year Plan for Renewable Energy Development in 2012.

Renewable Energy Law

The China's National People's Congress promulgated the Renewable Energy Law in 2005 (Zhang & He, 2013), which became effective on January 1, 2006 and was later amended in 2009. There are several key points contained in this law. First, the central government sets national targets for renewable energy, including solar energy. Second, grid companies are required to purchase all the electricity generated by renewable energy generators and provide grid connection services to end users. Third, a feed-in tariff system was created to stabilize the on-grid electricity price for power generated by renewable energies. In addition, renewable energy generators receive a fixed subsidy for each unit (kW/h) of electricity they generate. Fourth, a Renewable Energy Development Special Fund was created to provide financial support for R&D in renewable energies. The 2009 revision emphasized coordinated planning of renewable energy, and asserted that all the energy planning should be decided at the central level first. Local energy plans should be detailed and include specific information on targets and allocations as well as a timeline.

Rooftop Subsidy Program and Golden Sun Demonstration program

Two national solar subsidy programs were initiated in 2009 to boost the domestic solar market and wean off its dependence on overseas market. The rooftop subsidy program—backed by the Ministry of Finance (MOF) and the Ministry of Housing and Urban Rural Development of China (MOHURD)—provided support for on-grid, Building-Integrated Photovoltaics (BIPV) and Building-Applied Photovoltaics (BAPV), and for off-grid PV deployed in rural areas. To receive the subsidy, the PV projects must meet several requirements including mandates that the scale of the installations should exceed 50kw, and that the generation efficiency of monosilicon PV products, polysilicon PV products, and amorphous silicon PV products should exceed 16 percent, 14 percent, and six percent respectively (Xu, 2011). The Golden Sun demonstration program was announced by the MOF, the Ministry of Science and Technology (MOST) and the National Energy Administration (NEA), to provide support for both on-grid and off-grid systems that were no less than 300kW. Through this program, the on-grid system is eligible for a subsidy amounting to 50 percent of its total cost, and an off-grid system may qualify for a subsidy of 70 percent of total costs.

The Solar PV Concession Program

The National Energy Administration (NEA) started the Solar PV Concession Program by organizing an open bidding for a 10 MW project in Dunhuang, Gansu province in 2009, which was bid by China Guangdong Nuclear Power. The agency approved a Feed-in Tariff at RMB 1.09 /kWh ($0.17 /kWh) for the project. The NEA

announced a second-round tender for solar PV projects with a total capacity of 280 MW in June 2010 including 13 projects, including a 60 MW project in Inner Mongolia, a 60 MW project in Xinjiang, a 60 MW project in Gansu, a 50 MW project in Qinghai, a 30 MW project in Ningxia and a 20 MW project in Shanxi (China Economic Herald, 2010). Stated-owned companies typically bid to build most of these projects because they offer lower prices and reliable technology solutions. These companies are required to finish construction within two years of winning the bid. They also have the right to operate the plant over 25 years by selling the generated electricity at on-grid prices (Zhao et al., 2012). In October 2010, the NEA announced that the on-grid price for electricity from these projects would range from RMB 0.729/kWh to RMB 0.991/kWh based on the different regions in which they are located. The program created an incentive for domestic PV installation, but also highlighted problems that need to be addressed. For example, the only firms with the financial ability to pay for a solar PV plant are state-owned enterprises. They typically generate profits after 20 years of operation. Since these SOEs need to build a certain proportion of installed capacity for renewable energy to complete the task, they tend to focus on PV capacity instead of the total electricity generated.

National Feed-in Tariff System

To provide a stronger incentive for power companies to enter the PV market and bring in more private equipment companies, the NDRC announced a national unified Feed-in Tariff (FIT) scheme in July, 2011. It has been widely welcomed by PV project developers and is expected to increase domestic PV installation. The FIT scheme

implements a unified national FIT for non-tender PV projects based on the solar PV power plant tender price as well as solar resources condition, average social capital, and operating costs (Zhao et al., 2012). Solar PV projects approved for construction prior to July 1, 2011 and put into operation before December 31, 2011, were entitled to a FIT of RMB 1.15 /kWh. For solar PV projects approved prior to July 1, 2011 but had not finished constructing before December 31, 2011 or approved after July 1, 2011, could receive a FIT of RMB 1/kWh except in Tibet (RMB 1.15/kWh for every project there). The NDRC plans to make adjustments based on changes in the cost of investment, technological progress and other factors in the future. Solar PV projects that bid through this concession program may not enjoy an electricity price higher than those projects invested by Foreign Direct Investment (FDI). Solar PV projects receiving a subsidy from central government—through the Rooftop Subsidy Program and Golden Sun Demonstration program—have the same tariff as desulfurized-coal fired power projects, which varies by region (NDRC, 2011).

