The Impact of Multinational Presence on Domestic Investment: Firm-level Evidence from South Korea

Kwang Soo Kim
University of Texas at Dallas

Aslı Leblebicioğlu
University of Texas at Dallas*

April 2017

Abstract

In order to analyze the effects of foreign multinationals' presence on domestic firms' investment, we use a detailed firm level data-set from South Korea for the 2006-2014 period. We combine it with the input-output tables provided by the Bank of Korea to construct industry level measures of multinational presence in sectors that are horizontally and vertically linked, and estimate dynamic investment equations that are augmented with these foreign presence measures. We find a positive and significant effect of foreign presence in both horizontally and vertically linked industries on domestic firm's investment rate, with larger effects arising from multinational presence in the supplying sectors. Quantitatively, a 2 percentage point increase in the presence of multinational suppliers increases the domestic firms investment rate by 3.24 percentage points. We also find that this effect is larger for small and medium firms, private firms, non-exporters, firms that are not part of a chaebol, and for firms in external finance dependent industries. A similar 2 percentage point increase in the foreign presence in downstream sectors increases the investment rate of domestic suppliers by 0.55 percentage points. This effect is larger if the domestic firm is part of a chaebol, or is in a less external finance dependent industry. Investment increase by 0.53 percentage points following a 2 percentage point increase in horizontal linkages.

JEL Classification: E22, F21, F23
Key Words: Foreign direct investment; firm-level investment; South Korea

*Corresponding Author. Email: axl128330@utdallas.edu. Address: 800 W Campbell Rd, GR 31, Richardson, TX 75080. Phone: 972-883-6903.

1 Introduction

While it is commonly agreed that foreign direct investment (FDI) relaxes credit constraints for firms that receive capital transfers and allows them to invest more, there is no consensus on FDI's overall impact on domestic capital accumulation. The effects of FDI inflows on domestic investment have been investigated by a large number of empirical studies that use aggregate data. Some examples in this literature that find positive effects of FDI on domestic investment include Bosworth et al. (1999), Tang et al. (2008), and Farla et al. (2014). On the other hand, studies such as Agosin and Machado (2005), Mutenyo et al. (2010), Morrissey and Udomkerdmongkol (2012), and Ashraf and Herzer (2014) use aggregate data and find that FDI inflows crowd-out domestic investment. In contrast to the large number of studies that use aggregate data, there are very few studies that focus on how FDI affects domestic firm's investment behavior. We contribute to the literature by analyzing how the presence of multinationals in the downstream and upstream sectors can affect domestic firms' investment decisions using firm level data from South Korea.[1] To the best of our knowledge, our paper is the first to provide firm-level evidence on the effects of FDI on firm-level investment decisions through vertical linkages.

The presence of multinationals in vertically and horizontally integrated industries can affect investment behavior differently. In the horizontal linkage case (multinational presence in the same industry as the domestic firm), FDI inflows might have a positive effect on domestic firms investment, if enhanced competition forces domestic firms to become more efficient, and if firms undertake investment projects in order to copy foreign technologies. On the other hand, foreign multinationals can lead domestic firms to lower investment by acquiring market shares and/or increasing the cost of locally supplied inputs, and thereby lowering the marginal profitability of domestic firms' capital. By contrast, the presence of multinationals in vertically integrated industries is generally expected to increase domestic investment. FDI flows into upstream industries, resulting in an increase in the number of foreign suppliers of intermediate inputs, lower the cost of intermediates, which improve the marginal profitability of capital, and therefore allow domestic firms to accumulate more capital. Additionally, FDI flows into downstream industries can lead to higher investment, as multinationals increase the demand for local suppliers' products and increase their profitability.

[1] Using aggregate data for the 1985-1999 period, Deok-Ki Kim and Seo (2003) find that FDI neither crowded-in nor crowded-out domestic investment in South Korea.

In order to analyze the effects of foreign multinationals' presence on domestic firms' investment decisions, and to evaluate these mechanisms, we use a detailed firm level data-set from South Korea's manufacturing sector for the 2006-2014 period. One advantage of this data-set is that it contains information on private firms, whose investment decisions can be affected more by FDI inflows, as they are more financially constrained than the publicly traded firms. We combine the firm level data, which include information on foreign ownership of firms, with input-output tables provided by the Bank of Korea to construct industry level measures of multinational presence in sectors that are horizontally and vertically linked. We construct our baseline linkage measures following the methodology in Javorcik (2004). We then estimate dynamic investment equations that are augmented with these foreign presence measures using the system-GMM estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998). The use of firm panel data allows us to control for time invariant firm level unobservables relevant to the domestic firm's investment decision, as well as time-varying unobservable shocks common to all firms in South Korea. In addition, we are also able to analyze other important firm-level factors, such as firm size and public status, that influence how linkages with foreign multinationals might impact investment decisions.

We find a positive and significant effect of foreign presence in both horizontally and vertically linked industries on domestic firms investment rate, with larger effects arising from multinational presence in the vertically linked sectors. In particular, we find that a 2 percentage point (one standard deviation) increase in the presence of foreign multinationals in the upstream sectors, where foreign firms supply intermediate inputs, increases the investment rate of domestic customers by 3.24 percentage points. Since the mean investment rate is 22 percent of the existing capital stock, this increase corresponds to a 14.50 percent increase in the investment rate. When we analyze the heterogeneity of this effect on firms with different characteristics, we find that it is larger for small and medium size firms, private firms, non-exporters, firms that are not part of a conglomerate (chaebol), and for firms in external finance dependent industries. A similar 2 percentage point increase in the foreign presence in downstream sectors, where foreign firms are the customers, increases the investment rate of domestic suppliers by 0.55 percentage points. This effect is larger if the domestic firm is part a chaebol, or is in a less external finance dependent industry. Finally, we also show that the effect of a 2 percentage point increase in horizontal FDI is also positive, leading to a 0.56 percentage point increase in investment. Our results are robust to using alternative measures of using vertical linkages, in particular to the ones that take into account indirect linkages between industries (Antràs et al. (2012)).

Our paper is related to the broader literature on the effects of FDI on firm's productivity. Javorcik (2004) and Blalock and Gertler (2008) find productivity spill-overs from FDI

into downstream industries in Lithuania and Indonesia, respectively. Using data from the U.S., Keller and Yeaple (2009) show substantial productivity gains from horizontal FDI.[2] By providing evidence on the positive impact of FDI on firm-level investment, our results complement the findings in these papers. Moreover, different from the productivity literature, our results show that FDI into the upstream industries, which increase the number of multinational suppliers, can especially be important for capital accumulation.

Our work is also related to the literature that estimates dynamic investment equations to analyze how FDI affects firms' credit constraints. Harrison and McMillan (2003) estimate investment Euler equations using data from the Ivory Coast, and show that borrowing by foreign firms exacerbate domestic firm credit constraints, and thereby crowd-out investment. In contrast, using a cross-country firm-level panel data-set Harrison et al. (2004) find that FDI inflows are associated with a reduction in firm financing constraints. While our focus in this paper is not mainly on credit constraints, we also show that both horizontal and vertical linkages with multinationals contribute to capital accumulation also by relaxing the liquidity constraints faced by domestic firms.

The rest of the paper is organized as follows. In section 2, we describe the hypotheses regarding the effects of FDI in horizontally and vertically linked industries on the domestic firm's investment decisions. Also, within that section, we present the empirical model. In Section 3 we describe the firm-level data and how we construct the foreign presence measures of interest. Section 4 discusses our findings, and section 5 concludes the paper.

2 Foreign Multinational Presence and Domestic Firms' Investment

In order to motivate the empirical specification, and to describe how foreign multinationals' presence in the vertically and horizontally integrated industries can affect investment decisions of domestic firms, in this section we discuss a simple investment problem of the firm. With horizontal linkages, the firm faces the presence of foreign multinationals in the same industry as it operates in. Presence of foreign multinationals in the vertical industries can be in the form of backward or forward linkages. If the domestic firm has backward linkages with the foreign multinationals, then it supplies inputs to the foreign producers.

[2]In addition to improving within firm productivity through spill-overs, multinationals can enhance aggregate productivity through market reallocation and between firm selection. Using a cross-country firm-level panel dataset, Alfaro and Chen (2015) show that the latter mechanism account for the majority of the productivity gains.

