**Productivity Spillovers from Inward Foreign Direct Investment
in the U.S. Food Processing Industry**

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ACKNOWLEDGMENTS

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Abstract

Productivity spillovers in the U.S. food processing industry resulting from inward foreign direct investment (FDI) were examined for the time period of 1988 to 1992. Both Caves-type (unidirectional) and simultaneous (bidirectional) spillover models were considered in the analysis. Using the Caves-type spillovers model, foreign investment was found to have significantly negative spillovers. The technology gap between U.S. firms and foreign firms in the food processing industry was small, and it was positively related to the productivity growth. The simultaneous equation model revealed that spillovers were bi-directional in the U.S. food processing industry. The demonstration effect from foreign presence was negative, but the competition effect had even larger positive spillovers for U.S. domestically-owned firms. As a whole, the U.S. food processing industry has benefited from the competition brought by inward FDI.

Highlights

Direct investment by multinational corporations (MNCs) across national borders has grown significantly in the world economy, especially investment in developed countries. With the growing importance of foreign direct investment (FDI), most countries have sought to attract foreign firms to invest in their countries. FDI may affect the economic or productivity growth in host countries in several ways. FDI can directly influence the macro variables in the economy through capital inflows, employment, and trade. Furthermore, it is increasingly accepted that the more important impact of FDI is likely to occur indirectly. Investments by MNCs may generate important externalities that enhance the productivity of local firms in the economy. These externalities, which are typically referred to as 'technology or productivity spillovers,' are perceived to help improve the comparative advantage of the recipient economy over time.

The objective of this research is to empirically examine whether inward-flowing FDI in the United States had any impact on productivity growth of U.S. domestically-owned firms in the food processing industry from 1988 to 1992. In particular, we examine whether there is any evidence of productivity spillovers from foreign firms to U.S. domestically-owned firms in the food processing industry (SIC 201 to 209).

Both Caves-type (unidirectional) and simultaneous (bidirectional) spillover models have been considered in the analysis. The major findings are as follows. First, an increase in the foreign presence was found to be negatively related to productivity growth in U.S. domestically-owned firms. Second, the technology gap between U.S. and foreign firms is small, but spillovers in the U.S. food processing industry have grown with the size of the technology gap. This emphasizes the importance of local firms' ability to absorb information. Third, under the simultaneous equation model, spillovers were bidirectional in the U.S. food processing industry. Foreign firms benefited from the competition with U.S. firms. Fourth, although the demonstration effect from a foreign presence was negative, the competition effect resulted in even larger positive spillovers for U.S. domestically-owned firms. As a whole, the U.S. food processing industry benefits from inward FDI brought by foreign affiliates.

The policy conclusion is clear from these findings. The United States is a developed economy and among the leading world players in the food processing industry. The productivity levels of U.S. domestically-owned firms have been relatively high with steady growth rates. An increase in the presence of foreign firms in the industry does not have much demonstration effect on the domestic industry. However, for U.S. food processing industries, spillovers are more important in sectors where competition is intense. U.S. domestically-owned firms have greatly benefited from the competition instilled by foreign firms and FDI. Therefore, besides attracting FDI inflows, U.S. policies and other governmental actions intended to stimulate competition between foreign affiliates and local firms should be greatly emphasized.

**Productivity Spillovers from Inward Foreign Direct Investment
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Changyou Sun, Hyun J. Jin, and Won W. Koo[*]

INTRODUCTION

Over the past several decades, direct investment by multinational corporations (MNCs) across national borders has grown significantly in the world economy, especially investment in developed countries. With the growing importance of foreign direct investment (FDI), most countries have sought to attract foreign firms to invest in their countries. These countries perceive that FDI is an important channel for obtaining resources for development.