The FIT scheme shows the central government's effort to boost domestic solar PV industry and increase the share of solar energy in China's energy portfolio. However, it still has several deficiencies that need to be improved (Zhang & He, 2013). First, it conflicts with the previous solar PV concession program since those projects cannot enjoy a higher electricity price than FDI-invested projects. This provision reduces investors' incentive to participate in the concession program, and ultimately may put an end to this program. Second, the FIT does not take the great variation in PV cost and solar resources into account. Solar companies are concentrated along China's east coast,

where there is low solar radiation and a relative higher cost to transport solar electricity from the rich solar radiation area in the northwest. Third, it does not mention a definite time, nor a specific department to implement the FIT. This FIT scheme cannot be effective unless these problems can be fixed in the future.

12th Five Year Plan for Renewable Energy Development

The NEA issued the 12th Five Year Plan for Renewable Energy Development (12th Plan) on September 12, 2012. The plan set several energy targets for the next five years. By the end of 2015, the total PV installed capacity should reach 21 GW and the annual output should reach 25 billion kWh. The central and eastern region should focus on constructing distributed PV power generation systems connected with buildings, and the installed capacity should reach 10 GW. This implies that distributed PV generation would be a very important part in the future PV market. Furthermore, an administrative mechanism would be established whereby distributed PV power generation for private use easily can be connected with power grid. For those regions with abundant solar resources and unused land resources, such as Qinghai, Xinjiang, Gansu and Inner Mongolia, large, on-grid photovoltaic power stations would be the first choice, and could bring total installed capacity to 10 GW by 2015. In addition, solar-thermal power generation would also be built with a total installed capacity of 1 GW. Moreover, the 12th Plan also mentioned the improvement of PV cell conversion efficiency and industrial reorganization.

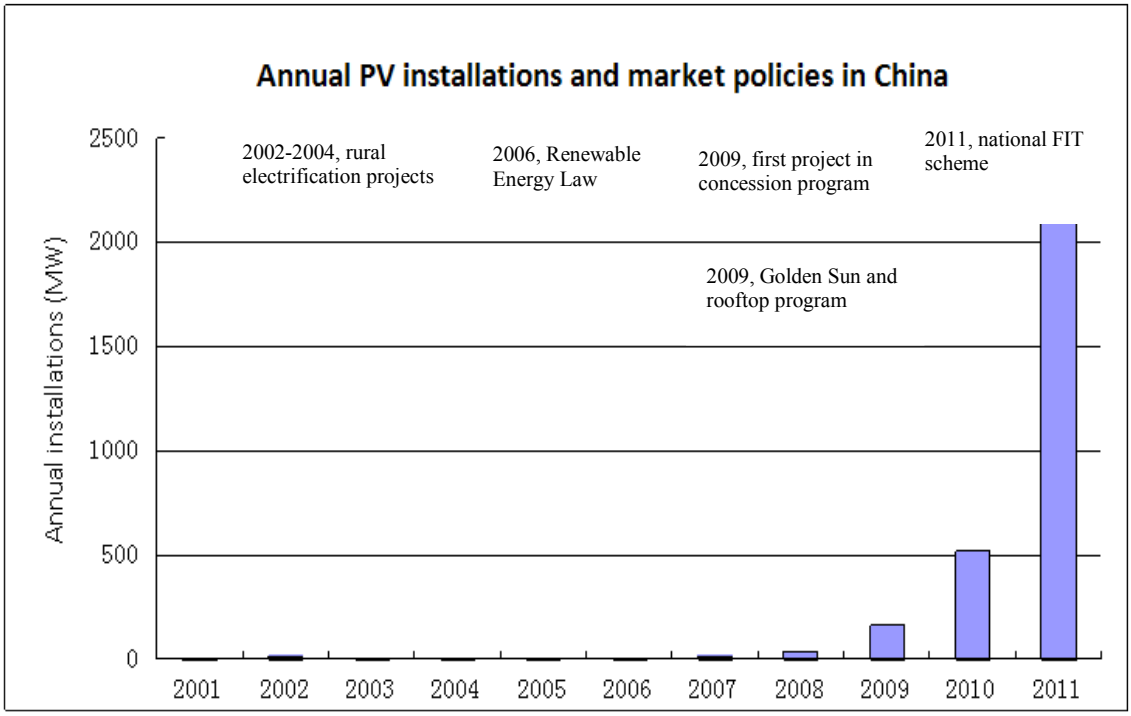

Figure 6: Annual PV installations and market policies in China

Source: EPIA, 2012.

