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Chinese Migrants and their Impact on Homeland Development

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1. INTRODUCTION

INTERNATIONAL labour flows are as much a part of the globalisation phenomenon as international flows of capital, goods and services. Throughout history, waves of mass migration have occurred such as the Chinese and Indian indentured workers of the nineteenth and early twentieth centuries (Harzig and Hoerder, 2009). These movements have displaced people in very large numbers. While the beginnings of international flows of skilled labour can be traced to the decades of the 1960s and the 1970s of the twentieth century, recent data suggest that the emigration of skilled labour from developing countries continues unabated. OECD statistics[1] show that of 70 million Asian migrants in 2009, one-third had tertiary education. This sizeable outflow of skilled labour from developing countries can be damaging since development depends on human capital, and the loss of educated manpower should be a matter of concern (Commander et al., 2008; Bhagwati and Hanson, 2009; Brinkerhoff, 2012). Much of the debate is focused on whether migration of skilled labour is brain drain, or brain circulation which leads to brain gain.

The nationalist model of brain drain views international flows of skilled labour as a zero sum game – the receiving countries gain, whereas the sending countries lose. In contrast, the cosmopolitan model enunciated by Johnson (1964), among others, argues that the outcome of such flows is in the nature of a positive sum game. The brain circulation argument suggests that migrants return to their home countries to productively invest capital and skills acquired from their adopted countries. Recent developments seem to substantiate the brain circulation argument; for example, the sizeable repatriation of funds by migrants to their countries of their origin (Brinkerhoff, 2008), which in total exceeds the volume of foreign aid allocated to many of these countries.[2] There is also evidence of migrants contributing to their countries of origin through investments, trade, aid, the transmission of technology and know-how, financial development and poverty reduction (e.g. Gillespie et al., 1999; Saxenian, 2002, 2006; Acosta et al., 2006; Cattaneo, 2009; Coughlin and Wall, 2011; Flisi and Murat, 2011; Javorcik et al., 2011; De Simone and Manchin, 2012; Amendolagine et al., 2013; Brown et al., 2013; Law et al., 2013).

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'We have only obtained restricted access to the dataset from the Administrative Committee of Zhongguancun Science Park in Beijing. This means that we did not have their permission to share the data.'

[1] Database on immigrants in OECD countries.
[2] World bank development indicators database.

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Of particular significance in this context is the substantial volume of inward foreign direct investment (FDI) in China undertaken by Chinese migrants/diaspora (Smart and Hsu, 2004). Their investments have accounted for over 40 per cent of the total FDI for the past three decades (Wei and Wang, 2009). The sizeable Chinese diaspora not only provide capital, but also much needed international networks, advanced technology and managerial knowledge. They act as a bridge to integrate China into the world economy (Saxenian, 2002; Smart and Hsu, 2004). It is asserted that 'China's development might have been very different had there not been 50 million people of Chinese origin living in the Asia-Pacific Rim, many of whom pooled their capital, technology, and access to export markets with cheap Chinese labour to produce China's export boom' (Ramamurti, 2004, p. 280). Despite such recognition of the contributions made by the Chinese diaspora, there is a lack of systematic study that empirically assesses the impact of foreign direct investment by ethnic Chinese (ECI) on indigenous Chinese firms.

Another dimension of Chinese migrants is returnees. Since the late 1970s, the Chinese government has sent a large number of students and scholars abroad expecting them to be able to enhance China's scientific and technological development when they return. More than 1.2 million have studied in developed countries and nearly 300,000 of them have recently returned to China (Lin, 2010), a dramatic increase from less than 10,000 in 2000 (Zweig, 2006). This group of people, who are called returnees, represent a new form of migrants and have profound implications for China's economic development. However, very few studies have examined the role of returnees in knowledge transfer and diffusion to indigenous firms. There is little empirical evidence to show whether migrants, including returnees, generate different levels of spillovers or whether they have higher social returns (Wei and Balasubramanyam, 2006). Hence, there is a need to produce more concrete evidence to assess the promise of brain gain.

We choose China as our research setting not only because of the level of investments by the ethnic Chinese or diaspora (Table 1) but also because of the sizeable number of Chinese migrants in the world. China's history includes waves of Chinese emigration. Wars, starvation, political deprivation and the hope for economic gain have led many Chinese to emigrate to countries such as the United States, Canada, Europe, Australia, South Africa, East and South-East Asia, and many other places. It is estimated that today around 50 million Chinese are living outside mainland China (Ramamurti, 2004). In 2000, Chinese migrants constituted the third largest group of skilled migrants among developing countries, behind only the Philippines and India (Docquier and Marfouk, 2004). OECD statistics[3] also show that among Chinese migrants in the United States, Canada, the UK, Sweden, Turkey, Poland and Slovakia in 2009, 50 per cent had tertiary education (Table 2). The return of skilled migrants represents an important source of capital, advanced technology and new ideas and has profound implications for China (Lin, 2010). Hence, it is important to empirically assess the role of ECI and returnees in the economic and technological development of their home countries, such as China.

This paper aims to systematically examine the impact of Chinese migrants on indigenous Chinese firms. Using a unique data set for firms in a high-tech cluster, the Zhongguancun (ZGC) Science Park in China, we focus on testing the impact of ECI, or ethnic Chinese-invested firms (ECIFs), and returnees on the productivity, exports and R&D of indigenous firms in comparison with non-ethnic Chinese FDI (NECFI) or non-ethnic Chinese-invested firms (NECIFs). More specifically, we empirically assess three questions:

[3] Database on immigrants in OECD countries.

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TABLE 1
FDI Inflows into China

Year	*Realised FDI (US$ billion)*	*Share (%)*				
		Hong Kong/Macao	*Taiwan*	*Japan*	*United States*	*EU*
1979–85	6.10					
1986	2.24	59.22	–	11.74	14.54	7.96
1987	2.31	69.08	–	9.50	11.36	2.28
1988	3.19	65.60	–	16.11	7.39	4.92
1989	3.39	61.24	4.56	10.50	8.38	5.53
1990	3.49	54.87	6.38	14.44	13.08	4.23
1991	4.37	56.96	10.68	12.20	7.40	5.63
1992	11.01	70.03	9.54	6.45	4.64	2.21
1993	27.52	64.91	11.41	4.81	7.50	2.44
1994	33.77	59.75	10.04	6.15	7.38	4.55
1995	37.52	54.64	8.43	8.28	8.22	5.68
1996	41.73	50.95	8.33	8.82	8.25	6.56
1997	45.26	46.46	7.27	9.56	7.16	9.22
1998	45.46	41.64	6.41	7.48	8.58	8.75
1999	40.32	41.35	6.45	7.37	10.46	11.11
2000	40.72	38.92	5.64	7.16	10.77	11.00
2001	52.79	32.27	5.64	8.24	8.40	8.49
2002	52.74	34.75	7.53	7.94	10.28	7.68
2003	53.51	33.86	6.31	9.45	7.85	7.98
2004	60.63	32.24	5.14	8.99	6.50	7.91
2005	72.40	30.75	3.57	10.82	5.07	9.35
2006	69.47	33.06	3.39	7.30	4.55	9.06
2007	82.66	37.90	2.37	4.80	3.50	5.84
2008	92.40	45.04	2.05	3.95	3.19	5.91
2009	90.03	52.08	2.09	4.56	2.84	6.13

Source: China Statistical Yearbook, various issues.

1. Does the presence of ECIFs affect: (i) productivity; (ii) exports; and (iii) R&D of indigenous Chinese firms?
2. Are knowledge spillovers from ECIFs to indigenous firms greater than those from NECIFs with regard to: (i) productivity; (ii) exports; and (iii) R&D of indigenous firms?
3. Do returnees affect: (i) productivity; (ii) exports; and (iii) R&D of indigenous firms?

We make a number of contributions to the existing literature. First, the study takes a step towards systematically investigating the impact of Chinese migrants on a range of economic activities of homeland indigenous firms and provides a better understanding of how the spillover effects of ECIFs differ from those of NECIFs. The findings add new empirical evidence on the role of migrants in the development of their country of origin. Second, differing from the existing literature, our study also considers a new form of migrants, returnees, and examines whether returnees act as a new mechanism of brain circulation/brain gain in today's globalised world economy. Third, we empirically investigate ECI-related and returnee-related knowledge spillovers simultaneously in a single framework. Hence, we are able to capture different dimensions of international knowledge spillovers. The paper is organised as follows.

