

Economic Effects of Information Technology Oriented Joint Ventures in China – A CGE Analysis

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Abstract

The aim of this study is to quantify the impact of China's joint ventures (JVs) in the information technology (IT) area on the economic development of the country. Since its economic opening in 1978 China offers a high attractiveness for foreign direct investments (FDIs) of international companies. These FDIs show a strong impact on the country's economic development. Is this general picture also true for IT-oriented JVs in a developing country? A computable general equilibrium (CGE) model is applied to analyze the potential impact. The results demonstrate that these JVs show a less strong economic performance for China than expected.

JEL classification: C68, E22, F2, F41, G32, O1

Keywords: economic development, joint venture, information technology, China

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1. Introduction

The study's aim is to reveal the significance of international joint ventures (JVs) in China, doing business in the area of information technology (IT), on the economic development of the country.¹ The motivation for this work resulted from the increasing importance of China in the international IT business. Within a few years the country gained a strong position behind the United States and Japan as number three world supplier of IT products (WTO, 2002, Table IV.44). Do IT-JVs contribute to this success of China or are other forms of enterprises, like for instance domestic firms or wholly foreign owned enterprises, the driving force behind this development? China still attracts a high level of net capital inflows in shape of foreign direct investments (FDIs) since its economic opening in 1978. In general FDIs promote a country's economic growth this being also the case for China. This study questions this broad view for a specific type of FDIs – the capital flows in IT-oriented JVs. The increasing integration of China within the international division of labor of making products and services in information technology might not be reflected in a push of China's economic performance.

Many motives exist for companies to do business abroad. Internationalization is influenced by reasons like opening up new sales markets, accessing cost advantages, achieving higher incomes than at home, diversifying risks, and circumventing trade barriers. At a higher level of internationalization firms take capital-based investments into account. Companies invest in regions by portfolio investments and direct investments, respectively. A portfolio investment is a way of transferring domestic capital into a foreign country to obtain receivables, e.g., by obligations or stocks. On the other hand, a foreign direct investment (FDI) is made by a company to acquire a foreign company, to build a plant or a subsidiary as a wholly foreign owned enterprise (WFOE), or to form a joint venture (JV).² Thus, an enterprise's direct investments include the transfer of management capabilities. A JV is a company of joint ownership set up for the cooperation of a non-resident partner and a domestic partner.³ In addition to the capi-

¹ IT products are defined as office machinery and telecommunication equipment.

² The World Bank (2001), pp. 32 ff., analyzes the pattern of private international capital flows in detail. In addition, Patibandla (2001) gives an in-depth analysis of determinants for FDI flows in emerging economies like China. Smarzynska (2000) shows that international enterprises in the high-technology business prefer wholly foreign owned investments than a shared ownership. Chadee and Qiu (2001) conclude in their analysis that FDIs in China have been mainly made via JVs with a gradual trend towards higher share of foreign ownership in international joint ventures. The determinants are duration of the joint venture agreement, origin of the foreign investor, size of the jointly owned enterprise, and location of it.

³ The question for a foreign investor is how to select an appropriate domestic partner to achieve successful international JVs in China and is the topic of Luo (1998). Luo (2002) investigates what Chinese corporations are looking for from foreign partners. The categories of selection criteria are strategy, organization, and finance. If one of them is not present in the partners the joint venture is likely to be unstable, unprofitable, or unsustainable.

tal-based investment a joint venture is characterized by the risk sharing by all partners. The JV is set up for a long-term collaboration based on contractual provisions. Partners found a new company or acquire an existing one. This can be achieved with a minor, major, or equal share of the joint venture by the foreign partner. An incentive for building such a joint owned enterprise is to gain competitive advantages by combining the partners' strengths for market entrance. The accession of China to the World Trade Organization (WTO) at the end of 2001 should support international corporations in reaching their aims since this event promises the development of the legal and regulatory framework necessary for a market economy.⁴

Joint ventures potentially lead to the following positive impacts in the recipient country, especially in developing countries. These investments can reduce the capital shortage of an economy and thus increase productivity as well as the employment of other production factors. Hence, they induce positive employment effects. Economic growth can increase because of more investments by this external financing. JVs possibly improve the balance of payments. They might help to diversify the production structure including different levels of production stages. Additionally, a recipient country can face technology transfers. In contrast to this, enterprises with joint ownership might also create negative affects in the recipient country. Domestic producers might get displaced. Losses of economic welfare or income transfers towards the investors are likely if the public benefits are overdone. Developing countries are in the situation of a lower level of technological and economic development than highly industrialized countries. Thus, the JVs are mainly in the field of production by working syndicates to work more effectively, distribution by particular joint ventures to open up a specific market segment, and research and development for rationalization.⁵ China's economic policy makers use the regulation of this kind of enterprises as an instrument to improve economic performance of the country.⁶ This is done by, e.g., technology disclosure, contractual contents, owner-

⁴ Chen and Funke (2003) analyze the impact of policy uncertainty on FDI strategies of international firms with a real options model. Their result is that political uncertainty can be very disadvantageous for foreign direct investment decisions.

⁵ An empirical evaluation of the determinants of research joint ventures reveals beside other outcomes that a company's size and its experience with research cooperation increases the possibility of building this kind of JV (Marín, Siotis and Hernán 2000). Siebert (1996) finds the same results and in addition that these cooperating firms achieve a lower profit margin than non-cooperating enterprises.

⁶ According to Smarzynska (2000), governments of developing countries tend to prefer joint ventures over other forms of foreign direct investments supposing that local participation of international partners is a way to transfer skills in technology and marketing. China's policy makers might be very interested in attracting international partners for JVs in the information technology's business because, e.g., the Chinese software industry is in comparison to its computer and IT hardware industry small and underdeveloped compared with India's software industry. The position between China and India might change in future since China shows close

ship shares, openings for the sale, and local content shares of intermediate products. The economic development of a country is indicated, for example, by gross domestic product and gross national income per capita. The latter one was formerly called gross national product per capita (World Bank 2003a). JVs in the IT area strongly effect the economic development of China when their business activities create domestic value added with high magnitude.

