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RESEARCH ARTICLE

Home court advantage? Knowledge-based FDI and spillovers in emerging economies

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***Research Summary*:** Emerging economies increasingly try to stimulate innovation as a path toward economic development. One side effect of this is that foreign ownership of innovation in these contexts is increasing. This raises the question of how local vs. foreign ownership affects whether spillovers from innovation stay in the focal country or occur outside of it. Based on data from 1995 to 2014 across 35 emerging economies, we find that when ownership of an invention is local, spillovers are more likely to stay local. We also examine how the relationship between foreign ownership and spillovers is moderated by the stickiness of knowledge associated with the invention (relevant country-level knowledge stocks in the host country, applied orientation, and scope). We conclude with a discussion of theory and policy implications.

***Managerial Summary*:** Stimulating innovation is increasingly perceived as important in emerging economies. As a result, leaders in these economies work to increase foreign direct investment in innovation-related activities with the hope that these activities will encourage knowledge spillovers locally and, thus, stimulate greater economic development. The effect of foreign ownership of innovations is not yet well understood, though. In this study, we examine where the spillovers from foreign vs. locally owned inventions accrue. We find that when the ownership of an invention is local, the benefits from that invention are more likely to stay local. We also find that the technology characteristics of an invention influence the relationship between foreign ownership and spillovers. We conclude with a discussion of implications for theory and innovation policy.

KEYWORDS

emerging markets, innovation, knowledge, patents, value appropriation

1 | INTRODUCTION

Innovation and entrepreneurship has become a priority in many emerging economies as a means of driving economic development (Aidis, Estrin, & Mickiewicz, 2010; Estrin, Hanousek, & Svejnar, 2009); it is often viewed as a mechanism for creating better, higher value-added jobs and more economic growth. According to the World Economic Forum, the Global Entrepreneurship Monitor, and other organizations, innovation in an economy is an indicator of a country's development, such that economies move from factor driven to efficiency driven to innovation driven ones as they advance. At the foundation of national policies in emerging markets aimed at stimulating innovation is the hope that benefits will accrue at home. These benefits may arise, for example, from knowledge spillovers where local entities benefit from and build upon the innovation activities of co-located foreign entities, thereby further expanding the local knowledge stock (Acs, Braunerhjelm, Audretsch, & Carlsson, 2009; Griliches, 1992) and, accordingly, generating economic growth and job creation.

Countries seek to stimulate innovation locally and may also solicit foreign involvement. Efforts to stimulate innovation locally can include items such as local tax or investment incentives or programs to generate more knowledge sharing among home country firms working to innovate. In terms of foreign involvement, countries may court foreign firms with financial incentives to attract investments and develop a local presence. When a foreign firm decides to conduct innovation outside its home country, this represents a knowledge-based foreign direct investment (FDI). There is a large and well-developed literature on knowledge spillovers associated with FDI focused on tangible asset investments. This research finds there can be productivity gains to local firms from working with foreign ones that have superior knowledge (Aitken & Harrison, 1999; Buckley, Clegg, & Wang, 2007; Haskel, Pereira, & Slaughter, 2007; Javorcik, 2004; Xiaowen, 2007; Zhang, Li, Li, & Zhou, 2010). Though some of these findings are inconclusive, inconsistent, or variable over time due to differences such as the time window associated with investment and spillovers or barriers to imitation (Zhang, Li, & Li, 2014), there are important factors that enhance or inhibit the ease of transferring this knowledge to the local context. Interestingly, prior work on spillovers looks largely at knowledge flows from a foreign firm to a target local context. While this generates valuable insights, the advent of global innovation means that understanding the creation of new knowledge (i.e., a new invention) and the implications of this for knowledge spillovers, both locally *and* nonlocally, are increasingly important in the context of emerging economies where developing and capturing value from new knowledge is perceived as central to the advancement of these economies.

In this article, we examine the knowledge spillovers associated with inventions in emerging economies. Understanding this relationship is especially consequential for emerging economies looking to use innovation to advance economic development. Building on research that uses patent citation data to track knowledge flows across country boundaries (e.g., Almeida & Phene, 2004; Hu & Jaffe, 2003; Jaffe & Trajtenberg, 1999; Song, Almeida, & Wu, 2003), we develop a model that examines how foreign (vs. local) ownership of an invention affects the proportion of spillovers that remain local. Using 20 years of data from 35 emerging market economies, we find that for foreign-owned inventions, the proportion of local spillovers is lower than for locally owned inventions. Our findings underscore the fact that the knowledge from inventions by foreign firms spills ***out*** of the country in which it was invented in greater proportions than knowledge from inventions developed by local firms.

In additional analyses, we explore the effect of knowledge embeddedness in the local context on this relationship. While a few studies address embeddedness of a foreign firm within its host country (e.g., Eapen, 2012; Spencer, 2008), to our knowledge, the issue of the embeddedness of the *knowledge* associated with the firm and specifically how ownership affects the outcomes associated with

this embeddedness has received little attention. Accordingly, looking at the knowledge created and what proportion of that accrues locally provides new insights related to knowledge spillovers and allows us to unpack the relationship between foreign ownership and these spillovers. More specifically, we examine the role relevant country-level knowledge stocks, the applied vs. basic orientation of the invention, and the scope of the invention play in moderating the relationship between ownership and local spillovers. In these analyses, we find evidence that locally owned inventions benefit from relevant country knowledge stocks at a greater rate than foreign-owned ones do in terms of generating local spillovers. The relationship between foreign ownership and local spillovers is also affected by the applied vs. basic science orientation of the invention. Applied knowledge spills out at a lower relative rate in the case of foreign ownership compared to local ownership. Finally, inventive scope affects the relationship between the ownership and local spillover such that the rate of local spillovers increases along with the scope of the invention in the case of foreign ownership and decreases in the case of local ownership.