Solar PV R&D, investment policies

In addition to the market creation policies mentioned above, China also implemented nationwide solar PV R&D, and investment policies. The Ministry of Science and Technology (MOST) initiated two programs to support R&D within research institutions, universities and companies. First, the state council approved the national high-tech R&D program (863 program) in March 1986 to support technical innovation in selected high-tech fields. The total funding it provided to support solar PV field R&D reached RMB 160 million from 2006 to 2010 (863, 2012). Second, the state council approved the national basic R&D program (973 program) in June 1997 to support basic technology research with a wider range than the previous 863 program. It provided about

RMB 30 million to support PV thin-film research from 2006 to 2010 (973, 2012). Chinese solar firms responded to the move by increasing production capability, especially in the upstream of the PV value chain. For example, Chinese solar PV companies imported most polysilicon before the state-owned Emei Semiconductor Research Institution conducted R&D of polysilicon. After they acquired the technology, they transferred it to Chinese polysilicon manufacturers. The production capacity increased dramatically from 1801 MW in 2008 to 6824 MW in 2009 due to this development. (Huo & Zhang, 2011). However, the state can only do so much long-term research, which requires significant input of research resources with an uncertain return. The Ministry of Finance (MOF), the General Administration of Customs (GAC) and the State Administration of Taxation (SAT) exempted R&D institutions that purchase equipment from import and VAT taxes. This move can encourage R&D investments especially in the private sector and has a much wider range of recipients than other R&D incentives only suitable for a small group of research institutions.

LOCAL POLICY SUPPORT

In response to the national policies, a number of provincial governments provided their own policy support to boost solar PV development. For example, Jiangxi province recently announced it would provide subsidies of RMB 18.54 million to solar PV building demonstration projects in order to encourage use of PV generation in both public and private buildings (China Economic Herald, 2010). Jiangsu province issued a PV installation plan and a fixed FIT policy in 2009, the annual new installations of on-grid PV would be 80 MW in 2009, 150 MW in 2010, and 170 MW in 2011. Thus, the total

installation capacity in Jiangsu province would reach 400 MW in 2011 (Zhao et al., 2012). The FIT for these new installations would also change with the decrease in cost.

PROBLEMS FACED BY CHINA'S PV INDUSTRY

The rapid growth of China's solar industry also has concealed several problems. Thanks to a reduction of solar subsidies by EU nations and the implementation of anti-dumping duties and countervailing duties in the U.S., China's PV industry experienced a slowdown. In 2012, the total imports and exports of Chinese PV production was $28.95 billion, a 32 percent reduction compared to 2011. Total exports from China were $23.3 billion, 35 percent lower than 2011; total imports into China were $5.6 billion, a year-on-year decline of 16.1 percent (Man, 2013). The whole PV industry is facing the risk of losing capital investments and even rupturing, given the high level of inventories, the sharp drop in operating cash flows and declining enthusiasm for PV investments from banks and financial firms. Below, I discuss the five major causes of the problems being faced by Chinese solar firms.

1. *Reduction in market demand due to the change of solar PV subsidy in EU.* The rapid growth of Chinese PV industry in the last decade mainly depended on the continuous increasing demand in the EU and North America's markets. In 2011, the exports to EU market reached $20.4 billion, accounting for 57 percent of the total exports, making it the largest export market for Chinese PV production (Yang, 2013). Influenced by the financial crisis, those countries with huge PV installation in the EU such as Germany and Italy started to cut the subsidy for PV generated electricity. The German government announced the reduction in the subsidy by 29 percent on April 1, 2012. The

Italian government announced a 35 percent reduction in the subsidy in the second half of 2012, and the annual subsidy expenditure was limited to 500 million euros (Yang, 2013). Other countries such as United Kingdom, Greece, Spain and Switzerland also scaled back solar subsidies. These large scale cuts in subsidies led to the decrease of PV installation and market demand in Europe, which resulted in the reduction of imports from Chinese companies.

2. *High-profile international trade cases affected the production of Chinese PV companies.* The U.S. Department of Commerce imposed sanctions against Chinese PV companies in October 2012, levying an anti-dumping tax ranging from 18.32 to 249.96 percent, and a countervailing duty ranging from 14.78 to 15.97 percent on all Chinese PV cells and modules (Solar International, 2012). For example, Suntech Power would be charged a 31.73 percent anti-dumping tax and a 14.78 percent countervailing duty, which has made its product less competitive in the U.S. market. The EU also started to investigate the dumping of Chinese PV companies on September 6, 2012. It plans to issue a final decision in June 2013. The products under investigation range from PV modules, cells, and wafers, which covers more products than the U.S. anti-dumping taxes and countervailing duties. If the EU decides to levy an anti-dumping tax and countervailing duty, it would further worsen the situation since Europe is the largest export market for Chinese solar companies.