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TABLE 2
Distribution of Chinese immigrants in OECD countries in 2009

	Tertiary Education	*All Levels of Education*	*Share (%)*
United States	362,312	658,287	55
Canada	76,895	150,500	51
Japan	41,904	121,751	34
Australia	29,222	63,327	46
Italy	1,278	22,372	6
United Kingdom	10,574	20,271	52
France	4,591	17,276	27
Spain	1,220	14,640	8
New Zealand	4,110	12,525	33
Austria	646	4,042	16
Switzerland	1,558	3,550	44
Sweden	1,735	3,275	53
Hungary	581	2,736	21
Denmark	526	1,764	30
Portugal	119	1,705	7
Ireland	510	1,653	31
Mexico	250	1,108	23
Czech Republic	356	922	39
Finland	265	850	31
Turkey	285	492	58
Luxembourg	87	476	18
Greece	88	337	26
Poland	156	243	64
Slovakia	33	66	50

Source: International Migration Statistics (2009; http://dx.doi.org/10.1787/mig-data-en).

Section 2 discusses the relationship between migrants and spillover effects. Section 3 describes the methodology and data. The empirical results are presented in Section 4. Finally, Section 5 concludes with policy implications.

2. MIGRANTS AND SPILLOVER EFFECTS

The literature on FDI spillovers is based on the notion that multinational enterprises (MNEs) must possess superior technology, management skills and intangible assets in order to overcome the difficulties of doing business abroad. Dunning's (1973) OLI paradigm explains the motives for firms to invest abroad and implies some possible impacts of such investment on a host country. According to the paradigm, to successfully invest abroad a firm has to possess three advantages: firm-specific assets which no other firm possesses (O), location advantages (L) offered by the countries in which they invest, and capability of internalising and exercising control over international operations (I). Such control is essential for the exploitation of O and L advantages.

The presence of FDI may be a channel for indigenous firms to gain external knowledge (e.g. Tian, 2007; Girma et al., 2009; Todo et al., 2009, 2011; Zhang et al., 2010; Vahter, 2011; Iršová and Havránek, 2013; Jefferson and Miao, 2014). External knowledge spillovers occur when a firm 'cannot capture all quasi-rents due to its productive activities, or to the

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removal of distortions by the subsidiary's competitive pressure' (Caves, 1974, p. 176). They arise from both intended and unintended communications between economic agents over time. It is noted that inward FDI may generate knowledge spillovers through demonstration effects, competition effects, vertical linkage effects and labour mobility effects. As a result, FDI spillovers may affect indigenous firms' productivity and their export and R&D decisions.

Existing literature tends to treat ECI as a conventional type of FDI (Wei and Balasubramanyam, 2006). However, such treatment may not fully reflect the special features of ECIFs, given that they possess a unique combination of 'O' and 'L' advantages (Wei and Balasubramanyam, 2006). They are simultaneously embedded in two country contexts: their country of origin and adopted country (Gillespie et al., 1999; Brinkerhoff, 2008; Javorcik et al., 2011; De Simone and Manchin, 2012). They are familiar with cultural norms and methods of operation in both countries and international markets. Embeddedness in the adopted country gives them an opportunity to draw upon sources of advanced knowledge and develop their own core competencies. When investing in their country of origin, apart from a shared culture, they are also able to assess the competence and ability of cooperant factors, negotiate much more efficiently with local bureaucracy and organise and manage local resources, chiefly labour, effectively. The complementarity of 'O' and 'L' advantages can therefore place ECIFs in a better position to overcome market uncertainties and the 'liability of foreignness' than NECIFs. ECIFs are also able to link the manufacturing establishments in China with marketing outlets in their adopted countries. Much more significant is their contribution to the marketing and networking activities of Chinese firms, and their mentoring of Chinese entrepreneurs (Liu et al., 2010). As a result, they are better placed to integrate their operations effectively in their country of origin and to establish formal and informal contacts with indigenous firms. Hence, indigenous firms may be able to imitate and absorb advanced technology and knowledge possessed by ECIFs more easily than those by NECIFs.

Reflecting the significant difference between diaspora and non-diaspora FDI, Wei and Balasubramanyam (2006) develop a theoretical argument and suggest that the migrants' contribution to the social product of countries of origin could be higher than that of other forms of FDI. Spillovers, a recognised contribution of FDI to host countries, are a much more readily recognisable feature of diaspora FDI. Although the channels for the spillover effects of diaspora FDI share some common features with those of non-diaspora FDI, diaspora-invested firms also exhibit distinctive features in terms of their spillover effects.

First, positive spillovers may take place through information externalities (Buck et al., 2007; Liu and Buck, 2007; Liu et al., 2009; Iršová and Havránek, 2013). In the context of this study, ECIFs and NECIFs tend to have advanced technologies, know-how, widely recognised brand names, well-established distribution networks and sophisticated research into international markets. This information/knowledge can be transferred to local subsidiaries and may spill over to indigenous firms including suppliers, customers and competitors. This spillage helps indigenous firms to be more productive as it may provide a way for them to improve quality and general knowledge in order to compete successfully. It may offer them an opportunity to observe what is feasible for exporting in terms of the products, prices and tastes of foreign customers, hence encouraging the adoption of an internationalisation strategy. Indigenous firms may improve their competitiveness on the international market by learning from foreign firms. In addition, the presence of ECIFs and NECIFs in an industry may push indigenous firms to boost their R&D efforts in order to learn technologies and know-how used by foreign firms. The spillovers offer indigenous firms a way to augment their human capital

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base, which contributes to their ability to undertake production, exports, R&D and other business activities.

However, there are some differences between ECIFs and NECIFs which may affect their impact on indigenous firms. ECIFs possess unique 'O' advantages ranging from knowledge of organisation of work, non-codifiable knowledge, marketing and financial know-how, and product innovations to the networks they have established with customers in their adopted countries, and an ability to forecast new developments (Wei and Balasubramanyam, 2006; Wei et al., 2008). Hence, there is a substantial volume of human and social capital embedded in Chinese migrants. They possess transferable tacit knowledge and are much more conversant with location advantages/disadvantages in China than NECIFs. Given ECIFs' more pronounced 'O' and 'L' advantages over NECIFs as outlined above, information flows between ECIFs and indigenous firms may be faster than that between NECIFs and indigenous firms. ECIFs may transfer knowledge which is most suitable for the production of goods and services in China. This may in fact produce stronger demonstration effects on indigenous firms than NECIFs.

Second, spillovers may occur through market competition (Buck et al., 2007; Liu and Buck, 2007; Liu et al., 2009; Iršová and Havránek, 2013). Such effects can be either positive or negative. The presence of ECIFs and NECIFs may increase competitive pressure which forces indigenous firms to be more efficient, seek new markets and gear up R&D activities. It may also improve the resource allocation of indigenous firms (Tian, 2007). The threat of competition may spur indigenous firms to adopt best practice and advanced technology sooner. Hence, the presence of ECIFs and NECIFs may improve indigenous firms' productivity and increase their possibility of being exporters and being R&D active. However, there can be negative spillovers. As Aitken and Harrison (1999) note, the entry of local market-oriented foreign firms can draw demand from indigenous firms, causing them to cut production. Thus, the productivity of indigenous firms would fall as they are forced to push up their average cost. In addition, they may not be able to venture abroad through exporting or invest in R&D activities.

Furthermore, given ECIFs' intermediate position, they suffer less 'liability of foreignness' than NECIFs as they are familiar with the cultural norms and methods of operation in their country of origin and have better access to advanced knowledge than indigenous firms because they are also embedded in their adopted countries. As such, ECIFs may transfer knowledge effectively due to their embeddedness in both country contexts which enables them to avoid cultural incompetence and a lack of local networks (Lin, 2010).

Third, linkages including both backward and forward linkages are another channel of spillovers (Buck et al., 2007; Liu and Buck, 2007; Liu et al., 2009). Backward linkages exist when ECIFs and NECIFs acquire goods and services from firms in upstream industries, while forward linkages arise when foreign firms sell goods and services to indigenous firms. ECIFs and NECIFs may affect suppliers in terms of the quantities of goods and services that are purchased, and through imposing requirements on the quality of inputs, and the efficiency with which those inputs are supplied. Javorcik (2004) argues that foreign firms have no incentive to prevent technology diffusion to upstream sectors as they may benefit from the improved performance of intermediate input suppliers. As a result, intangible and tangible assets can be passed on from foreign to indigenous firms. Forward linkages may contribute to the development of local distribution and sales organisations through facilitating the adoption of new technology and know-how. Again, the unique characteristics of ECIFs imply that they could generate stronger vertical linkages compared with NECIFs, as discussed above.