This study makes a theoretical contribution by bringing together work on knowledge spillovers with work on the geography of knowledge to address questions related to knowledge creation and where the resulting spillovers go. Rather than looking at just one direction of transfer, from a foreign firm to the local context, we examine knowledge creation by both local and foreign owners and the extent to which that new knowledge remains local. Our results are consistent with theory on the important role that domestic linkages (local ownership)—one key mechanism from the knowledge spillover literature—play in generating local knowledge spillovers. Our study also has important economic implications. Emerging economies have limited resources to devote to important innovation activities; our findings provide insights to guide assessments of the payoffs to encouraging innovation activities by local firms or by soliciting innovation-focused foreign direct investment.

2 | FDI AND KNOWLEDGE SPILLOVERS

There is a rich literature on knowledge spillovers that identifies productivity gains by local firms leveraging knowledge from foreign firms in the local environment. For example, local firms adjacent to the foreign firm in the supply chain show increases in productivity (Javorcik, 2004). Relationships with foreign firms that have superior production processes can stimulate a transfer of knowledge about these processes and best practices that can improve the efficiency of local host country firms. These spillovers are largely the result of "learning from a distance" (Nelson & Winter, 1982; Zhang et al., 2014) and are driven through mechanisms, such as a demonstration effect, employee turnover, domestic linkages, and competitive pressures, that affect motivations to learn (Blomström & Kokko, 1998; Spencer, 2008). Factors such as time also affect the level of spillovers, since it takes time for knowledge to be disseminated into the local context through, for example, employee mobility. This work often assumes knowledge types are equally transferrable and assumes a one-way transfer of knowledge from (superior) foreign firms to the host country firms.

That said, for foreign firms, foreign direct investments can stimulate their own innovation efforts (e.g., Bishop & Wiseman, 1999; Choi, Lee, & Williams, 2011; Falk, 2006; Sadowski & Sadowski-Rasters, 2006). While foreign owners bear a liability of foreignness (e.g., Zaheer, 1995), they may benefit from leveraging superior firm resources and capabilities in different country contexts (e.g., Caves, 1996), including those related to innovation (Sadowski & Sadowski-Rasters, 2006). FDI can be used to gain access to new sources of knowledge (e.g., Almeida & Phene, 2004; Dunning, 1994). Taken together, this work suggests that activities of foreign firms in local contexts may yield knowledge benefits for these foreign firms as well as spillovers into the local context, although these

literature streams to date have largely evolved separate from one another. Integrating insights from the spillovers literature with those from the geography of knowledge, we now examine how ownership affects spillovers by first discussing the important role "stickiness" or knowledge embeddedness plays in generating spillovers and then examining how ownership influences this stickiness.

3 | OWNERSHIP AND SPILLOVERS

At the root of much research related to geography and innovation is the finding that knowledge can be geographically localized and embedded in that local context. This means it is "sticky" (Jaffe, Trajtenberg, & Henderson, 1993). This idea forms part of the foundation for research on geographic clusters. The stickiness of knowledge means that it will have the most application to entities in close geographic proximity. For example, close proximity can lead to better access to information due to the mobility of workers within that area or from informal social networks among individuals and a range of organizations (e.g., Marshall, 1920; Saxenian, 1996). This work parallels the discussion in the spillovers literature on barriers to imitation where, for example, the degree to which knowledge is embedded in intangible (rather than tangible) assets impedes spillovers (Zhang et al., 2014). And it is well recognized that the tacit nature of skills and knowledge makes imitation difficult (Polanyi, 1967).

Country boundaries can create additional impediments to knowledge flows. For example, a common country culture can shape the magnitude and type of knowledge that is transmitted within and across country contexts (e.g., Bjorkman, Sthal, & Vaara, 2007; Kwon & Arenius, 2010), and different institutional arrangements, such as property right and IP regimes, influence innovation within a country in important ways (e.g., Baumol, 1990; Freeman, 1995; Lundvall, 1992, 2007; Nelson, 1993; Sobel, 2008). Operating in various country contexts requires detailed knowledge of each of them (Henisz, 2003). Understanding and building upon an invention is easiest within the boundaries of the country where the invention occurred due to more plentiful, better contextualized, and/or richer sources of knowledge about it, as well as more networks and relationships that can facilitate accessing this knowledge. Overall, research suggests that spillovers are greater within a country than between countries.

Foreign ownership can also affect spillovers. Foreign ownership with regard to invention refers to inventions where the inventor is local, but the ownership (i.e., the assignee) resides outside the country. This foreign ownership can be accompanied by motives to foster knowledge spillovers outside the country in which the invention is developed. As an illustration, firms operating across country boundaries have evolved from a traditional view of host countries as a source of cheap labor or as an additional market to a broader focus on host countries as sources of new knowledge and ideas (e.g., Almeida & Phene, 2004; Dunning, 1994). Though these firms do not uniformly benefit from the different countries in which they are active (e.g., Almeida & Phene, 2004; Phene & Almeida, 2008), they are more likely to have strategies aimed at capitalizing on inventive activities in regions outside the country in which they create an invention (e.g., Sadowski & Sadowski-Rasters, 2006). In addition, foreign firms are imprinted by the practices and norms from their home country environment and vary in the level to which they adapt to the countries in which they may be doing business (Kogut, 1993; Kostova & Zaheer, 1999; Spencer, 2008). Differences between home and host country environments impede knowledge spillovers from foreign firm inventions since local firms may find it difficult to benefit from foreign firm knowledge when it is embedded in organizational systems and practices that are notably different than those in the host country (Spencer, 2008).

Local owners, in contrast, have more local networks and relationships that can facilitate accessing and utilizing inventions created locally. These domestic linkages are important mechanisms leading to local knowledge spillovers (e.g., Blomström & Kokko, 1998; Spencer, 2008; Zhang et al., 2014).

Additionally, local owners are less likely to try to encourage knowledge dissemination outside the local context, as foreign owners may. Finally, spillovers are easier among firms with similarity in organizational practices and routines, which is more likely to take place among domestic firms rather than between foreign firms imprinted by the home country environment and local firms (Spencer, 2008). This suggests that the benefits from locally owned inventions are more likely to remain with that country.