FDI may affect the economic or productivity growth in host countries in several ways. FDI can directly influence the macro variables in the economy through capital inflows, employment, and trade. Furthermore, it is increasingly accepted that the more important impact of FDI is likely to occur indirectly in the form of technology or productivity spillovers (Kokko 1994). This is particularly important at a time when the process of technological change is accelerating and trade is globalizing. Blomstrom and Kokko (1998) argue that the most important reason behind many countries' efforts to attract foreign investment today is a desire to acquire modern technology (interpreted broadly to include product, process, and distribution technology), as well as management and marketing skills. Investments by MNCs may generate important externalities that enhance the productivity of local firms in the economy. These externalities, which are typically referred to as 'productivity spillovers,' are perceived to help improve the comparative advantage of the economy over time.

There are a number of empirical investigations of productivity spillovers through FDI from developed to developing countries. In contrast, similar studies for developed countries as the host of FDI are relatively limited. The exceptions are Caves (1974), whose work examines the manufacturing industries in Australia; Globerman (1979), who conducts similar research for Canada; and Liu et al. (2000) for the United Kingdom.

The objective of this research is to empirically examine whether inward FDI in the United States has any impact on the productivity growth of U.S. domestically-owned firms in the food processing industry, with the sample period from 1988 to 1992[1]. In particular, we examine

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[1] The sample period was constrained by data availability, as explained in the data section.

whether there is any evidence of productivity spillovers from foreign firms to U.S. domestically-owned firms. The food processing industry is defined by the Standard Industry Classification (SIC) and has nine sub-industries (SIC 201 to 209). In the United States, the food processing industry is among the largest product-manufacturing and -distribution segments of the economy, accounting for more than one-sixth of the nation's industrial activity (Henderson et al. 1996). In 1992, the total value of food product shipments in the United States was $406 billion. In terms of FDI, the United States is one of the most globalized economies in the world. The food processing industry has attracted a large amount of foreign investment. In 1992, the total value of foreign affiliates' shipments in the U.S. food processing industry reached $47 billion. It comprised 11% of the value of shipments by all foreign affiliates in the manufacturing industry, second only to the chemicals and allied products industry (SIC 28). The findings of this study contribute to the existing empirical evidence about spillover effects when the recipient is a developed country.

The order of exposure is as follows. In the next section, previous studies on spillovers and related issues are reviewed. This is followed by a description of the models used. A Caves-type single-equation model is introduced to test for technology spillovers resulting from the presence of foreign affiliates. To examine the bidirectional spillover effect between foreign affiliates and U.S. firms, a simultaneous equation system is specified. The subsequent section describes the data used in the study. Finally, the empirical results are presented and policy implications are discussed.

LITERATURE REVIEW

Productivity Spillovers in Host Countries

When MNCs establish affiliates abroad, they differ from existing firms in the host country for two reasons (Blomstrom and Kokko 1998). One is that they bring with them some amount of the proprietary technology that constitutes their firm-specific advantage and allows them to compete successfully with other MNCs and local firms that presumably have superior knowledge of local markets, consumer preferences, or business practices. Another reason is that the entry and presence of MNC affiliates disturbs the existing equilibrium in the market and forces local firms to take action to protect their market shares and profits. Both of these factors are likely to cause various types of productivity spillovers to local firms.

Caves (1974) classified the external benefits brought by MNCs into several categories. MNCs may improve *allocative efficiency* by entering into industries with high entry barriers and reducing monopolistic distortions; MNCs may induce higher *technical efficiency* by spurring local firms to more efficiently use existing resources via the increased competitive pressure or some demonstration effect; and MNCs also may speed up the rate of *technology transfer*. Blomstrom and Kokko (1998) noted that spillovers in host countries can occur through three main channels. First, if there are movements of highly skilled staff from MNCs to domestic firms, these employees may take with them knowledge which may be usefully applied in the domestic firm. Second, if there are close relationships between MNCs and domestic firms, there may be so-called 'demonstration effects' and domestic firms may learn superior production

technologies from MNCs. Third, competition from MNCs may force domestic rivals to update production technologies and techniques to become more productive. This is frequently referred to as a 'competition effect.' As Aitken and Harrison (1999) point out, however, this competition effect may also reduce productivity in domestic firms, if MNCs attract demand away from their domestic competitors.