Alternatively, the domestic firm can source inputs from the foreign firms that operate in the upstream industries, in which case the domestic firm has forward linkages with the multinationals. We start by describing the investment decision of the firm, and the hypotheses we test in our empirical application. Then, we describe our empirical set-up, and the estimation methodology.

2.1 Investment Decisions and the Hypotheses

To obtain the investment Euler equation, we consider the standard investment problem of a firm (see for example Love (2003) and Harrison et al. (2004)). At the beginning of period t, the firm optimally chooses the level of variable inputs, output price, and the investment expenditures. Firm i enters period t with K_{it-1} units of capital. Due to a one period time-to-build lag, the new capital resulting from total investment becomes productive in the following period, i.e., production in period t depends on K_{it-1}. The firm chooses total investment expenditures I_{it} to maximize the expected present value of current and future profits subject to the standard capital accumulation equation. Denoting the maximum profit of firm i obtained by choosing the optimal level of variable inputs and the output price with Π_{it}, we can write the expected present value of profits as:

$$V_{it}(K_{it-1}) = \max_{I_{it}} \{\Pi_{it} - G\left(K_{it-1}, I_{it}\right) - I_{it} + \beta E_t\left[V_{it+1}(K_{it})\right]\} \tag{1}$$

subject to

$$K_{it} = (1-\delta)K_{it-1} + I_{it}, \tag{2}$$

where β is the discount factor; δ is the rate of depreciation; and $G\left(K_{it-1}, I_{it}\right)$ denotes the cost of altering the capital stock, which leads to a loss of a fraction of total investment. The first order conditions of the firm's problem yield the following equation:

$$1 + \frac{\partial G\left(K_{it-1}, I_{it}\right)}{\partial I_{it}} = \beta E_t\left[\frac{\partial \Pi_{it+1}}{\partial K_{it}} - \frac{\partial G\left(K_{it}, I_{it+1}\right)}{\partial K_{it}} + (1-\delta)\left(1 + \frac{\partial G\left(K_{it}, I_{it+1}\right)}{\partial I_{it+1}}\right)\right]. \tag{3}$$

This standard Euler equation implies that along the optimal path, the marginal cost of investing in a new unit of capital equals the present discounted value of the marginal return to capital. The marginal return depends on the marginal profitability of capital (net of adjustment costs) and the value of undepreciated capital.

Following Love (2003), we measure the marginal profitability of capital, $\frac{\partial \Pi_{it+1}}{\partial K_{it}}$, using the firm's sales-to-capital ratio. Additionally, we assume that the presence of foreign multinationals can affect the investment decisions by altering the marginal profitability of capital.

Foreign presence in the vertically integrated industries is expected to have a positive effect on the marginal profitability of capital, and therefore on the investment decisions, as in the case for productivity spill-overs (see e.g., Javorcik (2004)). Given an increase in the number of foreign suppliers, FDI spill-overs through forward linkages lower the cost of intermediates, and also potentially increase the quality of available varieties. Since capital and intermediate inputs are used in conjunction, higher quality and/or lower input costs in turn would improve the marginal profitability of capital, and therefore allow domestic firms to increase investment.[3] FDI flows into downstream industries can lead to higher marginal profitability of capital through backward linkages, as an increase in the number of multinationals (as customers) would raise the demand for domestic suppliers' products, and their revenues. Additionally, the presence of multinational firms in the downstream industries might lead domestic firms to increase investment by requiring them to upgrade the quality of their products (Javorcik (2004)).

In the case of horizontal linkages, the presence of multinationals can have both positive and negative effects on domestic firms' investment decisions. An increase in the foreign multinational presence can lower marginal profitability of capital and thereby reduce investment by intensifying competition, acquiring market shares and lowering the domestic firms' sales (Aitken and Harrison (1999); Markusen and Venables (1999)). Additionally, by increasing the demand for locally supplied inputs, such as labor, foreign multinationals can also lead to lower marginal profitability and investment. On the other hand, domestic firms might increase investment to benefit from the knowledge that spills over from the more productive foreign firms, and/or to become more efficient in order to compete with the foreign firms. Hence, the net effect of FDI spillovers on firm's domestic investment through horizontal linkages is á priori ambiguous, and needs to be determined empirically.

2.2 Empirical Investment Equation and Estimation

In order to test for the mechanisms through which the presence of multinationals can affect investment decisions, we specify an empirical investment Euler equation that is augmented with three foreign multinational presence measures. Because the main goal of this study is to estimate the impact of FDI spill-overs on domestic firms' investment decisions,

[3]Similar to this mechanism through which FDI spill-overs through forward linkages impact marginal profitability of capital, imported inputs can also improve firm's productivity (see for example Halpern et al. (2015) and the references therein) and lead to more investment. Ideally, we would want to distinguish the effect of imported inputs on investment from the impact of forward linkages by controlling for both mechanisms simultaneously. Unfortunately, we do not have information on the firms' imports; therefore, we cannot differentiate between these two mechanisms in our sample.

we estimate a standard reduced form investment equation instead of focusing on a structural relationship. We start by estimating the following baseline specification

$$\frac{I_{ijt}}{K_{ijt-1}} = \alpha_1 \frac{I_{ijt-1}}{K_{ijt-2}} + \alpha_2 \frac{S_{ijt}}{K_{ijt-1}} + \alpha_3 \frac{C_{ijt}}{K_{ijt-1}} + \alpha_4 FP^H_{jt} + \alpha_5 FP^B_{jt} + \alpha_6 FP^F_{jt} + \upsilon_i + \eta_t + \tau_{jt} + \varepsilon_{ijt}, \quad (4)$$

where $\frac{I_{ijt}}{K_{ijt-1}}$ denotes investment rate for firm i, in industry j in year t; and $\frac{S_{ijt}}{K_{ijt-1}}$ and $\frac{C_{ijt}}{K_{ijt-1}}$ are the firm's total sales and cash flow, respectively, normalized by its capital stock. The normalization by capital stock naturally arises in a model with quadratic adjustment costs, and it allows us to control for the size of the firm.[4] The term FP^H_{jt} is a measure for foreign presence in the same sector as the firm operates in, i.e., sector j, and captures the horizontal linkages; FP^B_{jt} is a proxy for foreign presence in sectors that are supplied by sector j, and provides a measure for backward linkages; and FP^F_{jt} is a proxy for foreign presence in sectors that provide inputs to sector j, i.e., forward linkages. We describe the construction of each of these measures in the following section.

As firm-level determinants of investment, we include sales-to-capital ratio in order to control for marginal profitability of capital, and cash flow as a proxy for financing constraints, which arise due to capital market imperfections (Fazzari et al. (1988)). Cash flow can affect investment decisions, since it might be difficult for some firms to smooth investment behavior via external capital markets. Empirically, cash flow is constructed as the difference between sales and costs, adjusted for taxes and depreciation. We also include the lagged investment rate to control for the autocorrelation that may arise due to adjustment costs in investment. The specification also includes firm specific fixed effects, υ_i, that capture the time-invariant firm-level determinants of investment, as well as year dummies, η_t, that capture aggregate economy-wide fluctuations. Macroeconomic factors common to all firms, such as changes in the exchange rates, will be captured by these year effects. Since firms in different industries might face different productivity trends, which may be correlated with foreign presence in horizontally and vertically linked industries, we include interaction terms between two-digit industry dummies and a linear time-trend, τ_{jt}, to allow for industry-specific trends.[5]

Given the short time dimension of our panel data-set (9 year), we estimate the dynamic investment equation (4) and the augmented specifications using the *system-GMM estimator*

[4] One can obtain a linearized Euler equation similar to the one presented in equation (4) by adopting a functional form for the adjustment costs, and taking a first-order Taylor approximation of the resulting Euler equation (see Love (2003) for derivation of such a model).

[5] We construct the measures of foreign presence in the horizontally and vertically linked industries using the input-output matrix at the two-digit level. If we were to include two-digit industry-year fixed effects in our specification, we would not be able to identify the coefficients on the foreign presence measures of interest since they vary at the two-digit industry-year level. Therefore, we are only able to include industry-specific time trends.

of Arellano and Bover (1995) and Blundell and Bond (1998). This estimator addresses the potential biases that arise from the correlation between the firm fixed effects, υ_i, and the lagged dependent variable, $\frac{I_{ijt-1}}{K_{ijt-2}}$, and allows us to treat sales, $\frac{S_{ijt}}{K_{ijt-1}}$, and cash flow, $\frac{C_{ijt}}{K_{ijt-1}}$ as endogenous variables. We use lagged values of firm-specific variables dated $t-2$ and $t-3$ as the GMM-type instruments.[6] We report the second order serial correlation tests and the Sargan-Hansen tests of over-identification to show the validity of our instruments. Finally, we cluster the standard errors at the industry-year level since firms in the same industry j may experience the same shocks in a given year.