In sum, foreign owners are less likely to have deep domestic linkages and are more likely to have organizational routines and practices that are different from those in the host country. So, local spillovers from foreign owners, relative to host country enterprises, are more arduous. Taken together, these arguments suggest the benefits from foreign-owned inventions are more likely to spill out of the host country than are locally owned ones. Accordingly, we hypothesize:

> **Hypothesis 1 (H1)** *The proportion of knowledge spillovers that remain local will be lower for foreign-owned inventions (i.e., inventions created by a nonlocal entity) than locally owned inventions.*

4 | MODERATING EFFECTS

While we do not develop formal hypotheses for any moderating effects, we conduct additional *ex post* tests on the relationship between foreign ownership and the proportion of local knowledge spillovers. In particular, we further explore embeddedness by looking at the extent to which the knowledge associated with the invention is embedded in the local context and how this may affect the relationship between foreign ownership and local spillovers; we examine the role relevant country-level knowledge stocks, the applied vs. basic orientation of the invention, and the scope of the invention play in moderating the relationship between ownership and local spillovers.

A host country's relevant knowledge stock can affect local spillovers. This is because in a country with knowledge stocks related to a new invention, there are more likely to be greater levels of supporting resources, such as interfirm linkages, social networks, and an available workforce with the relevant technological skills necessary to build on an invention that is related to its existing knowledge stocks (Almeida & Kogut, 1999; von Hippel, 1988; Marshall, 1890). Relevant country-level knowledge stocks facilitate local spillovers from new inventions (e.g., Glaeser, Kallal, Scheinkman, & Shleifer, 1992; Romer, 1986). These knowledge stocks may also influence the relationship between foreign ownership and local spillovers.

Additionally, the applied vs. basic orientation of an invention may affect the relationship between ownership and local spillovers. Applied research is often developed with the purpose of creating a solution to a problem with commercial potential, while basic research is focused on generating and testing theory and creating more generalizable information (e.g., Fleming & Sorenson, 2004; Henderson, Jaffe, & Trajtenberg, 1998). Applied research is more likely to be undertaken when an inventor or owner perceives the results from this research will have commercial value, in excess of the costs associated with undertaking the research in the first place. This can affect how embedded the invention is in the local context and may influence the relationship between foreign ownership and local spillovers.

Finally, the scope of an invention represents the complexity of the invention as well as its potential to be leveraged in multiple other innovations (Lerner, 1994). Narrow scope inventions are the result of greater specialization and within-domain expertise, and they encourage greater specialization of inventors and knowledge bases over time (Toh, 2014). In contrast, wide scope inventions require cross-domain coordination (Burns & Stalker, 1966; Chacar & Lieberman, 2003; Toh, 2014). Scope

can influence whether all of the different knowledge stocks associated with the invention can be leveraged across country contexts and, therefore, may influence the relationship between foreign ownership and local spillovers.

5 | DATA AND METHODS

We test our hypothesis using data on inventions from emerging market economies. We start by identifying countries that are listed on the most widely used classifications of emerging economies, including the Next-11/BRIC, CIVETS, FTSE, MSCI, *The Economist* list, S&P, Dow Jones, and EAGLEs/Nest classifications. Forty-six countries are classified as emerging based on their presence on one of these lists. To enable comparison across different country contexts, we use data from the United States Patent and Trademark Office (USPTO) to construct our invention measures (Almeida & Phene, 2004; Furman, Porter, & Stern, 2002; Hu & Jaffe, 2003; Jaffe & Trajtenberg, 1999; Porter & Stern, 2001; Song et al., 2003; Zander, 1997).[1] To identify inventions from emerging economies, we searched the USPTO inventor database for patented inventions from 1995 to 2014 with at least one inventor who resided in one of the emerging economy countries. We then matched these data to the information contained in the USTPO patent database that contains information about the assignee of the invention, the date at which it was developed, and the technology areas in which it is allocated. Of the 46 countries that are listed on the emerging economy lists, 36 countries have some U.S. patenting activity and data from which to compute country-level control variables from the Heritage Foundation and World Bank over the entire time period of our study.[2]

On initial examination of the distribution of patenting activity, we discovered that almost 70% of the patents in the sample (42,363 out of 60,656) were from South Korea. These South Korean inventions are heavily concentrated in two large industrial conglomerates, that is, 20,390 are assigned to Samsung, and 7,625 are assigned to LG, together representing 66% of the patents developed in South Korea. In looking more closely at foreign-owned patents in South Korea, we find that South Korea has one of the lowest percentage of foreign-owned inventions (2.8%) in our data. Further, South Korea is widely recognized as a modern-day economic miracle; it has had five straight decades of growth above 5%, invests heavily in R&D, has a per capita income of more than $20,000, and is the seventh-largest economy in the world (Sharma, 2012). Thus, it is substantially different from the other emerging economies in our sample. Since we want our model to focus on emerging economies overall, rather than the special case of South Korea, we decided to estimate our models for the 35 emerging economies excluding South Korea[3] and present the results for South Korea separately.

6 | MEASURES

6.1 | Dependent variable

The number of citations received by a patent provides direct information about the knowledge spillovers from a patented invention (Hall, Jaffe, & Tratjenberg, 2001; Jaffe et al., 1993; Jaffe &

[1]The pros and cons of using U.S. patent data to study innovation across country contexts have been well discussed. See Zander (1997) for an example.

[2]Note that some have further distinguished developing economies from emerging economies (e.g., IMF, 2015). Seven countries fall into the "developing" country category based on the IMF classification. These are included in our main analyses.

[3]After excluding the South Korea data, no single country's data represents more than 32% of our final sample.