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Fourth, employees of ECIFs and NECIFs who possess firm-specific knowledge assets may act as a potential channel for spillovers as technology, organisation, management and production skills, and international marketing techniques can be transferred to indigenous firms through labour mobility (Buck et al., 2007; Liu and Buck, 2007; Liu et al., 2009). This potential channel may enable indigenous firms to be more efficient, more willing to enter exporting markets and more active to step up R&D efforts. Apart from a shared culture, including language, ECIFs are able to assess local knowledge and information, such as local business practices, institutional differences, operating conditions, government policies and regulations, and general knowledge of the economy (Wei et al., 2008). Such information helps them to gain a better understanding of local markets, social and business environment conditions. Therefore, ECIFs may be better able to select and effectively train local employees who can be better equipped and suited to the local environment. This may in fact generate stronger labour mobility effects on indigenous firms than NECIFs.

Finally, the above argument can also be readily extended to returnees who either set up their own firms or work for indigenous firms. Returnees, as a new form of migrants, can make direct contributions to firms that they work for and act as an important source of dynamic externalities (Saxenian, 2002; Altenburg et al., 2008; Commander et al., 2008; Lin, 2010; Nanda and Khanna, 2010). As these migrants study and/or work in foreign countries, they acquire superior technical knowledge, managerial and entrepreneurial skills and build social and professional networks. When returning to their home country, they can transfer and apply knowledge and skills they acquired from foreign countries to the new context. Their familiarity with both their home and host countries gives them opportunities to identify gaps and capitalise on cross-border differences or distances. Their international networks can help them access vital information and knowledge, and secure resources. Leveraging their possession of technologies, skills and networks can help improve the performance of indigenous firms that they work for.

Returnees can also act as a new channel for international knowledge spillovers (Lin, 2010; Liu et al., 2010). Returnees have been documented to contribute to scientific and technological development in Taiwan, South Korea and India (Saxenian, 2002; Altenburg et al., 2008; Commander et al., 2008; Nanda and Khanna, 2010). The positive information externalities and labour mobility effects associated with ECIFs, as identified above, can also be achieved through returnees. Indigenous firms are able to observe and absorb new knowledge and ideas from returnees that are not otherwise readily accessible locally and tap into returnees' networks easily due to a similar cultural background. Through interacting with returnees, indigenous firms can collect and evaluate information and knowledge possessed by these returnees, establish new contacts through returnees' networks and identify innovative opportunities. Given the advanced knowledge they bring home, returnees may collectively affect the technological base of industries. Thus, the existence of returnees may facilitate knowledge diffusion and lead to an increase in the productivity, exports and R&D of local firms.

A few empirical studies have compared spillovers from both ECIFs and NECIFs in China (e.g. Buckley et al., 2002; Hu and Jefferson, 2002; Wei and Liu, 2006; Buck et al., 2007; Wei et al., 2008; Lin et al., 2009; Ito et al., 2012). ECI is often captured by investment from Hong Kong, Macao and Taiwan (HKMT), because most of it is through HKMT sources (Smart and Hsu, 2004). At the same time, firms with investments from other foreign countries are considered as NECIFs. Empirical findings are mixed. For example, in the study of FDI productivity spillovers, Hu and Jefferson (2002) find insignificant spillovers from ECIFs to indigenous firms and statistically significant negative spillovers from NECIFs. Buckley et al.

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(2002) also reveal insignificant spillovers from ECIFs to indigenous firms, but statistically significant positive spillovers from NECIFs. Wei and Liu (2006) and Wei et al. (2008) report positive spillovers from both ECIFs and NECIFs. Lin et al. (2009) show negative spillovers from ECIFs and positive spillovers from NECIFs. In a more recent study, Ito et al. (2012) fail to find any significant spillover effects from ECIFs and NECIFs. This inconsistency may be because these studies cover firms of broad geographical spread, while spillovers are likely to be localised (Aitken and Harrison, 1999). Thus, in this study, the location of firms in the same science park provides an excellent opportunity to test the impact of spillover effect due to close geographical proximity.

3. DATA AND METHODOLOGY

Most of the data are drawn from the annual reports filed by firms in the Zhongguancun (ZGC) Science Park with the Administrative Committee of the ZGC Science Park, which is China's largest science park in the north-western part of Beijing. The data set has been used previously (e.g. Cai et al., 2007; Todo et al., 2009, 2011). The data set provides information with a wide range of firm characteristics, notably ownership classification, sales, total assets, fixed assets, intangible assets, number of employees, number of female employees, number of employees who graduate from foreign universities or institutions, and exports. In this paper, we focus on data covering the period 2000–03, as detailed information on R&D was not available before 2000 and data are unavailable after 2003.[4] For deflators, price indices are obtained from CNBS (2005).

Due to entry and exit and ownership restructuring, the number of firms in operation changes over time. In this study, the same firms have been identified, based on their identifiers, to produce a final unbalanced set of 6,444 firms. A firm has been identified as an ECIF if investors from HKMT have an ownership share of 10 per cent or more, and an NECIF if other foreign investors have an ownership share of 10 per cent or more.[5] When we construct the industry aggregate of spillover variables, industries are categorised according to the Industrial Classification and Codes for National Economic Activities of China at the four-digit industry level. Following Liu et al. (2010), a returnee is defined as a Chinese native who worked or studied in an OECD country and returned to China. Details on the construction of variables are presented in the Appendix.

We examine the spillover effect of ECIFs in contrast to that of NECIFs and the direct and indirect effect of returnees on the productivity, exports and R&D of indigenous Chinese firms. Following Wei and Liu (2006), we confine our analysis to indigenous Chinese firms to take

[4] Previous studies using the same data set, for example Cai et al. (2007), Todo et al. (2009), have covered the same period as data are not available after 2003.

[5] 10 per cent threshold level is used by OECD (http://www.oecd.org/investment/investment-policy/2090148.pdf). According to the document – OECD Benchmark Definition of Foreign Direct Investment, 10 per cent of equity share usually leads to an effective voice in the management, and the exercise of significant influence. There are a small number of firms which received investment from both ethnic Chinese and non-ethnic Chinese foreign sources. In 2003, the figure stood at 28. In the main discussion of the empirical results, these firms are classified as both ECIFs and NECIFs. Inevitably this introduces a double counting issue and therefore management errors. To address this, we carry out robustness checks and employ two alternative measures: (i) excluding these firms and (ii) classifying these firms to one ownership group according to the one with the highest share.

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account of the differences between indigenous firms, ECIFs and NECIFs. Table 3 reports firm characteristics differentiated by ownership.

Foreign firms were larger in size measured by either sales or employment than indigenous Chinese firms. The t-test statistics indicate that NECIFs were statistically significantly larger than ECIFs which in turn were significantly larger than indigenous firms, whereas the three groups of firms were not significantly different in capital intensity and human capital. However, foreign firms enjoyed substantially higher labour productivity and paid higher average wage rates than indigenous firms. ECIFs and NECIFs had a similar level of labour productivity and average wage rates. Considering the share of returnees in employment, on average, NECIFs had the highest share, followed by indigenous firms and ECIFs which had the lowest share. Around 11.7 and 8.5 per cent of NECIFs and ECIFs were engaged in exporting, respectively. This is in comparison with just 1.6 per cent of indigenous firms undertaking exports. Finally, on average, 25.6 per cent of indigenous firms were R&D-oriented, as opposed to 34.8 per cent of ECIFs and 31.1 per cent of NECIFs, but indigenous firms had statistically higher R&D intensity than foreign firms, whether they are ECIFs or NECIFs. Between the two groups of foreign firms, they shared a similar level of R&D intensity. These observed differences in output, productivity, exports and R&D therefore warrant our decision to focus on indigenous Chinese firms in the analysis.