3 Data

3.1 Firm level data

To identify the impact of foreign presence in horizontally and vertically linked industries on domestic firms' investment, we use firm-level data for South Korea's manufacturing sector from the Korean Information Service, Inc. (KIS). The data are obtained from the balance-sheet of both public and private firms.[7] Our sample covers the 2006-2014 period. We choose 2006 as the initial year of our sample in order to maximize the coverage of firms included.[8]

The data-set includes information on sales, costs, as well as various types of assets that allow us to construct the investment rate $\left(\frac{I_{ijt}}{K_{ijt-1}}\right)$, which is defined as the ratio of real investment to the lagged replacement value of real capital stock. We follow Kim et al. (2015) closely in constructing the real investment and the real capital stock measures. Real investment is measured as nominal investment deflated by the capital goods price index (source: Bank of Korea), where nominal investment is calculated as the change in the book value of capital (tangible assets minus land and lease assets) plus depreciation costs. We construct the real capital stock using the perpetual inventory method with an 11 percent depreciation rate, and the real investment described above. As the measure of initial capital

[6] In some specifications, including lagged value dated $t-2$ of the investment rate as a GMM-type instrument violates the validity of the Sargan-Hansen tests of over-identification. In those cases, we include only the lagged value dated $t-3$ of the investment rate in the instrument set.

[7] KIS compiles data on all firms conforming to one of several criteria, who are required by the Act of External Audit of Joint-Stock Corporations to report audited financial statements to the Financial Supervisory Commission. Based on the 2014 revision of the law, the following firms are required to report financial statements: (i) firms assets more than or equal to 12 billion Korean Won; (ii) public firms; (iii) firms with assets more than or equal to 7 billion Won and total liabilities more than or equal to 7 billion Won; (iv) firms with assets more than or equal to 7 billion Won and employees more than or equal to 300.

[8] Before 2006, total sales of firms recorded in the KIS data is less than 75% of the total sales of all manufacturing firms with at least 5 employees in Korea reported by the Mining and Manufacturing Survey of Statistics Korea.

stock, we use the real book value of capital in the first year the firm appears in the data-set.

Since our focus is the impact of foreign presence on domestic firms' investment behavior, we exclude firms with foreign ownership of more than 10 percent from the sample. However, we show the robustness of our results to also including firms with foreign ownership. Additionally, we drop the observations in the top and bottom 1 percent of the sample based on investment rate, sales and cash-flow in order to eliminate outliers. As a result, we end up with 6,285 firms over the 2006-2014 period.[9] We present the descriptive statistics for the variables included in our estimations in Table 1.

3.2 Horizontal and vertical linkage measures

In constructing the foreign presence measures, we follow Javorcik (2004) closely, and calculate the same measures in her paper for our sample. The proxies for horizontal and vertical linkages are constructed at the two-digit industry level, as defined by the Bank of Korea. The proxy for horizontal linkages, FP^H_{jt}, measures the extent of foreign presence in the same sector j as the firm is operating in. It is constructed as the total foreign equity participation in the sector, weighted by each firm's share in total output of the sector:

$$FP^H_{jt} = \frac{\sum\limits_{\text{for all } i \in j} ForeignShare_{it} * S_{it}}{\sum\limits_{\text{for all } i \in j} S_{it}}, \tag{5}$$

where $ForeignShare_{it}$ is the percentage of firm i owned by foreign firms, and S_{it} is the real sales of firm i (sales deflated by the producer price index).

Foreign presence in the downstream industries, where foreign multinationals are supplied by domestic firms, measure the extent of backward linkages and are captured with the FP^B_{jt} variable constructed as

$$FP^B_{jt} = \sum_{k, k \neq j} \gamma_{jkt} FP^H_{kt}. \tag{6}$$

The term γ_{jkt} is the fraction of sector j's output supplied to sector k during year t, and is obtained from the input-output matrix provided by the Bank of Korea at the two-digit level for the corresponding year t. In using time-varying input-output coefficients to construct the backward linkage measure, we allow for potential changes in the relationships between the sectors. However, we check the robustness of our results to constructing the foreign presence measures using fixed input-output coefficients. This measure of backward linkages

[9] We end up with an unbalanced sample as there are firm entries and exits between 2006 and 2014.

does not include inputs supplied within sector j ($k \neq j$), since they are already included in the horizontal linkages measure, FP^H_{jt}.

The proxy for forward linkages is FP^F_{jt}, and it measures the foreign presence in the upstream industries, where foreign multinationals provide inputs to the domestic firms. It is constructed as the weighted share of output by firms with foreign equity in the supplying sectors, i.e.,

$$FP^F_{jt} = \sum_{m,m\neq j} \sigma_{jmt} \frac{\sum_{\text{for all } i\in m} ForeignShare_{it} * (S_{it} - X_{it})}{\sum_{\text{for all } i\in m} (S_{it} - X_{it})}. \quad (7)$$

Following Javorcik (2004), we exclude exports by (X_{it}) foreign firms since only intermediates sold to domestic firms are relevant for the forward linkages under consideration.

Table 1 presents the descriptive statistics for the horizontal, backward, and forward linkage measures for the overall sample, and Table 2 presents the average value of the three measures for each of the two digit industries, ranked by the average horizontal foreign presence measure. There is considerable variation across industries for each of the foreign presence measures. While the overall average for the horizontal linkage measure for all of the industries is 10 percent, it displays a large variation from 0.4 percent in ship building at the low end to 45 percent in glass product manufacturing at the high end. The overall average backward linkage measure is 3.2 percent. It takes on a value zero for ship building and tobacco product manufacturing, suggesting that those to industries do not supply inputs to any foreign multinationals. At 13.87 percent, the industry with the highest average backward linkages to foreign multinationals is basic chemical product manufacturing. The forward linkage measure ranges between 0.8 percent in non-ferrous metal manufacturing and 16.95 percent in synthetic resin and rubber manufacturing, which implies that the latter industry had the most linkages with suppliers with at least part foreign ownership.

4 Results

We start by estimating the impact of horizontal, backward, and forward linkages on domestic firms' investment decisions in South Korea, as specified by equation (4). In the first subsection, we discuss the main effects of these three foreign presence measures on investment decisions, show that the results are robust to including firms with foreign ownership in the sample, and to accounting for the financial crisis years. Also, within that subsection, we show the robustness of our results to using alternative measures of foreign presence in the vertically linked industries. Next, we discuss the heterogeneity in the impact of the foreign

presence measures for exporters, large firms, and firms that belong to a chaebol. In the final subsection, we consider the role of financial constraints in mediating the impact of foreign firm presence on domestic investment.

4.1 Main Effects of FDI on Domestic Firms' Investment Decisions

Table 3 presents the results from our baseline specification (4) for investment, which includes firm and year fixed effects, as well as industry specific time trends. Additionally, it includes total domestic sales of the two-digit industry the firm is operating in (industry j) as a measure of aggregate size of the industry.[10] Column (1) of Table 3 shows that all three foreign presence measures have positive and significant effects on domestic firms' investment decisions. In column (2), we add a Herfindahl index to the baseline specification to control for the overall industry concentration, which would affect the marginal profitability of the firms and could be correlated with foreign firm presence.[11] Following Javorcik (2004), in column (3), we further include a measure of total demand for the (two-digit) industry's output in a given year, calculated using information on input coefficients from the input-output matrix and the value of sales in the using sectors.[12] The results from this augmented specification show that all three measures are positive, but only the forward and horizontal linkage measures are statistically significant. The largest impact is obtained for the forward linkage variable with a coefficient of 1.622, which implies that a one standard deviation increase in the presence of foreign suppliers–corresponding roughly to a 2 percentage point increase in FP_t^F–, the domestic customers increase investment rate by 3.24 percentage points. Given that the average investment rate in the sample is 22.38 percent, this increase corresponds to a 14.50 percent increase in the investment rate. Hence, as expected, the increase in the presence of multinationals in the supplying sectors improves the marginal profitability of capital, and allows domestic firms to increase investment by potentially lowering the cost of intermediates and/or improving the quality of available varieties.