A significant contribution by information technology oriented shared owned firms to China's economic performance might be questionable. Developing countries such as China do not reveal their international competitive advantages in the development of products in the field of high technology. China's strengths are based in low wages of their large amount of unskilled labor. On the other hand, this is attractive for foreign investors since intermediate products with high technology can be exported to China, be assembled with low costs, and then the final high-technology products can be re-exported to foreign markets. Economic effects of JVs in the IT area might be of low magnitude for China because not many of them might exist and it might be possible that few domestic production factors are applied by these corporations. This would mean that not much value added would be created by these enterprises and that a relatively large fraction of induced value added would be distributed outside China in countries where the partners of the joint ventures are located. To answer the question about the possible economic outcomes of IT-focused joint ventures in China a computable general equilibrium (CGE) model gets used for the analysis. It models the economic interconnections within China as well as between the country and other economies in the world. By taking the countries' international competitive advantages into account the CGE model estimates economic effects of these joint ventures. The background of the study outlined that jointly owned enterprises in the information technology might influence the economic development of China and that this relationship can be analyzed with a CGE model.

OECD (2000), Hu and Khan (1997), and Chen, Chang and Zhang (1995) show in general positive economic effects of foreign direct investments in China. Also Tseng and Zebregs (2002) confirm that this type of investments plays an important role in China's economic development process but highlight, for example, the growing regional income disparities. In contrast to the positive view of the importance of FDIs as well as JVs for the economic progress of China, Braunstein and Epstein (2002) present a less glamorous picture. They reveal a small positive impact on wages and employment and a negative influence on domestic in-

links to rapidly growing domestic industrial and commercial users fostering learning in product development. India, in contrast, is exporting its software services showing a less dynamic development (Tschang 2003).

vestments and tax revenues suggesting that FDIs crowd out domestic investments and the bargaining power provided by China's consumers is not realized due to the highly decentralized political system with widespread corruption. Basu and Weil (1996) explain that technology improvements resulting from the technology transfer from the international partners of JVs diffuse only slowly. To increase national development policy makers have not only to create an environment attracting international investors for joint ventures but also make spillovers possible by creating the ability and motivation in local firms to invest in absorbing foreign technologies and skills (Blomström and Kokko 2003). Smarzynska (2002) partly questions this economic policy advice. She concludes that domestic firms benefit little from multinational corporations in the same sector. Foreign companies have an incentive to prevent spillovers enhancing the performance of local competitors. Knowledge transfers to their local suppliers of intermediate products in other sectors are more likely because spillovers increase their own performance. Productivity growth in domestic suppliers reduces costs of international enterprises – they can buy cheaper inputs. But it is also possible that the productivity growth is a result of increased competition among the supplying sectors then attracting FDI inflows might be not the policy of choice. The survey of recent studies could not answer the question: How strong do IT-JVs effect the economic development of China? The general positive picture might be not the case for JVs in the high-technology area.

We believe that IT-focused joint ventures impact the economic development of China with very low magnitude. The country's international competitive disadvantages are supposed to be in high technology. Furthermore, since China shows advantages in low-skilled labor and the country's role as an international working bench it is additionally expected that only a low level of value added being created by jointly owned companies in the information technology area stays in China.⁷

This study proceeds as follows: Section 2 portrays the economic development of China. It is so doing by highlighting the importance of the international financing of investments and the evolution of the country's economic performance. Furthermore, the access of China's people to information technology gets investigated. The simulation design to empirically analyze the

⁷ For example, in the software industry India produces mainly for export demand whereas China produces for domestic demand. This indicates that the international competitive power of China's software industry is weak as compared with the Indian sector (see JBIC 2002). JBIC (2002) estimates the macroeconomic effects in China and many other countries due to the increase of labor productivity by applying the computable general equilibrium model GTAP version 5. The actual labor productivity changes in the United States serve as shock for the simulation. The results indicate for China that GDP growth is 0.7 percent, the price level increase is 0.1 percent, and that exports rise for 0.1 percent which is twice as much as for imports.

linkage between joint ventures in information technology and China's economic progress gets introduced in section 3. Next, section 4 outlines the simulation results of FDI inflows in IT-concentrated JVs and interprets these outcomes. The economic effects of interest are the expansion of China's gross domestic product (GDP), changes in the output of sectors and thus structural transformations within China. This goes in line with variations in international trade patterns and shifts in labor use reflecting labor movements. Moreover, the section presents changes of the investment-induced domestic and international value added. Section 5 draws some conclusions of this study and presents an outlook for further work.

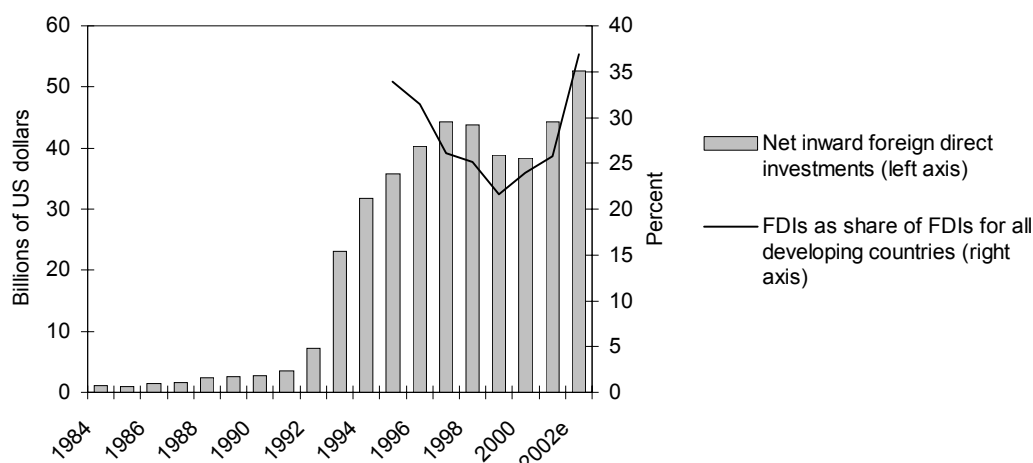
2. The IT sector and FDI in China

An overview of the history of China's economic growth lays out the foundation for the following empirical analysis. This section presents the international financing of investments because a fraction of the international capital flows in IT-oriented joint ventures.⁸ This includes an exploration of the domestic financing of investments adding the international inflows to the national financial sources. Hence, this reveals the significance of international capital for China. A view on receiving enterprises as well as industries supplements this part. Furthermore, this section presents the output of goods and services of the country to highlight its convergence process within the world economy. China's penetration with information technology draws attention to the magnitude of the usage of IT products.