Following recent literature on FDI productivity spillovers, for example Haskel et al. (2007) and Keller and Yeaple (2009), we use total factor productivity (TFP) as a dependent variable. In terms of exports and R&D, they both involve sunk costs and therefore can be thought of as a two-stage decision process, whereby firms first decide whether to export or conduct R&D, and second, how much exporting or R&D should be carried out, that is export or R&D intensity (Buck et al., 2007; Du et al., 2007). Therefore, for exports, we examine export orientation (EO) and export intensity (EI)) and for R&D, we investigate R&D orientation (RDO) and R&D intensity (RDI).

The main explanation variables of interests in all five models are three spillover variables – spillovers from ECIFs (*ECIF_SP*), spillovers from NECIFs (*NECIF_SP*) and spillovers from

TABLE 3
The Comparison of the Characteristics of Indigenous Chinese firms, ECIFs and NECIFs

	Indigenous Chinese Firms (1)	*ECIFs (2)*	*NECIFs (3)*	*t-Test (1) vs. (2)*	*t-Test (1) vs. (2)*	*t-Test (2) vs. (3)*
log(sales)	7.5511	8.5346	8.8113	11.22***	18.64***	2.46***
log(employment)	2.858	3.1992	3.2782	10.48***	18.05***	1.70*
log(labour productivity)	4.2667	5.0519	5.0937	11.99***	16.56***	0.54
Average wage	0.1329	0.2731	0.2988	8.59***	12.97***	0.81
Capital intensity	1.1816	1.1882	1.0746	0.01	0.16	0.32
Share of returnees in employment	0.0150	0.0083	0.0319	3.72***	12.60***	8.82***
Share of employees with bachelor degree or above	0.2876	0.2735	0.2571	0.38	1.20	1.04
Export intensity	0.0181	0.0569	0.1274	7.83***	24.65***	5.58***
R&D intensity	0.5443	0.4955	0.5066	2.74***	2.74***	0.49

Note:
*$p < 0.10$, ***$p < 0.01$.

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returnees (*Returnee_SP*). If the coefficient on ECIF_SP is statistically greater than that on NECIF_SP, this confirms that ECIFs generate more spillovers than NECIFs. To capture the direct effect of returnees, we also include a variable *Returnee*. Control variables are included in different models. Specifically, the productivity model includes *Size*, *Market Share*, *Human Capital* and *R&D Intensity* as adopted in previous studies for FDI productivity spillovers (e.g. Aitken and Harrison, 1999; Buckley et al., 2002; Haskel et al., 2007). *Size*, *Market Share*, *Human Capital*, *R&D Intensity* and *Capital Intensity* are included for FDI export spillovers (e.g. Buckley et al., 2002; Buck et al., 2007) and for R&D analysis (Liu and Buck, 2007; Vahter, 2011).

Before proceeding to the empirical results, we need to address a few econometric issues. The first is the possibility of endogeneity in productivity analysis: ethnic Chinese and other foreign firms may be attracted to sectors with higher productivity. Various strategies have been put forward, but few studies have tackled the issue satisfactorily. One common approach is the use of instrumental variables. However, as is well known, it is very difficult to create an effective set of instruments (Wei and Liu, 2006). To minimise the possible endogeneity and take into account the lag between knowledge spillovers and gains in productivity, we used the lagged spillover variables (with one year) when estimating differenced equations. Following Haskel et al. (2007), we also included a full set of fixed effects which take account of time and industry-specific factors such as high-quality management, infrastructure and technology opportunity. Second, given the nature of the dependent variables, the export orientation and R&D orientation equations were estimated using the probit model and the export intensity and R&D intensity equations using the tobit model. Similar to the productivity analysis, we included year and industry dummies in the export and R&D equations and used the lagged spillover variables to consider the fact that spillovers may take time to materialise. Finally, all equations are estimated with correction for the clustering effect. Since our spillover variable measures vary across industries, any clustering in the residuals estimated regressions may be exacerbated (Moulton, 1990). Hence, correction is made for heteroscedasticity and for clustering at the industry-year level.

In addition, the existing literature suggests that the extent of knowledge spillovers is a function of a technology gap (e.g. Kokko, 1994; Sjöholm, 1999). We estimate two models for each dependent variable according to a firm's technology gap with the industrial frontier. To define the industrial frontier, we use the average level of capital intensity of the top 1 per cent percentile of ECIFs and NECIFs in four-digit industry. We choose capital intensity as our metric because this measure captures expected differences in technology rather than observed differences (Kokko, 1994).[6] The larger the difference between a firm's own capital intensity and the industrial frontier, the higher is the technology gap. The median value of the technology gap variable is used as the selection criterion to divide the sample in two. The technology gap reflects both the potential of spillovers and indigenous firms' capacity to absorb external knowledge. A low-technology gap indicates that indigenous firms are close to the industrial frontier and therefore have better absorptive capacity to take advantage of international knowledge diffusion. However, a low-technology gap may also mean limited benefits that indigenous firms can extract from knowledge spillovers. On the other hand, although a higher technology gap represents more opportunities for indigenous firms to benefit from

[6] Kokko (1994) proposes another two measures: patents and labour productivity. However, data for patents at industry level are unavailable. The latter measure suffers from the possibility that the cause of observed differences can be the result of differences in capital intensities or scales of production rather than differences in technologies (Sjöholm, 1999).

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international knowledge diffusion (Gerschenkron, 1962), it also implies that indigenous firms lag behind in their technology level. Therefore, knowledge brought by foreign firms to the host country may be too advanced to add value to indigenous firms or indigenous firms may not have the level of absorptive capacity to internalise and integrate such knowledge for their own use (Crespo and Fontoura, 2007). Therefore, how a technology gap moderates spillover effects is an empirical question.

4. EMPIRICAL RESULTS

Table 4 reports summary statistics and the matrix of Spearman correlation coefficients for the variables used in the analysis. It shows that the correlation between variables is relatively low. The main regression results are summarised in Table 5. Columns I-V represent the estimation results for productivity, export orientation, export intensity, R&D orientation and R&D intensity, respectively. For each set of regressions, we divide sample into two groups, that is low-technology gap vs high-technology gap. Below, our discussion will focus on the key findings on ethnic ECIF and NECIF spillover variables (*ECIF_SP* and *NECIF_SP*), *Returnee* and *Returnee_SP* variables after controlling for firm characteristics and industry- and year-fixed effects. The evidence points to significant externalities from ECIFs, NECIFs and returnees on indigenous firms, but in different areas. On the productivity front, ECIFs and returnees have a positive impact on indigenous firms, albeit the coefficient on *Returnee_SP* is statistically insignificant when the technology gap is high. NECIFs' impact is negative and statistically significant regardless of the technology gap. These results are generally in accordance with the expectations formulated in Section 2. As for the direct impact of returnees, the coefficients on *Returnee* are positive, but only statistically significant given a high-technology gap.

TABLE 4
Descriptive Statistics and Correlation Matrix

Variable	*Mean*	*SD*	*1.*	*2.*	*3.*	*4.*	*5.*	*6.*	*7.*
TFP	3.333	4.800							
Export orientation	0.027	0.161							
Export intensity	0.032	0.155							
R&D orientation	0.261	0.439							
R&D intensity	0.536	0.469							
1. ECIF_SP$_{-1}$	0.065	0.099							
2. NECIF_SP$_{-1}$	0.134	0.121	0.293						
3. Returnee_SP$_{-1}$	0.009	0.013	0.099	0.241					
4. Returnee	0.138	0.344	0.019	0.045	0.136				
5. Size	0.528	0.295	0.021	0.003	−0.058	0.032			
6. Market share	0.044	0.172	0.036	−0.031	−0.072	0.112	0.100		
7. Human capital	6.727	18.316	−0.063	−0.059	−0.067	0.088	0.081	0.486	
8. Capital intensity	1.167	31.593	−0.137	−0.158	−0.272	−0.024	0.115	0.200	0.340

Notes:
(i) Variable definitions are provided in the Appendix.
(ii) SD, Standard deviation.
(iii) Correlation matrix contains spearman correlation coefficients.