3. *The PV industry in China has significant overcapacity, leading to an underuse of the production capacity.* Attracted by potentially high profits, many small and medium enterprises entered the Chinese PV industry from 2005-2007. Thirty-one provinces,

municipalities and autonomous regions across the country cited the PV industry as a priority industry to support. About 300 cities have developed PV capabilities: 100 of them have constructed PV industry bases (Zhao et al., 2010). This unlimited expansion led to the overcapacity in the PV industry and oversupply in the PV market. In 2011, the total capacity around the world was 63 GW with the total installation for only 27.7 GW (Xu, et al, 2011). The price competition caused by overcapacity further led to a substantial price decline in PV products. The price of polysilicon, wafer, cell and module decreased by 63.5 percent, 68.9 percent, 59.2 percent and 37.5 percent, respectively in 2011 (Xu, et al, 2011). PV companies in China generally faced the situation of not having enough orders due to this serious overcapacity and price decline problem; as a result some of them chose to reduce or even stop production.

4. *Compared to other renewable energies, solar PV also has no advantage in price.* Table 4 provides several on-grid prices for different power generations; only solar PV exceeded RMB 1/kWh. These price differences have greatly weakened the competitiveness of solar PV power generation and restricted the development of large-scale PV power generation because solar still has a relatively high electricity price compared to electricity generated by fossil fuels and other renewable energies. Although the price of electricity generated by PV generation is decreasing dramatically these days, it remains high compared to other energy sources (Figure 7). The FIT scheme also set a national PV electricity price at RMB1.15 /kWh, while the average conventional electricity price in that year was around RMB 0.55 /kWh. According to some forecasts,

although PV electricity price will be lower than conventional electricity in the near future, it still needs strong policy support (Zhao, 2012).

Type of energy	On-grid price (RMB/kWh)	Equivalent to $/kWh
Hydropower	0.265	0.042
Coal-fired	0.35	0.056
Nuclear	0.44	0.069
LNG	0.53	0.084
Wind	0.56	0.089
Biomass	0.75	0.119
Solar PV	1.15	0.183

Table 4: The on-grid prices of various power generation types in China

Source: Zhao, 2012.

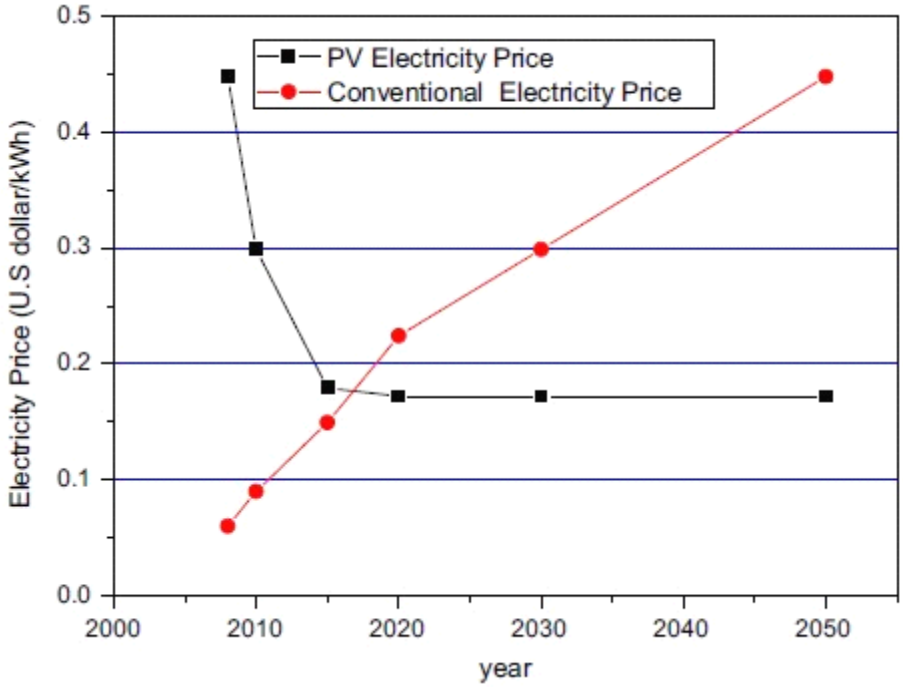

Figure 7: Forecasted electricity prices in China.

Source: Hoffmann, 2006.

5. *Financial strain in most PV companies in China.* By the end of 2012, many commercial banks started to tighten or even stop providing credit to solar PV enterprises due to the declining market conditions and financial health of the these firms. They also accelerated the loan recovery rate and limited other companies from providing credit guarantees to PV companies (Green World Investor, 2012). For example, Suntech Power has a total debt of nearly $2.3 billion and $541 million of convertible notes due in March 2013; more than triple its market value of $164 million (Green World Investor, 2012). Its liability ratio exceeded 80 percent in 2012. Similarly, Yingli Green Energy has a total of $2.5 billion in debt, and its net income last year was $-891.16 million.

Chapter 4: Integrative analysis

Several case studies showcase the contributions that local governments have made to the solar PV industry development. They also highlight the strategies and drivers behind the activities that these local governments are taking to help solar companies through the difficulties that currently plague the industry. These case studies also provide the backdrop for discussing incentives that drive the local governments to support PV industry. Why would local governments choose to support solar PV industry even though it is on the edge of collapse? What capabilities do the local governments have to support the industry and attract investment? These questions would be explored in this section.