Statistical Tests of Spillover Effects

The general approach in literature to examining productivity spillovers from foreign to local firms has been to relate the productivity of domestic firms to some measure of foreign presence, while controlling for industry and firm characteristics. The productivity of domestic firms is usually measured as labor productivity or total factor productivity. The presence of foreign firms through FDI is usually measured as the ratio of foreign affiliates' employment to total employment in the industry. If the coefficient estimate of the foreign presence variable turns out to have a positive and statistically significant sign, this is taken as evidence that positive spillovers have taken place from MNCs to domestic firms.

Caves (1974) conducts one of the earliest empirical studies on productivity spillovers from FDI to host countries. Applying econometric techniques to Australian industry-level data on 22 industries at the two-digit level for 1962 and 1966, he finds that the coefficient for the foreign firm's presence is positive and significant. Relatively high subsidiary shares in Australian manufacturing sectors are associated with higher productivity levels in domestic firms. Globerman (1979) applies a similar approach to data on the Canadian manufacturing sector and concludes that differences in labor productivities are associated with spillover benefits from FDI.

Recent studies also present results that are consistent with these early analyses. Blomstrom and Wolff (1994) investigate whether the spillovers in the Mexican manufacturing sector are large enough to help Mexican firms converge toward U.S. productivity levels during the 1965-1982 period. They conclude that a foreign presence in Mexico has a significant and positive impact on the growth rates of local productivity. Blomstrom and Sjoholm (1999) and Driffield (2001) also find positive spillovers.

However, there are some studies suggesting that the effects of a foreign presence are not always beneficial for local firms. Haddad and Harrison (1993), in a test of the spillover hypothesis within Moroccan manufacturing during the 1985-1989 period, conclude that spillovers do not take place in all industrial sectors. Aitken and Harrison (1999) examine the issue for Venezuelan manufacturing plants with panel data. The results find that foreign investment negatively affects the productivity of domestically-owned plants, though the net impact is quite small. The gains from foreign investment appear to be entirely captured by joint ventures. Djankov and Hoekman (2000) and Kathuria (2000) also find negative spillover effects.

Overall, the empirical results on the effects of productivity spillovers are mixed. Gorg and Strobl (2001) summarize and compare 21 empirical studies by meta-analysis. On average, their meta-regression analysis suggests that these study results are not affected by the decision whether to use sector or firm level data. However, whether the data used are cross-sectional or

panel data is an important consideration. Cross-sectional studies report higher coefficients for the effect of foreign presence than do the panel data studies. They postulate that cross-sectional studies may overstate the spillover effects of MNCs on domestic productivity because they do not allow for other time-invariant firm or sector-specific effects, which may impact the relationship between MNCs and productivity.

Technology Gap and Competition Effect

There are several issues associated with the apparently contradictory findings from individual country studies. One issue is related to various host industry and host country characteristics. A number of studies stress the importance of the ability of local firms to absorb information. Cantwell (1989) states that a firm's ability to follow and adapt the technological developments of other firms largely depends on its existing technological capability. Wang and Blomstrom (1992) point out that the majority of spillovers do not automatically occur as a result of the presence of foreign firms. Instead, local firms need to invest in learning activities in order to benefit. Thus, the degree of the technology gap between local and foreign firms is relevant to the spillover effect.

Nevertheless, it is not obvious from a theoretical perspective what the relation between the level of the technology gap and spillovers should be. Two opposing arguments exist in the literature. On the one hand, MNC affiliates may be too advanced to leave any mark on local host country firms. This suggests the hypothesis that spillovers are negatively related to the complexity of MNC technology or to the size of the technology gap between affiliates and local firms. On the other hand, it is obvious that a certain technology gap is necessary for those spillovers to occur, as local firms copy the MNCs' technology or benefit from the MNCs' training of local employees. Thus, it is hypothesized that spillovers grow with the size of the technology gap (Wang and Blomstrom 1992). Kokko (1994) examined the spillover effects for the Mexican manufacturing industry in 1970 and concluded that positive spillovers are less likely to occur in industries with highly differentiated products and large economics of scale. Factors related to technology alone do not seem to inhibit spillovers, but large technology gaps and large foreign market shares together appear to make up significant obstacles.