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TABLE 5
Empirical Results

	TFP		*Export Orientation*		*Export Intensity*		*R&D Orientation*		*R&D Intensity*	
	I.1 Low-technology Gap	*I.2 High-technology Gap*	*II.1 Low-technology Gap*	*II.2 High-technology Gap*	*III.1 Low-technology Gap*	*III.2 High-technology Gap*	*IV.1 Low-technology Gap*	*IV.2 High-technology Gap*	*V.1 Low-technology Gap*	*V.2 High-technology Gap*
ECIF_SP$_{-1}$	3.165**	2.497**	−0.139	−2.923***	−0.137	−2.804***	0.340**	−0.082	0.200**	−0.142
	(1.188)	(0.990)	(0.289)	(0.738)	(0.217)	(0.256)	(0.172)	(0.273)	(0.100)	(0.159)
NECIF_SP$_{-1}$	−1.774**	−0.805**	0.816**	1.044**	0.724**	0.906***	0.288***	0.366*	−0.050	0.211*
	(0.699)	(0.378)	(0.374)	(0.520)	(0.291)	(0.092)	(0.100)	(0.194)	(0.093)	(0.113)
Returnee_SP$_{-1}$	55.710***	17.872	2.208**	4.914***	1.894**	4.626***	−1.314	−0.462	1.230***	0.588
	(11.388)	(15.612)	(0.962)	(1.598)	(0.791)	(0.395)	(2.579)	(2.592)	(0.437)	(0.933)
Returnee	0.268	0.497**	0.289***	0.264*	0.223***	0.227***	0.031	−0.079	0.035	0.053
	(0.508)	(0.197)	(0.079)	(0.151)	(0.070)	(0.023)	(0.046)	(0.065)	(0.032)	(0.049)
Size	2.200***	2.729***	0.910***	1.156***	0.655***	1.047***	0.769***	0.726***	0.001	0.022
	(0.339)	(0.851)	(0.176)	(0.271)	(0.185)	(0.044)	(0.062)	(0.117)	(0.051)	(0.092)
Market share	−1.029*	−0.039	1.155***	0.469	0.792***	0.373***	1.012***	0.929**	−0.116	−0.025
	(0.524)	(0.460)	(0.254)	(0.452)	(0.220)	(0.056)	(0.212)	(0.391)	(0.094)	(0.155)
Human capital	0.004	−0.019	0.002**	0.001	0.001***	0.000	0.000	−0.002	0.000	−0.000
	(0.005)	(0.013)	(0.001)	(0.004)	(0.000)	(0.001)	(0.001)	(0.003)	(0.000)	(0.001)
R&D intensity	−0.292	0.355	0.370***	0.105	0.275***	0.029				
	(0.245)	(0.258)	(0.099)	(0.133)	(0.081)	(0.031)				
Capital intensity			0.013*	−0.088	0.010	−0.320*	−0.034***	1.209***	−0.005	0.254
			(0.008)	(0.616)	(0.007)	(0.188)	(0.009)	(0.395)	(0.004)	(0.193)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	766	556	2,942	2,631	2,544	2,305	6,506	5,909	2,942	2,665

Notes:
(i) Standard errors clustered by industry-year in brackets.
(ii) *$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

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Ethnic Chinese from HKMT and returnees share the same culture with their local Chinese counterparts who can relatively easily understand the former's knowledge and skills. Thus, knowledge spillovers from ECIFs and returnees are evident in our findings. However, when the technology gap is taken into account, the effect of returnees varies. While returnees can improve the productivity of firms that they work for when the technology gap is high, they have a limited spillover effect on other firms' productivity. On the other hand, when the technology gap is low, returnees transmit few direct benefits to the firms that they work for, but collectively they bring up the overall efficiency level of the industry.

As we have included market share in the estimation which controls for competition effects (Girma et al., 2009), the reason for the negative spillover effects associated with NECIFs can be linked to the mobility of productive workers. As shown in Table 3, on average, NECIFs pay higher wages than those in indigenous firms, which can result in 'brain drain' from the latter to the former. In consequence, the presence of NECIFs has a negative spillover effect on the productivity of indigenous firms.

Quantitatively, *ceteris paribus*, for a low-technology gap, the point estimate on *ECIF_SP* indicates that an increase of 100 percentage points in the share of ECIFs in an industry in terms of employment leads to, on average, around 3 per cent increase in the TFP of indigenous firms in the same industry, while the same unit of increase in the share of returnees in an industry leads to nearly 56 per cent increase in the TFP of indigenous firms in the same industry. This substantially higher positive impact of returnees than ECIFs may reflect the fact that returnees with an educational background in China are able to maintain associations with China during their year abroad and have a better understanding of social, cultural and institutional environments than ECIFs. They also have a higher capacity to adapt to the context of the home country and have better connections with indigenous firms than ECIFs. In the same group, an increase in 100 percentage points in the share of NECIFs in an industry leads to, on average, about 0.8 per cent decrease in the productivity of indigenous firms in the same industry.

Comparing the point estimates on *ECIF_SP* and *NECIF_SP* between low- and high-technology gap groups, the magnitudes are higher in the former than in the latter, but such differences are not statistically significant with test statistics of the value 0.35 and 1.28, respectively. This implies that indigenous firms benefit more from ECIFs and NECIFs regardless of technology gap.

Results from the export (orientation and intensity) equations suggest negative spillover effects associated with ECIFs, but positive spillover effects with NECIFs, though *ECIF_SP* is statistically insignificant given a low-technology gap. The results may reflect the fact that ECIFs are more export-oriented and compete fiercely with indigenous firms in the international market (Buckley et al., 2002). On the other hand, NECIFs have carried out a lot of outsourcing in China, and thus provide ample opportunities for positive demonstration effects and labour mobility effects, while their competition effects are less significant. The effects of NECIFs are similar in both high-tech and low-tech scenario, with test statistics being 0.26 in export orientation equations and 0.47 in export intensity equations. In terms of the role of returnees, the coefficients on *Returnee_SP* and *Returnee* are all positive and statistically significant. The results suggest that returnee employees boost indigenous firms' exports both directly and indirectly due to their international knowledge acquired and networks established while studying and working abroad.

With regard to R&D activities, ECIFs have a significant and positive impact on indigenous firms' R&D orientation and R&D intensity when the technology gap is low, indicating that

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indigenous firms are able to benefit from ECIF knowledge spillovers only when they have a certain level of absorptive capacity, or are subject to a small technology gap. As argued by Wei and Liu (2006), the industrial projects launched by ECIFs are mainly labour intensive and therefore are compatible with mainland China's resource endowments based on which indigenous firms' R&D is developed. Buckley et al. (2002) also maintain that ECIFs use technologies that are generally standardised and mature. With a low-technology gap, indigenous firms can easily learn from ECIFs, and therefore, the presence of ECIFs facilitates the R&D activities of indigenous firms. However, when a technology gap between the two groups of firms is large, given the familiarity of ethnic Chinese with the local context, ECIFs can easily compete against indigenous firms, thus deterring the latter's innovation incentives and R&D activities.

Non-ethnic Chinese-invested firms positively and significantly influence R&D orientation regardless of the technology gap, but affect R&D intensity when the technology gap is high. NECIFs usually possess advanced technologies, enjoy strong technological and management capabilities and make great commitment to quality control and technological adaption to suit the needs of Chinese consumers (Buckley et al., 2002). Naturally, their mere presence in China gives indigenous firms the incentive to engage in R&D in order to imitate NECIFs and catch-up with industry leaders. However, when the technology gap is low, NECIFs have little impact on the extent of the R&D activities of indigenous firms. The high-technology gap on the other hand implies large potential for knowledge spillovers, thus facilitating indigenous firms to undertake more R&D activities in order to catch up with NECIFs. Returnees only have significant spillover effects on the R&D intensity of indigenous firms with a low-technology gap. Its direct and indirect effects in other scenarios are all statistically insignificant.

To complement our empirical findings, we used interview data to provide detailed information on how returnees affect exports and generate R&D spillovers for non-returnee firms as well as how local firms perceive ethnic Chinese investors and non-ethnic Chinese investors. First, our interview evidence shows that returnees perceived themselves as 'knowledge brokers' or a bridge between China and the outside world and they still keep regular contacts with professionals outside China after returning to their home country. They also revealed that they have learned a great deal about how to compete in the international market and have established international networks when studying/working abroad. They believe that their accumulated international experience and networks have helped to boost the export sales of their firms.

Second, our interviewees in local firms feel that they lack the knowledge and channels to target the international market compared with returnees. They acknowledged that returnees have brought some new technology, new ideas and new business concepts and feel that they can easily establish links with returnees through socialisation. Social contact and informal networks with returnees enabled them to develop trust and facilitate communications, hence serving as a mechanism for knowledge spillovers.