LOCAL CONTRIBUTIONS TO PV INDUSTRY

As mentioned before, the first national policy to support solar PV industry is the Renewable Energy Law enacted in 2006, several years later than start of this industry in China. It was the private investors and local governments who saw the broad prospect of solar PV industry and decided to invest and support it at the beginning of the 2000 (Dai & Kishimoto 2011). Suntech Power and LDK Solar Co. Ltd are two good examples that illustrate the contributions local governments made to help private investors in solar PV industry.

Suntech Power

Suntech Power once was the largest solar PV module manufacturing company around the world. It was established by a Chinese engineer named Shi Zhengrong in 2001after he earned a Ph.D on photovoltaic engineering at the University of New South

Wales (Ahrens, 2013). He returned to China with a plan of manufacturing PV cells and his own $0.4 million in 2000 to seek for local government's investment. After being rebuffed by the Shanghai government, the Dalian government, and the Hangzhou government, his plan was finally accepted by the Wuxi government, who agreed to let local state-owned enterprises and government funds invest $6 million in the venture, while Dr. Shi would contribute his own technology and money in exchange for 25 percent stake in the venture (Dai & Kishimoto 2011). It also helped the company to win projects and apply for financing. From 2001 to 2005, Wuxi government helped Suntech to get 11 projects, including the National Innovation Fund Project, the National Scientific and Technological Project and the Provincial Major Achievement Transformation Project (Liu & Bao, 2009). It received cumulative financial aid of $5.5 million from 2003 to 2004 (Liu & Bao, 2009). In order to list its stock on the New York Stock Exchange (NYSE), the local government agreed to sell their stocks back to Dr. Shi since stated-shared companies cannot be listed outside the country. In December 2005, Suntech became the first Chinese PV firm to list its stock successfully on the New York Stock Exchange (NYSE) (Ahrens, 2013). Recently, in the face of Suntech's deep financial troubles, the Wuxi government and Jiangsu provincial government have shown a willingness to help the company. In September 2012, the mayor of Wuxi declared the government's support for Suntech and brought a $31.7 million new loan from Bank of China (Wang, 2012).

LDK Solar

Many other local governments started to imitate the "Wuxi model" after Suntech's success in listing on NYSE. Xinyu, a small city in Jiangxi province, is one of the most ambitious imitators who helped to establish LDK Solar Co. Ltd, the largest solar cell packaging manufacturer around the world. Peng Xiaofeng launched the firm in 2005 with an investment of $31.7 million from the Xinyu government (Guangfu BJX, 2012). However, the entire bank loan limit was less than $31.7 million at that time. In order to get the money, the mayor of Xinyu himself pursued Jiangxi Provincial International Trust and Investment Corporation to issue a trust product of $19.0 million to LDK guaranteed by the Xinyu government. The Jiangxi provincial government also granted 15000 acres land to LDK solar and gave the right to the Xinyu government to implement it as soon as possible to pave road for the construction of LDK factory buildings (Guangfu BJX, 2012). Since Jiangxi is not a developed province and lacked a qualified labor force, the Xinyu government also helped LDK Solar to recruit talents from around the country to meet its goal of rapid expansion. Additionally, LDK Solar also enjoyed the benefit of subsidies in electricity usage. With this help from local government, LDK Solar successfully listed its stock on the NYSE in 2007,with the largest Initial Public Offerings (IPO) of $468 million among renewable energy industry. It became the largest solar cell packaging manufacturer then (Liu, 2013). However, the current situation of LDK Solar is quite dire. It has $4.8 billion in debt and it sits on the edge of bankruptcy (Liu, 2013). To help the company deals with these troubles, the Jiangxi provincial government allocated $321.4 million to support LDK Solar in May 2012. The Xinyu government also allocated $153.5

million from the city's own financial budget to pay the debt for LDK Solar in June, 2012 (Guangfu BJX, 2012).

LOCAL GOVERNMENT'S INCENTIVES TO SUPPORT SOLAR PV INDUSTRY

Besides the two famous examples mentioned above, there are hundreds of solar PV companies in about half of the total prefecture-level and county-level cities in China. For example, Yingli Solar is located in Baoding city, Hebei province; JA solar in Ningjin, Hebei province; Rene Solar in Jiashan, Zhejiang province; Trina Solar in Changzhou, Jiangsu province and Canadian Solar in Suzhou, Jiangsu province. And some of the industrialized cities even have several world-class solar PV enterprises. Wuxi is a good example as it has Suntech; Konca Solar, the second largest wafer manufacturer in China; Zhenfa Solar with the second largest solar-power station construction scale around the world; and Samil Power, a well-known provider of grid-tied solar inverters and mounting systems. The increasing number of solar PV companies formed a much larger industry cluster in the east coastal area compared to 1998 (Figure 8; Yu & Luo, 2012). So, what are the incentives that drive many localities to develop solar PV industry leading to a mass over-capacity problem? My analysis suggests that there are three main incentives:

Figure 8: Chinese Photovoltaic Industry Expanding Trend, 1998 and 2008.

