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Research on FDI Driving Mechanism in the Process of RIS Evolution

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Abstract: This study presented the Driving mechanism of FDI (Foreign Direct Investment, FDI) to the Regional Innovation System (RIS) evolution. Firstly the study systematically summarized the existing theories of FDI and regional innovation system evolution and defined the evolution essence of regional innovation system as four manifestations. They were Fittest of main subjects, strengthening of the relationship network, Appearance of new order, Promotion of innovation ability and vitality. Then the study analyzed the synthesis Driving mechanism of FDI to regional innovation system evolution. At last the study established up a driving mapping model for FDI to regional innovation system evolution and made out an in-depth analysis on the driving relationship between FDI and the evolution of regional innovation system in theory. The study would help to enrich the regional innovation system theories and provide theoretical support for host countries to develop the regional innovation system by using FDI effectively.

Key words: FDI, RIS, driving mechanism

INTRODUCTION

Literatures about the relationship between FDI (Foreign Direct Investment, FDI) and Regional Innovation System (RIS) are relatively few but emerge in endlessly. Theoretically, FDI is thought to influence the main subjects in host Regional innovation system, namely, local enterprises, universities, research institutes, government and intermediary organizations and then indirectly promote the innovation ability of system through these subjects. Yang and Ou (2013) In empirical direction, they focus on conducting repeated demonstration about FDI technology spillover's positive and negative influence to the Regional innovation system. In recent years, with the rapid development of economic globalization, FDI has evolved into a relatively stable investment mode from a fresh none, host countries also continuously carries out economic reforms to conform to the trend of economic integration (Sun *et al.*, 2012; Li, 2010). Old FDI activities root more deeply and new emerging FDI continue to embed in, so FDI is never categorized in the Regional innovation system only for owning high innovation productivity, but has become the main innovation subject in RIS with its abundant capital, advanced technology, forward-thinking innovation concept and well-developed innovation system. Influence of FDI to Regional innovation system is never limited to enhance regional innovation production capacity; the effect is more and more obvious. Adner (2006) But there aren't any literatures resources revealing the internal

relations between FDI and Regional innovation system evolution. Liang and Zhang (2011) Based on these, this study tries to propose the driving mechanism of FDI to the evolution of RIS, FDI as the starting point, RIS as the end point, building Driving mechanism as the function bridge, aiming at providing powerful arguments for FDI to the driving force for system's upgrading and evolving. On one hand conducive to enrich the Regional innovation system theories, on the other hand, it can provide theoretical support for host countries to develop the region innovation system by using FDI effectively.

DEFINITION OF REGIONAL INNOVATION SYSTEM EVOLUTION

Based on the concept of Regional innovation system, through extensive reading and research for multidisciplinary Regional innovation system evolution theories, finding that main subjects, relational network, innovation ability as well as order act as evolution elements, the results of their progressing and evolving: Fittest of main subjects, strengthening of the relationship network, appearance and consummation of new order, promotion of innovation ability and vitality, are the macroscopic manifestations for Regional innovation system evolution.

Fittest of main subjects: Evolution originally refers to the process of creatures for developing from preliminarily to high-level, simply to complex. During the evolution,

individuals carry on cruel fittest for the purpose of adapting to the living environment. Competition makes adaptable ones survive, while others are eliminated for lacking of adaptive ability. In the continual pros-and-cons replacement and old-and-new transmutation, biological species and the whole biological systems are constantly improving and evolving to higher levels. Creature individuals to biological species to biological systems, exactly as innovation subjects to innovative subsystems to Regional innovation systems, fittest is both the process and result, which means resource allocation is more reasonable, industrial structure continuously upgrades, the efficiency has improved. Therefore, fittest of main subjects is an important manifestation for Regional innovation system evolution.

