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Foreign direct investment and technological change: The case of China

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Abstract

The main objective of this study was to know the extent of foreign direct investment in transferring knowledge to local firms. Knowledge transfer to local firms is the key role played by foreign investors and this has a remarkable impact on the development process in the South, despite of the relevant issues concerning foreign direct investment. In this study we found a significant relationship between technological change and foreign direct investment. The data was taken for 20 years from 1991 to 2010, from World Bank Development Indicators. Technological change was measured in terms of high technology exports and foreign direct investment was measured in terms of millions of US dollars.

Keywords: Technological Change; Foreign Direct Investment; State Policy

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1. Introduction

In common and popular scholarly vocabulary, an increase in foreign direct investment is associated with local capabilities, (Sanjaya and Rajneesh, 2004) rather than mere liberalization of the economy, where success stories and sophistication of the affiliates are not automatic, they ride on the advantages that already exist in the local economies. Sophistication of the process and production techniques depends on the location that provides high level competence and capability to foreign investors. It is the technological capability, other than market size and regulation, that determines linkages and linkages increase with high level of local entrepreneurial skills.

Though economic growth is high in economies open to trade, however the view that open economies grow faster, is still sceptical. Scholars have found international technology transfer through a multitude of sources but it makes the argument quite vague to assess the contribution and role of the foreign investors in technology transfer. Two channels have been exposed in the recent literature that focuses on trade and foreign direct investment. The literature that marginalizes the role of foreign direct investment in technology transfer has been challenged but this depends on the internal trade policy of the local economy.

Empirical studies on international technology transfer have focused on foreign direct investment comparatively more than trade but these studies were challenged on the ground of tradable goods as a source of technology transfer in the presence of international trade and absence of FDI. Even some of the literature reveals that international trade relocating resources, irrespective the gains are static or dynamic, and scatter knowledge internationally.

Theoretical literature has revealed issues relevant to operation of the multinational firms and its impact on the local economy. Selection of least cost combination in the process and production techniques by multinational firms has negatively affected local economies (Jean and Robert, 2002). Irrespective the impact on the local economy is positive or negative, some of the researchers have revealed the necessarily negative impact on production and employment of the parent country by allowing the operation of local firms in the foreign countries and substitute local production and employment with foreign.

In the context of economic exploitation and sovereignty, FDI raises even more issues, (Bijit, 2002) requiring better understanding of its determinants, also deliberate under the agenda of World Trade Organization to set rules for foreign investors through which their activities can be regulated. But the underlying issues are more complicated, encompassing problems from commerce to management and from employment and wages to intellectual property rights and development.

Regarding economic development and growth, the importance of foreign direct investment is obvious, but realistically, differences in nature, behaviour and impact of market seeking and efficiency seeking foreign direct investment, its long term production orientation, mobility and rate of return from arbitration to speculation raise certain issues, intricate from market to market and firm to firm, still require rigorous investigation for more cost-effective and profitable allocation of resources.

This paper focuses on the basic issues concerning foreign direct investment, its role in transferring knowledge and steps taken by the Chinese government for attracting and managing foreign direct

investment. Specifically this paper investigates the relationship between technological change and foreign direct investment, because technological change has been one of the remarkable impacts of foreign direct investment on the local economy.

2. Literature review

Firms operating beyond borders or controlling production in more than one country or engaged in international production are known as transnational corporations (Collin and Nixan, 1981). Foreign direct investment flow to a particular country is almost from the operation of transnational corporations, but it depends on the strategies of the corporation to penetrate into the foreign markets. These investment strategies differ to different corporations, depend on the size, scope, structure and organization, precedent to geographical or market related factors.

In order to get locational advantages, firms open subsidiaries in other countries, despite of having ownership advantages in one country. These firms can be either market seeking or efficiency seeking. Differences in factor prices and resource endowment compel firms to move from one market to another in order to utilize the resources efficiently and to get advantage of the cheap labour and other factors of production. Growth in market size, human capital and infrastructure development are some of the key factors driving foreign direct investment, (Zhang, 2000) but these changes are associated with better economic performance. Better economic performance attracts foreign investors with the expectations of better opportunities and incentives.

Strengthening its presence in the market in a particular industry, a particular firm prefers to operate internationally (Wild and Han, 2000) and this preference of the firm is regarded as market power theory. In addition to market power theory, the internalization theory explains that firms usually involve in international production in order to internalize market externalities and remove imperfection, because markets are imperfect and there are differences in transaction costs. But internalization of the market externalities may not always be the driving force for foreign direct investment. The eclectic paradigm theory (Markusen, 2000) explains the exploitation of ownership advantages as the main reason describing international production. This theory further explains market power as a more contributing factor for international production.