Third, the interview evidence demonstrates that local firms regarded ethnic Chinese investors as part of a broader Chinese community as they share the same language and culture. The local interviewees feel relatively easy about learning from ECIFs as they encountered smaller barriers to knowledge transfer than those of NECIFs. They believe that sharing the same identity with ethnic Chinese investors enables them to have more informal contacts with ECIFs than NECIFs, thus increasing the opportunities for knowledge transfer through frequent interactions. On the other hand, such cultural and strategic similarities with returnees and

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ethnic Chinese investors made local firms fear such industry leaders due to a lack of complementarity.

a. Robustness Checks

Various checks of robustness are performed. Table 6a presents the results when human capital is measured by skilled intensity. The qualitative findings are the same as those in Table 5. Table 6(b)–(d) shows the results when alternative measures of ECIF_SP$_{-1}$ and NECIF_SP$_{-1}$ are constructed using the share of capital investment, sales and assets of foreign firms in a four-digit industry. Again similar results are obtained, demonstrating the robustness of our key empirical findings. Following Haskel et al. (2007), one alternative strategy in dealing with the endogeneity issue in productivity analysis is to replace changes in spillover variables with their initial levels. The results are presented in Table 6(e). The only noticeable difference between Table 6(e) and columns I.1 and I.2 in Tables 5 and 6(a)–(d) is that the coefficients of NECIF_SP$_{-1}$ are mostly statistically insignificant. In one occasion, the coefficient is positive and statistically significant. Despite this, that is our key result, the productivity spillovers of NECIFs are lower than those of ECIFs.

Other robustness tests are also performed including constructing alternative measures of ECIF_SP$_{-1}$ and NECIF_SP$_{-1}$ variables by: (i) excluding firms with investment from both ethnic Chinese and non-ethnic Chinese foreign sources and (ii) classifying these firms to one ownership group according to the one with the highest share.[7] Instead of using the share of employment to calculate spillover variables, we also employ the level variables. Finally, we calculate all spillover variables – ECIF_SP$_{-1}$, NECIF_SP$_{-1}$ and Returnee_SP at the three-digit industry level. The results are broadly in line with those in Table 5. The coefficients tend to have consistent signs, though occasionally some statistically significant variables become insignificant, while at times, some statistically insignificant variables become significant.

5. CONCLUSION

This paper analyses the impact of migrants on development in the country of origin using a unique data set from China. The findings show that ECI does have positive and significant spillover effects on the productivity of indigenous Chinese firms and on R&D activities of indigenous firms whose technology level is not too far from the industrial frontier (i.e. the technology gap is low). The productivity spillovers of NECIFs are negative and their R&D spillovers are lower than those of ECIFs in the low-technology gap group. These results provide empirical evidence to support Wei and Balasubramanyam's (2006) proposition that the social rate of return to ECI is significant and higher than that from non-ethnic Chinese FDI in terms of productivity and R&D in the low-technology gap group. This is because of the ability of the migrants to fully utilise and exploit location advantages in the country of origin, that is the fact that ECIFs are able to transmit tacit knowledge and that they provide much needed information, knowledge and skills to indigenous firms. In contrast to Smart and Hsu's (2004, p. 562) argument that the utilities provided by ECI 'have become less necessary and even less useful as the reforms have matured and become more systematic', ECI still makes a

[7] For brevity, these results are not presented here, but are available upon request.

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TABLE 6

(a) Robustness Test Results: Skill Intensity as a Measure of Human Capital; (b) Robustness Test Results: Measuring ECIF_SP$_{-1}$ and NECIF_SP$_{-1}$ Variables Using the Share of Capital Investment of Foreign Firms in a Four-digit Industry; (c) Robustness Test Results: Measuring ECIF_SP$_{-1}$ and NECIF_SP$_{-1}$ Variables Using the Share of Sales of Foreign Firms in a Four-digit Industry; (d) Robustness Test Results: Measuring ECIF_SP$_{-1}$ and NECIF_SP$_{-1}$ Variables Using the Share of Assets of Foreign Firms in a Four-digit Industry; (e) Robustness Test Results: In Productivity Analysis, Replacing Changes in Spillover Variables with Their Initial Levels

	TFP		*Export Orientation*		*Export Intensity*		*R&D Orientation*		*R&D Intensity*	
	I.1 Low-technology Gap	*I.2 High-technology Gap*	*II.1 Low-technology Gap*	*II.2 High-technology Gap*	*III.1 Low-technology Gap*	*III.2 High-technology Gap*	*IV.1 Low-technology Gap*	*IV.2 High-technology Gap*	*V.1 Low-technology Gap*	*V.2 High-technology Gsap*
(a)										
ECIF_SP$_{-1}$	3.163**	2.494**	−0.054	−2.932***	−0.091	−2.814***	0.324*	−0.084	0.185**	−0.127
	(1.185)	(0.998)	(0.252)	(0.735)	(0.195)	(0.259)	(0.171)	(0.276)	(0.094)	(0.153)
NECIF_SP$_{-1}$	−1.789**	−0.818**	0.809**	1.046**	0.721**	0.905***	0.296***	0.356*	−0.043	0.207*
	(0.711)	(0.386)	(0.371)	(0.531)	(0.291)	(0.093)	(0.101)	(0.191)	(0.095)	(0.109)
Returnee_SP$_{-1}$	55.829***	18.211	2.123**	4.855***	1.862**	4.593***	−1.364	−0.531	1.193***	0.547
	(11.421)	(15.676)	(1.065)	(1.692)	(0.841)	(0.404)	(2.596)	(2.654)	(0.442)	(0.896)
Returnee	0.269	0.493**	0.333***	0.263*	0.249***	0.223***	0.035	−0.091	0.039	0.047
	(0.502)	(0.178)	(0.075)	(0.158)	(0.067)	(0.022)	(0.048)	(0.067)	(0.033)	(0.050)
Size	2.209***	2.596***	0.962***	1.170***	0.674***	1.047***	0.758***	0.681***	0.001	0.013
	(0.355)	(0.796)	(0.173)	(0.265)	(0.183)	(0.043)	(0.065)	(0.106)	(0.051)	(0.084)
Market share	−1.029*	−0.037	1.179***	0.469	0.801***	0.370***	1.006***	0.955**	−0.119	−0.003
	(0.523)	(0.453)	(0.255)	(0.448)	(0.222)	(0.051)	(0.212)	(0.389)	(0.093)	(0.153)
Skill intensity	−0.026	−0.655	0.016	0.129	0.009	0.122	0.068**	0.137	−0.018	0.073
	(0.030)	(0.392)	(0.036)	(0.298)	(0.031)	(0.085)	(0.027)	(0.129)	(0.016)	(0.105)
R&D intensity	−0.296	0.337	0.370***	0.108	0.275***	0.034				
	(0.244)	(0.248)	(0.097)	(0.133)	(0.080)	(0.031)				
Capital intensity			0.011	−0.121	0.009	−0.368*	−0.037***	1.077***	−0.003	0.167
			(0.012)	(0.659)	(0.011)	(0.188)	(0.009)	(0.388)	(0.005)	(0.196)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	766	556	2,953	2,639	2,555	2,313	6,519	5,917	2,953	2,673
(b)										
ECIF_SP$_{-1}$	1.454	1.949**	0.058	−2.395***	0.393	−2.110***	0.548*	0.225	0.124	−0.034
	(1.099)	(0.705)	(0.691)	(0.608)	(0.588)	(0.329)	(0.309)	(0.333)	(0.182)	(0.236)
NECIF_SP$_{-1}$	−0.459	−0.321	0.621	0.653	0.528*	0.527***	0.399*	0.651***	0.104	0.412***
	(1.315)	(0.460)	(0.392)	(0.596)	(0.318)	(0.101)	(0.218)	(0.204)	(0.122)	(0.120)