Another issue is that most empirical tests have not distinguished between the demonstration and competition effects (Kokko 1996). Typical spillovers studies measure spillovers as the impact of a foreign presence on the level of local productivity and assume that the externalities are strictly proportional to the foreign presence. That may fail to capture much of the competition impact. Wang and Blomstrom (1992) construct a theoretical model in which spillovers from competition are not necessarily proportional to the presence of foreign firms, although demonstration effects are. They argue that the competition effects may dominate the demonstration effects, so that a large foreign presence may coincide with a small technology transfer. Kokko (1996), in a study of Mexican manufacturing, confirms that the spillovers from competition are the simultaneous interactions between foreign and local firms. Liu et al. (2000) reach similar conclusions in their study of the manufacturing industry in the United Kingdom.

METHODOLOGY

In order to examine productivity spillovers from MNCs to local firms in the U.S. food processing industry, we first follow the general approach in the literature and specify a Caves-type labor productivity equation for U.S. domestically-owned firms in the food processing industry. Then, a simultaneous equation system is set up for testing possible spillovers from competition effects. The models cover nine sectors of the food processing industry from SIC 201 to SIC 209 and the time period from 1988 to 1992. All variables are measured annually by sector.

Unidirectional Spillovers

The Caves-type model of industry-level productivity spillovers from FDI is shown in Equation (1) below. In this model, labor productivity of U.S. domestically-owned firms (VAD) is supposed to be influenced by the presence of MNCs, or foreign presence (FP). Following the general specification in the literature and data constraints, other controlling variables include: (a) the physical capital intensity in an industry (CAP); (b) new expenditures of U.S. firms (IVD); (c) human capital of U.S. firms (LQD); and (d) size of U.S. firms (SD).

$$VAD = f(CAP, IVD, LQD, SD, FP) \tag{1}$$

VAD is measured by value added per employee for U.S. domestically-owned firms. Because the data on physical capital intensity are available only for all firms in aggregate, CAP is measured by the capital stock per employee for all the firms in an industry. IVD is measured by the expenditure for new plant and equipment per employee for U.S. domestically-owned firms. LQD is the percentage of non-workers among total employees of U.S. domestically-owned firms. SD is the value of shipment per establishment for U.S. domestically-owned firms. FP is the ratio of foreign subsidiaries' employment to total employment in each industry (Table 1).

Positive relationships are expected between VAD and all explanatory variables except foreign presence. Firm productivity is an increasing function of physical capital stock and new expenditure per employee. A higher value of human capital may be seen as evidence of greater learning efforts, or a larger effective labor force. The average firm size variable represents economies of scale in the industry. Given the emphasis of this study, the coefficient on the foreign presence variable is the main focus. If positive (negative) spillovers take place, foreign presence should have a significant positive (negative) effect on labor productivity in U.S. domestically-owned firms.

As noted in Kokko (1994), the spillover effect from FDI may be related to the technology gap between local and foreign firms. Thus, a variable representing technology gap is added to Equation (1) to test this hypothesis. The technology gap between foreign and U.S. firms (TG) is measured by the ratio of labor productivity in foreign-owned firms to that in U.S. domestically-owned firms. The underlying presumption is that high labor productivity is a reflection of advanced technology.