All markets are not similar but differ on the basis of the prevailing institutional and organizational structure, as the sole inherent features of the markets, increasing complexities or paving the way for entrepreneurs. Entrepreneurs adopt different strategic approaches while entering a particular market. In third world countries the process is quite complicated due to ineffective institutional and organizational set up, but easy in the emerging markets due to extra legal measures and the accumulated social capital or informal economy - playing an important role in strengthening and supporting the formal sector. In emerging markets social contracts in the informal economy are making agreements easy to take place and these markets, both the formal and informal, have strong social orientation (Ted and Steuart 2004), reducing uncertainty and bringing transparency in agreements and transactions.

TNCs consider the world as a single market and manage their activities at international level, (Richard and Muller, 1974) though highly oligopolistic in nature, (Ibid) controlling the local market and diverting the resources for their own benefit, however transfer of new knowledge to local firms is also their central role. But despite of the role of these corporations in boosting up of the local economy, knowledge transfer, training and employment opportunities to local firms and labour force etc, their pace for profit maximization is the ultimate goal that surpasses the rest of motives in the corporate policy.

Relevant literature has revealed that the goals of the corporation are given priority over the interests of the state in expanding its tax base, increasing revenue and employment and providing the local firms with sophisticated techniques of process and production. Ted and Steuart (2004) are of the view that transnational corporations using modern capital intensive than labour intensive techniques to maximize their profit and create little employment opportunities for the local labour force. They also avoid taxes and focus more on the import rather than export to harvest as much of the local resources for their profit as they can.

Firms, engaged in international production, trade intangible assets (Terutomo, 1992) and they are the real actors operating across national borders. The host country state has no longer the control over the market because it is illogical to see perfect competition in the market and most of the transnational firms operate in imperfect markets, thereby controlling the markets and exploiting the resources to gain the high level of benefits.

Though corporate policy has the focus on benefits, however development economics literature has general consensus that foreign direct investment inflow plays a critical role in growth dynamics, (Rahim, 2007) because of the transfer of modern process and production techniques to local firms. Transferring modern techniques to local firms is one of the important and primary factors driving developing countries towards opening up of their markets for foreign investors, where openness and growth, particularly in the innovative process, are positively associated (Richard, Henrick and Rikard, 2005). This growth is faster in the transition economies (Luo, 2003) on the basis of liberalization and provision of opportunities for foreign investors.

Foreign technology is the easy source to expedite the domestic innovative process and capability. Channels, through which foreign direct investment benefits the local innovative process, are up to a greater extent, identified in the literature. These techniques can be learnt, stolen or adopted through a demonstration effect of local research and development. Even mere presence of foreign investors can encourage local firms to absorb new techniques, (Smarzynska, 2002) because of the prevailing competition in the market with great rivalry on production and process techniques. For rivalry brings competition in the market and when competition policy is based on rivalry then the innovative process can be higher.

2.1. Foreign direct investment and knowledge transfer

Knowledge acquisition depends on the absorptive capacity of the local firms, but it is context bound, that can be either tacit or explicit. Tacit knowledge is digested by the individuals and gained from past experiences and applied to development of new products. Explicit knowledge can be communicated and intuited. There is

no systematic way to transfer tacit knowledge because of its invisibility to codify and communicate but of great importance to firms competing in the market, either local or international.

Context plays an important role in knowledge transfer, (Nilson and Winter, 1982) where institutional and organizational context is the most complicated and sophisticated determinant in knowledge transfer (Hondong, 2005). Before transferring, this knowledge shall be adapted to the local environment because knowledge transfer is profusely institutional and organizational centred and embedded.

Extraneous factors responsible for knowledge transfer are up to a greater extent objectified in the literature but still micro level factors are under hunt. It depends on the size of the firm, mode of venture and the mechanism for interaction but mode of venture can be posited in knowledge transfer only if the objectives of the agreement are conducive to greater involvement (Tsang, 2002) and there is consistency on the part of the strategic importance of the mode of venture between the two or more parties. It means strategic importance of the objectives shall be mutually exclusive.