Source: Yu & Luo, 2012.

1. The first and most important incentive for local governments to support solar PV industry is increasing local revenue. As discussed in the Chapter 2, the tax-sharing system has been implemented since 1994. The local proportions of shared taxes such as VAT, and specific kinds of local taxes have been fixed within this system, which provides a strong incentive for local governments to gain more revenue by developing local industry. The Solar PV industry has its own characteristics being attracted by local governments. Those large solar PV enterprises with both upstream and downstream chains can create high output, which makes a huge contribution to local revenue through local taxes. The small solar PV companies commonly focus on downstream chains, although they have lower profits, the barrier to entry is low; therefore, they can enter the market with a relatively small investment and short production cycle. LDK Solar is a good example showing how important it is to increase local revenue. From January to May 2011, the tax paid by LDK Solar to central government was about $64.1 million

which accounted for 93.6 percent of the total central tax paid in the Xinyu high-tech zone, and about $31.7 million to local government which accounted for 96 percent of total local tax (Liu, 2012). It made LDK Solar the largest taxpayer in Xinyu city and one of the largest in Jiangxi province. Even as LDK Solar is on the brink of bankrupting, the local government continues to support the firm directly and indirectly because of the close ties with the local economy. In fact, LDK Solar filed for bankruptcy protection in 2012, but its application was rejected by the Jiangxi provincial government. Jiangxi cannot afford such a huge loss if this large enterprise went under (Liu, 2012).

2 Another concern for local governments to support solar PV industry is local employment. Most large solar PV companies have huge numbers of employees, which contribute significantly to local employment. For example, Suntech Power has about 120, 00 employees in Wuxi, which accounts for 0.3 percent of the city's total population (Ahrens, 2013); Yingli has about 15,000 employees in Baoding, comprising 1.3 percent of the total population (Yingli Solar, 2013); LDK Solar has about 16000 employees in Xinyu, which accounts for 1.9 percent of the total population (Guangfu BJX, 2012). If we take the employees of their affiliated enterprises and suppliers into account, the number will be even larger. According to an announcement by some employees in Suntech this January, the company has more than 400 affiliated enterprises and suppliers with more than 200,000 employees (Guangfu BJX, 2013). If one employee is fired, average six family members would be impacted that means 1.2 million people will be impacted if Suntech closes down. The potential negative impacts are quite significant and this causes great concern for local governments. Some scholars even believe that it is the most

important reason local governments choose to help these companies instead of abandoning them (Guangfu BJX, 2013).

3 The third important incentive for local government to develop the solar PV industry is based on the incentives to the local officials themselves. As mentioned in Chapter 2, the central government set up an employment promotion structure that is tied to an economic indicator system in order to increase the efficiency and job performance of local government officials. The central government chiefly relies on GDP to evaluate local officials' performance in managing the local economies. If they can complete or even exceed the economic growth quota in given period, they may be promoted. Developing the solar PV industry helped lots of local officials advance in their careers since the industry has contributed to local GDP. Xinyu's GDP reached $9.6 billion in 2010, double the amount in 2005 when LDK solar was first put into production. During these years, Xinyu's GDP grew annually at 15.5 percent. The revenue of the Xinyu government increased from $4.8 billion in 2008 to $7.9 billion in 2009 and reached $12.7 billion in 2010 (Xiong, 2013). This achievement helped Mayor Wang getting promoted to the director of decision-making consultation committee in Jiangxi provincial government (Xiong, 2013). The story between Suntech and Wuxi government is different. Since Wuxi is a much more developed city compared to Xinyu with multiple industries, the local government is not solely dependent on the solar PV industry. Still, the industry does make a sizable contribution to local GDP, and has even become embedded into the social fabric of this city. "Shangde", the Chinese name of Suntech, which means "advocating morality" has been written into the city's spirit (Xinhuanet, 2008). Based on these

achievements, Yang the former municipal party committee secretary has also been promoted to a number of Jiangsu provincial party standing committee and the municipal party committee secretary of Nanjing city (People.com.cn, 2012).

LOCAL GOVERNMENT'S CAPABILITIES TO SUPPORT SOLAR PV INDUSTRY

Although different local governments share similar incentives to develop and support the solar PV industry, their activities vary widely based in part on the capabilities and resources that they have at their disposal. Local governments have their own economies, educational levels, geographical positions and other attributes, which themselves can become incentives to support the development of the PV industry.