Strengthening of the relationship network: The relationship network, are relationship chains formed by various innovative subjects through formal or informal relations. These relationship chains provide distribution channels for the flowing of innovative resources, which are conducive for the system innovation subjects to intentionally or unintentionally help innovative resources flow. Relationship network's growing out of nothing, is also the process of subjects aggregating from distributed nodes. The aggregation and strengthen of industrial chain, technical chain, talented person chain, capital chain make it possible for isolated individuals to build a huge system. Strengthening of the relationship network, in essence is to change stochastic accidental relation to stable normal interactions, making it more freely to search, share, exchange and complement knowledge, realizing innovation emergence on the overall level by Regional innovation system internal participants' mutual trust, mutual dependence and common vision. Thus, strengthening of the relationship network is another embodiment of Regional innovation system evolution.

Appearance of new order: From the perspective of system dynamics, combined with theory of dissipative structure, no lack of scholars hold that Regional innovation system is an open non-linear complex great system, displaying continues evolution and rich changeable characteristic. The essence of evolution lies in the gradual changes from chaotic disorder to order. Originally, disorder and order are physical parameters to measure motion state of system units, using which to explain economic phenomena causing difficult-overcoming obstacles, so order parameter can be defined as the economic concept of "order". Looked from the regional economic system level and the organization interaction nature, order as

constraint specification embedded within the different hierarchies of Regional innovation system, can be divided into organization order, market intrinsic order and policy laws and regulations. Regional innovation system evolution is the process of order's collaboration, reconstruction and down to changes. The appearance of sequence marks the evolution of chaotic systems, in that way, the appearance of new order, means constant evolution and development of Regional innovation system.

Promotion of innovation ability and vitality: Regional innovation ability is a key to measure the effectiveness of Regional innovation system and also an important indicator of whether the system is normally operating. If the innovation ability is improving, the region innovation system is also developing and evolving; if the innovation ability is declining, it always means the region innovation system is also in stagnation and retrogression. Promotion of regional innovation ability is a relentless pursuing goal for the Regional innovation system to sustain its development.

Regional innovation vitality refers to the exuberant vitality of continuing good function of the whole system aiming at enabling innovation. Filling with vitality is the basic guarantee for the healthy development of system, lacking of vitality makes it easy to stagnate and rigid, showing a trend of recession. Lacking of innovation vitality, the social production life cannot get rid of repetition or circulation under low level and is far from progress in true sense.

Therefore, promotion of innovation ability and vitality is a dynamic embodiment for the evolving and maturing of Regional innovation system.

ANALYSIS ON THE DRIVING MECHANISM OF FDI TO THE RIS EVOLUTION

FDI acts as a kind of economic activity, affecting all aspects of Regional innovation system under externality. The Regional innovation system evolution is a dynamic evolution process, whose vicissitude is towed by certain economic achievement target and is also driven by various internal and external factors. Hu *et al.* (2011) FDI with its own characteristics, has a driving mechanism for the Regional innovation system evolution, specifically, six Driving mechanisms are included.

Embedding mechanism: FDI taking transnational corporation's establishment as the main form, its embedding in Regional innovation systems can be

divided into four dimensions: Economical embedding, social embedding, Technical embedding and Institutional embedding. Economical embedding refers that transnational corporations constantly investment in the local and form industry association with local enterprises, including procurement and supply of raw materials, localization of the upstream-downstream product supplies, interfacing with local industries and so on. Social embedding refers that transnational corporations establish interpersonal relationships in local, realizing localization of human resources and assembling up relationships with other social institutions, including universities, research institutes, etc. Technical embedding refers that transnational corporations get technology associated with local enterprises, forming channels for technical communication and metastasis. Institutional embedding refers that transnational corporations do as the Romans do, forming institutional association as the result of complying with laws and regulations within system.

FDI embedding in Regional innovation system is a process of rooting and networking. Transnational corporations often become the backbones of regional innovation promotion because of superior investment background and technical strength, acting as an important node in the relationship chains within system. Transnational corporations itself has a more mature industrial system, which makes it easier to rapidly assemble network in local and can add the chains bold and spread with its own development. The construction of such a network relationship, from nothing to something, form weak to strong, distributes throughout the system, like blood vessels.