Mechanism for interaction between parent and subsidiary, other than between the local and foreign firms, revolve around three distinct phases (Paul, Mark and Neil 2007). Paternalism is the first phase, where knowledge is embodied in products exported by these companies. Expansionism is the second phase, where investment by the firms is targeted to further innovation. In expansionism, that innovation is focused which is not yet integrated internationally. The third phase is liberalism, where knowledge can come from everywhere and this is the core channel through which knowledge can be integrated at global level.

Paul, Mark and Neil (2007) have furthered the domain of the interaction between parent and subsidiary to polarization, homogenization and syncretisation. Polarization is the coalition of the cultures of nations (Huntington, 1996) that requires a common ground to merge but impossible and it is difficult to manage across the boundaries. Homogenization eradicates the conflicting views in interaction and counting on both global and local perspectives as mutually exclusive. In addition to homogenization and polarization, syncretisation provides an alternative platform for the co-existence of heterogeneous cultural elements. This platform is regarded as a cosmopolitan platform for diverse cultural elements (Levit, 1983). But political and cultural differences erect huge barriers to get through and adapt to individual values and behaviour, that's why multinational companies customize their products and services to the unique requirements in order to overcome these constraints.

To human resource perspectives, existing literature has explored knowledge transfer through human resource strategies, up to a greater extent and this role in knowledge transfer and creation is critical, because it is human mind from where knowledge oozes out. However few studies have related expatriate characteristics and their knowledge transfer activities to firm's performance. But skill development, knowledge creation, acquisition and learning are the outcomes of human resource strategies, (Arthur, 1994 and McDuffie, 1995) making the environment either conducive or absurd for the creation of knowledge.

Knowledge transfer is a change in employee ability and motivation, through discrete practices in human resources. It is a change in the characteristics of skills (Minbaeva, Bjorkman and Park, 2003) that affects knowledge creation and transfer. This impact of human resource practices can be negative, if not eliciting

change in human capital, because human capital is the central focus of knowledge creation and transfer, therefore human resource strategies in this regard shall be change focused.

This knowledge transfer process is expedited among those multinational companies which are mobilizing skilled personnel from parent to subsidiaries (Bonache et al., 2001), because individuals are the rudimentary source of knowledge (Argyris and Schon, 1978) that facilitate knowledge transferring process - partially depend on the type of expatriates operating in a particular firm, whether focusing on skill transfer from parent company or not.

Minbaeva et al. (2003) are of the view that, in regardless of other activities of the multinationals, research and development activities conducted by the multinational firms is the central source of knowledge transfer, because most of the multinational organizations conduct their research in the host country which provides an opportunity for the domestic firms to learn from the foreign firms but literally research and development sector in the developing countries is very weak that inhibits the transfer process.

2.2. Issues in Foreign Direct Investment

Overseas involvement decisions taken by the multinational firms predicate on many factors, still interrogative in the multilateral trade negotiations by the developing countries and require in-depth theoretical and empirical investigation in order to identify the associated determinants and policy measures for a transparent control mechanism. New institutional economics has the focus on the market and introduces the role of the state as an economic agent to formulate regulatory framework for the multinational firms, while questioning the classical assumption of perfect competition with perfect knowledge and rational behaviour on the part of both the producers and consumers.

Realistically perfect market is an imaginary situation and it is illogical to talk about perfect competition, because there are distortionary forces in abundance in the market, which increase negative market externalities. To reduce these negative externalities there is a real need to formulate a regulatory framework for investors, which has grown in importance in policy making processes. Regulation in terms of competition or environment is the most active area in policy making (Sanjaya, 2000). It is inevitable for the developing world to have an effective competition policy, firstly, in order to guarantee gains from foreign firms and secondly to allow room for local firms to catch up with the foreign firms.

Issues like Trade Related Investment Measures have already contracted policy space for the governments in the developing world, where markets are featured with ineffective institutional and organizational practices. Though complicated to have an active regulatory framework, requires specialized skills, which the developing world already lacks, however states have to focus on the initiatives of implementing this policy measure for this necessitated and mounting problem.

The issue of accurate measurement of the impact of foreign direct investment on the host country, irrespective positive or negative, has increased in importance and complexity on the basis of varying attributes of transnational corporations from time to time and country to country. Both the qualitative and quantitative analyses, if not all then at least few, of particular aspects of the contribution of transnational

corporations, require contemplative and rigorous research. The problem even gets more intricate when we question the inward and outward, large and small, types of mode and agreements, locational and sectoral distribution and trends, involvement decisions and also the counter-factual aspects of foreign direct investment.