Table 1. Definitions of Variables

Abbreviation	Variables
VAD	Value added per employee for U.S. domestically-owned firms in each industry. Proxy for labor productivity of U.S. firms.
VAF	Value added per employee for foreign affiliates in the United States in each industry. Proxy for labor productivity of foreign affiliates.
CAP	The capital stock per employee for all the firms in each industry. Proxy for capital intensity in each industry.
IVD	The expenditure for new plant and equipment per employee for U.S. domestically-owned firms.
IVF	The expenditure for new plant and equipment per employee for foreign affiliates.
LQD	Percentage of non-workers among total employees for U.S. domestically-owned firms in each industry. Proxy for human capital of U.S. firms.
LQF	Percentage of non-workers among total employees for foreign affiliates in each industry. Proxy for human capital of foreign affiliates.
SD	The value of shipment per establishment for U.S. domestically-owned firms in each industry.
SF	The value of shipment per establishment for foreign affiliates in each industry.
FP	Ratio of foreign subsidiaries' employment to total employment in each industry. Proxy for the presence of foreign affiliates in each industry.
TG	The ratio of labor productivity of foreign affiliates to that of U.S. firms in each industry. Proxy for technology gap between foreign and domestic firms.

Bidirectional Spillovers

While the traditional Caves-type model captures the impact of most of the important variables, it does not account for the possibility of bidirectional spillovers highlighted in the recent literature. These bidirectional spillover effects may be important given our study of a developed economy, the United States, in contrast to the situation of FDI flowing from developed countries into developing countries. To capture these interactive relationships, we follow Kokko (1996) and specify a simple simultaneous equation system. In our case, the system consists of the following two equations.

$$VAD = g \ (CAP, IVD, LQD, SD, FP, VAF) \tag{2}$$

$$VAF = h \ (CAP, IVF, LQF, SF, VAD) \tag{3}$$

Equation (2) is similar to Equation (1) except for the addition of the variable VAF, the labor productivity of foreign-owned firms in the U.S. food processing industry. Spillovers are supposed to be the endogenous outcomes of interactions between foreign and domestic firms. This addition is intended to capture the impact of competition effects from foreign rivals, while foreign presence is assumed to reflect the demonstration effect. In Equation (3), the productivity of foreign-owned firms (VAF) is influenced by the productivity of U.S. domestic firms (VAD) plus other variables that are defined similarly (Table 1). In the simultaneous system, the key variables of interest are FP, VAD, and VAF. Positive coefficients for the endogenous variables VAF and VAD would suggest that spillovers from the competition effects between foreign and U.S. domestic firms raises the productivity for both. A positive (negative) coefficient for FP implies that the presence of foreign affiliates in the United States leads to positive (negative) externalities via demonstration effects (Kokko 1996; Liu et al. 2001).

The endogeneity of VAF can be examined using the Geroski Test (1982) by estimating the equation

$$VAD = \beta_0 + \beta_1\, CAP + \beta_2\, IVD + \beta_3\, LQD + \beta_4\, SD + \beta_5\, FP + \beta_6\, VAF + \gamma\, R + \varepsilon_i \qquad (4)$$

where R is the residual from the reduced form OLS estimate of VAF from the simultaneous Equation (2) and (3). If γ is statistically different from zero, then VAF is endogenous and the use of a simultaneous equation system is justified. If γ is not statistically significant, then VAF can be modeled as an exogenous variable and there is no need for a simultaneous equation system.

DATA

The annual data cover nine sub-sectors of the U.S. food processing industry, from SIC 201 to SIC 209[2], and the time period from 1988 to 1992. In total, there are 45 observations. All data are from the U.S. Department of Commerce and its related bureaus' publications.