Technology diffusing mechanism: Establishment of network relations of FDI in the Regional innovation system guarantees transnational corporations to carry on economic activities smoothly. Foreign merchants invest in the host country, at the same time demonstrate capital, management experience, technical knowledge, operating model, business skills and entrepreneurial skills to the host country, which can be called technical advantages collectively. Through the chains of a variety of relationships in the network, though, for example, local enterprises can hire for staff having been trained in transnational corporations before, etc., new technology always can be passed to the host country in the form of independent or non-independent. With that technology, local enterprises begin to study, digest, absorb and innovate again, thus accelerating the transfer and diffusion of technology, finally enhance the independent

innovation capability of host country. In this way, technology with huge differences of geographical isolation can be rooted in host country economical system by FDI.

Many transnational corporations set up overseas R and D (research and development) institutions when being established, injecting into special funds for R and D activities. No matter enterprise production activities or R and D activities, the places are within regional scope of host country, its embedding nature decides the localization of industrial connection and human resources, so even if the knowledge and technology are blocked on purpose, there will still be varying degrees of spillovers. Sometimes the spillover and disclosure of knowledge technology instead it prompt transnational companies simply decide to transfer technology, bringing direct level-leap increases for host country. Meanwhile, the host country can take advantage of existing innovation achievements to innovate at a higher level of technology, avoiding detours while exploring themselves, indicating higher levels of innovation capability. Technology diffusing of FDI, taking sharpening region system innovation ability as the direct performance, drives the evolution of Regional innovation system.

Agglomerating and deriving mechanism: FDI stations among the Regional innovation system as one of the main innovation subject, also forms a centripetal gather strength internal and external system. FDI provides technologies and concepts beyond county-species, improves visibility of regional industries in worldwide scale, related industries will gather here to seek opportunities for cooperation. Since transnational corporations has given full consideration to the host country's regional development potential, stationing of FDI often becomes a benchmark to guide the direction of investment, similar industries of host country will also tilt attention gravity here. In order to gain more benefits from technology diffusion, local enterprises will enhance the communication with transnational corporations, innovative resources and persons flow more frequently, forming industrial agglomeration. Industrial agglomeration leads directly to the improvement of the industry professional, making it easier to produce innovations, industry standards are constantly being improved and new order appears.

FDI will not only attract the migration of capital, but also spawn out many derivative organizations. For example transnational corporations sometimes give birth to overseas R and D institutions and then R and D

institutions cooperate with local universities, spawning out more research institutes. Transnational corporations' financing demand is exuberant and some of them will list in host country's market because of enough strength, so banks, credit center, and the stock exchanges will be derived here as the representative of financial institutions. Transnational corporations face different laws, patents and intellectual property rights system, so they require a variety of consulting services when carrying out production activities-Intermediary organizations would active in the region. Taking FDI as the center of Regional innovation system, the quantity of nodes is growing due to the absorption, accumulation and derivation of FDI, the network cover is more widespread, the relations interweave more complexly. Agglomerating and deriving mechanism of FDI drives the evolution of Regional innovation system from multiple directions.

Adaptive competing mechanism: In the Regional innovation system without any transnational corporations, local enterprises carry on producing activities according to customary pattern, under relatively irrevocable environment lacking of spanning technology adjustment, often follow some stable industrial relations. Competition between each other changes extremely slowly in fine tuning, especially after the formation of local monopolies, local enterprises more lack the sense of crisis, innovation system trends to be rigid for short of vitality. Introduction of FDI, just like throwing a catfish into the sardine slot which is originally peaceful, smooth, no awareness of possible dangers, causes a "Catfish effect", forcing local enterprises to rapidly alert and swim like sardines. They generate survival awareness and the heart of competing to win, maximize their potential to maintain a more durable strong vitality. Transnational corporations' increasing makes "Catfish effect" more significant and it will break the existing local monopoly before long. Enterprises being conservative and complacent active up again to excavate innovation potential and improve technical efficiency, with a view to innovate in competition and develop in innovation.