Trajtenberg, 1999). Accordingly, for our measure of the dependent variable, local knowledge spillovers, we construct a measure of the proportion of knowledge generated by each patent that stays within the host country by dividing the number of citations to the focal patent that are made inside the focal country by the total number of citations received within 5 years from the date of patent grant.[4] We focus on the citations received within the 5-year window, as Heeley and Jacobson (2003) find that a 5-year post-grant period is sufficient to isolate differences in patent citation activity. Our measure is a percentage measure ranging from 0 (no knowledge generated remains in the focal country) to 1 (all knowledge generated remains in the focal country). Patents that do not receive any future citations within the five-year time period are excluded from the analyses, as the percentage is undefined and also such patents are unlikely to be important since no other inventions have built upon them in the 5-year time period.

6.2 | Ownership variable

To indicate whether the invention is *foreign owned* or owned by a local entity, we use a dummy variable that equals 1 if the country of origin of the assignee (company owner) of the invention is different from that of the inventor and 0 if it is the same.

6.3 | Moderating variables

To measure the *relevant country-level knowledge stock*, we use a 5-year depreciated measure of the number of prior patents in the inventor's country in the same technology area as the current invention. To reflect possible erosions of the benefits of a country's knowledge stocks, we follow Hall, Jaffe, and Trajtenberg (2005) and use a 0.15 annual discount rate. This variable is scaled by dividing by 1,000 and reflects a per thousand patent measure. Following Fleming and Sorenson (2004), we operationalize the degree to which the invention builds on *applied* (rather than basic) knowledge by dividing the number of citations to prior patents by the total number of all prior citations (both patent and non-patent[5] citations). The *scope of the invention* is measured with the number of unique patent classes to which the patent is assigned. Patents that are assigned to more patent classes are thought to be broader in scope (Lerner, 1994).

6.4 | Control variables

We also control for additional patent-, firm-, and country-level factors. At the patent level, we control for the *internationalization of the inventive team* by including a count of the number of different countries represented on the inventive team, since a geographically diverse team may be associated with greater knowledge from outside the focal, home country. In addition, we include a dummy variable equal to 1 if the focal firm is a *multinational* inventing firm and 0 if it is not. We define multinational inventing firms as firms that are patenting in multiple countries within a specific year. Since multinationals may have well-developed systems in place to capture value from subsidiaries, they may have different patterns of capturing spillovers than other firms. Note that while an international inventive team means, by definition, the firm is multinational, not all multinational firm inventions will make use of international inventive teams. We consider these measures as capturing two levels

[4]Within the inventing country context, the local future citations may be from the original inventor him or herself or from a different entity since our aim in constructing this measure is to evaluate where the future benefits from the invention accrue—locally or outside of the focal context.

[5]These citations are non-patent literature citations and include items such as scientific articles, technical documents, and books.

of internationalization—the invention team level and the firm level. We also control for the focal *firm's knowledge stock*, by computing a 5-year depreciated stock measure based on a firm's patent activities within the same technology area as the focal patent during the preceding 5 years. Similar to our country stock measure, we use a 0.15 depreciation rate (Hall et al., 2005) to account for possible erosion of a firm's knowledge stocks usefulness and scale this measure by dividing by 1,000.

At the country level, we use data from the Heritage Foundation to control for the *property rights* in the home country and data from the World Bank to measure a country's *GDP* per capita, *stock market capitalization as a percent of GDP*, and *exports as a percent of GDP*. These variables capture potential differences in the ability to retain value in the case of property rights and the general competitive conditions and demands for the output of the innovation process in the case of the other three variables. We also include *country* and *year fixed effects* to account for any potential country differences and macroeconomic factors.

After deleting observations with missing information, 18,293 patented inventions from the 35 emerging economies are available for the main analysis. As our dependent variable is a percentage with a restricted range from 0 to 1, we use a Tobit model with fixed effects to estimate our models.

7 | RESULTS

Table 1 lists the means, standard deviations, and intervariable correlations for the 35 emerging economies. The average proportion of inventive knowledge spilling into the country is 25.6%, however, there is large variance. About 65% of the patented inventions in our sample are foreign owned (i.e., they are invented in a different country than the country of the entity that owns the invention), indicating the prominent role multinational corporations play in inventive activity in emerging economies. In looking at the bivariate correlations, we observe a number of significant correlations between the proportion of local spillovers and our primary variables of interest. We find positive correlations between the proportion of local spillovers and foreign ownership, as well as between relevant country-level knowledge stocks and inventive scope. We find a negative correlation between the proportion of local spillovers and the applied orientation of the invention. Caution must be used in evaluating these correlations, as multivariate relationships are likely present. We also find the correlation between being a multinational corporation and using an international inventive team is 0.360, suggesting that these two variables are measuring distinct international effects.

The results of our multivariate Tobit analysis are in Table 2. The first column contains Model 1, which includes only the control variables. In Model 2, we add the measure of local ownership and, for completeness, also include as main effects the variables that capture the embeddedness of an invention in the local context, that is, the measures of country-level knowledge stocks, the applied orientation of the invention, and inventive scope. In support of Hypothesis 1, we find that foreign ownership is negatively (−0.040) and statistically significantly ($p < 0.05$) related to the proportion of local (within-country) spillovers generated by the invention. The coefficient estimate of −0.040 indicates that the proportion of local spillovers generated by foreign-owned inventions is 4% lower than locally owned inventions. We also find the main effects of relevant country-level knowledge stocks and inventive scope are positively and significantly related to the proportion of local spillovers, while the applied orientation of the invention is negatively and significantly related.