Markets, plagued by the existence of oligopolistic firms, is another issue resulting in market distortion, already hunted by the scholarly community but the issue of interaction, resulting in market failure on the basis of differences in interests and insufficient information, needs to be investigated further in order to smoothen this process. Information failure can either affect the quality of investment attracted from abroad, or results in least or static benefits from foreign direct investment. Inconsistency between the interests of private investors and the host country leads to negative market externalities. Less or no commitment to local economy by foreign investors erodes national interests, when the decision making process is guided by the parent, rather than subsidiary. Therefore the control mechanism either through organizational or institutional involvement or cultural or strategic measures can make the environment conducive.

The issue of infant industry (Bruton, 1998) is of equal importance to almost all the developing countries, where costly entry and access for local firms to learning and skills due to huge competition from foreign investors result in the fall or quit of many of local firms from the industry. Privileged access of foreign firms to almost all the resources due to their good reputation and links with state departments and other supply chains erect new problems for local investors and tighten the corner on local firms. In factors market, foreign investors have access to skilled personnel and finances both at the local and international levels, which make the game path uneven for local firms. Strong bargaining position, both in the local and international markets and the favour they receive from states, not only deprive local firms from best factors of production by overtaking them but also make the ground conducive for strong international lobbying.

Overseas involvement decision brings even more complex issues forward, while counting the impact of foreign direct investment on the development of local economy. One of the factors of overseas involvement decision is the transaction cost but transaction cost theory partially explains the decision making process, (Teece, 1986) because there are other incentives that drive multinational firms operate beyond the national boundaries such as production, real costs, market share, location preferences, ownership and licensing agreements (Anderson and Gatington, 1986). But it partially depends on the origin of the firm, such as American and Japanese firms prefer ownership than other factors in their decisions to invest abroad, (Erramilli and Rao, 1993 and Nicolas et al, 1996) distinct from other countries.

Tax compliance issue (ibid) has led to transfer prices regulation and enforcement due to setting up of the transfer prices on cross border transaction by the transnational corporations to reduce taxable profits. It is a common practice of the multinational firms to evade taxes (James S. Hanson, 1975) as one of the main practices of market distortion.

To local savings and consumption perception, the impact goes more negatively by enhancing consumption opportunities for the local consumers, (Martin Chore, 2000) where increase in demand for consumption goods from the foreign world increases imports. The figure gets worse when added with the high demand of imports of intermediate and capital goods by foreign investors. In addition rapid expansion of foreign

investors in local economy expedites de-nationalization and reduces local share. If the rate of growth of foreign investment increases at a faster pace than the local, the problem can get worse, therefore the rate of growth of local investors must be higher than the foreign investors.

2.3. The case of China

Intrinsic factors play an important role in extracting benefits from foreign investors. It depends on how the local market is maintained for investors. The movement of Chinese government from restrictive to permissive and then to encouraging policies, resulted in the attraction of huge foreign direct investment. Further step in encouraging FDI in general to high technology products and more capital, rather than labour intensive investment increased local production in high technology products. Establishment of special economic zones, particularly in Guangdong and Fujian provinces (Cheung and Lin, 2004) and the provision of different incentives to foreign investors, attracted foreign investment profusely into these zones. Expansive investment in these provinces in a short period of time led the government implement the same policy with more nationwide concentration rather than focusing on special zones only. This expansively implemented policy elicited remarkable results and by 2003 FDI in China reached to US $ 50 billion (Forbs, 2005). According to recent IMF estimates, three percent increase in annual growth rate in China was due to FDI inflow, (Tseng and Zebregs, 2002) where benefits from increased productivity were central.

Regarding the creation of employment opportunities by foreign investors in China, the impact was even more enormous. Creation of employment opportunities and efficient utilization of labour force could be attributed to FDI, because of huge difference in the production of private enterprises and directly state controlled enterprises. This difference was not seen in production only but a change in structure between local and foreign firms was also considerable. Local firms concentrated on conventional production in large industries while the foreign firms introduced new techniques in new industries of telecommunication and electronics.