With the increase of FDI stepping into Regional innovation system, competition among transnational corporations forms. Competition similar to the "arms race" probably drives collisions between high technologies, stimulating higher level innovations, Regional innovation system as a carrier can profit more or less from different degree of technology spillovers. Many new-coming FDI will consider being partners with host country in order to get the project opportunity, cooperating to develop new technologies more suitable for regional

competitiveness. Thus it comes to a virtuous cycle of "Cooperation-Innovation-competition". Between transnational corporations and transnational corporations, transnational corporations and local companies, local companies and local companies, there always exists competition and cooperation of different degree, whose deep motivation is the natural selection and survival of fittest. No matter transnational corporations or the local enterprises, in the competition for purpose of strengthening its own adaptability, individuals maintaining innovation vitality win and annex, while those lifeless and inefficient ones suffer the elimination. Adaptive competing of FDI is a dynamically driven process of absorbing the essence and rejecting the dross, the result is that the superior win and the inferior wash out, stimulating innovation vitality, finally realizing the Regional innovation system evolution.

Multi-agent coupling mechanism: Coupling, refers to the phenomenon of two or more main subjects influence each other and produce increasing strength through a variety of interactions, for example, if two pendulums are connected by a spring, their original trajectories will be changed, leading to the waving and interaction of vibration. Similar to the pendulum coupling, two subjects or subsystems in system present dynamic correlation under positive interaction, they interdependent, coordinate mutually, promote mutually, showing the effect of coupling as well.

While embedding in Regional innovation system more deeply, FDI gets an increasingly close relationship with the system internal innovation subject elements such as local enterprises, universities, research institutes, government, intermediary organizations. FDI doesn't influence these main elements one-way, it interacts, couples each other, creating innovation force increasing in the process of coupling.

FDI has technical overflow and competitive excitation to local enterprises, further resulting in the formation of industrial agglomeration by attracting gathering, having promoted the innovation ability of local enterprises. Development and growth of local enterprises can optimize the value chain division, coordinate with transnational corporations more efficiently and can possibly increase the sense of urgency among transnational corporations to urge home country to increase investment in R and D, further affecting innovation behavior of transnational companies. Combined with local supporting industries and the concentration level to improve, more and more FDI will be attracted in the Regional innovation system, so FDI and local enterprises form a virtuous cycle of