TABLE 1 Means, standard deviations, and intervariable correlations for the 35 emerging economies[a]

VARIABLE	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10	11
Proportion of local spillovers	0.256	0.329											
Foreign ownership dummy	0.652	0.476	0.109*										
Applied orientation of invention	0.829	0.269	−0.101*	−0.069*									
Inventive scope	1.713	0.926	0.029*	−0.006	−0.056*								
Relevant country-level knowledge stocks	0.033	0.070	0.052*	−0.052*	0.073*	0.011							
Multinational corporation dummy	0.861	0.346	0.142*	0.549*	−0.046*	0.035*	0.102*						
Internationalization of inventive team	1.578	0.644	0.231*	0.419*	−0.107*	0.063*	−0.080*	0.360*					
Prior firm knowledge	0.085	0.209	0.022*	0.273*	0.043*	−0.069*	0.443*	0.163*	−0.034*				
Country property rights	44.246	14.194	−0.037*	0.069*	−0.100*	−0.008	−0.344*	−0.053*	0.046*	−0.175*			
Stock market capitalization	37.045	41.472	0.034*	−0.070*	0.096*	−0.030*	0.429*	0.060*	−0.078*	0.158*	−0.272*		
Exports as percentage of GDP	33.779	22.816	−0.061*	0.059*	0.086*	0.011	−0.006	0.055*	0.059*	0.000	0.174*	0.038*	
GDP per capita	3.476	3.567	−0.058*	0.011	−0.002	−0.003	−0.186*	−0.045*	0.077*	−0.112*	0.430*	−0.190*	0.360*

Variable Definitions: ***Proportion of local spillovers*** – number of local citations from future patents developed in the same country divided by the total citations received by the focal patent within the first 5 years. ***Foreign ownership dummy*** – a dummy variable indicating whether the patent is developed by a foreign (dummy = 1) or a local (dummy = 0) firm. ***Applied orientation of invention*** – the ratio of the focal patent's prior art citations to patents divided by the total number of prior art citations. ***Inventive scope*** – the number of unique patent classes to which the patent is assigned. ***Relevant country-level knowledge stocks*** – a depreciated count of the number of patents in the same class that were developed in the country in the preceding 5 years divided by 1,000. ***Multinational corporation dummy*** – a dummy variable indicating whether the focal firm had inventions in more than one country. ***Internationalization of inventive team*** – a count of the number of unique countries in which the inventors of the patent reside. ***Prior firm knowledge*** – a depreciated count of the number of patents in the same class that were developed by the firm in the preceding 5 years divided by 1,000. ***Country property rights*** – Heritage Foundation property rights index assessing the ability of individuals within a country to accumulate private property secured by clear enforceable laws. The index ranges from 0 to 100 in 10-point increments. ***Stock market capitalization*** – a measure of a country's market capitalization of listed domestic companies as a percentage of GDP (World Bank data). ***Exports as a percentage of GDP*** – a measure of the value of all goods and services provided to the rest of the world as a percentage of GDP (World Bank data). ***GDP* per capita** – a country's gross domestic product divided by midyear population. Data are in 2005 U.S. (thousand) dollars (World Bank data).

[a] Sample size for all measures is 18,293.

*$p < .05$.

TABLE 2 Value appropriation Tobit models for the 35 emerging economies

Dependent variable: Proportion of local spillovers Model	Model 1	Model 2	Model 3
Intercept	−0.372	−0.223	−0.084
	(0.225)	(0.225)	(0.228)
Multinational corporation dummy	0.148**	0.163**	0.157**
	(0.019)	(0.021)	(0.022)
Internationalization of inventive team	0.260**	0.263**	0.263**
	(0.009)	(0.010)	(0.010)
Prior firm knowledge	0.034	0.014	0.046
	(0.027)	(0.031)	(0.034)
Country property rights	−0.001	−0.001	−0.001
	(0.001)	(0.001)	(0.001)
Stock market capitalization	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Exports as percentage of GDP	0.004**	0.004*	0.004*
	(0.001)	(0.001)	(0.001)
GDP per capita	0.019	0.020	0.020
	(0.014)	(0.014)	(0.014)
Foreign ownership dummy		−0.040*	−0.197**
		(0.016)	(0.046)
Applied orientation of invention		−0.199**	−0.292**
		(0.021)	(0.037)
Inventive scope		0.014*	−0.011
		(0.006)	(0.010)
Relevant country level knowledge stocks		0.488**	0.717**
		(0.104)	(0.128)
Foreign OD * Applied orientation			0.135**
			(0.044)
Foreign OD * Inventive scope			0.035**
			(0.013)
Foreign OD * Relevant country-level knowledge stocks			−0.460**
			(0.170)
Log likelihood	−14,901	−14,833	−14,822
N	18,293	18,293	18,293
Likelihood ratio test		Model 1 vs. model 2 $\chi^2_4 = 136$**	Model 2 vs. model 3 $\chi^2_3 = 22$**

[a] All models include country and annual dummy variables to control for fixed effects. Standard errors in parentheses.
*p < .05. **p < .01.

7.1 | Supplemental analysis: Moderating effects of invention embeddedness

To investigate how the embeddedness of an invention in the local context may affect the relationship between foreign ownership and local spillovers, in Model 3, we include the moderating effects of country-level knowledge stocks, the applied orientation of the invention. We find a negative (−0.460) and statistically significant interaction effect ($p < 0.01$) between foreign ownership and relevant country-level knowledge stock. To illustrate this relationship, we plot the effect for foreign vs. local ownership in Figure 1; foreign-owned inventions have a lower proportion of local spillovers,