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TABLE 6 *Continued*

	TFP		*Export Orientation*		*Export Intensity*		*R&D Orientation*		*R&D Intensity*	
	I.1 Low-technology Gap	*I.2 High-technology Gap*	*II.1 Low-technology Gap*	*II.2 High-technology Gap*	*III.1 Low-technology Gap*	*III.2 High-technology Gap*	*IV.1 Low-technology Gap*	*IV.2 High-technology Gap*	*V.1 Low-technology Gap*	*V.2 High-technology Gsap*
Returnee_SP$_{-1}$	56.162***	19.105	2.411**	4.120**	2.121**	3.865***	−1.163	−0.312	1.232***	0.733
	(11.961)	(15.731)	(1.024)	(1.631)	(0.842)	(0.385)	(2.669)	(2.710)	(0.462)	(0.964)
Returnee	0.275	0.495***	0.298***	0.252*	0.233***	0.219***	0.033	−0.077	0.035	0.054
	(0.496)	(0.176)	(0.079)	(0.144)	(0.070)	(0.023)	(0.046)	(0.066)	(0.032)	(0.050)
Size	2.093***	2.719***	0.905***	1.113***	0.658***	1.032***	0.773***	0.726***	0.001	0.023
	(0.347)	(0.862)	(0.175)	(0.268)	(0.183)	(0.046)	(0.062)	(0.116)	(0.051)	(0.091)
Market share	−1.040*	−0.003	1.107***	0.444	0.757***	0.360***	0.999***	0.902**	−0.116	−0.032
	(0.543)	(0.456)	(0.243)	(0.451)	(0.217)	(0.061)	(0.215)	(0.396)	(0.095)	(0.156)
Human capital	0.004	−0.020	0.002**	0.001	0.001**	0.000	0.000	−0.002	0.000	−0.000
	(0.006)	(0.013)	(0.001)	(0.004)	(0.000)	(0.001)	(0.001)	(0.003)	(0.000)	(0.001)
R&D intensity	−0.290	0.347	0.358***	0.107	0.263***	0.036				
	(0.217)	(0.247)	(0.099)	(0.130)	(0.079)	(0.032)				
Capital intensity			0.014*	−0.006	0.011	−0.221	−0.033***	1.202***	−0.005	0.252
			(0.008)	(0.627)	(0.007)	(0.184)	(0.008)	(0.395)	(0.004)	(0.188)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	765	556	2,942	2,631	2,544	2,305	6,506	5,910	2,942	2,665
(c)										
ECIF_SP$_{-1}$	1.275**	1.029**	0.234	−1.186***	0.162	−1.130***	0.187	−0.041	0.142**	−0.099
	(0.504)	(0.371)	(0.261)	(0.397)	(0.206)	(0.074)	(0.126)	(0.146)	(0.065)	(0.087)
NECIF_SP$_{-1}$	−1.250***	−0.879***	0.371*	0.189	0.338**	0.114**	0.009	0.171*	−0.034	0.106**
	(0.416)	(0.284)	(0.215)	(0.290)	(0.158)	(0.052)	(0.066)	(0.089)	(0.050)	(0.051)
Returnee_SP$_{-1}$	50.356***	13.424	2.147**	4.772***	1.836**	4.515***	−1.249	−0.565	1.087**	0.582
	(11.417)	(16.200)	(0.857)	(1.590)	(0.723)	(0.415)	(2.597)	(2.660)	(0.475)	(0.924)
Returnee	0.309	0.518***	0.291***	0.237*	0.222***	0.199***	0.036	−0.075	0.033	0.050
	(0.506)	(0.175)	(0.079)	(0.144)	(0.070)	(0.024)	(0.048)	(0.065)	(0.032)	(0.050)
Size	2.154***	2.792***	0.887***	1.101***	0.638***	1.014***	0.774***	0.708***	−0.001	0.009
	(0.365)	(0.870)	(0.176)	(0.258)	(0.185)	(0.047)	(0.063)	(0.115)	(0.051)	(0.092)
Market share	−0.953*	−0.190	1.181***	0.435	0.808***	0.312***	0.970***	1.256***	−0.108	0.061
	(0.528)	(0.476)	(0.247)	(0.455)	(0.210)	(0.065)	(0.221)	(0.459)	(0.097)	(0.150)
Human capital	0.004	−0.018	0.002**	0.001	0.001*	0.000	0.000	−0.002	0.000	0.000
	(0.006)	(0.014)	(0.001)	(0.005)	(0.000)	(0.001)	(0.001)	(0.003)	(0.000)	(0.001)

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TABLE 6 *Continued*

	TFP		*Export Orientation*		*Export Intensity*		*R&D Orientation*		*R&D Intensity*	
	I.1 Low-technology Gap	*I.2 High-technology Gap*	*II.1 Low-technology Gap*	*II.2 High-technology Gap*	*III.1 Low-technology Gap*	*III.2 High-technology Gap*	*IV.1 Low-technology Gap*	*IV.2 High-technology Gap*	*V.1 Low-technology Gap*	*V.2 High-technology Gsap*
R&D intensity	−0.286	0.317	0.361***	0.101	0.268***	0.033				
	(0.241)	(0.264)	(0.100)	(0.130)	(0.081)	(0.033)				
Capital intensity			0.013*	−0.084	0.010	−0.292	−0.034***	1.254***	−0.005	0.239
			(0.008)	(0.656)	(0.007)	(0.192)	(0.008)	(0.398)	(0.004)	(0.184)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	761	551	2,916	2,616	2,528	2,295	6,364	5,808	2,916	2,649
(d)										
ECIF_SP$_{-1}$	1.969*	1.501**	0.024	−1.788**	0.024	−1.751***	0.472***	0.198	0.185*	−0.071
	(0.975)	(0.661)	(0.311)	(0.827)	(0.250)	(0.157)	(0.178)	(0.242)	(0.096)	(0.137)
NECIF_SP$_{-1}$	−1.493*	−0.989**	0.289	0.358	0.259	0.247***	0.242**	0.349***	−0.020	0.140*
	(0.785)	(0.360)	(0.256)	(0.463)	(0.202)	(0.075)	(0.117)	(0.135)	(0.058)	(0.078)
Returnee_SP$_{-1}$	53.161***	16.394	2.307**	4.490***	1.977**	4.187***	−1.238	−0.286	1.204***	0.652
	(10.755)	(14.894)	(0.948)	(1.626)	(0.787)	(0.397)	(2.610)	(2.594)	(0.445)	(0.947)
Returnee	0.322	0.522**	0.292***	0.252*	0.228***	0.220***	0.030	−0.079	0.035	0.053
	(0.497)	(0.190)	(0.078)	(0.144)	(0.070)	(0.023)	(0.047)	(0.066)	(0.032)	(0.050)
Size	2.137***	2.759***	0.892***	1.121***	0.647***	1.030***	0.770***	0.725***	0.002	0.022
	(0.326)	(0.873)	(0.175)	(0.268)	(0.183)	(0.045)	(0.062)	(0.117)	(0.051)	(0.092)
Market share	−1.015*	0.009	1.114***	0.425	0.755***	0.326***	1.017***	0.942**	−0.117	−0.029
	(0.527)	(0.450)	(0.254)	(0.448)	(0.221)	(0.060)	(0.213)	(0.393)	(0.095)	(0.154)
Human capital	0.004	−0.019	0.002**	0.001	0.001**	0.000	0.000	−0.002	0.000	−0.000
	(0.005)	(0.013)	(0.001)	(0.005)	(0.000)	(0.001)	(0.001)	(0.003)	(0.000)	(0.001)
R&D intensity	−0.347	0.356	0.363***	0.116	0.269***	0.043				
	(0.221)	(0.250)	(0.098)	(0.129)	(0.080)	(0.032)				
Capital intensity			0.013*	−0.096	0.011	−0.307	−0.034***	1.210***	−0.005	0.252
			(0.008)	(0.624)	(0.007)	(0.190)	(0.008)	(0.393)	(0.004)	(0.189)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	766	556	2,942	2,631	2,544	2,305	6,507	5,910	2,942	2,665

