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Foreign Cuisine or Local Delicacies? How Sectors and Firm Heterogeneity Matter in the Acquisition-Productivity Linkage

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FOREIGN CUISINE OR LOCAL DELICACIES? HOW SECTORS AND FIRM HETEROGENEITY MATTER IN THE ACQUISITION-PRODUCTIVITY LINKAGE

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Abstract

This paper examines the productivity impacts of cross-border and domestic M&A under sectoral differences and firm heterogeneity. After studying both domestic and cross-border acquisitions pursued by Chinese listed firms in 2000-2013, I find that, in high-tech sectors, cross-border M&A are positively associated with firms' productivity (especially among leading firms). However, in low-tech sectors, domestic M&A are positively associated with firms' productivity (especially among lagging firms). This paper contributes to the literature on emerging market firms' internationalization by shedding light on when cross-border (or domestic) M&A could be an appropriate catch-up strategy for enhancing firms' productivity.

Keywords: M&A, productivity, sectoral differences, firm heterogeneity

Foreign Cuisine or Local Delicacies? How Sectors and Firm Heterogeneity Matter in the Acquisition-Productivity Linkage

There has been increasing recognition among business scholars that international business (IB) research should speak more to real world phenomena (Doh, 2015). One striking phenomenon in international business is the rapid increase of outward FDI (OFDI) from emerging market economies. According to UNCTAD (2015), MNEs from emerging economies invested 468 billion US dollars abroad in 2014, reaching a record 35 % of global FDI. As one of the largest emerging economies, China has already become the second largest global investor, only after the US (UNCTAD, 2015). And, its OFDI is expected to further expand over the next decade (Anderlini, 2015).

Insert Figure 1 here

One of the main characteristics, which distinguishes emerging market multinationals (EMNEs) from developed market ones when it comes to internationalization, is EMNEs' preference for acquisitions as the primary foreign entry mode (Madhok & Keyhani, 2012, Peng, 2012, Ramamurti, 2012). Such phenomenon posed an intriguing question to IB scholars, which is why EMNEs acquire other firms across borders (Ramamurti, 2012), given the fact that EMNEs usually do not possess conventional ownership advantages by western standards (Dunning, 1980).

One of the most widely accepted explanation for such phenomenon is an explanation from a "latecomer perspective", which argues that EMNEs tend to use cross-border M&A as a catch-up strategy for enhancing their capabilities (Child & Rodrigues, 2005, Luo & Tung, 2007,

Madhok & Keyhani, 2012). By definition, "catch-up" refers to a process through which latecomers narrow the productivity gap between themselves and forerunners (Abramovitz, 1986), therefore, the "latecomer perspective" on EMNEs' cross-border M&A assumes that there is a positive relationship between cross-border M&A and firms' productivity. However, such relationship has rarely been empirically tested (Deng, 2013, Peng, 2012).

In fact, the scant evidence on the performance outcome of EMNEs' cross-border M&A casts doubts on the "latecomer perspective". For example, using Russian data, Bertrand and Betschinger (2012) found that cross-border M&A were actually negatively correlated with Russian acquirers' performance (ROA).

Even if it is true that, acquisitions, as a vehicle for reshaping firms' resources and capabilities, could increase firms' productivity, managers of EMNEs might need to ask themselves whether their firm should acquire another firm across national borders or acquire another firm within the home country.

In this paper, I submit that whether certain type of M&A strategies could enhance emerging market firms' productivity, largely depends on the sectors where firms operate, and it also depends on firms' prior productivity.

First, I argue that, in high-tech sectors, overseas M&A are positively associated with firms' productivity (especially among leading firms). This is mainly because tech progress is important mostly in high tech sectors. Compared with domestic M&A, overseas M&A are more likely to facilitate technological progress. At the same time, firms' prior productivity levels matter for absorbing and transforming foreign knowledge. Overseas M&A are more likely to bring productivity gains for firms which have adequate capabilities to leverage on the acquired foreign knowledge.