1. One important capability a local government may have to develop the solar PV industry or other emerging industries, is its business vision. Business vision is a capability of local officials themselves; a farsighted leading team with sensitive business sense could result in early development with fewer competitors in the market. Otherwise, they can only be followers with more barriers to market entry. For example, Jiangsu province has the capabilities to make it a leader in the domestic solar PV industry. Four domestic enterprises, Trina Solar (Changzhou), Suntech Power (Wuxi), Hanwha Solarone (Qidong) and Canadian Solar (Suzhou) have been listed in the China's top ten solar PV companies. Trina Solar and Hanwha were founded in 1997 and began mass production in 2004, Suntech Power and Canadian Solar were founded in 2001. Among these four companies, the story of Suntech Power best embodies the business vision of local government. As mentioned above, Wuxi government chose to accept Dr. Shi's plan and seek investment for him instead of rejecting just as Shanghai, Dalian and other localities

did. Although some critics have questioned the help they provided to Suntech, their farsighted business vision is undeniable. If they could not see a bright future for the solar PV industry, Suntech may not have enjoyed such a rapid development and great influence to other followers. Compared to Suntech, the rise of LDK Solar exemplifies a 'follower.' After several years working in Jiangsu province, Peng the founder of LDK Solar envisioned a bright future for the PV industry. Then he returned to his hometown and founded LDK Solar in 2005. However, Dr. Shi already was the richest man in China at that time. With the help from local government, the development of LDK Solar was even faster than Suntech. However, the business vision of the Jiangxi province does not seem to be comprehensive enough since they only have this one world-class PV company. Most of the other PV companies in this region are raw material suppliers and affiliated enterprises, which means that if LDK goes bankrupt, the whole industry in Jiangxi province will likely suffer.

2. The second factor that enabled some of the provinces to develop solar PV industry more than others is that ability to attract and build talented. Solar PV is a high-tech industry, which needs a large number of well-trained professionals. In order to catch up with the rapid growth of this industry, different localities used different methods to attract more talents. The Jiangxi Provincial Development and Reform Commission initiated a plan to train 20 Ph.D. and 200 masters, 20,000 undergraduate students, 40,000 vocational students, and 60,000 secondary vocational students in three years beginning in 2009. In Jiangsu province, the annual training funding for solar PV talents is about $3 million. Zhejiang City announced a plan to introduce 31,000 talents for renewable energy

firms in 2012. After Suntech's start, the Wuxi government even established a plan so-called "530" plan in 2006 to introduce 30 leading foreign talents from different areas within 5 years. With these incentive plans, more and more intellectuals and skilled workers chose to work in these areas and contributed to the rapid growth of the solar PV industry (Shen, 2013).

3. Another important factors that affected the growth of PV industry among provinces is transportation infrastructure. Since most of PV production manufactured in China has so far been shipped overseas, it has been critical for solar manufacturers to locate their production facilities near ports. As shown in Figure 8, most PV companies are gathered in the east coastal area and formed an industry cluster in Jiangsu, Zhejiang, Hubei, and Jiangxi provinces. However, more companies are choosing to build branches in the central area with the decreasing overseas demand and increasing domestic demand. Sichuan province, which is located next to Tibet and Xinjiang province with the richest solar resource in China, has become another center for solar PV industry.

RECENT MEASURES TAKEN BY THE GOVERNMENT

Since the solar PV industry in China is struggling nowadays, and has been plagued by excessive capacity and obstacles in overseas expansion, the government announced a range of measures intended to boost the industry by expanding the domestic market and cutting off local governments' incentives to increase capacity. As announced by the State Council, China will accelerate structural adjustments and technological improvements in solar PV industry, as well as encourage mergers and restructuring among manufacturers to phase out outdated capacity (Han, 2012). It also will strictly

control the approval of new projects that produce polysilicon, PV cells and other related components. The State Council also promised to enhance coordination between PV power generators and on-grid service providers, and set on-grid electricity prices according to local conditions and subsidizing the usage of PV-generated power (Han, 2012). The cabinet also promised to reduce government intervention in the sector in order to let market forces operate (Han, 2012).

The first signal of the government's bailout is the promulgation of 12th Five Year Plan for Renewable Energy Development. According to the plan, the total PV installed capacity should be 21 GW by the end of 2015 and reach 50 GW in 2020, the annual output should reach 25 billion kW/h. The target for distributed photovoltaic power generation systems connected with buildings has also been set at 10 GW till 2015. However, some experts such as Bohua Wang, the Secretary-General of the China Photovoltaic Industry Alliance, predicted that just 8 GW of new PV will be added in China this year compared to the 10 GW target, and the Golden Sun Program will soon be scrapped. (Eckhart, 2013).