Tseng and Zebregs (2002) found an increased level of production in China due to low cost of access to modern technology by the domestic firms and local scientists. Existence of foreign firms in domestic market and their linkages with domestic firms, particularly with the suppliers, produced a positive technological spillover. Foreign firms hired local scientists at low cost and employed them in the established laboratories. Hiring local scientists by foreign multinational firms and their cooperation with local companies and research institutions and organizations positively impacted the development process in China (Gelb, 2000). Technical services and training to local firms in China was the result of cooperative multinational firms in terms of licensing agreements, positive interaction and supply chains. Expansion in subcontractors to multinational firms in China, particularly those foreign firms, who were engaged in export production, paved the path to international market for the local companies. Supply chains between local and foreign firms was a source of learning, which expedited the replication of modern process and production techniques from foreign firms, which in a short period of time highly increased local production growth.

Spillover means the transfer of resources, particularly technical knowledge between organizations. Technological spillover does not take place unless technological superiority is demonstrated by firms.

Competition between firms is also important here and plays an important role in transferring knowledge. In China the benefits of spillover were high in terms of modern techniques, (Jin and Dean 2008) because foreign firms, invested in China, were highly generative for the local firms to access international market and to learn contemporary techniques in process and production.

Knowledge transfer from FDI was from three main channels; training programmes, product and production technology. Qualified persons were given modern management, supervision, marketing and advertisement techniques. In-plant training programmes for the workers were proactive, (Richard, 2004) particularly in training local people on the operation of machinery and supply of inputs and outputs. Improvement in production standard was due to the financial assistance to local firms to obtain modern machinery and access raw materials and other inputs, and consultation. Technical assistance on the design of the product to local firms and regular feedback, and collaboration on research and development in different product areas with mutual consultation by foreign firms improved product technology in China.

Increased research and development activities by multinational companies in China and their collaboration with the local firms furthered the process of knowledge transfer. About 34 R & D units were established by multinational firms in early 2000 (Ibid). Motorola alone established 18 R & D units and seven more to be established. A number of companies have established their own centres in which LG had opened its own largest R & D site in China. More than a dozen centres were still under construction by multinational firms, but the figure is underestimated because smaller companies did not advertise Chinese R & D investment internationally. However there had been a continued improvement shown in the number of R & D units established in China from 1996 to 2003, which had a remarkable impact on technology transfer to China.

Technology intensive production agreements played a vital role in technological change and China had become the third R & D intensive country in the world in 2001 when research and development reached to $ 60 billion. The innovative process in China got momentum with such huge focus on research and development, where China stood ahead of Japan and Russia with 743,000 researchers in the world but behind the United States with 1.3 million.

There were diverse factors responsible for making the market conducive for foreign investors in China but the most important was the open door policy and the reforms, worth mentioning, introduced by the state. A restructuring process of the conventional firms into contemporary new style was the initiative of the state which facilitated the process and made state owned enterprises catch up with the foreign enterprises. Profusion of foreign direct investment in China, particularly in the special economic zones and then its dissemination to the rest of the regions resulted in a huge demonstration effect. Diverse regional markets at provincial level with differences in geography, customs, taste, and tradition (Jin, Quian and Weingast, 2005) and diversified policy structure (Vanhonacker, 1997) on the part of the state for each region, and the boundaries, based on provinces, for foreign firms (Prahalad and Lieberthal, 1998) furthered the scope of the market and strategy for investment.

In China, bureaucracy played an important role in making the process smooth and transparent for foreign investors. Bureaucratic delays are considered as a serious harm more than the implementation of the project

(Cull and Xu, 2000). Unlike other countries, in China bureaucracy is robust to accept the responsibility and allows no space for delays in project implementation. Strong institutional and organizational set up proved alleviation of all male-practices from bureaucracy. The establishment of the Ministry of Foreign Economic Relations and Trade, facilitated by China International Trust and Investment Corporation, based on strong communication with the concerned bodies, made it clear for foreign investors, where to invest and whom to contact.

Local authorities were also given autonomy in dealing with the transnational corporations for small projects. Regional specification like Guangdong and Fujian and other special economic zones like Shanghai and Hainan were granted certain powers in dealing with the transnational corporations. The organization of national corporations, such as shipping and automobiles, facilitated the coordination of regional activities. Other organizations were also given power to deal with the transnational corporations. Capital Iron and Steel Corporation was also granted the power to deal with foreign firms. These local authorities played an important role in determining foreign investment in the country.

Regarding the allocation of transnational corporations, the introduction of export oriented joint ventures and joint ventures using high technology, specified the activities of the foreign firms. The state played an important role here in property rights protection and other legislative provisions (Cheng and Kwan, 2000). Completely foreign owned enterprises were also allowed, and special and preferential tax treatment was also given to foreign firms. Legislative provision provided tax benefits and the right to retain and swap foreign exchange. Foreign joint ventures were given the guarantee of eliminating the bureaucratic interference, unfair local costs and to provide alternative ways to balance foreign exchange. Preferential treatment to different foreign firms, including privileged access to water, electricity, transport and communication, was also granted.