FDI inflows rose from 916 million US dollars in terms of actually realized investments in the year 1983 to 3,487 million US dollars in 1990. Then they rapidly accelerated in the mid-1990s before stabilizing at around 40 billion US dollars by 2000 (see OECD 2003). Figure 1 illustrates the FDI net inflows to China from the year 1984 to 2002.

⁸ Multinationals have the option to invest in a wholly foreign owned enterprise instead of a joint venture reducing the FDI flows to the latter type of international corporations. An additional way for a financial commitment is a portfolio investment in a domestic firm which also lowers international capital flows in information technology focused joint ventures by the degree of substitution of FDI with this type of financial transfer.

Figure 1: Net foreign direct investments flows to China, 1984-2002



Source: World Bank (2003), p. 208, ADB (2002), pp. 130 f.
 Note: e is estimate.

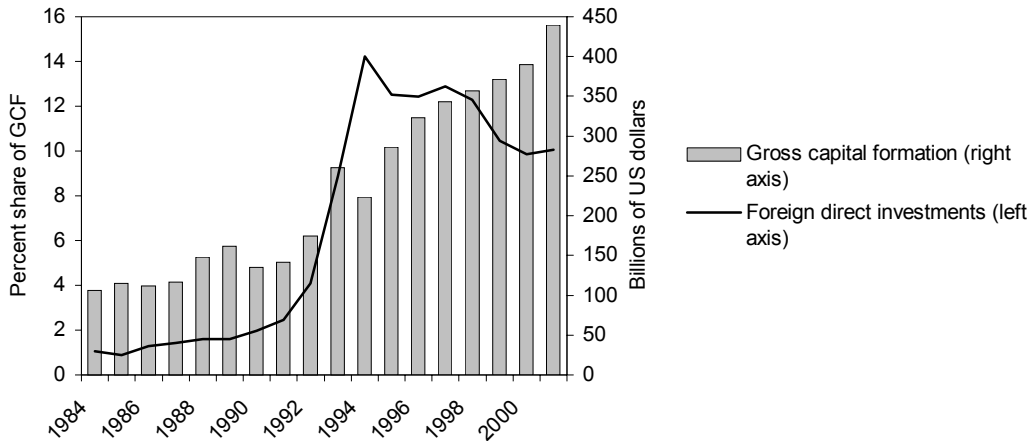
In 1993 the FDIs gained momentum to a level of 52.7 billion US dollars in 2002 which is the number one position of all developing countries in that year (share of 36.9 percent).⁹ In addition to this figure, China became the world's largest recipient of FDIs by overtaking the USA's FDIs in 2002. The FDIs to China is estimated to reach the level of 62.0 billion US dollars in 2003 in spite of the influence of SARS and the world recession (see The Economist Intelligence Units (EIU), the Economist Groups¹⁰). Two factors lead to the decline in FDI net inflows in the years 1999 and 2000. Since the abrupt slowdown of private capital inflows in developing countries in the financial crises of 1997 to 1999, these capital flows only slowly recover. Secondly, the increased capital inflows in the United States due to optimism about technological trends were realized in the expense of capital inflows in developing countries. (World Bank, 2001, pp. 34 f.). After the year 2000 the technology-driven capital flows slowed down abruptly because of the burst of the technology bubble. FDI net inflows in China as share of FDIs for all developing countries extremely increased again in 2000 due to the introduction of market reforms which improved the investment climate as desired by foreign investors (World Bank 2002, p. 39). The gross capital formation (GCF) and the FDI net inflows as share of GCF are portrayed in Figure 2 from 1984 to 2001.¹¹

⁹ In 1992 China adopted new open policies for foreign direct investments (OECD 2000, p. 4).

¹⁰ <http://www.eiu.com/>

¹¹ GCF is the gross investments within a period of one year and thus the domestic financing of investments which consists of national and international financial sources to increase the country's capital stock.

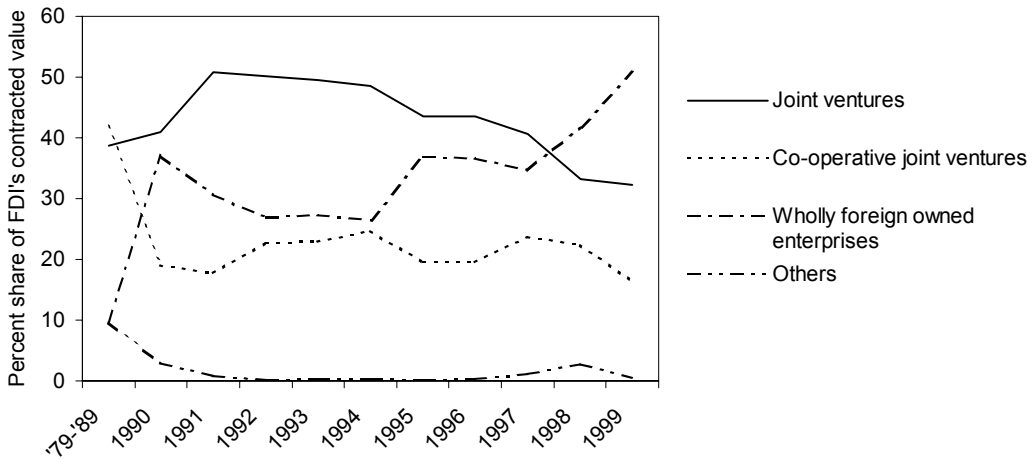
Figure 2: Investments financing in China, 1984-2001



Source: World Bank (2003), pp. 208 f., ADB (2002), pp. 124 f.