The coefficient on the backward linkage measure is smaller at 0.276, and it is not statistically significant. The size of the coefficient implies that a similar 2 percentage point increase in foreign presence in the downstream sectors, where the customers are multinationals, raises

[10] We are not able to construct industry-specific control variables or include industry-year fixed effects at a more disaggregate level due to the fact that Bank of Korea changed industry classifications during our sample period, and there is no straightforward mapping between the new and old classifications.

[11] The Herfindal index is constructed as the sum of squared sales share of firms in each two digit industry.

[12] More specifically, the demand variable is constructed as $Demand_{jt} = \sum_{k} \alpha_{jkt} S_{kt}$, where α_{jkt} is the fraction of output purchased by industry k from industry j, and S_{kt} is the total sales in industry k, proxying for the value of output in that industry.

investment by 0.55 percentage points, corresponding to a 2.47 percent increase in the investment rate. This result suggests that backward linkages potentially can increase investment by raising the demand for domestic suppliers' products and increasing their profitability. However, in addition to being insignificant, this effect is smaller than the impact Javorcik (2004) obtains for output, which indicates that backward linkages may be more important for growth through productivity increases and knowledge spill-overs, rather than capital accumulation.[13] We find a positive and significant effect of horizontal FDI on domestic firms' investment decisions. At 0.280, the coefficient on FP_t^H implies an addition of 0.56 percentage points to the investment rate following a similar 2 percentage point increase in the foreign presence in the domestic firm's own industry. Hence, by allowing for knowledge spill-overs within the same industry, horizontal linkages lead firms to invest more, but its impact is relatively small.

In terms of the firm-specific determinants of investment, lagged investment rate is positive and statistically significant in all specifications, demonstrating the serial correlation in investment. The coefficient on sales, which proxies for marginal profitability of capital, is positive and significant at the 10 percent level. Similarly, the coefficient on cash flow is also positive and significant, underscoring the importance of liquidity constraints in investment, and suggesting that if firms' liquidity constraints are relaxed (an increase in the cash flow), firms would raise their investment rates. Turning to the industry-specific determinants of investment, we find a positive and significant impact of industry sales and the Herfindahl index, suggesting that larger and less competitive industries (higher values of the Herfindahl index) are associated with higher investment rates, as the firms' profit margins are likely to be higher. Additionally, we obtain a positive and significant coefficient on the industry demand variable, which means that when the demand for the industry's output increases, firms become more profitable and expand investment.

The specifications in Table 3 are supported by the tests of over-identifying restrictions, for which the Hansen test statistic fails to reject the validity of the instrument sets. Moreover, the tests for serial correlation, which are applied to the residuals in the first differenced equations ($\Delta\varepsilon_{ijt}$), show that we can reject the null-hypothesis of no first-order serial correlation, but cannot reject the null-hypothesis of no second order serial correlation.[14] The fact that the errors only have first order autocorrelation confirms the validity of instruments dated $t-2$ and $t-3$.

[13] More specifically, Javorcik (2004) finds that a 4 percentage point increase in the backward linkages is associated with a 15 percent rise in output of the firms in the supplying industry.

[14] Assuming that the residuals, ε_{ijt}, in equation (4) are i.i.d, we expect $\Delta\varepsilon_{ijt}$ in the first-differenced equations to have first order autocorrelation.

In columns (4) and (5) of Table 3, we consider the sensitivity of our results to accounting for the 2007-2008 global crisis, which might have adversely affected both the investment decisions of firms and FDI flows. The year dummies we include in our specifications control for the effect of the crisis that are common to all the firms. However, some industries might have been impacted more by the crisis, for example due to their import or export exposures. In order to control for the heterogeneous impact of the crisis across the industries, in column (4) we include interaction terms between the industry dummies and a crisis indicator that takes on a value one for 2007 and 2008, and zero otherwise. The results mainly remain unchanged from the estimates we obtain for the baseline specification in column (3). In column (5), we further analyze the sensitivity of our results by excluding the 2007-2008 global crisis years, hence limiting the time span of our sample to 2009-2014. The results show that the impact of each of the three foreign presence measures is larger in the post crisis years compared to the full sample results in column (3), hinting that domestic firms could not benefit from linkages with foreign multinationals during the financial crisis as much as they did during the non-crisis years.

The last column of Table 3 reports the estimates obtained from a sample that also includes firms with partial or full foreign ownership, for the full set of years (2006-2014). In this specification, we add a foreign ownership dummy variable, which takes on a value one if and when the firm receives foreign participation, to the previous set of covariates. When we include firms with foreign equity, the coefficients on all three foreign linkage measures decline in size, and the forward linkage and the horizontal linkage coefficients remain statistically significant. This suggests that purely domestic firms in the downstream sectors benefit more from forward linkages compared to firms with foreign ownership, since multinationals likely already have access to cheaper inputs through their international supply networks. Similarly, purely domestic firms may be gaining more from knowledge spillovers through horizontal linkages because the multinationals firms with foreign ownership already have access to better technology, and therefore higher marginal profitability of capital. Finally, the positive and significant coefficient on the foreign ownership indicator shows that in general multinationals have higher investment profiles.

In Table 4, we check the robustness of our results to using alternative measures of foreign presence in the vertically linked industries. One potential concern with our baseline measures constructed using time-varying input-output coefficients is that the input-output linkages may change with the firms' investment, in which case our linkage measures might be endogenous. To check whether our results are affected by this potential endogeneity issue, we construct the backward and forward linkage measures in equations (6) and (7) using the input-output coefficients (γ_{jk} and σ_{jm}) for 2006, and therefore eliminating the time-variation

in the foreign presence measures arising from the changes in these coefficients. Using these alternative measures, we obtain stronger results. The results reported in column (1) of Table 4 show that the coefficient on backward linkages more than triples in magnitude (compared to the baseline results in column (3) of Table 3), and becomes statistically significant. While the coefficient on forward linkages slightly declines, it remains statistically and economically significant.

An additional consideration when constructing the foreign presence measures is the indirect linkages between industries. Even if a domestic supplier in an upstream industry j is not directly selling inputs to a foreign multinational, it might be selling its product to domestic firms in an other industry (industry l) that provides inputs to a further downstream industry k, where foreign multinationals operate. An increase in the foreign presence in industry k can affect the investment decisions of firms in industry l directly as it increases the marginal profitability in industry l. Furthermore, it can impact the firms in industry j indirectly as it improves the marginal profitability in industry l, which purchases inputs from industry j. Similarly, domestic firms in downstream industries might be affected by an increase in the foreign presence of suppliers that they are not directly sourcing inputs from. In order to check the robustness of our results to accounting for indirect linkages between industries, we construct variables capturing foreign presence in vertical industries based on the upstreamness measure developed in Antràs et al. (2012).[15] Specifically, we consider the following measure for foreign presence in downstream industries supplied by a firm in upstream industry j

$$FP_{jt}^{D} = FP_{jt}^{H} + 2\sum_{l}^{N} \delta_{jl} FP_{jt}^{H} + 3\sum_{j}^{N}\sum_{k}^{N} \delta_{il}\delta_{lk} FP_{jt}^{H} + ...,$$

where FP_{jt}^{H} denotes foreign presence in industry j as defined in equation (5); and, δ_{jl} captures the value of inputs produced in industry j needed to produce one dollar worth of output in industry l and corresponds to the direct requirement coefficient (adjusted by exports and imports of industry l) obtained from the input-output tables. Following Antràs et al. (2012), we construct a vector of foreign presence measure, whose j^{th} entry captures the foreign presence in downstream industries supplied by industry j as

$$FP_{t}^{D} = [I - D]^{-1} FP_{t}^{H}. \tag{8}$$

Similarly, we use the transpose of the direct coefficients matrix, D^{T}, to construct measures

[15] See Chor et al. (2014) for an application of this upstreamness index to Chinese firms' exports and imports.

of foreign presence in upstream industries j sources inputs from using

$$FP_t^U = \left[I - D^T\right]^{-1} FP_t^H. \tag{9}$$

The results in column (2) of Table 4 show that both vertical linkage measures and the horizontal linkage measure are positive and significant. The coefficient of 0.367 on FP_{jt}^D implies that if foreign presence in downstream industries increases by two percentage points, investment of a domestic firm will increase by 0.73 percentage points. If we consider a one standard deviation (14.53 percentage points) increase, investment rises by 5.33 percentage points. Following a two percentage point or a one standard deviation (9.44 percentage points) increase in foreign presence in upstream industries, domestic firms foster investment by 0.24 or 1.13 percentage points. Hence, the results remain economically and statistically similar to the findings from our baseline measures when we use foreign presence measures that account for indirect vertical linkages between the industries.