The State Grid Corporation then promulgated the "Opinions on Improving Distributed Photovoltaic Power Generation and Connection Services" on Oct 26, 2012. According to this announcement, PV generation projects under 6 MW can be approved by local power enterprises to connect to the grid started from November 1, 2012. The process would be completed within 45 days and no extra fees would be charged on the application. In order to connect distributed PV power generation with low voltage grid, the State Grid Corporation promised to purchase all the surplus electricity generated by

these small distributed PV power generation at the price of RMB 1/kWh (Zhen, 2012). Since the distributed PV generation could be used for local electricity users, and then transport the extra electricity to the grid, it can solve the long-distance transmission problem and is conducive to the large-scale installation of PV power generation.

The Chinese government also plans to provide credit support to twelve key PV companies (ChinaNews, 2012). On September 25, the China Securities Journal published an article saying that the NDRC had been involved in negotiations with a number of government departments regarding the extension of financial support to the country's solar photovoltaic companies. The China Development Bank disclosed recently that it will maintain the loans it is providing to 12 PV companies (Guangfu BJX, 2012). Support for other companies, however, will be limited. An informed source said that the 12 companies that will receive further government support are LDK Solar (LDK: NYSE), GCL-Poly Energy Holdings (3800: HKG), Suntech Power Holdings (STP: NYSE), Yingli Green Energy Holdings (YGE: NYSE), Trina Solar (TSL: NYSE), JA Solar Holdings (JASO: NASDAQ), Canadian Solar (CSIQ: NASDAQ), Jinko Solar Holding (JKS: NYSE), Sungrow Power Supply (300274: SHE), China Sunergy (CSUN: NASDAQ), ENN Energy Holdings (2688: HKG), Rene Sola (SOL: NYSE). That means several other companies will still be increasingly more exposed to market forces, thereby accelerating the pace of industry restructuring with more closure of companies lacking competitiveness.

Chapter 5: Conclusion

This thesis examined the local governments' incentives to overinvest in the solar PV industry in China by exploring the political structure, fiscal system, and financing mechanisms of local governments in China. Throughout the research, we gained a clearer picture of China's PV industry. The PV manufacturing industry has experienced rapid growth in China since 2005. At the same time, beneath this growth had been hidden several structural problems such as overreliance on overseas market and distorted local incentives leading to massive overcapacity. The transient boom attracted several local governments to invest in the industry without a calculated view of the global supply-demand dynamics. This was the main culprit behind the overcapacity problem. After the 2008 financial crisis and the 2012 anti-dumping investigation initiated by the U.S. government, all these problems came to the forefront, significantly impacting both production and financial situation of Chinese PV manufacturers. To help support domestic production and somewhat close the gap between massive overproduction and tiny domestic demand, the central government has promulgated several incentive policies within the last couple of years to increase domestic installation. In its efforts to help reorganize the Chinese PV industry, the central government has also restricted the approval of new solar PV manufacturing projects.

It was the 1994's fiscal reform that gave the local governments more economic autonomy to support industrial investment and economic development at the local level. In marked contrast to the previous fiscal system, under this new system local governments could retain all the local taxes and the local portion of shared taxes as their

local revenues. In addition, local extra-budgetary revenue was institutionalized after the reform. These reforms gave the local governments strong fiscal incentives to gain more revenue by supporting local industry. They invested in certain chosen industries (PV being one of them) by using different financial mechanisms such as financial allocations by the central government, land financing, platform financing, and local bonds financing to gather capital. They also set up special development zones or industrial parks to provide cheap land for these chosen industries. The solar PV industry is particularly attractive to the local governments because this industry is high-tech, seemed to generate high profit margins, and led to high local employment.

In addition to the fiscal incentives at the local level, the system of evaluation and promotion of local officials has also created acute distortions that have contributed to the problems in China's PV industry. The central government created the economic indicator system as a human-resource tool designed to enhance local officials' efficiency and job performance. This system created further incentives for the local officials to support local industries that could contribute to local GDP growth. The higher the GDP gained during their term in office, the greater the opportunities that local officials have to get promoted. As demonstrated in this thesis, this distorted system of incentives played out in several local governments supporting the PV industry.

To summarize, there are three major incentives for local governments in China to overinvest in the solar PV industry. First, because of the nature of tax incentives, local governments have supported the PV sector to increase local revenue. Second, as these industries have become significant sources of local employment, it is hard to stop

supporting them now that PV companies are having difficulties. Third, local officials want to get promoted under the economic indicator system by gaining higher GDP, and PV companies have been very helpful in contributing to local economic growth.

A variety of special capabilities — such as a well-developed semiconductor manufacturing base, proximity to ports, and ability to attract high-skill workers — of provinces like Jiangsu created incentives to initially support and develop the solar PV industry. These early, farsighted investments were quickly followed by myriad other imitating provinces, thanks to the distorted economic and political incentives at the local government level in China. Now that the sector has grown up and is experiencing problems of indebtedness and oversupply, those local problems have become bigger headaches for the Chinese central government.

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