Figure 2 reflects the tendency of the GCF to increase steadily to 439.5 billion US dollars in 2001. Since 1994 FDIs account for a large share of the GCF (10.1 percent in 2001). In addition, Figure 3 splits up the FDI inflows by their receiving firms between the years 1979 and 1999.

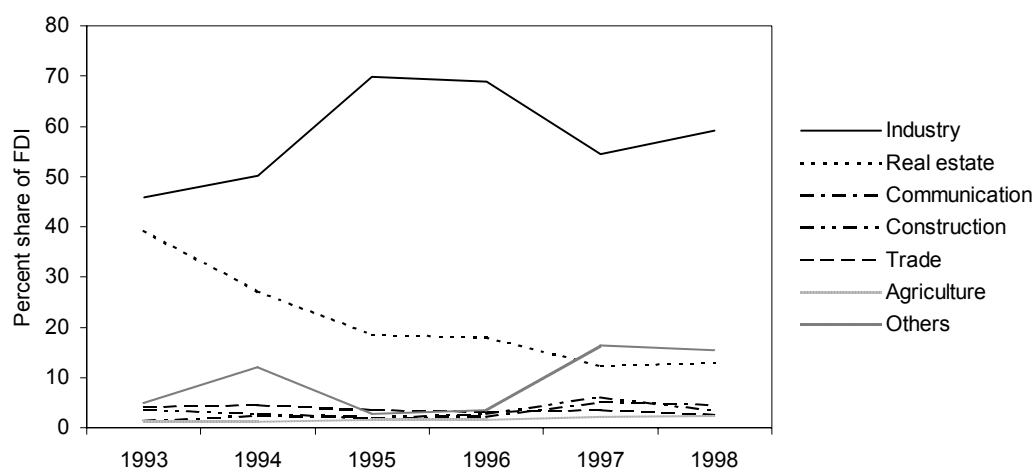
Figure 3: Foreign direct investment flows to enterprises in China, 1979-1999



Source: OECD (2000), p. 10.

Joint ventures together with co-operative joint ventures play the dominant role in China which is in trend declining because of the growing attractiveness of wholly foreign owned enterprises through China's WTO accession. Wholly Foreign Owned Enterprises (WFOEs) outperform joint ventures and co-operative JVs in 1999 with 50.7 percent of foreign direct investment's contracted value by 1.9 percentage points. The answer to the question which economic sectors catch the attention of FDIs gives Figure 4 for the years 1993 to 1998.

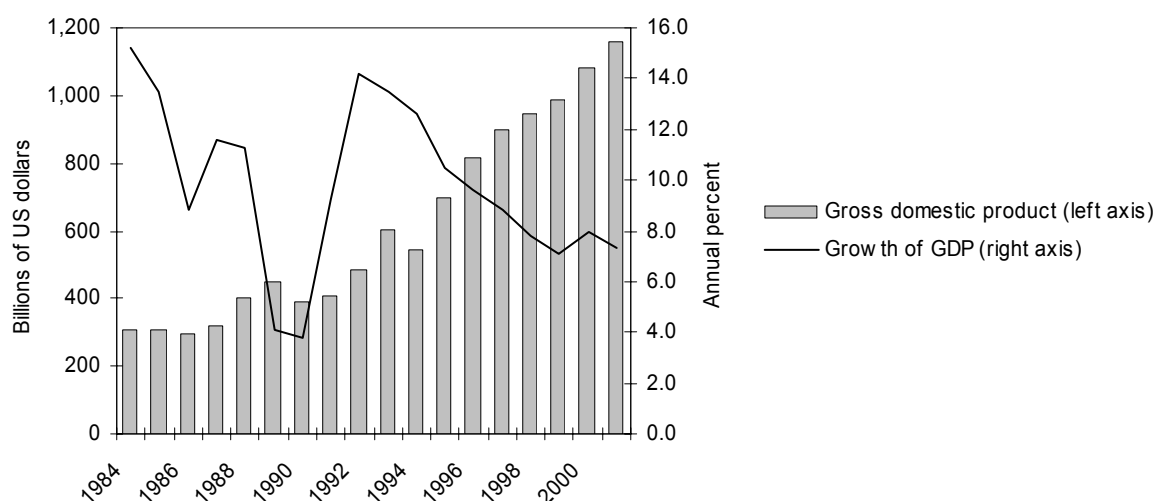
Figure 4: Foreign direct investment flows to economic sectors in China, 1993-1998



Source: OECD (2000), p. 31.

Most capital flows in the industry sector accounting for 59.1 percent share of FDI in 1998. Within the last 25 years, this capital concentrated to low technology, or labor intensive, industries. The fourth important sector is communication with 4.4 percent in 1998 (1.3 percent in 1993). Though the share of communication sector is relatively small, this sector grows up steadily in this period. Figure 5 shifts the focus to the economic development of China from the year 1984 to 2001.