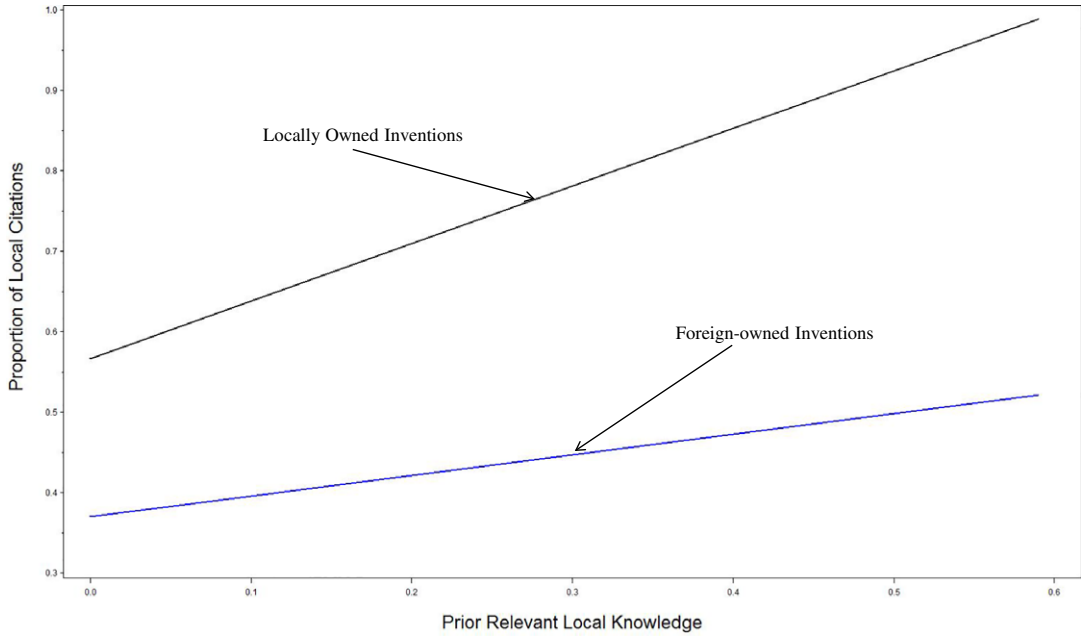

FIGURE 1 The effect of relevant country-level knowledge stocks on the proportion of local spillovers for foreign and locally owned inventions

which increase slowly as relevant country-level knowledge stocks increase. In contrast, the proportion of local spillovers is higher for locally owned inventions and increases at a faster rate as relevant country-level knowledge stocks increase.

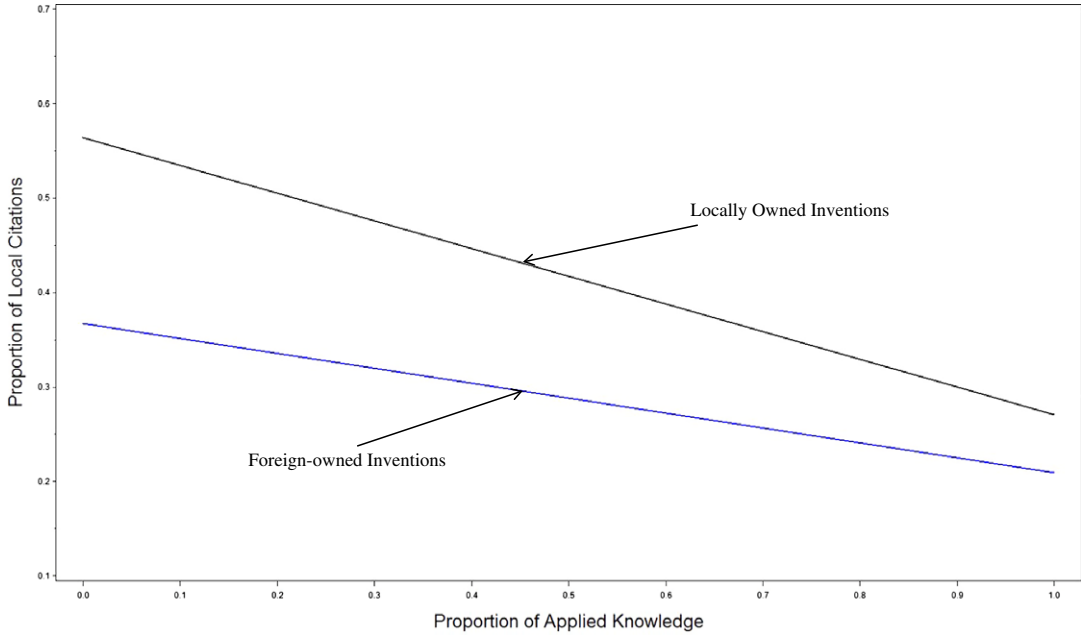

FIGURE 2 The effect of applied orientation on the proportion of local spillovers for foreign and locally owned inventions

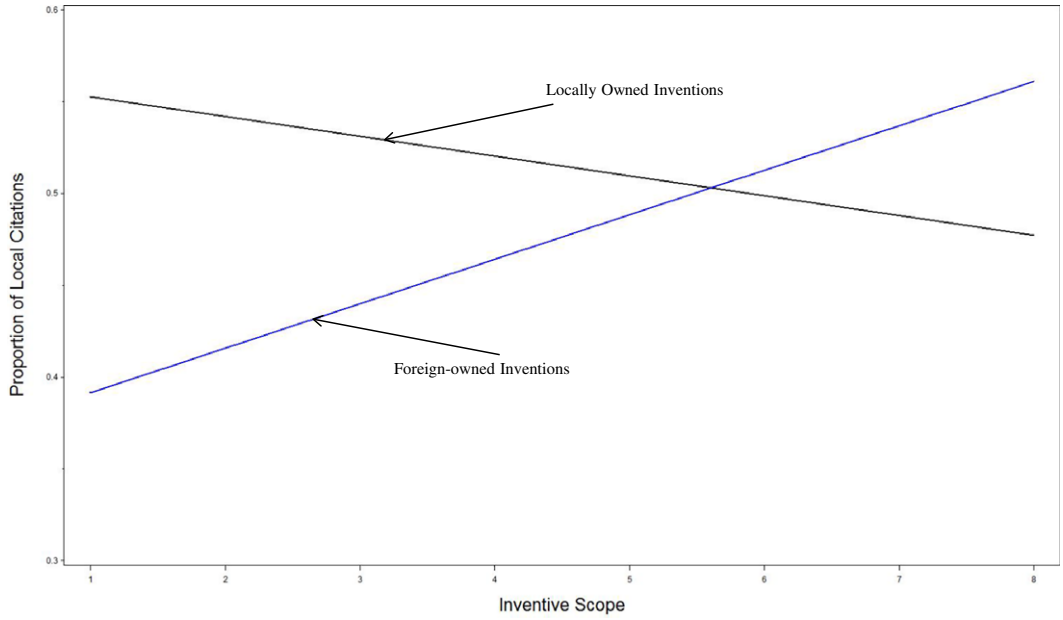

FIGURE 3 The effect of inventive scope on the proportion of local spillovers for foreign and locally owned inventions