4.2 Firm Characteristics

Next, we analyze whether firms with different characteristics respond differently to foreign presence in the vertically and horizontally linked sectors. The first characteristic we consider is the size of the firm. We define a large firm dummy variable that takes on a value one if the firm is categorized as a large enterprize by the Korean Small and Medium Business Administration.[16] We then interact the large firm dummy variable with the three foreign presence measures and include them in our baseline specification (see Table 3, column 3). The coefficients on the main foreign linkage variables capture the effect of foreign presence in horizontally and vertically linked industries on the investment decisions of small and medium firms, and the interaction terms provide the marginal effects for the large firms. The results in column (1) of Table 5 show a statistically significant difference for large firms only with the forward linkage measure. The negative and significant interaction between the large firm dummy and FP_t^F together with the main coefficient on FP_t^F imply that when foreign presence in the supplying sectors increase by 2 percentage points (one standard deviation), small to medium firms raise investment rate by 3.38 percentage points, where as large enterprizes increase it by 2.13 percentage points. This result conforms with the findings in Keller and Yeaple (2009), who show that small firms' productivity increases more as a result of (horizontal) FDI spill-overs, since they have most to learn technologically. In

[16]The Small and Medium Business Administration categorizes firms into two as large enterprizes and small and medium enterprizes. The classification is based on industry-specific sales cut-offs or total asset values.

the case for investment, large firms reap the benefits of an increase in the multinational suppliers less, potentially because they already have access to cheaper inputs through their production networks. Similarly, large firms seem to be less impacted by an increase in horizontal linkages, although the coefficient on the interaction term with FP_t^H is small and insignificant. By contrast, the interaction term with the backward linkage variable is positive, but also insignificant.

In the second column of Table 5, we analyze whether the presence of multinationals affects firms belonging to a chaebol, i.e., a conglomerate, differently. To that end, we define a chaebol dummy that takes on a value one if the firm is part of a conglomerate, and interact it with the three FDI measures.[17] We find that the signs of the interaction terms are the same as the interaction terms for the large firm dummy.[18] However, in this specification, the interaction term between the chaebol dummy and the backward linkage variable is positive and significant at the 10 percent level. The coefficient on the interaction term implies an additional increase in the investment rate of 1.80 percentage points following a 2 percentage point increase in the foreign presence of firms in the downstream sectors if the supplier firm is part of a chaebol. These results suggest that local suppliers that are part of a business conglomerate find it easier to serve multinational customers, and benefit more from the backward linkages. As in the previous column, the interaction term between the forward linkage measure and the chaebol dummy is negative and significant. Hence, we find that firms belonging to a chaebol do not benefit from an increase in the presence of foreign suppliers as much, likely because they source inputs through their own production networks.

The next characteristic we consider is the exporting status of the firm, defined as the average exports to total sale ratio for each firm. We interact the average export ratio with the three foreign presence measures and report the results in column (3). Consistent with the results in the previous columns, the coefficient on the forward linkage interaction is negative, and the coefficients on backward and horizontal linkage interactions are positive, although only the coefficient on the forward one is significant. The coefficient of 1.745 on FP_t^F implies that a 2 percentage point increase in the multinational suppliers will increase the investment rate of domestic firms who do not export by 3.49 percentage points. By contrast, a domestic firm that exports half of its output will increase investment rate by 2.50 percentage points.[19] This difference resembles the findings in Javorcik (2004), and reflects

[17] The chaebol dummy is not time-varying; i.e., all firms in our data-set are either a part of the chaebol or not throughout the sample period. Therefore, we cannot estimate the impact of being a part of a chaebol on investment directly in our specification, since it already accounts for firm fixed effects.

[18] The correlation between the chaebol dummy and the large firm dummy is 0.34.

[19] In an alternative specification, we defined the exporting status of the firm as the median level of exports to total sale ratio for each firm. The results are very similar to the ones reported in column 3 of Table 5 and

the fact that exporting firms that are part of international production networks likely already have access to international suppliers, and therefore an increase in the presence of foreign suppliers affects them less.

In addition to responding to the presence of foreign firms differently, exporters and non-exporters in general might have different investment profiles. To allow for the overall investment dynamics to differ across the two groups, we estimate our baseline specification separately for the exporter and non-exporter sub-samples. We define a firm to be an exporter if the firm exports at least for two years during our sample period. The results in the last two columns of Table 5 show that an increase in the presence of foreign multinationals affects just the non-exporter firms through both vertical and horizontal linkages. While the coefficients on all three foreign presence measures are positive for the exporters, they are not significant. By contrast, the coefficients on the foreign presence measures are statistically significant for the non-exporters and the implied impacts are larger than the ones obtained for the full sample (see column 3 of Table 3). In particular, we find that a 2 percentage point increase in the foreign presence in the upstream and downstream industries increases investment by 4.39 and 1.02 percentage points through forward and backward linkages, respectively. A similar increase in the horizontal linkages increases investment by 0.61 percentage points. Overall, these results suggest that the benefits of FDI might accrue to the non-exporter firms that do not already have international production or sales networks.

4.3 Financial Constraints

Heterogeneity in the spill-overs from FDI to domestic investment can also depend on the financial constraints that the firms face. In their paper, Alfaro et al. (2010) suggest that external financing is necessary for local entrepreneurs to start supplying inputs to multinationals and to benefit from FDI through backward linkages. Hence, domestic firms that are credit constrained may or may not be able to increase investment given a surge in the number of multinational customers, depending their ability to become suppliers. By contrast, FDI into the upstream industries (forward linkages) can have a larger impact on the financially constrained firms, since the marginal profitability of their capital would improve by more given the lower cost of inputs generated by the increase in the presence of multinational suppliers.

In order to test for these predictions, we first consider publicly traded status of the firm. Since publicly traded firms can issue equity in the capital markets, they would be

are available upon request.

less financially constrained compared to non-public firms that rely only on debt-financing. We interact the public status dummy with the foreign presence measures and examine the differential effects of foreign presence on publicly traded firms. Second, we interact cash flow with the foreign presence measures, and analyze whether an increase in the presence of multinationals contributes to firm's investment by alleviating liquidity constraints. Lastly, we consider an industry-specific measure of external finance dependence provided by Braun (2003), and interact it with the foreign presence measures.[20] The external finance dependence measure is constructed as the median value of the ratio of capital expenditures minus cash flow from operations to capital expenditures of firms in each 3-digit ISIC industry, and is based on the data for publicly listed U.S. companies.[21] Higher values of the external finance dependence measure suggest that the firms in the corresponding industry have less free cash flow, and need to issue debt or equity to finance their investments.

We begin with a specification that adds the public status of the firm to our baseline specification.[22] The positive and significant (at the 10 percent level) coefficient on the public status dummy in column (1) of Table 6 confirms the notion that on average public firms are able to invest more as they are less credit constrained. When we include the interaction terms between the public status dummy with the three foreign presence measures in column (2), we obtain negative coefficients on all three interaction terms; however, only the one with the forward linkage measure is statistically significant. The negative interaction term together with the coefficient on forward linkage variable suggest that a 2 percentage point increase in the presence of multinational suppliers leads private firms to raise investment by 2.5 percentage points, whereas it does not impact the public firms' investment decisions. This result suggests that, potentially by lowering the cost of inputs, an increase in the presence of multinational suppliers improves the marginal profitability of capital and allows credit constrained private firms to increase investment. By contrast, public firms are not affected as they are able to finance inputs more easily.

Next, in column (3) of Table 6, we analyze the role of linkages with foreign multinationals in relaxing liquidity constraints and thereby in enhancing investment. To that end, along the same lines as Harrison et al. (2004) and Javorcik and Spatareanu (2009), we interact the foreign presence measures with the cash flow variable. If FDI in vertically and horizontally

[20] This measure of external finance dependence have been previously used in studies that focus on financial constraints and international activity, such as Manova (2008).

[21] The correspondence between the 3-digit ISIC industries and the Korean industry classification is available upon request.