Figure 5: Economic performance of China, 1984-2001

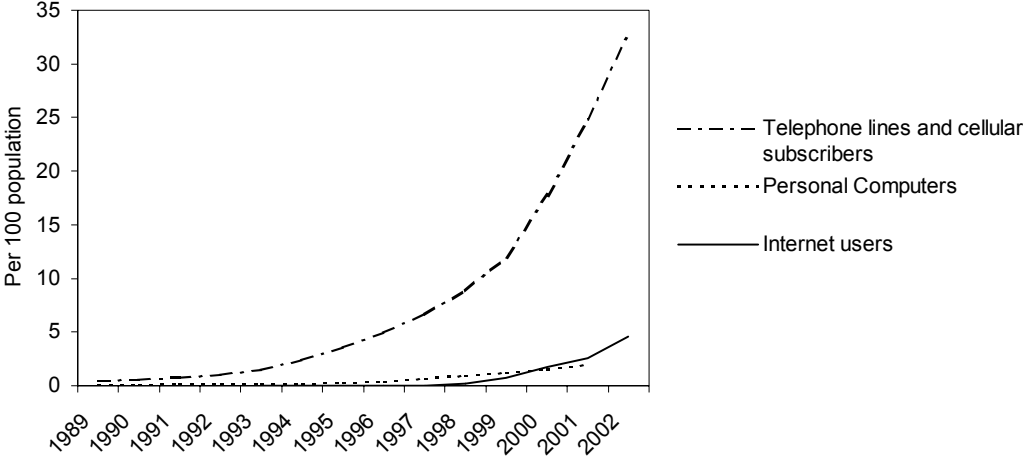


Source: ADB (2002), pp. 124 f., World Bank (2003a).

The GDP increases in tendency every year to 1,159 billion US dollars in 2001. China faces a remarkably high but since 1992 declining grow rate (7.3 annual percent in 2001). With Figure

6 the intensity of the information technology’s usage in China gets illustrated between the years 1989 and 2002.

Figure 6: China’s penetration with information technology, 1989-2002



Source: UN (n.a.).

China faces a low level of 32.8 telephone lines and cellular subscribers per 100 population in 2002 but with a strong annual growth rate. In addition, 1.9 Personal Computers per 100 population (2001) and 4.6 Internet users per 100 population (2002) indicate the country’s diffusion degree of information technology at a very low but increasing level.¹² The scenario for the empirical analysis of economic effects of China’s international joint ventures in the information technology business gets introduced in the following section.

3. The framework of CGE and database

CGE models assume an economic equilibrium that gets distorted by an external shock. Then, they estimate economic effects necessary to come back into a situation of system-wide balance. The Global Trade Analysis Project (GTAP) model is chosen for this study (see Brockmeier 2001, Itakura and Hertel 2000, Hertel 1997, Hertel and Tsigas 1997). The GTAP model is a multi-regional multi-sector applied general equilibrium (AGE) model. AGE models are members of the class of CGE models. It is an applied model and not a theoretical one because its focus is on economic policy relevance and not insights about economic key mechanisms. Furthermore, it is a general equilibrium model and not a partial equilibrium model because resources shift among alternative uses, feedback effects among income and expenditure exist,

¹² As reference, the US shows 114.7 telephone lines and cellular subscribers per 100 population (2002), 62.5 Personal Computers per 100 population (2001), and 53.75 Internet users per 100 population (2002) (UN n.a.).

and it offers a sound theoretical structure. The model is also multi-regional and not single-regional because patterns of specialization and trade among regions exist and international trading partners are not exogenous. In addition, this model consists of accounting equations and relies on value flows. Value flows correspond to real flows crossing markets in the opposite direction. In so doing, the GTAP model describes the economies of the world. It divides the world in several countries and regions, respectively. Hence, every economy is modeled in the same way. The model links all economies by trade flows and thus it is a global model (see Hertel 1997).

How does the GTAP model describe economic relationships within an economy as well as between economies? Inside an economy the regional household's income is linked with spending of private households, government expenditure, and savings. Producers are connected with income and expenditure. Taxes and subsidies are related to the agents. Furthermore, a region is linked with the rest of the world by exports and imports. A global banking sector ties global savings to investments. The linkage of the agents and the world is done through markets where supply equals demand. The underlying equation system of the GTAP model includes two different kinds of equations. Equilibrium relationships ensure that receipts and expenditures of agents are balanced and behavioral relationships specify the agents' behavior of optimization (see Brockmeier 2001, Itakura and Hertel 2000, Hertel and Tsigas 1997, pp. 13 ff.).

The GTAP Data Base and the GTAP behavioral parameters along with the theory of the GTAP model determine simulation results (Dimaranan and McDougall 2002, Gehlhar et al. 1997, pp. 74 ff., Huff et al. 1997, pp. 124 ff.). Version 5 of the GTAP Data Base consists of 66 regional economic data bases being linked among each other by bilateral trade, transport, and protection matrices (Center for Global Analysis 2001). The data are value flows being measured in US dollars and effective rates of protection. Regional data bases describe the intersectoral linkages of 57 sectors within each region and these databases are derived from individual national input-output tables.¹³ Endowment commodities of each sector include unskilled labor, skilled labor, capital, land, and natural resources. To simulate the economic effects of foreign investment financing in China's IT-JVs regions, economic sectors, and production factors are aggregated according to the problem. Table 1 illustrates the aggregations for the model experiment.

¹³ Input-output tables link production output of economic sectors with the necessary input of intermediates and production factors.

Table 1: Aggregations of regions, sectors, and factors

Regions	Industries	Factors
China	Information Technology	Capital
United States	Manufactures	Un-skilled Labor
European Union	Services	Skilled Labor
Japan	Primary Products	Land
Rest of Asia		Natural Resources
Rest of the World		

The table shows that the scenario consists of the regions China and its most important business partners US, EU, Japan, and the other countries within Asia. All other economies are represented by the region rest of the world. In addition, the economic sectors of interest are aggregated to the IT, manufactures, services, and primary products sector. But, the GTAP database does not explicitly include an information technology sector (see McDougall and Dimaranan 2002, pp. 8-9 ff.). The electronic equipment sector matches the information technology industry best of all other sectors. It is assumed that the production function of the sector of electronic equipment equals that one of IT-oriented shared owned companies. The production of, for instance, electronic circuits and boards of computers and telecommunication equipments needs comparable experiences and manufacturing facilities as for radio and television sets. Furthermore, the GTAP data base does not distinguish between joint ventures and other forms of enterprises as, e.g., state-owned, mixed-owned, private owned, and wholly foreign owned enterprises. The private forms of companies dominate the technology-oriented industries which have similar levels of productivity because of relatively homogenous cost structures based on their concentration on the assembly of products with a low level of research and development. Behavioral parameters consist of the agents' elasticity specifications for each region. These are substitution elasticities in consumption and production, demand elasticities of consumers, transformation elasticities determining the degree of mobility of primary production factors across sectors, and allocation flexibilities of regional investment.