In China two types of joint ventures were reached; the cooperative joint ventures and equity joint ventures (Paul, 2005). Both of the two joint ventures were similar in nature on the basis of format of agreement, legal provision and procedure and the autonomy for dispute settlement and resettlement. Though equity joint ventures were popular in China, however investors preferred cooperative joint ventures. Cooperative joint ventures made the process easy and transparent by allowing access to restricted sectors, reducing risk and management, control mechanism, controversies and difficulties in capital formation and sharing.

Domestic requirements increased for those foreign firms that produced low technology products and operated in the main land China with import substitution industries. Fully foreign owned enterprises were required to be export oriented and using advanced technology. Special encouragement was given to foreign firms in agriculture, basic raw material and projects that could take advantage of rich natural resources and relatively low labour cost. For rural development, China gave high privileges to those foreign firms that operated in the central and northwest areas of the country.

Projects were divided into three main categories according to the type of technology they used and the area they operated in. These projects were encouraged, restricted and prohibited. Projects, that used advanced technology in infrastructure and underdeveloped agriculture, were encouraged. Projects, where

the technology was either developed or transferred and where the production exceeded the domestic demand, were restricted. While those projects that were harmful for national security, society and the environment, strictly prohibited. According to this division, the allocation of foreign direct investment, its control and monitoring procedure in accordance with the domestic requirements, was improved.

In order to protect the exploitation of the resources, particularly the labour, mutual benefit policy was introduced where both the employers and the employees were benefited. Mutual benefit did not mean that both would be given equally but it meant that the two parties, the exploiters and the exploited should be benefited. Technical assistance was a highly valued benefit by the Chinese, which was provided without explicit charges. The division of profit was not proportional to capital contribution but negotiated case by case. The principle of equality was also introduced in the bargaining with the transnational firms. This principle meant the willingness of the Chinese to be fair. On the basis of these two principles greater transparency was brought in the process of negotiations and operation of the foreign firms and their control and monitoring procedure.

Transparency in government and the rule of law was guaranteed through the maintenance of strong legal and tax systems, transparent budgetary process and the effective measures to combat bribery and corruption. Chinese government ensured the implementation and enforcement of the system and punitive actions were taken against the corrupt. Sound governance and an open environment for investment through stable economic growth, development of open, transparent and non-discriminatory policies towards investment were ensured. Investor's confidence was improved by giving full protection to intellectual property rights. All these steps taken by the Chinese government in attracting foreign investors, resulted in the huge inflow of foreign direct investment with technological change.

3. Research method

The data for this study was taken from the website of World Bank Development Indicators from 1991 to 2010. The data was initially taken for two main variables, but extended to certain other relevant variables influencing technological change. Technological change was measured in terms of high technology exports in millions of US dollars and foreign direct investment was also measured in millions of US dollars. It was a meaningful way to use China as a case study to explore the significance of the main variables. For statistical data analysis we used e-views.

Hypothesis

H_0: There is no relationship between technological change and foreign direct investment.

H_1: There is a significant relationship between technological change and foreign direct investment.

$$Yi = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 + \beta 6X6 + Ui$$

OR

$$HTE = FDI + TR + LF + Y + REM + INF + Ui$$

THE	High Technology Exports, the explained variable measured in millions of US dollars
FDI	Foreign Direct Investment, the explanatory variable measured in millions of US dollars
TR	TR is total tax revenue, taken as percentage of gross domestic product
LF	LF is total labour force
Y	Y stands for GDP growth taken in percentage
REM	Foreign remittances measured in millions of US dollars
INF	Rate of inflation taken in percentage

4. Data analysis and interpretation

We found a significant relationship between high technology exports and foreign direct investment. This relationship was significant at 5 percent with t-statistics as greater than 2. The co-efficient of determination was 0.98, meant that 98 percent of the total variation in the dependent variable was explained by the explanatory variables and the rest of the 2 percent variation goes into the error term. The results showed that one unit change in FDI would bring 0.710765 units change in technological change, while taking the rest of the variables as constant. The variation in high technology exports was partially associated with foreign direct investment. The results showed that at 5 percent level of significance we failed to reject the alternative hypothesis that there was no relationship between technological change and foreign direct investment.