Conversely, I argue that, in low-tech sectors, domestic M&A are positively correlated with firms' productivity (especially among lagging firms). This is because in low-tech sectors, "enhancing operating efficiency" might be the primary mechanism through which M&A could increase firms' productivity. The positive relationship between domestic M&A and firms' productivity might be more pronounced among lagging firms, because lagging firms, whose prior productivity was relatively low, might have greater potential for further enhancing their operating efficiency.

To test these arguments, I examined both domestic and cross-border M&A conducted by Chinese listed firms during 2000-2013. China presents an interesting setting to conduct this research. First, as one of the largest emerging economies, China is the largest OFDI investor among all developing economies (UNCTAD, 2015). Second, Chinese MNEs' preference for acquisitions as the primary entry mode has been well documented in the literature (Peng, 2012, Rui & Yip, 2008).

This paper contributes to the IB literature on EMNEs by bringing empirical evidence to a widely spread (but rarely tested) argument that EMNEs tend to enhance their capabilities through overseas acquisitions. The results of this paper show that it is true that firms might improve their productivity through overseas M&A, but the effectiveness of overseas M&A as a productivity-enhancing strategy is conditioned on sectors and firms' prior productivity. In addition, this paper also contributes to the strategy literature on the M&A-productivity link, which has often shown us mixed evidence. The discussion on how different value-creation mechanisms play their role in different circumstances sheds additional light on the complex picture of M&A-productivity link.

The ensuing sections are organized as follows: Section 2 introduces the theoretical background for this study. Section 3 presents the hypotheses development. Section 4 describes

the data and methods. Section 5 contains the results of analyses. Section 6 presents the discussion. Section 7 concludes the paper.

Background

An interesting phenomenon in the field of IB is the rapid increase of OFDI from emerging market firms. One distinctive feature of emerging market firms' international expansion is a strong preference for acquisitions over other entry modes (Madhok & Keyhani, 2012, Peng, 2012, Rui & Yip, 2008). Why do EMNEs conduct cross-border M&A, given the fact that EMNEs usually do not have traditional type of ownership advantages which they can exploit abroad (Dunning, 1980)? Answers to this question have been proposed by different scholars under different labels, including "springboard perspective" (Luo & Tung, 2007), "strategic intent perspective" (Rui & Yip, 2008), or simply a "latecomer perspective" (Child & Rodrigues, 2005). Although the framing of these perspectives is slightly different from each other, the common logic behind these perspectives is that EMNEs tend to use cross-border M&A as a catch-up strategy to enhance their capabilities. Despite such logic is widely accepted in the literature, the performance outcomes of cross-border M&A by emerging market firms have rarely been tested (although there are a few exceptions such as Bertrand and Betschinger (2012)'s study on Russian acquirers). Just as Deng (2013) pointed out, "*the latecomer logic claiming that Chinese firms internationalize to address their competitive weaknesses has become so accepted that it is less rigorously explored and tested than it could be*".

Meanwhile, there is a long history of research on the relationship between M&A and firms' productivity in the strategy literature. Although early studies tended to suggest a negative relationship between M&A and productivity (e.g., (Ravenscraft & Scherer, 1987), later studies tended to suggest a positive one (e.g., (McGuckin, Nguyen, Reznek, & Census, 1995)).

As M&A activities became increasingly globalized (UNCTAD, 2000), international business scholars introduced a geographic dimension into the M&A literature by comparing the performance impacts between domestic and cross-border M&A (Bertrand & Betschinger, 2012, Bertrand & Zitouna, 2008, Bertrand & Zuniga, 2006). For example, Bertrand and Zuniga (2006) examined the impacts of domestic and cross-border M&A on industry-level R&D investments across OECD countries. The authors found that, on the aggregate level, neither domestic nor cross-border M&A could significantly increase R&D investments. Bertrand and Zitouna (2008) examined the performance impacts of domestic and cross-border M&A on French target firms, and they found that both types of M&A tended to increase target firms' total factor productivity, but neither type of M&A could improve French firms' profits. Using Russian data, Bertrand and Betschinger (2012) found that both domestic and cross-border M&A were negatively correlated with Russian acquirers' performance (ROA). More recently, Bertrand and Capron (2014) found that cross-border M&A were positively associated with French acquirers' productivity, whereas domestic M&A were not.