The capital inflows for the IT-JVs in China represent the shock to the system and economic outcomes, bringing the system into a circumstance of stability, correspond to the economic development. The GTAP model is supported by the GTAP database (refer to Dimaranan and McDougall 2002, Center for Global Trade Analysis 2001, Gehlhar et al. 1997, pp. 74 ff., Huff et al. 1997, pp. 124 ff.). An empirical analysis with the GTAP model enhances a theoretical

one because it allows estimating the magnitude of the induced economic consequences. Thus, the empirical investigation offers additional implications for economic policy.

An assessment of the influence of foreign direct investment inflows to China’s shared owned enterprises in the IT business on the country’s economic development begins with an implementation of these capital flows in the model framework. FDI is capital which is usually backed by transfers of managerial skills, technological capabilities, and marketing expertise (see section 1). Spillover effects of these non-monetary transfers from receiving sectors to others occur, for instance, through the use of intermediate inputs. This study investigates the economic effects of capital inflows but excludes those of the technology transfer and spillovers.¹⁴ Furthermore, the scenario, chosen for this contribution, is based on an estimated foreign direct investment inflow to joint ventures in the information technology sector of China defining the shock to the model. Table 2 presents the estimation results for the year 1993 to 1998. This period reflects the most recent available data.

Table 2: Estimation of FDI inflows into IT-oriented JVs in China, 1993-1998

Billions of US dollars	1993	1994	1995	1996	1997	1998	1993-1998
Total FDI inflow	23.1	31.8	35.8	40.2	44.2	43.8	218.9
Joint ventures	16.7	23.3	22.6	25.3	28.4	24.4	140.7
IT-joint ventures	0.2	0.4	0.4	0.4	1.1	0.8	3.4

Source: Calculated from ADB (2002), pp. 130 f., OECD (2000), p. 10, p. 31, and Center for Global Trade Analysis (2001).

The starting point is the net FDI capital flow into China which cumulates within 1993 and 1998 to 218.9 billion US dollars as illustrated in Figure 1 (section 2). Next, it is of interest how much of total FDI inflows address international JVs in China. Figure 3 portrays the percentage distribution of foreign direct investments between enterprises which leads to a cumulated foreign investment financing of all joint ventures of 140.7 billion US dollars (1993 to 1998). Finally, the focus is put on that part of the capital which joint ventures in the field of IT receive. Figure 4 illustrates the percentage distribution of FDIs among industries. It is assumed that the pattern of foreign capital flows to the IT industry is comparable of that one for the communication sector within the period of investigation because both economic sectors show similar characteristics in factor endowment, output, and development. The GTAP 5 Data Base indicates for China’s capital commodities in the IT sector a value of 7.3 billion US dollars and for those in the communication sector 9.3 billion US dollars in 1997. The relation

¹⁴ The modeling of the technology transfer and spillovers are not taken into account because they should contribute little to the economic growth as described in section 1.

of capital commodities in the IT sector to those in the communication sector is used to represent the percentage share of FDI flows to the information technology industry based on the communication sector. Table 2 displays the cumulated FDI flow into IT-JVs in China which amounts for 3.4 billion US dollars during 1993 to 1998.¹⁵ The estimated cumulative FDI capital inflow to China's IT-focused international jointly owned enterprises is used to define the shock being expressed in relative terms as 0.2 percent of the total capital stock of China.¹⁶

The specification of the closure to simulate the economic effects of the FDI shock in IT-oriented JVs in China is as follows: The base year on the simulation of the GTAP 5 is 1997. The split between model exogenous and endogenous variables is necessary to build a solvable equation system of the GTAP model. Exogenous variables are given and do not change by the model equations' interplay as the endogenous variables. The closure fits to the country-wide FDI shock and does not address the IT-specific FDI shock due to the lack of the authors' possibility of a recompilation of the model's scripts. The following changes of variables are exogenous in the specification: population, slack of saving, profit, income, endowment, capital goods, and trade, world price index of primary factors, augmenting technological change, output technological change, factor input technological change, input-neutral shift in utility function, private and government consumption distribution parameters, saving distribution parameter, tax, and output of commodities. The latter variable is exogenous because this is the place where the foreign investment financing of IT-JVs in China comes into the model as a shock. Finally, the Gragg's approach with extrapolation is used for solving the GTAP model. This method offers a good linear approximation to non-linear problems of solving approaches.

4. Simulation and results

After the previous section introduced the simulation framework, this one summarizes the outcomes of China's joint ventures in the field of information technology. The impact of these enterprises on the economic development of the country gets characterized by a closer look on

¹⁵ Our sensitivity analysis could help to clarify the quality of the estimation results. Two alternative estimation methods calculate FDI inflows to IT-JVs for 0.6 billion US dollars and 2.0 billion US dollars in 1997. The first alternative approach emphasizes the GCF of China and the latter one applies the relation between private investments and FDIs in the communication sector of all developing countries to the IT sector of China. It seems that the chosen approach produces usable results for the period with, e.g., 1.1 billion US dollars in 1997 (data source: OECD, 2000, p. 7, p. 31).

¹⁶ According to the GTAP database, total capital stock in China accounts for 2,130.46 billion US dollars in 1997 (Center for Global Trade Analysis, 2001).

changes in the production output, the pattern of international trade, and the utilization of production factors. To investigate the economic convergence process of China, its trading partners are included in the analysis being the United States, the European Union, Japan, the other countries in the Asian region, and the rest of the world. In addition, the section reflects the evolution of China’s international joint ventures in the information technology industry against the sectors of agriculture, manufacturing, and services.