Generally, the Bureau of Economic Analysis (BEA) publishes data about foreign direct investment on the basis of enterprise or company. The Bureau of the Census (BC) reports the data for all U.S. manufacturing, including foreign affiliates, on the basis of establishment or plant in the *Annual Survey of Manufactures* (ASM) or the *Census of Manufactures*. Each enterprise may have several establishments, so the data from BEA and BC are not directly comparable. The data from BEA and BC also differ in other ways, such as geographic coverage and definitional differences. Therefore, it is hard to link them directly although both publications have long series. To improve U.S. government data on FDI in the United States, a joint effort from the two Bureaus was initiated in 1990. The publications *Foreign Direct Investment in the United States Establishment Data* 1987 and the *Foreign Direct Investment in the United States*

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[2] SIC 20 is food and kindred products. It has nine sub-sectors: 201 meat products, 202 dairy products, 203 preserved fruits and vegetables, 204 grain mill products, 205 bakery products, 206 sugar and confectionery products, 207 fats and oils, 208 beverages, and 209 miscellaneous food and kindred products.

Establishment Data for Manufacturing from 1988 to 1992 (thereafter, *Establishment Data*) were produced as a result of this relationship. In addition, the National Bureau of Economic Research (NBER) and the Center for Economic Studies (CES) in the BC began jointly producing the *NBER-CES Manufacturing Industry Database*, which contains detailed annual industry-level data (Bartelsman and Gray 1996).

Most of the data used are from the publication *Establishment Data*. However, the publication reported less information in 1987 than in other years. The time period is constrained by this publication and only five years (1988 to 1992) are covered. *Establishment Data* reports the number of employees, value added by manufacture, and value of shipments for each industry on an annual basis. The data are separately documented for foreign-owned establishments and all establishments in the United States. Therefore, data for U.S. domestically-owned firms can be calculated as the difference between them. *Establishment Data* also contains information on the other three variables for foreign-owned establishments: the number of establishments, the number of production workers, and expenditure for new plant and equipment. The corresponding information for all U.S. establishments is reported in the ASM or the *Census of Manufactures*. Finally, the capital stock for each industry in each year originates from the *NBER-CES Manufacturing Industry Database*.

Among the key variables, foreign presence (FP) is defined as the ratio of foreign affiliates' employment to the total employment in each industry. It also can be defined as the value added of foreign affiliates over the total value added in each industry (FP2). These two measures are highly correlated, with a correlation coefficient of 0.93. As shown in Table 2, FP2 is larger than FP in most cases. This is consistent with the fact that foreign affiliates have higher labor productivity for most sub-sectors (i.e., VAF is larger than VAD). Over the study period, and for most sub-sectors, the number of establishments owned by foreign affiliates has been increasing at a faster rate than domestically-owned establishments (Table 2). The exception is the sugar and confectionary products industry (SIC 206). Overall, the foreign presence has been increasing in the U.S. food processing industry.

Another key variable, the technology gap (TG), is measured by the ratio of labor productivity in foreign-owned firms to that in U.S. domestically-owned firms (Table 2). TG is greater than one in eight out of the nine sub-sectors, meaning that foreign firms have higher average values of labor productivity than U.S. firms in most cases. The exception is meat products (SIC 201), with a TG of 0.82. For SIC 204 and 208, the values are almost one. The average value of TG for all sub-sectors is 1.19, which suggests that the labor productivity of foreign affiliates is 19% higher than that of U.S. firms. This is smaller than the values reported in prior studies. For example, Liu et al. (2000) reported that the average value of TG for UK manufacturing is 2.01; similarly, Kokko (1994) reported 2.03 for Mexico. Considering the United States has been the leading developed country in this industry, the small technology gap measured by labor productivity is reasonable.

Table 2. Summary Statistics

SIC	FP	FP2	TG	Number of Establishments			
				Foreign 1987	Foreign 1992	U.S. 1987	U.S. 1992
201	0.04	0.03	0.82	47	49	3,193	3,191
202	0.12	0.14	1.25	67	122	2,299	1,898
203	0.12	0.17	1.50	82	116	1,836	1,936
204	0.14	0.14	1.03	162	210	2,445	2,406
205	0.12	0.16	1.48	67	106	2,783	3,044
206	0.16	0.18	1.15	62	57	1,013	1,072
207	0.20	0.21	1.10	33	52	553	489
208	0.09	0.10	1.01	93	141	2,118	1,924
209	0.12	0.15	1.40	134	160	3,596	3,825
mean	0.12	0.14	1.19				

Note:
1. FP is the foreign presence measured by the ratio of foreign subsidiaries' employment to total employment.
2. FP2 is the foreign presence measured by the ratio of foreign subsidiaries' value added to total value added in each industry.
3. TG is the technology gap.
4. The last four columns are the number of establishments of either foreign affiliates or domestically-owned firms for two years.