We also find a positive (0.135) and statistically significant ($p < 0.01$) effect of the applied orientation of an invention on the relationship between foreign ownership and local spillovers, indicating that as the nature of the knowledge underlying the invention becomes more applied, the rate at which foreign-owned inventions generate local spillovers is less than in the case of locally owned inventions. Figure 2 depicts this relationship and shows that as the applied orientation of the invention increases, local spillovers decrease, but at a faster rate for locally owned inventions than for foreign-owned ones. Lastly, we find a positive (0.035) and statistically significant ($p < 0.01$) effect of inventive scope on the relationship between foreign ownership and local spillovers. Figure 3 illustrates this effect and indicates that for foreign-owned inventions, more local spillovers are generated as the scope of the invention increases. This suggests that foreign-owned broad scope inventions are an important source of local spillovers. In addition, we find that locally owned inventions that are narrow in scope have a higher proportion of local citations, and the proportion decreases as inventive scope increases. This is consistent with the idea that knowledge from broad scope inventions is not tightly embedded with its owners.

7.2 | Estimating models for the South Korean data

As noted earlier, 69.7% of the patents in the data were invented in South Korea, with few inventions by foreign firms. To see if the results from the 35 emerging economies are consistent with South Korea, we estimated our models using only the South Korean data. Table 3 presents these results. In the main effects model (Model 5), we find that foreign ownership is no longer significant, perhaps due to the low proportion of foreign ownership in South Korea. The effect of relevant country-level knowledge is still positive and statistically significant, while the effect of inventive scope is now negative (−0.025) and significant, and the effect of applied orientation of the invention is no longer significant. In looking at the interaction model (Model 6), consistent with our moderation analyses

TABLE 3 Value appropriation Tobit models—South Korea

Dependent variable: Proportion of local spillovers Model	Model 4	Model 5	Model 6
Intercept	23.575	18.039	17.240
	(22.269)	(22.620)	(22.664)
Multinational corporation dummy	0.258**	0.257**	0.258**
	(0.018)	(0.018)	(0.018)
Internationalization of inventive team	0.157**	0.134**	0.111**
	(0.020)	(0.026)	(0.026)
Prior firm knowledge	0.413**	0.125**	0.094**
	(0.024)	(0.033)	(0.033)
Country property rights	−0.119	−0.090	−0.087
	(0.110)	(0.112)	(0.112)
Stock market capitalization	0.017	0.013	0.013
	(0.016)	(0.016)	(0.016)
Exports as percentage of GDP	0.079	0.062	0.059
	(0.067)	(0.068)	(0.068)
GDP per capita	−1.149	−0.887	−0.848
	(1.056)	(1.072)	(1.074)
Foreign ownership dummy		0.040	0.299**
		(0.034)	(0.100)
Applied orientation of invention		−0.063	−0.027**
		(0.025)	(0.026)
Inventive scope		−0.025**	−0.028**
		(0.005)	(0.006)
Relevant country-level knowledge stocks		0.152**	0.167**
		(0.012)	(0.012)
Foreign OD * Applied orientation			−0.312**
			(0.091)
Foreign OD * Inventive scope			0.052
			(0.028)
Foreign OD * Relevant country-level knowledge stocks			−0.237**
			(0.047)
Log likelihood	−39,697	−39,605	−39,578
N	42,363	42,363	42,363
Likelihood ratio test		Model 4 vs. model 5	Model 5 vs. model 6
		$\chi^2_4 = 184$**	$\chi^2_3 = 54$**

*p < .05. **p < .01.
[a] All models also include annual dummy variables to control for fixed effects. Standard errors in parentheses.

results, we observe a negative (−0.237) and significant interaction effect between relevant country-level knowledge stocks and foreign ownership. However, the interaction effect between the applied orientation of the invention and foreign ownership is now also negative (−0.312) and significant. The interaction between inventive scope and foreign ownership is no longer significant. These results suggest that the effects of relevant country-level knowledge stocks are robust across the different country contexts. But, the relatively high level of sophistication with regard to commercialization in South Korea (e.g., Sharma, 2012)—particularly with regard to such large firms as Samsung and LG—

results in a more nuanced and idiosyncratic effect of inventive scope and the applied orientation of the invention on the proportion of local spillovers.

8 | DISCUSSION

As emerging economies increasingly turn their attention to stimulating innovation as a means of generating economic growth, understanding how the home country context may or may not benefit from invention becomes increasingly important. In this study, we find that ownership has important implications for knowledge spillovers associated with inventive activity. More specifically, foreign ownership is negatively associated with the proportion of knowledge that spills over locally, consistent with our expectations; locally owned inventions have proportionately more local spillovers.

These results complement other research (e.g., Almeida & Kogut, 1999) on how the embeddedness of the foreign firm affects spillovers such that higher levels of embeddedness positively affect local spillovers. Presumably, locally owned firms are more embedded in the local context, so they have linkages and networks that facilitate these spillovers. This finding has important policy and economic implications, suggesting that if local spillovers are an important policy goal, devoting resources to helping locally owned firms innovate may yield better spillover outcomes than deploying those resources to attract foreign firms to innovate in the host country.

We also explored this relationship further in additional *ex post* analyses to understand how the knowledge related to the invention, specifically with regard to how embedded it is in the local context, affects this relationship. We examined the role of relevant country knowledge stocks, applied knowledge orientation, and the scope of the invention. We find that foreign-owned inventions are less sensitive to the embeddedness of the underlying knowledge in the local environment. Our results suggest that locally owned inventions benefit from relevant country knowledge stocks at a greater rate than foreign-owned ones do in terms of generating local spillovers, and applied knowledge spills out at a lower relative rate in the case of foreign ownership compared to local ownership. Additionally, the rate of local spillovers increases along with the scope of the invention in the case of foreign ownership.