The cumulative FDI inflows in IT-JVs, accounting for 0.2 percent of the total capital stock of China, influence the total output in the country and via trade interdependencies this capital affects in addition the main business partners as presented in Table 3.

Table 3: Change of GDP due to FDIs into IT-JVs in China

Percent of GDP	1993-1998
China	0.045158
United States	0.000330
European Union	0.000315
Japan	0.000603
Rest of Asia	0.000740
Rest of the World	0.000468

Source: Own calculations.

The table displays the value of total output increasing in China by 0.05 percent of the GDP value before the simulation. Firms invest the foreign capital in plants and machineries which make it possible for them to produce more output. The other regions’ GDPs rise with a significant lower magnitude. China’s IT-JVs and their supplying industries demand imported intermediate inputs to produce output as a link in the international working bench. A closer look at shifts in the production output of the sectors indicates structural changes within China. Table 4 presents the results.

Table 4: Change of output due to FDIs into IT-JVs in China

Percent of output quantity	China	United States	European Union	Japan	Rest of Asia	Rest of the World
Information Technology	0.089636	-0.001172	-0.001407	-0.000166	-0.000298	-0.001625
Manufactures	0.076337	-0.000950	-0.001175	-0.001309	-0.001370	-0.001446
Services	0.058445	0.000177	0.000283	0.000255	0.000317	0.000317
Primary Products	0.039955	0.000473	0.000360	0.000273	0.000441	0.000397

Source: Own calculations.

All sectors in China profit from the FDI inflows where the output of IT which is actually the electronic equipment sector increases most by 0.09 percent of the pre-simulation quantity. The additional capital omits the industries to employ further production factors to produce

more commodities. In case of the other regions, their output declines in information technology and manufactures and the output increases in services and primary products reflecting the ability of China to reach a stronger position in the world market of IT products at the expense of other regions. Besides the output quantity, the price of output is altered by the cumulative IT-JVs' capital as summarized in Table 5.

Table 5: Change of output price due to FDIs into IT-JVs in China

Percent of output price	China	United States	European Union	Japan	Rest of Asia	Rest of the World
Information Technology	-0.017384	0.000021	0.000076	0.000337	-0.000113	0.000058
Manufactures	-0.017326	0.000159	0.000128	0.000356	0.000302	0.000243
Services	-0.017581	0.000261	0.000239	0.000535	0.000526	0.000340
Primary Products	0.008543	0.000338	0.000269	0.000595	0.000937	0.000463

Source: Own calculations.

China's output prices decline in the sectors within the same range, e.g. for IT by -0.02 percent of the original output price, except primary products which get slightly more expensive. The price of output in the IT sector declines because an excess supply of IT products forces the firms to reduce prices to increase demand until it equals supply. Furthermore, an increase in output leads to a reduction of production costs because, e.g., of a decline in unit labor costs. The other economies have increasing prices of their industries' output at a lower level excluding the decreasing price for information technology of the region "Rest of Asia".

Furthermore, foreign direct investments, flowing in China's IT-joint ventures, influence the formation of the international division of labor. Table 6 reproduces the outcomes for the changed export pattern of the country and other regions.

Table 6: Change of export due to FDIs into IT-JVs in China

Percent of export value	China	United States	European Union	Japan	Rest of Asia	Rest of the World
Information Technology	0.068510	-0.001008	-0.001994	0.000776	-0.000377	-0.003230
Manufactures	0.071608	-0.002177	-0.001982	-0.001933	-0.000670	-0.003421
Services	0.046906	0.001251	0.002429	0.001922	0.001588	0.002002
Primary Products	-0.026798	0.004813	0.001394	0.007542	0.004427	0.002387

Source: Own calculations.

China's exports rise in all sectors except for primary products. The value of exported IT commodities increases by 0.07 percent of the initial export value. Japan's exports in the information technology area increase with small magnitude and all other business partners of China face a decline of exports in IT and manufactures. The outcomes reflect the strengthened position of China in the international information technology market. The other countries'

export values of services and primary products increase at a low magnitude. Table 7 emphasizes effects on the import side.

Table 7: Change of import due to FDIs into IT-JVs in China

Percent of import value	China	United States	European Union	Japan	Rest of Asia	Rest of the World
Information Technology	0.050671	0.000790	0.000269	0.004265	-0.000131	0.000426
Manufactures	0.025093	0.001859	0.000172	0.004485	0.001195	0.000507
Services	0.022388	0.000505	0.000523	0.001127	0.001225	0.000677
Primary Products	0.071118	-0.000250	-0.000019	0.000158	0.000658	0.000175

Source: Own calculations.

Import values of all industries in China increase due to capital inflows by, e.g., 0.05 percent of the original import value in the field of information technology because a higher level of output needs more imports of intermediate inputs. Also imports of the other trading partners of China increase but at a lower level. Exceptions are the region “Rest of Asia” in the IT industry as well as the US and the EU in the sector of primary products where import values decline. In addition, the net trade effect on domestic income is represented by the change of the terms of trade summarized in Table 8.¹⁷

Table 8: Change of terms of trade due to FDIs into IT-JVs in China

Percent of terms of trade	1993-1998
China	-0.015637
United States	0.000947
European Union	0.000306
Japan	0.001428
Rest of Asia	0.000825
Rest of the World	0.000503

Source: Own calculations.

China’s terms of trade decrease as a reaction of the stimulus by -0.02 percent of the terms of trade before the simulation. Different to that, the terms of trade of the other regions increase. The raised output in China forces the firms to reduce prices to increase international demand.

¹⁷ The terms of trade express the amount of import goods an economy is able to buy when it sells one unit of export goods. A rise (decline) in the terms of trade increases (reduces) a country’s welfare because a relative increase (decrease) of the price of exports in relation to the price of imports allows a country to buy more (less) units of imports. Thus, consumers reach a higher indifference curve describing the combinations of commodities that create the same level of the individual’s consumption utility (see Krugman and Obstfeld 2003, pp. 94 ff.). For the calculation of the terms of trade refer to Hertel and Tsigas (1997), pp. 61 f.