ESTIMATION AND RESULTS

Unidirectional Spillovers

All variables have a logarithmic transformation. Equation (1) is estimated by ordinary least squares and the results are presented in (Table 3)[3]. The estimation has a good model fit. The adjusted R^2 is 0.95. All variables except the human capital proxy (LQD) have significant effects on labor productivity at the 1% significance level. The capital intensity in each industry and expenditure for new plant and equipment by U.S. domestically-owned firms have positive

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[3] Since the data are a panel set, they can also be estimated by panel model techniques. Following Greene (2000), the selection of the panel models can be based on several tests: the Lagrange Multiplier (LM) test, for the OLS model against the fixed and random effects models, and the Hausman Specification (HS) test, for the random effects model against the fixed effects model. In our case, the LM test revealed that the OLS model was superior to both fixed and random effects models. Thus, only the OLS results are reported here.

effects on their labor productivity. The magnitude of the elasticity is approximately 0.5. The size of the firm has a significantly negative effect, however.

Table 3. Results for Single Equation (OLS)

	Without TG		With TG	
	Coefficient	t-ratio	Coefficient	t-ratio
ONE	5.26	11.81*	4.22	7.80*
CAP	0.57	7.16*	0.56	7.57*
IVD	0.46	6.28*	0.53	7.17*
LQD	0.03	0.74	0.03	0.64
SD	-0.28	-6.64*	-0.26	-6.23*
FP	-0.22	-3.89*	-0.29	-5.13*
TG	—	—	0.20	3.06*
Adj-R^2	0.95		0.95	
F	163.98		147.28	

Note: * represents significance at 1%.

More importantly, foreign presence has a significantly negative effect at -0.22. This suggests that a 1% increase of foreign presence in the U.S. food processing industry decreases labor productivity of U.S. domestically-owned firms by 0.22%. This is consistent with the findings of negative spillover effects in Haddad and Harrison (1993) and Aitken and Harrison (1999), but contradicts the positive results in Blomstrom and Wolff (1994) and Liu et al. (2001).

Equation (1) with the addition of the technology gap variable was estimated. The results are quite similar (Table 3). The new variable, technology gap, as measured by the ratio of labor productivities, has a positive effect on the labor productivity of domestically-owned firms. This result is consistent with the theoretical argument that spillovers grow with the size of the technology gap when the gap is small (Wang and Blomstrom 1992).

Bidirectional Spillovers

For the bidirectional estimation, endogeneity was first tested using Equation (4). The test reveals that γ is statistically significant at the 5% level. The estimation of the simultaneous system is justified. The results of the two stage least squares estimation (2SLS) are presented in Table 4.

The model has a good fit with an adjusted R^2 of 0.97 and 0.85 for the two equations, respectively. Most variables have significant results similar to those in the unidirectional spillovers model, as presented in Table 3. Specifically, capital intensity has a significantly positive effect for domestic firms but a significantly negative effect for foreign affiliates. Expenditure for new plant and equipment has positive effects for both equations, but human capital again has no effect. Size of the firm has a significantly negative effect for domestic firms

but an insignificant positive effect for foreign affiliates. The variable of foreign presence still has a significantly negative effect with an elasticity of -0.28, which suggests that the demonstration effect of a foreign presence in the U.S. food processing industry is negative.