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TABLE 6 *Continued*

	FDI spillover variables are measured by employment		*FDI spillover variables are measured by capital investment*		*FDI spillover variables are measured by sales*		*FDI spillover variables are measured by assets*	
	I.1 Low-technology gap	*I.2 High-technology gap*	*I.1 Low-technology gap*	*I.2 High-technology gap*	*I.1 Low-technology gap*	*I.2 High-technology gap*	*I.1 Low-technology gap*	*I.2 High-technology gap*
(e)								
ECIF_SP	5.588***	4.393**	6.058***	4.884**	2.996***	1.702**	5.253***	3.496**
	(1.693)	(1.713)	(1.829)	(1.984)	(0.745)	(0.642)	(1.537)	(1.279)
NECIF_SP	−1.809	0.501	−0.733	1.318*	−1.111*	−0.422	−0.600	0.469
	(1.218)	(0.518)	(1.375)	(0.764)	(0.615)	(0.494)	(1.025)	(0.743)
Returnee_SP	55.212***	19.814	54.363***	24.209	51.390***	23.991	54.230***	20.901
	(10.410)	(20.247)	(11.990)	(21.712)	(11.383)	(20.074)	(9.763)	(20.254)
Returnee	0.179	0.414	0.147	0.373	0.178	0.452*	0.185	0.439*
	(0.402)	(0.261)	(0.432)	(0.228)	(0.423)	(0.227)	(0.387)	(0.257)
Size	2.359***	2.887***	2.261***	2.724***	2.323***	2.775***	2.395***	2.804***
	(0.407)	(0.848)	(0.382)	(0.875)	(0.377)	(0.854)	(0.403)	(0.879)
Market share	−1.290**	−0.375	−1.263**	−0.312	−1.237**	−0.075	−1.367**	−0.292
	(0.585)	(0.462)	(0.555)	(0.473)	(0.557)	(0.456)	(0.593)	(0.466)
Human capital	0.006	−0.015	0.004	−0.016	0.006	−0.015	0.005	−0.016
	(0.006)	(0.013)	(0.005)	(0.013)	(0.005)	(0.013)	(0.005)	(0.013)
R&D intensity	−0.319	0.371	−0.274	0.326	−0.312	0.340	−0.332	0.333
	(0.246)	(0.237)	(0.216)	(0.223)	(0.238)	(0.235)	(0.228)	(0.225)
Industry dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	783	587	783	587	783	587	783	587

Notes:
(i) a:Following Liu and Wang (2003), skill intensity is measured by the ratio of wage rates to the number of employees.
(ii) a–e:Standard errors clustered by industry-year in brackets.
(iii) a–e:*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

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significant, positive and larger contribution than non-ECI in productivity enhancement and stimulating local R&D activities when indigenous firms are equal players in the same industry. Where ECIFs do pose a competitive threat to indigenous firms is in the area of exporting. Our empirical evidence shows that ECIFs have a negative impact, while NECIFs have a positive impact on the export orientation and export intensity of indigenous firms, regardless of technology gap. This implies that ECIFs are more export-oriented than NECIFs and compete directly against indigenous Chinese firms in terms of exporting.

As for the impact of returnees, the findings show that returnees play an important role in enhancing the exports of firms they work for and generating productivity and R&D spillovers to other indigenous firms whose technology gap is low in the same industry. They therefore serve as a new channel through which indigenous firms are able to gain external knowledge and skills. The econometric evidence here on Chinese returnees echoes a few studies on Indian returnees. For example, the build-up of the entrepreneurial and innovation capabilities of Indian software and the space industry is cited to have benefited from returnees (Saxenian, 2006; Altenburg et al., 2008; Commander et al., 2008).

Our findings have important policy implications. While China's ambitions in technology development highlight the need for a variety of FDI (Zhang et al., 2010), there is a biased preference for Western firms in China. Our results reveal that ECI is an important source for development and should be treated as equally important as non-ECI. The government should also provide some policy incentives and continue to attract highly skilled return migrants in order to gain knowledge and skills and increase overall industrial technological standards, as returnees represent a positive benefit to national technological development.

Although the study only focuses on a single science park, our findings are applicable to other science parks in which different types of firms have intensive interactions and indigenous firms have the opportunity to learn from returnees, ECIFs and NECIFs. Increasing numbers of science parks have been set up across provinces in China to facilitate technological development and promote innovation through the establishment of high-tech companies (Tan, 2006). Chinese governments at various levels have provided policy incentives to firms locating in science parks. Chinese science parks serve as ecosystems or clusters which attract domestic firms and foreign firms (Hu, 2007). The policy implications are not only relevant to China, but also to other developing countries such as Brazil, India, Philippines and Russia which have experienced sizeable inflows of returnee migrants. Developing countries can utilise migrants advantages to turn brain drain into brain gain. Future research should investigate whether these findings can be extended to other emerging economies.

There are some limitations in this study. First, the data set used may suffer from possible bias in measuring export value due to the incentives offered by the Chinese government to exporting firms, the relatively short time period, and the unavailability of more detailed information on the country of origin. Second, we used FDI from HKMT to capture ECI, given that these regions have become the major source of ECI and have accounted for over 50 per cent of total inward FDI since China's open door policy (Table 1). Nevertheless, this measure may have underestimated the impact of the Chinese migrants from other countries even though we also measure the impact of returnees as a new form of Chinese migrants who returned to China mainly from OECD countries. Future studies should examine ECI from different individual countries and compare whether the impact of ECI is contingent on the level of economic development and institutional environment of adopted countries when detailed data on ECI are available.

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Third, we have mainly focused on the impact of ECIF and NECIF spillovers by taking the location choice of foreign firms as given. By concentrating in a single science park, we are able to capture knowledge spillovers within the same geographical proximity in which interactions among different types of firms are intensive, thus facilitating knowledge flows. However, we are unable to control for location choices of foreign firms due to data availability though the results regarding the impact of ECIFs and NECIFs are also similar to those of previous studies based on firms outside science parks (Liu et al., 2009; Xu and Sheng, 2012). This indicates that the location choice of foreign firms does not change the nature of the main findings. It would be interesting to examine how foreign firms choose their locations and whether location choices affect knowledge spillovers.

Finally, the extant literature has suggested the use of instrumental variable estimations to deal with the endogeneity issue associated with spillover variables. Unfortunately we were unable to find an effective set of instruments. Hansen J-statistics indicate such instruments as inward FDI into the United States (Haskel et al., 2007), inward FDI into South-East Asian countries (Xu and Sheng, 2012), and lagged levels of real exchange rates which interact with industry dummies (Keller and Yeaple, 2009) are invalid. Following Liu's (2008, p. 191) arguments that 'from the standpoint of an individual domestic firm, foreign entries are largely exogenous in that the performance or characteristics of the individual domestic firm has a very minimum, if any, impact on the amount of FDI received by its own industry', we expect that the confinement of the analysis to only indigenous Chinese firms and the use of differenced equations and lagged spillover variables with the control of fixed effects have dealt with the possible endogeneity issue, if any.

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APPENDIX: VARIABLE DEFINITIONS AND DATA CONSTRUCTIONS

Variable	*Definition and Measurement*
TFP	Total factor productivity, estimated by one-digit industry using the method of Olley and Pakes (1996). Output is measured by sales adjusted by ex-factory price index of industrial output. Labour is the number of employees. Capital is total assets. Both capital and investments are adjusted by investment in fixed assets price index. Material is adjusted with purchasing price index. For all deflators, 2000 = 100
Labour productivity	Sales per worker adjusted by industrial output deflator
Export orientation	Taking value 1 for exporting firms, otherwise 0
Export intensity	The share of exports in sales
R&D orientation	Taking value 0 if firm's new product output being 0, otherwise 1
R&D intensity	The share of new product output[a] in total output
ECIF_SP	Ethnic Chinese FDI spillover variable proxied by the share of employment in Hong Kong, Macao and Taiwan (HMT) firms in total employment in a four-digit industry, excluding the employees in the focal firm
NECIF_SP	Non-ethnic Chinese FDI spillover variable represented by the share of non-ethnic Chinese foreign firms' employment in total employment in a four-digit industry, excluding the employees in the focal firm
Returnee_SP	The share of returnees in total employment in a four-digit industry, excluding the returnees in the focal firm
Returnee	Taking value 1 for firms hiring returnees, otherwise 0
Size	Following Keller and Yeaple (2009), size is measured in terms of the rank in the distribution of sales, normalised by the total number of firms for each year and each four-digit industry
Market share	The share of firm's sales in a four-digit industry
Capital intensity	Total assets adjusted by investment in fixed assets price index per employee
Human capital	The number of employees with bachelor degree or above (hundreds)
Technology gap	We define technology gap as the distance between firm and the industrial frontier in terms of capital intensity. As argued by Sjöholm (1999), capital-intensive industries tend to have high levels of technology. The industrial frontier is identified as the average level of capital intensity of the top 1% percentile of ECIFs and NECIFs

Note:
[a]When measuring R&D, some studies use input indicators of technology such as R&D expenditures and patents, while others use output indicators such as new product sales. One disadvantage of input indicators is that they cannot measure the 'efficiency' of knowledge development. In this paper, we use an output indicator – new product sales as firm's productivity and exports are likely to be driven by available R&D outputs.

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