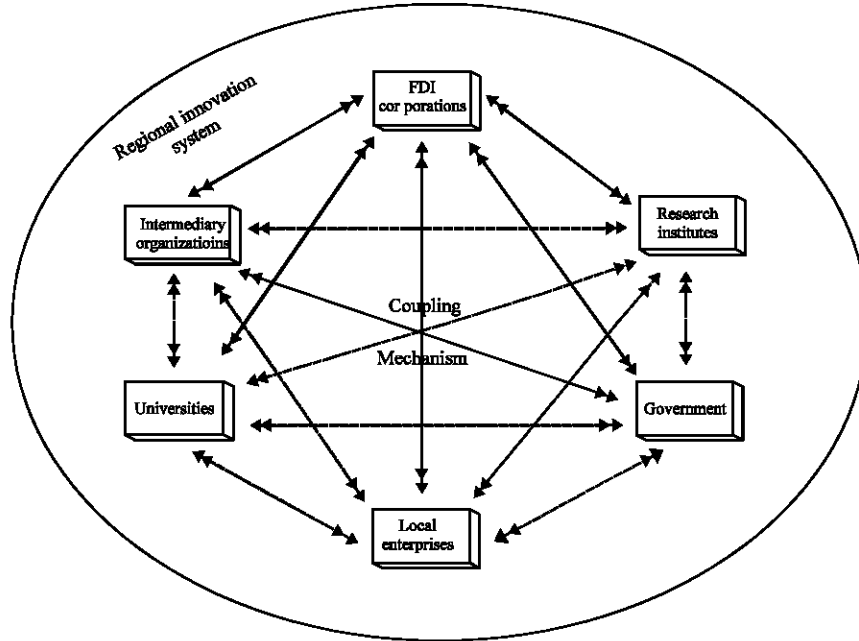


Fig. 1: Coupling mechanism figure of FDI to regional innovation main subjects

coupling under interaction. FDI often conduct R and D activities in host country, in order to seek technological convergence or out of demand for research facilities, they carry on cooperation with native universities and research institutes. This makes up for lack of local scientific research fund, enhance the R and D capabilities of local researchers. In turn, universities and research institutes innovation achievements' direct receptor is transnational corporations, who can ensure continued technical updates, widen technology gap with other enterprises, so transnational corporations are more likely to generate willingness of further cooperation, which means the existence of coupling between FDI and research system. The FDI cultural backgrounds and economic system lead to different economic activity behaviors, enlarging the difficulty for local government to manage the market. The government will pay more attention to FDI and make relevant policies due to innovation system development such as enlarging FDI introductive dynamism or not, or how to distribute innovation achievements. Correspondingly, government policies and regulations will restrict the economic behaviors of FDI, making it develop towards the direction more conducive to the evolution of Regional innovation system, therefore, there is coupling mutual function between FDI and government. FDI steps in host country, demands more help from intermediary organizations when carrying on producing activities in the strange environment. The business scope

can be broadened and intermediary organizations are able to learn foreign merchants' service concept and carry on intermediary service innovation. Instead, intermediary organizations provide authoritative systematic agency information such as marketing, law, accounting, quality controlling, etc, which makes FDI activities go on smoothly in knowing thyself, speeding up innovation emergence, consequently, there also exists coupling interaction between FDI and intermediary organizations. Different from embedding, coupling is not a simple contact expressing buying and selling, rights and obligations, but a systematic relationship tied up by a cycle of action and reaction. FDI itself as the center, couples with a number of main subjects, eventually gives rise to the increasing force of innovation. In fact, Regional innovation system inner subjects are multitudinous and these subjects couple complexly with each other at every moment. These difficult-to-analyzing interactive processes, can be regarded as indirect coupling with FDI. As is shown in Fig. 1, considering a simple Regional innovation system consisting of FDI corporations, local enterprises, universities, research institutes, government and intermediary organizations, the two-way double-headed arrows reflect the multi-loop coupling relations, the solid lines represents coupling between FDI enterprises and other subjects and the dashed lines indicate the coupling among other main subjects. By the coupling progresses of virtuous circling, FDI keeps

strengthening relationship network, stimulating innovation achievements, driving the continuing evolution of Regional innovation system.

Resource allocation regulating mechanism: Resources are the sum of innovative elements of manpower, material, financial, intelligence, science, technology and information, etc., are the basic material conditions for economic activities operating on normally. Regional innovation system is an open system, in the process of developing and evolving, resources always show scarcity relative to demand, this requires people to make reasonable spatial allocation for limited and relatively scarce resources, adjusting the flowing of resources internal and external the system, to obtain the greatest possible innovation benefits by over-consuming as little as possible. Original natural endowments vary in different countries, the geographic isolation of resources inevitably results in strong regional characteristics of production activities. Transnational corporations carry on FDI activities in host countries, having directly brought transnational re-combination of capital, technology and goods. For example, FDI introduces fund to the region short of capital but superfluous of labors, simultaneously absorbs surplus labors to make up for own labor shortage. Also, for example, FDI brings in domestic mature production modes and management concepts, which are the right scarce resources in host country. Regional innovation system achieves internal and external resource flowing, making it easier to work out innovation results. Within the Regional innovation system, FDI embeds and forms industry association, distribution of resources changes after the changing of supply and demand relations. Phenomenon of industrial agglomeration and subject derivation is also the product of regulating allocation of resources. They seek technical resource sharing, or introduce in complementary resources, are essentially regulating supply-demand and optimizing division. In the process of deploying resources, enterprises of high consumption and low efficiency tend to exit because of loss of competitiveness, resources flow to those of high efficiency and high vitality to realize higher using value, thus will realize fittest of innovation main subjects in system. The driving behavior of FDI to allocate resources reasonably is somewhat similar to the "invisible hand", which tows resources to move towards invisible specific direction, aiming at re-integrating innovation elements and reducing unnecessary consumption, right showing the internal order of market. The macroscopic appearance of regulating resource allocation will attract the attention of

governments and policy makers within innovation system. They will intense efforts to regulate supply and demand out of goals for improving regional innovation ability, or, set up laws and regulations to deal with the unfair phenomenon of market automatic adjustment, but the final purpose is to achieve sustainable development of Regional innovation system. Ether market internal order or policy and regulations, is the emerging of new order, which represents the evolution of Regional innovation system from disorder to order.