[22] The public status dummy variable is time-varying for some firms, as they become publicly traded during our sample period. Therefore, we are able to identify the impact of becoming publicly traded in our specification with firm fixed effects.

integrated industries relaxes liquidity constraints for the domestic firms, then we would expect it to lower the sensitivity of investment to cash flow. Thus, we would expect the interaction terms to be negative. Moreover, we include an interaction term between the public status dummy and cash-flow to allow for the fact that publicly traded firms may be less sensitive to liquidity constraints. As expected, the three interaction terms with the foreign linkage measures are negative, although only the interaction term with the backward linkage measure is statistically significant (at the 10 percent). The coefficient on the cash-flow and its interaction with the backward linkage measure together imply that a domestic firm in an industry that does not supply any inputs to multinationals (no backward linkage linkage) has an elasticity of investment to cash-flow equal to 0.33 at the mean values of investment and cash flow. The elasticity goes down to 0.27 for a firm in an industry with horizontal linkage measure equal to the mean (0.032). Although statistically insignificant, the negative interaction term between cash flow and the forward linkage measure implies that having multinational suppliers may also lower the sensitivity of investment to cash flow and therefore lead the firm to invest more by relaxing liquidity constraints. Contrary to our expectations, we do not uncover a significant impact of publicly traded status on the sensitivity of cash-flow.[23]

Finally, column (4) of Table 6 provides the results for the specification that includes the interaction terms between industry's external finance dependence measure and the three foreign presence measures, as well as the public status dummy. The negative coefficient on the interaction term with the backward linkage measure suggests that firms in more external finance dependent industries are not able to benefit from an increase in the multinational customers as much. Combined with the main effect backward linkage variable, the interaction term suggests that a firm in an industry with an external finance dependence measure equal to the mean (0.404), increases investment only by 0.32 percentage points following a 2 percentage point increase in the presence of multinational customers. On the other hand, a firm in an industry with external finance dependence one standard deviation below the mean (0.404-0.332=0.072; see Table 1 for the descriptive statistics), increases investment by 1 percentage point following a similar increase in the presence of multinational customers. These findings suggest that financially constrained domestic firms that rely more heavily on external financing find it more difficult to start supplying inputs to multinationals and therefore they do not benefit from FDI through backward linkages as much. These findings also conform with the findings in Javorcik and Spatareanu (2009), who show that less liq-

[23]In an alternative specification, we included an interaction term between cash-flow and the chaebol dummy, instead of the interaction term between cash-flow and the public status dummy. We found the interaction with the chaebol dummy to be also negative and insignificant. The results are available upon request.

uidity constrained firms in the Czech Republic self-select into supplying multinationals, and thereby take better advantage of the benefits of FDI inflows.

By contrast, the positive interaction term with the forward linkage measure suggests that firms in the more external finance dependent industries are able to benefit more from the increase in the presence of foreign suppliers. FDI spill-overs through forward linkages are expected to lead to higher investment by lowering the cost of intermediates, and also potentially by increasing the quality of available varieties. Since financing intermediates is more expensive for credit constrained firms that rely on external markets, a reduction in the inputs cost would increase their marginal profitability by more (compared to a firm that can purchase inputs with internal financing). Therefore, firms in external finance dependent industries can benefit more from an increase in the presence of foreign suppliers. Our results provide support to this hypothesis. Specifically, the coefficients on the interaction term implies that firms in the most external finance dependent industries increase their investment by an additional 1.82 percentage points compared to the firms that are in the average external finance dependent industries, following a 2 percentage point increase in the forward linkages. Similar to the results in the previous columns, these findings highlight the impact of the presence of multinational suppliers in improving the marginal profitability of capital (potentially by lowering the input costs) and allowing the credit constrained private firms to increase investment.

5 Conclusion

In this paper, we provide evidence on the impact of FDI in vertically and horizontally linked industries on the domestic firms investment decisions. Using firm-level data on South Korea for the 2006-2014 period, we show that foreign multinationals' presence increase investment rate of domestic firms through both horizontal and vertical linkages. We also show that the largest gains are acquired as a result of the increase in foreign presence in the supplying sectors, i.e., forward linkages. In particular, we find that a 2 percentage point increase in the presence of multinational suppliers increases the domestic firm's investment rate by 3.24 percentage points, which corresponds to a 14.50 percent increase. We also find that this effect is larger for small and medium firms, private firms, non-exporters, firms not part of a chaebol, and for firms in external finance dependent industries. A similar 2 percentage point increase in the foreign presence in downstream sectors, increases the investment rate of domestic firms by 0.55 percentage points. This effect is larger if the domestic firm is part of a chaebol, or is in a less external finance dependent industry. The effect of a 2 percentage

point increase in horizontal FDI is also positive, but also smaller at 0.56 percentage points.

Assessing the costs and benefits of FDI for the local economic activity has become more important in an increasingly global economy, where policy-makers are aiming to attract foreign investors. Our work extends the literature that analyzes how FDI in the vertically and horizontally linked industries affects the domestic economy. We provide the firm-level estimates of the impact of FDI on domestic firms' investment decisions through backward and forward linkages. The evidence strongly suggests that FDI inflows can help countries accumulate capital, especially by increasing the number of multinationals that supply inputs to the domestic firms.

References

Agosin, Manuel R and Roberto Machado, "Foreign investment in developing countries: does it crowd in domestic investment?," *Oxford Development Studies*, 2005, *33* (2), 149–162.

Aitken, Brian J. and Ann E. Harrison, "Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela," *American Economic Review*, 1999, *89* (3), 605–618.

Alfaro, Laura and Maggie X Chen, "Selection and Market Reallocation: Productivity Gains from Multinational Production," 2015.

_ , Areendam Chanda, Sebnem Kalemli-Ozcan, and Selin Sayek, "How does foreign direct investment promote economic growth? Exploring the effects of financial markets on linkages," *Journal of Development Economics*, 2010, *91* (2), 242–256.

Antràs, Pol, Davin Chor, Thibault Fally, and Russell Hillberry, "Measuring the upstreamness of production and trade flows," *The American Economic Review*, 2012, *102* (3), 412–416.

Arellano, M. and O. Bover, "Another Look at the Instrumental Variable Estimation of Error-Components Models," *Journal of Econometrics*, 1995, *68*, 29–51.

Ashraf, Ayesha and Dierk Herzer, "The effects of greenfield investment and M&As on domestic investment in developing countries," *Applied Economics Letters*, 2014, *21* (14), 997–1000.

Blalock, Garrick and Paul J Gertler, "Welfare gains from foreign direct investment through technology transfer to local suppliers," *Journal of International Economics*, 2008, *74* (2), 402–421.

Blundell, R. and S. Bond, "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models," *Journal of Econometrics*, 1998, *87*, 115–143.

Bosworth, Barry P, Susan M Collins, and Carmen M Reinhart, "Capital flows to developing economies: implications for saving and investment," *Brookings papers on economic activity*, 1999, *1999* (1), 143–180.

Braun, Matias, "Financial contractibility and asset hardness," Technical Report, University of California-Los Angeles 2003.

Chor, Davin, Kalina Manova, and Zhihong Yu, "The global production line position of Chinese firms," Technical Report 2014.

Farla, Kristine, Denis de Crombrugghe, and Bart Verspagen, "Institutions, Foreign Direct Investment, and Domestic Investment: crowding out or crowding in?," *World Development*, 2014.

Fazzari, S.M., R.G. Hubbard, and B.C. Petersen, "Financing constraints and corporate investment," *Brooking Papers on Economic Avtivity*, 1988, pp. 141–195.

Halpern, László, Miklós Koren, and Adam Szeidl, "Imported inputs and productivity," *The American Economic Review*, 2015, *105* (12), 3660–3703.

Harrison, A.E. and M.S. McMillan, "Does foreign direct investment affect domestic firms credit constraints?," *Journal of International Economics*, 2003, *61* (1), 73–100.

_ , I. Love, and M.S. McMillan, "Global capital flows and financing constraints," *Journal of Development Economics*, 2004, *75*, 269–301.

Javorcik, B., "Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages," *American Economic Review*, 2004, *94* (3), 605–627.

_ and Mariana Spatareanu, "Liquidity Constraints and Firms' Linkages with Multinationals," *World Bank Economic Review*, 2009, *23* (2), 323–346.

Keller, Wolfgang and Stephen R Yeaple, "Multinational enterprises, international trade, and productivity growth: firm-level evidence from the United States," *The Review of Economics and Statistics*, 2009, *91* (4), 821–831.