Table 4. Results for Simultaneous Equations (2SLS)

	VAD			VAF	
	Coefficient	t-ratio		Coefficient	t-ratio
ONE	0.85	0.84	ONE	0.89	0.20
CAP	0.32	4.33*	CAP	-0.52	-1.67***
IVD	0.40	7.05*	IVF	0.31	3.41*
LQD	0.01	0.20	LQF	0.40	4.21*
SD	-0.12	-2.97*	SF	0.19	1.05
VAF	0.42	4.42*	VAD	0.97	2.03**
FP	-0.28	-6.48*			
Adj-R^2	0.97			0.85	
F	262.47			51.71	

Note: *, **, and *** denote significance at 1%, 5%, and 10% respectively.

The variables VAD and VAF in the equations reveal spillover effects from competition between domestic firms and foreign affiliates. Both variables have significantly positive effects. For U.S. domestically-owned firms, the competition from foreign affiliates improves the productivity with an elasticity of 0.42. Similarly, foreign affiliates benefit from competition spillovers with an elasticity of 0.97. Therefore, the competition between domestic firms and foreign affiliates increases the labor productivity for both.

Accordingly, the increasing presence of foreign affiliates in the U.S. food processing industry has two opposite effects. The spillovers from demonstration effects and the simple presence of foreign affiliates are negative. But the competition between foreign and domestic firms improves the labor productivity for both. The magnitude of the positive competition effect is larger than the magnitude of the negative demonstration effect. This suggests that for the United States, as the leading developed country in the food processing industry, overall positive spillovers come mainly from competition, which dominates other negative effects.

SUMMARY

In this study, productivity spillovers brought by foreign affiliates through inward FDI in the U.S. food processing industry are examined for the time period 1988 to 1992. The food processing industry is among the largest manufacturing industries in the United States and has hosted a large amount of FDI. Foreign presence, measured as the employment share by foreign affiliates in the industry, averaged 12% over the sample period covered and increased for most sub-industries over the study period. The technology gap between foreign affiliates and U.S. local firms is small and averaged 19%.

Models of both Caves-type (unidirectional) and simultaneous (bidirectional) spillovers have been considered in the analysis. The major findings are as follows. First, within both models, U.S. domestically-owned firms did not benefit directly from inward FDI through demonstration effects. Instead, increasing foreign presence was found to be negatively related to the productivity growth of U.S. domestically-owned firms. Second, the technology gap between domestic and foreign firms is small, but spillovers in the U.S. food processing industry have grown with the size of the technology gap. This emphasizes the importance of local firms' ability to absorb information. Third, the simultaneous equation model made an explicit distinction between demonstration and competition effects. Spillovers were bidirectional in the U.S. food processing industry, so foreign firms also benefited from the competition with domestic firms. Fourth, although the demonstration effect from a foreign presence was negative, the competition effect resulted in even larger positive spillovers for U.S. domestically-owned firms. As a whole, the U.S. food processing industry still benefits from inward FDI brought by foreign affiliates.

The policy conclusion is clear. When the host country of inward FDI is a developing country, its productivity level is, in most cases, lower than foreign firms' and productivity spillovers may occur in several ways. The situation is different for the United States because it is a developed economy and among the leading players in the worldwide food processing industry. The productivity levels of U.S. domestically-owned firms have been relatively high with steady growth rates. The increasing presence of foreign firms in the industry does not have much demonstration effect on the domestic industry. However, for U.S. food processing industries, spillovers are more important in sectors where competition is intense. U.S. domestic firms have greatly benefited from the competition brought by foreign firms and FDI. Therefore, besides attracting FDI inflows, U.S. policies and other government actions intended to stimulate competition between foreign affiliates and local firms should be greatly emphasized.

The shortcoming of this study is that, due to data constraints, the analysis only covered five years. It would be worthwhile to examine the issue when data are available for a longer period. In addition, the United States has also been a large investor in other countries. The outward FDI from the United States' own MNCs may affect their degree of interaction with foreign firms in the United States. Future studies might investigate whether this outward FDI from the United States has promoted the productivity of U.S. domestic firms in the food processing industry.

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