The fact that local owners generate local spillovers at a significantly higher rate in the context of relevant country knowledge stocks suggests that local owners are much better able to leverage locally embedded knowledge. Also, in the case of foreign owners, the relationship between the applied vs. basic nature of an invention and local spillovers is less pronounced than in the case of local owners. This indicates that applied inventions are easily appropriated outside the host country, especially in the case of locally owned invention. This perhaps suggests that the nature of applied inventions in emerging economies where the inventor applies for a U.S. patent is such that these inventions have broad commercial appeal across multiple markets. The fact that those outside of the host country are able to leverage these innovations may indicate that, in the case of emerging economies, the local infrastructure is not sufficiently developed to take advantage of these inventions or that the local market is relatively small or underdeveloped so that there are limited opportunities to build on these ideas in the focal country.

We also find that foreign ownership affects the relationship between inventive scope and local spillovers. Specifically, we find that foreign ownership of broad scope inventions is more likely to generate spillovers in the local market, while local ownership of broad scope inventions generates proportionately more spillovers outside the home market. The spillover pattern is consistent with local entities monitoring advances by foreign firms and being able to act on broad scope inventions due to local market knowledge. It is also consistent with foreign entities monitoring advances of local

firms and being able to act on these inventions outside the host market. These results together suggest that wide scope inventions are less embedded within the inventing entity and can be leveraged by those monitoring the creation of these types of inventions.

As with all studies, ours is not without limitations. The primary limitation is that we use U.S. patent data. As we note, the limitations and advantages of these data are well documented (e.g., Zander, 1997), yet prior scholars have found these data useful in generating insights across country contexts due to the detailed nature of U.S. patent records and their extended history. Additionally, U.S. patents are typically used in emerging country contexts when: (a) the inventor has any plans to ever enter markets outside of his/her home country; and (b) the inventor perceives that anyone from outside his/her home country may try to commercialize a similar idea within the home country. Accordingly, the inventions represented in this study are those that are more likely to have higher perceived commercial potential than all inventions on average. While this is a limitation, since we are focused on where spillovers from inventions accrue, those patents that generate impact (i.e., citations) are what we focus on in our study. Inventions that generate no citations do not provide a foundation for looking at where spillovers accrue because they do not generate spillovers in terms of future inventions building upon them. Additionally, our main dependent variable in this study is the proportion of spillovers that stay in the local context. We construct our study in this way because our main goal is to understand where the relative knowledge benefits from an invention accrue. The challenge to this approach is that we look at where the relative, not absolute, benefits accrue. For example, if an invention generates relatively few total future citations, but the majority of these accrue in the focal context, this creates a large value with regard to local spillovers, while an invention that generates many future citations, but only a small percent accrue in the focal market, this creates a relatively smaller value with regard to local spillovers. Future studies may want to investigate both relative and absolute levels of knowledge spillovers that result from foreign and local ownership associated with inventive activity.

Our findings have implications for policy and theory. From a policy perspective, if national policy is aimed at generating knowledge spillovers within an emerging economy, local ownership is important to encourage. Also, encouraging inventive efforts in areas related to a country's technical strengths (i.e., where there are relevant country-level knowledge stocks) can help generate greater gains in terms of building on these inventions in the focal country. The results in terms of encouraging basic vs. applied research are interesting. They suggest that basic knowledge inventions by local owners have the largest proportional effect on local spillovers. This suggests that increasing investments in basic science may have valuable payoffs. Additionally, encouraging foreign owners in the development of broad (rather than narrow) scope inventions is useful. Incentives could be targeted toward these types of inventive activity when courting FDI related to innovation activities.

From a theory perspective, our findings indicate that foreign ownership not only affects inventive outcome for a focal entity, as prior research has noted (e.g., Bishop & Wiseman, 1999; Choi et al., 2011; Falk, 2006; Sadowski & Sadowski-Rasters, 2006), but also has important implications for knowledge spillovers. Foreign ownership is associated with spillovers outside the host country, while local ownership may allow for greater transfer of knowledge about inventions to the local context, providing a foundation for the creation of new knowledge that builds upon those ideas. This is consistent with research on knowledge transfer mechanisms (e.g., trade associations and professional affiliation activities, networks) broadly; knowledge transfers via these mechanisms are likely more effective in the case of local owners. Our results suggest that ownership effects in addition to those associated with aligning incentives and time horizons are worth considering; while we know owners' embeddedness in a context can have important effects (e.g., Spencer, 2008), our findings suggest that

it is important to understand the embeddedness of the *knowledge* in a context and how ownership affects that embeddedness, and then, in turn, spillovers. These effects are especially important to consider with research questions related to knowledge and innovation. While we focus on these relationships within the context of emerging economies because of the economic implications associated with effective resource allocations for innovation, we expect our results are generalizable to other country contexts as well. Better understanding innovation ownership effects may yield new insights related to stimulating spillovers in geographies near and far from the owner. Future research may also want to examine knowledge spillovers at a finer-grained level—for example whether characteristics of the inventors, firms, or technology areas also influence ownership and spillovers.

In closing, existing research on spillovers largely considers the transfer of existing (presumed superior) knowledge from a foreign firm into a host context. The spillovers from *new* knowledge creation—and how foreign and local owners compare in generating local spillovers—are important to understand in the context of emerging economies. These contexts are often characterized by limited or scarce resources for development efforts and place great value on increasing the stock and quality of knowledge as a means of generating economic development. In this study, we investigate the role of ownership and local spillovers. It is our hope that our findings stimulate more attention to factors that affect spillovers from new knowledge creation at the invention, firm, region, and country level, with the aim of generating knowledge to help emerging economies in the efforts to use innovation investments to drive economic development.

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