The ambiguous findings regarding the performance impacts of M&A largely stem from the multiple mechanisms through which M&A might affect firms' productivity (Anand, Capron, & Mitchell, 2005). Prior literature (e.g., (Bertrand & Betschinger, 2012)) suggests that the main mechanisms through which M&A can enhance (revenue-based) productivity can be summarized as the following three: (1) technological progress (2) enhanced operating efficiency (3) enhanced market power.

The "technological progress" argument suggests that M&A might increase firms' productivity because M&A might help acquirers making technological progress. First, M&A might enlarge firms' knowledge repertoire by bringing acquirers complementary knowledge /

resources (Capron et al 1998). Since innovation, to a large extent, comes from recombination (Nelson & Winter, 1982), the new knowledge brought by M&A might serve as a stepping stone for future innovation. Second, prior research shows that R&D activities are also subject to "economy of scale" and "economy of scope" (Henderson & Cockburn 1996). In this sense, by increasing the size of a firm, M&A might also increase firms' efficiency in doing R&D (Cassiman, Colombo, Garrone, & Veugelers, 2005). Third, if M&A could increase firms' effectiveness and efficiency of doing R&D, it might also increase firms' incentives to conduct R&D. The positive relationship between M&A and "technological progress" has been confirmed by empirical evidence. For example, using patent data, Valentini (2012) found that M&A had a positive impact on firms' innovation output.

The "enhanced operating efficiency" argument suggests that M&A might increase firms' productivity through increasing firms' operating efficiency. First, M&A might increase firms' size, which would bring firms' economy of scale (Seth, 1990). For example, firms might be able to share fixed costs among multiple operating activities after the M&A. Such fixed costs might include physical input costs, managerial costs, advertising costs, and so on. Second, M&A might also increase firms' operating efficiency through bilateral resource redeployment (Capron & Mitchell, 1998). By resource redeployment, firms might be able to rationalize their operations, and therefore, obtain synergistic efficiency gains from such rationalization.

The "enhanced market power" argument suggests that M&A could increase firms' productivity through enhancing the acquirers' market power. In a standard Cournot-type model, a decrease of the number of competitors in a market might lead to an increase of all players' market power in that market. And, such market-power benefits will be disproportionally greater for the acquirers whose size and resources have also been enlarged during the M&A (Moatti,

Ren, Anand, & Dussauge, 2015). Enhanced market power might allow acquirers to extract greater consumer surplus that would subsequently be transformed into a greater revenue-based productivity. However, real world evidence on the relationship between M&A and firms' market power remains mixed, with some scholars (e.g., (Chatterjee, 1991)) suggested that M&A increased firms' market power, while others (e.g., (Goldberg, 1973)) found no evidence to support such allegation.

Departing from the three main mechanisms through which M&A might affect firms' productivity, I argue that the effectiveness of the three mechanisms varies according to sectors and firms' prior productivity. Therefore, whether certain type of M&A strategies could enhance firms' productivity, should be examined under sectoral differences and firm (productivity) heterogeneity.

Hypotheses

High-tech sectors

High-tech sectors are knowledge intensive sectors where firms' long-term success is tied to their technological capabilities (Chaudhuri & Tabrizi, 1998). Among the three main mechanisms through which M&A could affect productivity, "technological progress" tends to be more influential than the other two in high-tech sectors. This is because in high-tech sectors, the frequency of technological change is relatively high, and consumers tend to be willing to pay a higher price for new products or new features (Golovko & Valentini, 2014). If firms can successfully innovate, they might be able to extract greater consumer surplus. If firms cannot successfully innovate, they might have to compete with a large number of players producing homogeneous products. For example, in the mobile phone industry, Huawei, the first Chinese company which entered the list of "Top 100 Global Innovators" (source: Thomson Reuters), can

charge a higher unit price for its mobile phones compared with other less innovative Chinese firms. At the same time, Huawei could maintain its retail volume in Top 3 among all Chinese mobile phone producers (source: Euromonitor Passport). This is not saying that "enhancing operating efficiency" is not important in high-tech sectors, but it is probably a less important mechanism from which M&A could enhance firms' productivity, compared with "technological progress". In addition, "enhancing market power" is also unlikely to be the primary mechanism through which M&A could affect firms' productivity, because frequent technological changes in high-tech sectors could always open up a window of opportunities for latecomers to enter the market (Perez & Soete, 1988).