CONSTRUCTION OF DRIVING MAPPING MODEL FOR FDI TO RIS EVOLUTION

On the basis of preamble elaboration, the six Driving mechanisms of FDI have special corresponding relations with various manifestations of Regional innovation system evolution, which are similar to the one-to-many mapping relations on mathematics (Ding *et al.*, 2011; Li and Zhang, 2011). Therefore, based on the different Driving mechanisms pointing to different effects, this study establishes up a driving mapping model for FDI to Regional innovation system evolution as follows:

- **FDI embedding mechanism:** Driving mapping to Strengthening of the relationship network, to drive Regional innovation system evolution
- **FDI technology diffusing mechanism:** Driving mapping to Promotion of innovation ability and vitality, to drive Regional innovation system evolution
- **FDI agglomerating and deriving mechanism:** Driving mapping to Strengthening of the relationship network, Appearance of new order, Promotion of innovation ability and vitality, to drive Regional innovation system evolution
- **FDI adaptive competing mechanism:** Driving mapping to Fittest of main subjects, Promotion of innovation ability and vitality, to drive Regional innovation system evolution, to drive Regional innovation system evolution
- **FDI multi-agent coupling mechanism:** Driving mapping to Strengthening of the relationship network, Promotion of innovation ability and vitality, to drive Regional innovation system evolution
- **FDI resource allocation regulating mechanism:** Driving mapping to Fittest of main subjects, Appearance of new order, to drive Regional innovation system evolution

The driving mapping figure is shown in Fig. 2.

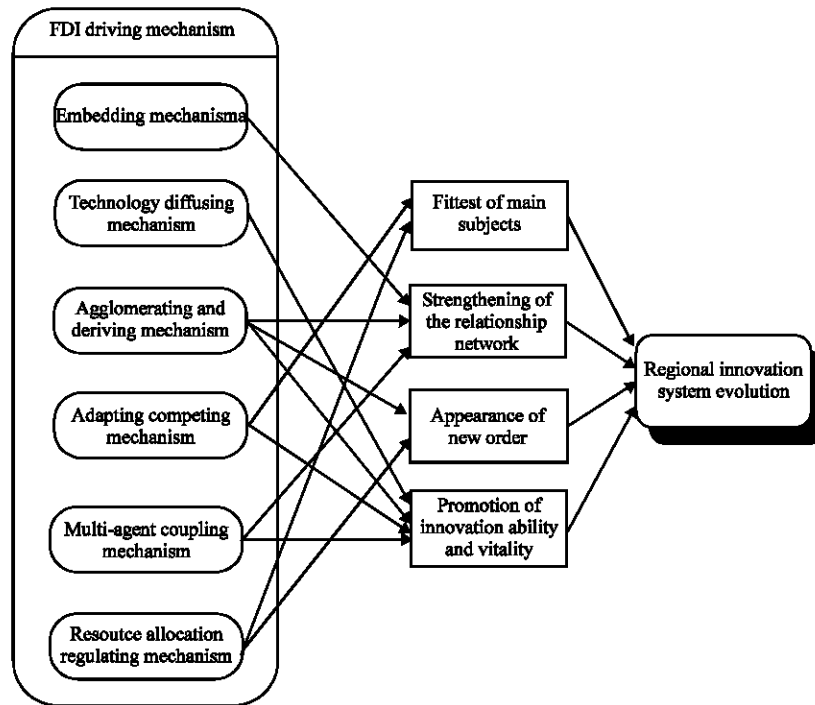


Fig. 2: Figure of driving mapping model

CONCLUSION

FDI has become the main innovation subject full of vitality within Regional innovation system as an important investment pattern of regional economic development. When carrying on production activities, FDI contributes six Driving mechanisms including embedding mechanism, technology diffusing mechanism, agglomerating and deriving mechanism, adaptive competing mechanism, multi-agent coupling mechanism and resource allocation regulating mechanism, from Fittest of main subjects, Strengthening of the relationship network, Appearance of new order, Promotion of innovation ability and vitality four aspects, drives the overall evolution of Regional innovation system. In summary, FDI has a comprehensive driving effect for the evolution of Regional innovation system and it would be of great help for host countries to introduce FDI actively to develop and improve the Regional innovation system.

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