This relationship between high technology exports and foreign direct investment was positive. It means that the variation in both the variables was similar, or the change was in the same direction. An increase in foreign direct investment would bring an increase in high technology exports in China, and vice versa. This relationship between technological change and foreign direct investment could be easily generalized and it might not be erroneous to associate the existing high technology exports of China with huge foreign direct investment.

Here we could not neglect the role of the state in managing such a huge foreign direct investment. Removal of bureaucratic delays, corruption and provision of incentives to foreign firms on priority basis, were few of the policy measures that helped China got further ahead than other regional states in attracting foreign investors. Division and then sub-division of projects into encouraging, restrictive and prohibited categories made the selection as well as the allocation of foreign investors easy and adaptable to local environment. State's agreement with foreign firms, particularly the joint ventures signed with most of the foreign firms, helped the local firms intermingled with foreign firms. This opportunity of interaction on the part of the local firms with foreign firms gave birth to learning and competition on processing and production of goods and services. Training to local people by foreign firms was of greater importance in this regard.

Among other variables, tax revenue did not show a significant relationship with technological change, because in China local requirements (those in the form of taxes) increased only for those firms who were

producing low technology products. Firms producing high technology products were subject to low level and even no local requirements, particularly taxes. GDP growth and remittances were also positively associated with high technology production, but labour force and rate of inflation were negatively associated with high technology exports, because the production of high technology products meant a movement of the local producers from labour intensive to capital intensive production. In addition, the adoption of new process techniques and new ideas in production, as well as linear programming in the industrial sector with least cost and massive production negatively affected local inflation rate.

Dependent Variable: THE
Method: Least Squares
Date: 20/12/12 Time: 02:40
Sample: 1991 2010
Included observations: 20

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
FDI	*0.710765*	*0.230584*	*3.082457*	*0.0081*
TR	*7.25E+09*	*4.44E+09*	*1.630951*	*0.1252*
LF	*-159.4926*	*61.73760*	*-2.583395*	*0.0217*
Y	*6.82E+09*	*2.79E+09*	*2.441279*	*0.0285*
REM	*4.661627*	*0.776253*	*6.005292*	*0.0000*
INF	*-1.51E+09*	*8.48E+08*	*-1.783883*	*0.0961*

R-squared	*0.987100*	*Mean dependent var*	*1.20E+11*
Adjusted R-squared	*0.982492*	*S.D. dependent var*	*1.36E+11*
S.E. of regression	*1.80E+10*	*Akaike info criterion*	*50.30404*
Sum squared resid	*4.52E+21*	*Schwarz criterion*	*50.60276*
Log likelihood	*-497.0404*	*Durbin-Watson stat*	*1.922028*

The concept of economic growth and technological change was also explained by Borensztein, Gregorio and Lee (1998), that technological diffusion affected economic growth positively, because the more local producers learned and adopted the more they had cost and time effective allocation of resources. In addition, most of the growth literature revealed that economic growth was highly dependable on the state of local technology as well as local capability such as Sanjaya and Rajneesh (2004).

The concept of positive relationship between technological change and foreign direct investment was also explained by Romer (1993), Ray and Nigel (1997) as well as Ben (1996). In addition, a major portion of the relevant literature found a positive relationship between technological change and foreign direct investment. Some of the writers such as Ben (1996) identified that openness of the local market played an important role in the innovation process. In China, after the introduction of the open door policy, foreign investors streamed

into the local market and a rapid change in the inflow of foreign direct investment was seen in the post-1980 period, which resulted in the rivalry of the local and foreign firms on the basis of learning and adopting new process and production techniques.

Conducive environment for research with greater availability of labour force as well as raw material, local infrastructure and state incentives, paved the way for further research by foreign investors. Even some of the foreign firms concentrated on China for research and development rather than on their mother country, in order to utilize their technology both in the local market as well as in their mother and foreign subsidiaries.