Compared with domestic M&A, overseas M&A are more likely to facilitate firms' technological progress, because overseas M&A are more likely to bring firms new knowledge and capabilities. As prior literature suggests, the diversity of knowledge increases as the geographic distance between two firms increases (Morosini, Shane, & Singh, 1998). Since innovation, to a large extent, comes from recombination (Nelson & Winter, 1982), the new knowledge and capabilities brought by overseas M&A can provide EMNEs with crucial ingredients for making technological progress. And, this is especially true for emerging market firms for which advanced foreign knowledge might not be available at their home countries (Luo & Tung, 2007). Therefore, in high-tech sectors, overseas M&A tend to be an appropriate catch-up strategy for enhancing firms' productivity.

However, the productivity-enhancing effect of overseas M&A in high-tech sectors might be conditioned on firms' capabilities to absorb and transform the foreign knowledge that firms could access from overseas M&A. Therefore, the positive association between overseas M&A

and firms' productivity is more likely to be observed among leading firms whose prior productivity has been relatively high.

First, compared with lagging firms, leading firms are more likely to have adequate absorptive capacity (Cohen & Levinthal, 1990, Zahra & George, 2002) to identify, assimilate, and transform the foreign knowledge embedded in the target firm *per se*. Such absorptive capacity is especially important in the context of overseas M&A, where uncertainty and information asymmetry are high due to the large distance between the acquirer and the target (Chakrabarti & Mitchell, 2013).

Second, overseas M&A might also increase high-tech firms' productivity, not because of the knowledge/resources embedded in the target firms *per se*, but because of the knowledge/resources embedded in the local innovation system surrounding the target firm. In this case, the target firm becomes a competence-creating subsidiary through which the acquirer extracts knowledge/resources from the local networks in the host country (Cantwell & Mudambi, 2011). Compared with lagging firms, leading firms might have greater capabilities to extract knowledge/resources from the local networks surrounding the target firms. On the one hand, leading firms might find it easier to initiate collaborations with other actors (e.g., firms) in the local networks surrounding the target firms. On the other hand, leading firms might also find it easier to hire talented employees from the local networks. For example, after Huawei established its dominance in the domestic telecom market, the company acquired a Silicon-Valley-based firm, OptiMight, to enhance its capabilities in optical network technologies (Hennart, 2012). It might be easier for Huawei to further extract knowledge from Silicon-Valley (either by collaborating with other Silicon-Valley firms or by hiring experts from Silicon Valley) than for a

less well-known Chinese firm to do so, assuming that this less-well known Chinese firm also acquired a similar target firm in the same industry cluster.

Third, leading firms tend to have the complementary assets (e.g. brand, manufacturing capability, marketing capability) for appropriating returns from the "technological progress" led by overseas M&A (Teece, 1986). This means that even if leaders and laggards could make similar technological progress from overseas M&A, leading firms are still more likely to successfully transform such "technological progress" into revenue-based productivity. Taking above arguments together, I expect that:

H1: In high-tech sectors, overseas M&A are positively associated with firms' productivity (especially among leading firms).

Low-tech sectors

Conversely, low-tech sectors tend to be less knowledge-intensive but more labor-intensive compared with high-tech sectors. In such sectors, technological progress might be less relevant for productivity growth due to the relatively slow pace of technological change. "Dominant designs" (Suarez & Utterback, 1995) might have already been established and diffused within the industry. In this sense, firms in low-tech sectors might mainly compete in terms of their "output capabilities" instead of "innovation capabilities" (Awate, Larsen, & Mudambi, 2012). Therefore, "enhancing operating efficiency" might be a primary mechanism through which M&A could enhance firms' productivity.