Kim, David Deok-Ki and Jung-Soo Seo, "Does FDI inflow crowd out domestic investment in Korea?," *Journal of Economic Studies*, 2003, *30* (6), 605–622.

Kim, Yun Jung, Linda L Tesar, and Jing Zhang, "The impact of foreign liabilities on small firms: Firm-level evidence from the Korean crisis," *Journal of International Economics*, 2015, *97* (2), 209–230.

Love, I., "Financial Development and Financial Constraints: International Evidence from the Structural Investment Model," *Review of Financial Studies*, 2003, *16* (3), 135–161.

Manova, Kalina, "Credit constraints, equity market liberalizations and international trade," *Journal of International Economics*, 2008, *76* (1), 33–47.

Markusen, J.R. and A.J. Venables, "Foreign direct investment as a catalyst for industrial development," *European Economic Review*, 1999, *43*, 335–356.

Morrissey, Oliver and Manop Udomkerdmongkol, "Governance, private investment and foreign direct investment in developing countries," *World development*, 2012, *40* (3), 437–445.

Mutenyo, John, Emmanuel Asmah, Aquilars Kalio et al., "Does Foreign Direct Investment Crowd-Out Domestic Private Investment in Sub-Saharan Africa?," *The African Finance Journal*, 2010, *12* (1), 27–52.

Tang, Sumei, EA Selvanathan, and Saroja Selvanathan, "Foreign direct investment, domestic investment and economic growth in China: a time series analysis," *The World Economy*, 2008, *31* (10), 1292–1309.

Table 1: Descriptive Statistics

Variable	Min	Mean	Standard Dev.	Max
Investment rate $\frac{I_{ijt}}{K_{ijt-1}}$	-0.299	0.224	0.335	3.290
Sales $\left(\frac{S_{ijt}}{K_{ijt-1}}\right)$	0.423	7.224	8.583	106.900
Cash-flow $\left(\frac{C_{ijt}}{K_{ijt-1}}\right)$	0.131	1.384	1.791	24.420
Forward linkages $\left(FP_{jt}^{F}\right)$	0	0.034	0.023	0.219
Backward linkages $\left(FP_{jt}^{B}\right)$	0	0.032	0.032	0.186
Horizontal linkages $\left(FP_{jt}^{H}\right)$	0	0.099	0.076	0.548
Industry sales	1.173	45.245	49.374	199.583
Herfindahl index	0.010	0.076	0.078	0.871
Industry demand	0.000	12.210	13.250	60.660
Exports to total sales ratio (%)	0	13.430	25.060	100
Chaebol dummy	0	0.035	0.184	1
Large firm dummy	0	0.229	0.420	1
Publicly traded dummy	0	0.174	0.379	1
External finance dependence	-0.451	0.404	0.332	1.140
Downstream foreign presence	0.023	0.177	0.094	0.723
Upstream foreign presence	0.000	0.144	0.145	0.907

Notes: This table show the descriptive statistics for the 31,608 observations from 6,285 firms used in the estimations. Industry sales and industry demand are in units of 2010 billions of Korean Won.

0

Table 2: Foreign Presence Measure Averages

Industry name	Backward FDI	Forward FDI	Horizontal FDI
Ship building	0.00	3.87	0.40
Telecommunication, video, and audio equipment	0.57	2.78	0.59
Leather product	0.28	2.34	1.11
Wood and wooden product	0.80	1.84	1.56
Chemical fiber	0.22	9.81	1.62
Iron and steel products	4.08	1.49	2.19
Printing and reproduction of recorded media	0.78	3.83	3.20
Fabricated metal products	7.14	3.18	3.89
Textile and apparel	2.32	1.85	4.11
Other non-metallic mineral product	0.51	4.10	4.80
Other manufacturing	3.31	3.59	5.16
Food	1.05	1.05	5.63
Fertilizer and pesticide	0.12	4.72	7.05
Electrical equipment	4.31	3.87	9.02
Motor vehicle	0.63	3.01	9.43
Electronic equipment	3.62	2.85	9.83
Pulp and paper product	3.27	2.16	10.20
Synthetic resin and rubber	8.19	16.95	10.49
Special machinery and equipment	3.15	3.41	11.40
Medicament	0.39	3.58	12.31
Tobacco product manufacturing	0.00	1.11	13.73
Household electrical appliance	0.04	4.88	13.74
General machinery and equipment	2.86	3.17	15.37
Beverage	0.03	3.60	15.63
Plastic product	8.32	6.85	16.72
Other transportation equipment	0.03	3.73	17.67
Non-ferrous metals	3.15	0.80	19.53
Other chemical product	3.21	7.36	19.56
Precision instrument	1.04	4.28	21.84
Rubber product	1.26	4.82	27.62
Computer and peripheral equipment	0.09	2.06	27.68
Basic chemical product	13.87	7.30	28.91
Petroleum and coal product	7.75	0.84	36.16
Glass product	1.80	2.36	45.02

Notes: This table show the average foreign presence values for each of the 2-digit industries as defined by Bank of Korea. The values are in percentages.

Table 3: Main Effects of FDI on Domestic Firms' Investment

Dependent Variable: $\frac{I_{ijt}}{K_{ijt-1}}$	(1)	(2)	(3)	(4)	(5)	(6)
Lagged investment rate $\left(\frac{I_{ijt-1}}{K_{ijt-2}}\right)$	0.114***	0.115***	0.115***	0.116***	0.117***	0.118***
	(0.012)	(0.011)	(0.011)	(0.011)	(0.013)	(0.011)
Sales $\left(\frac{S_{ijt}}{K_{ijt-1}}\right)$	0.008*	0.008*	0.008*	0.008*	0.008*	0.006**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Cash-flow $\left(\frac{C_{ijt}}{K_{ijt-1}}\right)$	0.038**	0.042**	0.041**	0.039**	0.037	0.029**
	(0.019)	(0.019)	(0.019)	(0.019)	(0.025)	(0.014)
Forward linkages $\left(FP_{jt}^{F}\right)$	0.951**	1.412***	1.622***	1.629***	1.994**	1.023**
	(0.451)	(0.524)	(0.603)	(0.599)	(0.785)	(0.499)
Backward linkages $\left(FP_{jt}^{B}\right)$	0.574***	0.793***	0.276	0.195	0.388	0.235
	(0.207)	(0.252)	(0.232)	(0.234)	(0.409)	(0.180)
Horizontal linkages $\left(FP_{jt}^{H}\right)$	0.235**	0.288***	0.280***	0.294***	0.410***	0.208**
	(0.099)	(0.106)	(0.106)	(0.107)	(0.131)	(0.086)
Industry sales	0.0004***	0.0002	0.0003**	0.0003**	0.0003	0.0002***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0001)
Herfindahl index		1.096***	1.007***	1.004***	1.069***	0.741**
		(0.374)	(0.350)	(0.343)	(0.402)	(0.311)
Industry demand			0.001**	0.002**	0.002	0.001*
			(0.001)	(0.001)	(0.001)	(0.001)
Foreign ownership						0.058***
						(0.010)
Crisis dummy*Industry interactions	no	no	no	yes	no	no
Observations	31,608	31,608	31,608	31,608	22,995	37,041
Number of firms	6,285	6,285	6,285	6,285	5,876	7,061
Hansen-Sargan test (p-value)	0.181	0.262	0.258	0.225	0.379	0.273
1st order serial corr. test (p-value)	0	0	0	0	0	0
2nd order serial corr. test (p-value)	0.692	0.717	0.737	0.741	0.201	0.698

Notes: The estimates are obtained from the two-step system GMM procedure. Standard errors are clustered at the industry-year level and are reported in parentheses. All firm-specific regressors are treated as endogenous. A set of year effects and industry-specific time trends are included in all specifications. The p-values for the Hansen over-identification test and the second order serial correlation tests are reported. ***, **, * denote significance at the 1, 5, and 10% level, respectively. Lags 2 and 3 of the investment rate, sales and cash-flow are included as GMM-type instruments. All industry-level variables are included as IV-type instruments.