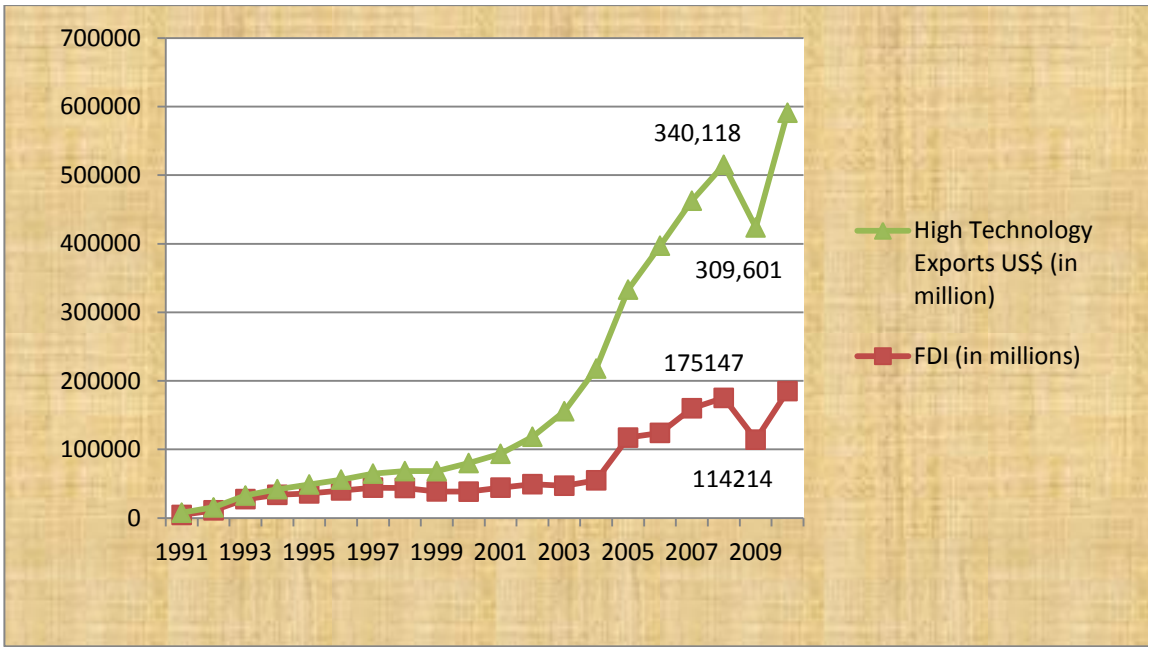

Figure 1. Trends in FDI and High Technology Exports (in Millions of US$)

The above figure shows the trends in foreign direct investment and high technology exports from 1991 to 2010. Both of the variables were measured in millions of US dollars. The variation in both the variables was the same. There was less increase in technological change until 2001 but onward the change in both the variables was very rapid. An increase in high technology exports was caused by an increase in foreign direct investment.

5. Conclusion and policy implications

In this study we found evidences of technological change due to huge inflow of foreign direct investment in China from 1991 to 2010. The impact of foreign direct investment was multiple due to the absorptive

capacity of the local firms and particularly the state in maintaining the market environment for investment. Technological change in China was associated with foreign direct investment but this change was not automatic, because local entrepreneurial capability, institutional setup, state policies towards foreign firms etc. all contributed to this change. Removal of bureaucratic delays, signing up of different ventures with foreign firms, provision of local incentives and preference of foreign ownership over local in certain projects and sectors were some of the policy steps that enormously contributed to technological change. In addition, proper training programmes in foreign private firms were part of the agreements signed by the state with multinationals. Cooperation on research and development activities and greater interaction between the local and foreign firms, guaranteed smooth flow of knowledge to local firms.

From this study we concluded that prior to attraction of foreign direct investment, local capacity building through human capital accumulation and maintenance of market environment through strong institutional and organizational setup would be inevitable. Minor bureaucratic delays or corruption could be enough to discourage foreign investment, therefore no space should be given to corruption or any other mismanagement of resources. Those joint ventures should be given preference in which local labour force and firms have greater opportunity of interaction. Greater local interaction would let the local firms learn more from foreign firms and compete with them on production techniques.

China's performance in the pre-open door policy was not as good as it was in the post-open door policy. In the post-open door policy China's performance continuously improved. The state highly concentrated on local labour force training and education, infrastructure development and corporate governance. These policy measures were conducive for the attraction of foreign direct investment. Development of special economic zones in mainland China absorbed huge investment in the initial stage which the state through different agreements and incentives extended to other sectors and regions.

An open door policy to trade and investment plays an important role in this regard, even bilateral and multilateral regional agreements in trade and investment would be supplementary to fill the gap in foreign direct investment, such as EU (European Union) and ASEAN (Association of Southeast Asian Nations) etc. Such trade and investment agreements boost up the local investment market, which adds more to local technological change.

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