Compared with overseas M&A, domestic M&A tend to be more effective for enhancing firms' operating efficiency, due to the geographic proximity of the two parties involved in domestic M&A. Generally speaking, the benefits of "economy of scale" (Seth, 1990) and the benefits of "resource redeployment" (Capron & Mitchell, 1998) might be more difficult to

realize in cross-border M&A, because the national boundaries might impose constraints on resource sharing and resource redeployment. If this is true, we may expect that in low-tech sectors, domestic M&A are positively associated with firms' productivity.

However, prior literature suggests that productivity growth could exhibit either "increasing returns" (Romer, 1986) or "decreasing returns" (Madsen, 2007). If the productivity growth follows an "increasing returns" model, then leading firms (whose prior productivity has already been relatively high) might be better positioned to further advance their productivity. Instead, if the productivity growth follows a "decreasing returns" model, then lagging firms (whose prior productivity was relatively low) might be better positioned to further advance their productivity.

I argue that in low-tech sectors, the productivity growth is more likely to follow a "decreasing returns" model. This is because the productivity frontier of low-tech sectors is relatively fixed, due to the relatively slow rate of technological change. Since firms in low-tech sectors tend to compete in "output capabilities" instead of competing in "innovation capabilities" (Awate, Larsen, & Mudambi, 2012), leading firms in low-tech sectors are more likely to be the ones whose prior operating efficiency has already been relatively high. As the theory of firms' growth (Penrose, 1995) suggests, the scale-related efficiency gains will diminish as firms' size continues to grow, because at a certain point, the increasing administrative costs will offset the benefits of economy of scale. Therefore, leading firms' potential for further increasing their productivity might be limited in low-tech sectors. This means that we are more likely to observe the expected positive association between domestic M&A and productivity among lagging firms.

H2: In low-tech sectors, domestic M&A are positively associated with firms' productivity (especially among lagging firms).

Methods

Data and sample

This research examines acquisitions conducted by Chinese listed firms[1] in the period between 2000 and 2013. I collected firms' financial information from the China Stock Market & Accounting Research (CSMAR) Database from 2000-2014. Although the number of listed firms is relatively small compared with the whole population of Chinese firms, the economic significance of these listed firms is disproportionately high. For example, in 2012, the market value of the approximately 2500 Chinese listed firms accounted for 43.7 percent of the country's GDP (World Bank, 2015). One potential problem of studying listed firms is that the results might be biased toward large firms. However, the topic of using M&A as a catch-up strategy *per se* might be a topic more relevant for large emerging market firms. Firms in the financial sector are excluded from the sample due to their unique characteristics. M&A information was extracted from the Zephyr M&A database and Thomson One Banker database. Zephyr has a special team devoted to monitoring Chinese sources (e.g., regulators' websites and stock exchange announcements).[2] Therefore, the information about acquisitions pursued by Chinese listed firms from Zephyr can be considered reliable. I included only majority acquisitions (at least 50% of stake acquired) because majority acquisitions would ensure that the acquirers have significant influence on the resources of the target firms. A description of the sample is shown in Table 1.

Insert Table 1 here

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[1] Firms listed in the A-share market of Shanghai Stock Exchange and Shenzhen Stock Exchange

[2] The author contacted the owner of Zephyr (Bureau Van Dijk) to confirm the database's coverage of Chinese M&A deals.

Variables

The dependent variable, labor productivity, is measured by operating revenue minus operating expenses divided by number of employees (Hillier, Marshall, McColgan, & Werema, 2007, Subramony & Holtom, 2011). This way of measuring productivity has the advantage of reflecting value-creation driven by intangibles (e.g., knowledge, R&D or marketing capabilities) embedded in talented employees (Bryan, 2007).

Capital intensity is measured by net fixed assets divided by number of employees (Bertrand & Capron, 2014). Debt intensity is measured by long-term debts plus short-term borrowings divided by total shareholders' equity (Pathak, Hoskisson, & Johnson, 2014). Average wage is measured by cash paid to and on behalf of employees divided by number of employees. Following Arnold and Javorcik (2009), all of the above variables are log-transformed. The variable "overseas MA" is measured by the number of overseas M&A a firm conducted in a specific year. The variable "domestic MA" is measured by the number of domestic M&A a firm conducted in a specific year.