Finally, the cumulative capital flow into China’s international jointly owned enterprises in the information technology industry influences the allocation of production factors which Table 9 emphasizes the factor quantity.

Table 9: Change of factor use due to FDI into IT-JVs in China

China, Percent of factor quantity	Information Technology	Manufactures	Services	Primary Products
Capital	0.167837	0.166109	0.172067	0.103329
Un-skilled Labor	-0.008642	-0.010367	-0.021831	0.032887
Skilled Labor	0.007058	0.005333	-0.004583	0.039156

Source: Own calculations.

The quantity of capital increases in all sectors. In case of the IT sector, the amount of capital raises by 0.2 percent of the initial level due to the additional investments. Un-skilled labor moves out of the IT industry to the sector of primary products by -0.01 percent because added investments are made also in form of new machineries in the production being more automated. This leads to less demand of un-skilled labor. In the information technology use of skilled labor increases by 0.01 percent on the expense of the services sector. A technology intensive sector as the IT industry demands for people with management, technology, and marketing skills. Table 10 illustrates the impact of the cumulative foreign investment financing of China’s information technology focused joint ventures on production factors’ prices.

Table 10: Change of factor price due to FDI into IT-JVs in China

Percent of factor price	China	United States	European Union	Japan	Rest of Asia	Rest of the World
Capital	-0.105726	0.000321	0.000358	0.000604	0.000687	0.000404
Un-skilled Labor	0.034175	0.000281	0.000182	0.000592	0.000729	0.000359
Skilled Labor	0.021711	0.000297	0.000284	0.000602	0.000759	0.000467

Source: Own calculations.

The cost of capital declines in China whereas the cost for labor increases. The rental rate decreases by -0.1 percentage points of the pre-simulation value in China because of a surplus in additional capital to bring the market back in equilibrium. In addition, the wage for un-skilled labor increases by 0.03 percent of its original level and the wage for skilled labor rises by 0.02 percent to attract the workers to work with the additional capital. Prices of capital and labor in other regions increase at a significant lower level than those of China.

5. Conclusions

The cumulative foreign direct investment inflows between the years 1993 and 1998 into China's joint ventures, doing business in the information technology area, influence the country's economic development only very moderately. These international enterprises do not push the economy.

In general, China holds a very strong position as a recipient of FDIs within the group of developing countries but capital inflows account for a small share of the country's capital stock. International companies, which do not share their power with domestic firms, gain momentum as addressees of foreign direct investments. Moreover, China's growth rates of production output as well as per capita income are high where capital inflows are only a very small part of the country's income. Manufacturing leads not only to the highest output level in China but also attracts most private capital from abroad. In addition, exports as well as imports are of high significance for the country's economy. Within the exports, the share of products in the information technology rises to a considerable level. In contrast to that, imports of these commodities are less important but at a stable share. The degree of information technology use in China is at a very low intensity.

A closer look at the international jointly shared enterprises in the information technology industry and their impact on the economic development reveals that the GDP slightly increases in China as well as the quantity of output in the sector of information technology whereas the IT output price declines. Additionally, values of exported as well as imported IT products increase in China and its terms of trade declines. As a result of the cumulative FDI inflows the price of capital declines and the price of labor increases in the country.

China's economic stance attracts international investors who seek for a cost efficient assembly line to manufacture their final products. International corporations in China import intermediate inputs and produce with low labor costs commodities for the domestic demand as well as for international markets. This trend gains also momentum in the information technology business. For instance Infineon Technologies AG opened their new Asian headquarters in Shanghai at September 17, 2003. The engagement of this company reflects also the plans of the Chinese regime to strengthen the country's international position in the field of information technology. For instance, until the year 2020 one billion domestic citizens should dispose of a telephone. This needs software, semiconductors, devices, infrastructure, etc. from the IT industry and its supplying sectors. Moreover, the expansion in income per capita indicates a growing well educated middle class asking for information and communication. Thus, demand for Personal Computers and Internet use rises. Since foreign

mand for Personal Computers and Internet use rises. Since foreign direct investments include not only the transfer of capital but also shifts of management, technology, and marketing capabilities it is also likely that international jointly owned firms in the information technology sector demand for IT infrastructure to link with their suppliers inside and outside China as well as with their headquarters abroad. This could lead to a network effect across the country's industries due to Internet-based business-to-business solutions.

Some recommendations can be made for further work. The simulation specification in this study could be improved by emphasizing technology transfers, knowledge spillovers, and different degrees of labor mobility between sectors. A comparison between the economic effects of foreign investments in joint ventures, wholly foreign owned enterprises, and other company forms would reveal additional insights in the structure of the information technology industry of China. With the concentration on JVs the IT business can only be partly described. Because of the dynamics of this industry more recent data than those of the year 1997 which the GTAP 5 Data Base offers are of interest to investigate structural changes over time more appropriate. Namely, these results may be estimated on the electronic equipment industry that is developing and less influential for other sectors in the concerned period. In addition, a closer look at China's international business partners could give insights about gainers and losers in the international information technology market.

A different picture of the relationship between IT-focused joint ventures and the economic development of China is very likely if we do not look at the country as a whole but at areas where these shared owned firms are located like Guangdong, Fujian, and Jiangsu. It is assumed that JVs in the information technology area in these provinces highly influence the regional economic development because not only these enterprises are concentrated there but also the fitting highly skilled domestic labor. The investments of international corporations especially in high-technology support the growth in China's stock of capital assets and the accumulation of human capital being important sources of economic development in these regions. These investments lead to more equipment to work with for the workforce and thus tend to increase the workers' efficiency as well as their income. Furthermore, this might indicate an increasing divergence in regional income distribution beside a growing average income within China.

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