Table 4: Alternative Measures

Dependent Variable: $\frac{I_{ijt}}{K_{ijt-1}}$	(1)	(2)
Lagged investment rate $\left(\frac{I_{ijt-1}}{K_{ijt-2}}\right)$	0.115***	0.116***
	(0.011)	(0.011)
Sales $\left(\frac{S_{ijt}}{K_{ijt-1}}\right)$	0.008*	0.008*
	(0.004)	(0.004)
Cash-flow $\left(\frac{C_{ijt}}{K_{ijt-1}}\right)$	0.044**	0.042**
	(0.019)	(0.019)
Forward linkages, fixed coefficient in 2006 $\left(FP_{jt}^{F,fixed}\right)$	1.338**	
	(0.533)	
Backward linkages, fixed coefficient in 2006 $\left(FP_{jt}^{B,fixed}\right)$	0.882***	
	(0.298)	
Horizontal linkages	0.275***	0.247**
	(0.105)	(0.108)
Industry sales	0.0003**	0.0002
	(0.0001)	(0.0001)
Herfindahl index	1.060***	0.888**
	(0.369)	(0.351)
Industry demand	0.001*	0.001
	(0.001)	(0.001)
Foreign presence, downstream $\left(FP_{jt}^{D}\right)$		0.367**
		(0.175)
Foreign presence, upstream $\left(FP_{jt}^{U}\right)$		0.121**
		(0.052)
Observations	31,608	31,608
Number of firms	6,285	6,285
Hansen-Sargan test (p-value)	0.268	0.246
1st order serial corr. test (p-value)	0	0
2nd order serial corr. test (p-value)	0.731	0.755

Notes: See Table 3 for notes.

Table 5: Firm Characteristics

Dependent Variable: $\frac{I_{ijt}}{K_{ijt-1}}$	(1)	(2)	(3)	(4)	(5)
	Full sample	Full sample	Full sample	Exporters	Non-exporters
Lagged investment rate $\left(\frac{I_{ijt-1}}{K_{ijt-2}}\right)$	0.115***	0.115***	0.115***	0.140***	0.113***
	(0.011)	(0.011)	(0.011)	(0.024)	(0.010)
Sales $\left(\frac{S_{ijt}}{K_{ijt-1}}\right)$	0.008*	0.008*	0.008*	-0.005	0.008
	(0.004)	(0.004)	(0.004)	(0.008)	(0.005)
Cash-flow $\left(\frac{C_{ijt}}{K_{ijt-1}}\right)$	0.041**	0.041**	0.041**	0.094**	0.049**
	(0.019)	(0.019)	(0.019)	(0.043)	(0.023)
Forward linkages $\left(FP_{jt}^{F}\right)$	1.690***	1.668***	1.745***	0.212	2.193***
	(0.611)	(0.616)	(0.617)	(0.826)	(0.692)
Backward linkages $\left(FP_{jt}^{B}\right)$	0.254	0.222	0.232	0.334	0.509*
	(0.247)	(0.237)	(0.246)	(0.382)	(0.306)
Horizontal linkages $\left(FP_{jt}^{H}\right)$	0.286**	0.277***	0.257**	0.252	0.304***
	(0.122)	(0.107)	(0.112)	(0.171)	(0.115)
Industry sales	0.0002*	0.0002**	0.0003**	0.0001	0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Herfindahl index	0.967***	0.998***	0.981***	0.361	1.170***
	(0.347)	(0.351)	(0.346)	(0.666)	(0.385)
Industry demand	0.001*	0.001**	0.001**	0.000	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Forward linkages*Large firm $\left(FP_{jt}^{B} * LF_i\right)$	-0.623***				
	(0.211)				
Backward linkages*Large firm $\left(FP_{jt}^{B} * LF_i\right)$	0.076				
	(0.240)				
Horizontal linkages*Large firm $\left(FP_{jt}^{H} * LF_i\right)$	-0.078				
	(0.085)				
Forward linkages*Chaebol $\left(FP_{jt}^{F} * CH_i\right)$		-0.721***			
		(0.271)			
Backward linkages*Chaebol $\left(FP_{jt}^{B} * CH_i\right)$		0.900*			
		(0.476)			
Horizontal linkages*Chaebol $\left(FP_{jt}^{H} * CH_i\right)$		-0.061			
		(0.098)			
Forward linkages*Avg. Exports $\left(FP_{jt}^{F} * EX_i\right)$			-0.991***		
			(0.303)		
Backward linkages*Avg. Exports $\left(FP_{jt}^{B} * EX_i\right)$			0.182		
			(0.378)		
Horizontal linkages*Avg. Exports $\left(FP_{jt}^{H} * EX_i\right)$			0.081		
			(0.100)		
Observations	31,608	31,608	31,608	6,041	23,288
Number of firms	6,285	6,285	6,285	1,353	5,352
Hansen-Sargan test (p-value)	0.229	0.254	0.237	0.404	0.600
1st order serial corr. test (p-value)	0	0	0	0	0
2nd order serial corr. test (p-value)	0.725	0.734	0.728	0.977	0.435

Notes: See Table 3 for notes.

Table 6: Financial Constraints

Dependent Variable: $\frac{I_{ijt}}{K_{ijt-1}}$	(1)	(2)	(3)	(4)
Lagged investment rate $\left(\frac{I_{ijt-1}}{K_{ijt-2}}\right)$	0.113***	0.112***	0.133***	0.114***
	(0.011)	(0.011)	(0.017)	(0.011)
Sales $\left(\frac{S_{ijt}}{K_{ijt-1}}\right)$	0.008**	0.006	0.004	0.008*
	(0.004)	(0.004)	(0.004)	(0.004)
Cash-flow $\left(\frac{C_{ijt}}{K_{ijt-1}}\right)$	0.038**	0.040**	0.053**	0.044**
	(0.019)	(0.019)	(0.023)	(0.019)
Forward linkages $\left(FP^F_{jt}\right)$	1.123**	1.251***	1.081*	0.778
	(0.554)	(0.572)	(0.554)	(0.484)
Backward linkages $\left(FP^B_{jt}\right)$	0.275	0.374*	0.607**	0.574*
	(0.234)	(0.207)	(0.254)	(0.306)
Horizontal linkages $\left(FP^H_{jt}\right)$	0.236**	0.237**	0.260**	0.123
	(0.101)	(0.115)	(0.109)	(0.088)
Industry sales	0.0002	0.0002*	0.0002*	0.0003*
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Herfindahl index	0.794**	0.725**	0.607	0.796**
	(0.339)	(0.325)	(0.390)	(0.353)
Industry demand	0.001	0.001*	0.001	0.001*
	(0.001)	(0.001)	(0.001)	(0.001)
Public dummy (P_{it})	0.041*	0.107	0.002	0.170**
	(0.023)	(0.084)	(0.046)	(0.084)
Public dummy*Forward linkages $\left(P_{it} * FP^F_{jt}\right)$		-1.225*		
		(0.743)		
Public dummy*Backward linkages $\left(P_{it} * FP^B_{jt}\right)$		-0.650		
		(0.439)		
Public dummy*Horizontal linkages $\left(P_{it} * FP^H_{jt}\right)$		-0.289		
		(0.281)		
Public dummy*Cash-flow $\left(P_{it} * \frac{C_{ijt}}{K_{ijt-1}}\right)$			0.031	
			(0.031)	
Cash-flow*Forward linkages $\left(\frac{C_{ijt}}{K_{ijt-1}} * FP^F_{jt}\right)$			-0.137	
			(0.181)	
Cash-flow*Backward linkages $\left(\frac{C_{ijt}}{K_{ijt-1}} * FP^B_{jt}\right)$			-0.289*	
			(0.173)	
Cash-flow*Horizontal linkages $\left(\frac{C_{ijt}}{K_{ijt-1}} * FP^H_{jt}\right)$			-0.060	
			(0.041)	
Public dummy*External Finance Dependence $(P_{it} * EFD_j)$				-0.262**
				(0.123)
External Finance Dependence*Forward linkages $\left(EFD_j * FP^F_{jt}\right)$				1.235*
				(0.724)
External Finance Dependence*Backward linkages $\left(EFD_j * FP^B_{jt}\right)$				-1.025*
				(0.548)
External Finance Dependence*Horizontal linkages $\left(EFD_j * FP^H_{jt}\right)$				0.254
				(0.173)
Observations	31,608	31,608	31,608	31,608
Number of firms	6,285	6,285	6,285	6,285
Hansen-Sargan test (p-value)	0.373	0.226	0.414	0.376
1st order serial corr. test (p-value)	0	0	0	0
2nd order serial corr. test (p-value)	0.624	0.617	0.537	0.671

Notes: See Table 3 for notes.