To explore the mechanisms through which M&A affect productivity, I further divided "overseas MA" into "G7 MA" and "non-G7 MA", where "G7 MA" ("non-G7 MA") represents the number of overseas M&A a firm conducted in a year, where the target firm is located in a G7 (non-G7) country. Similarly, I further divided "domestic MA" into "within-region MA" and "cross-region MA", where "within-region MA" ("cross-region MA") represents the number of domestic M&A a firm conducted in a year where the target firm is located in the same (a difference) region as compared with the acquirer's home region.

I used four additional variables for supplementary analyses, which included sales (per employee), operating efficiency, R&D intensity, and market share. Sales (per employee) is

measured by operating revenue divided by the number of employees (also log-transformed). Operating efficiency [3] is measured by operating expenses divided by operating revenue (Moatti, Ren, Anand, & Dussauge, 2015). R&D intensity is measured by R&D expenses divided by operating revenue (Hitt, Hoskisson, Ireland, & Harrison, 1991). Market share is measured by a firm's operating revenue divided by the sum of operating revenue of all firms in the same industry and the same region, which could be a proxy for a firm's market power in the local market (Moses, 1987).

The variable, "Peer group adoption of Domestic MA", refers to the percentage of firms in the same industry and same region which have adopted the domestic M&A strategy in a specific year. The variable, "Peer group adoption of Overseas MA", refers to the percentage of firms in the same industry and same region which have adopted the overseas M&A strategy in a specific year. These two variables will only be used as instrumental variables for robustness check.

The summary statistics of the variables are shown in Table 2.

Insert Table 2 here

Definition of high-tech sectors versus low-tech sectors

Based on OECD's definition and China's industry classification, I classified the following sectors as high-tech sectors: "raw chemical materials and chemical products," "railway, shipbuilding, aerospace and other transportation equipment manufacturing," "chemical fiber manufacturing," "automobile Manufacturing," "computer, communication and other electronic device manufacturing," "electric machines and apparatuses manufacturing," "instrument and

[3] By construction, this measure is inversely related to firms' real operating efficiency. A smaller value of

meter manufacturing," "Internet and related services," "pharmaceutical manufacturing," "software and IT services," and "special equipment manufacturing." All other sectors are classified as low-tech sectors.

Definition of leaders versus laggards

I classified firms as "leading firms" or "lagging firms" based on their prior productivity relative to other firms in the same industry. Firms whose prior productivity was above (or equal to) the median productivity of that industry in that year would be classified as a "leading firm." On the other hand, firms whose prior productivity was below the median productivity of that industry in that year would be classified as a "lagging firm." This approach of classifying leaders versus laggards based on the median has been widely adopted in the literature (e.g., (Alcacer & Chung, 2007)). Here, "prior productivity" refers to the productivity of a firm when the firm is observed in the dataset for the first time. This classification takes into account the unbalanced nature of the panel. Additionally, it is not confounded with any M&A strategies that firms might adopt in subsequent years. In addition, because the same firm will be consistently assigned to a specific group, it allows me to include the firm fixed-effects in estimations to control for time-invariant, unobserved heterogeneity.

Statistical approach

Main analyses

My arguments suggest that, whether certain type of M&A could be a productivity-enhancing strategy, largely depends on firms' sectors and prior productivity. To test these hypotheses, I conducted split-sample analyses, which have often been used in the literature to

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this measure means that operating costs account for a smaller proportion of the operating revenue, which reflects a greater efficiency of the firm.

explore how a certain relationship varies across different conditions (Golovko & Valentini, 2014, Salomon & Jin, 2008). The model specification in the main analyses is as below:

$$Productivity_{it} = \beta_1 MA_{i,t-1} + \beta_2 MA_{i,t-2} + \beta_3 MA_{i,t-3} + \gamma X_{it} + \sigma_i + \rho_t + \vartheta_{it}$$

where $MA_{i,t-1}$, $MA_{i,t-2}$, and $MA_{i,t-3}$ are sets of M&A variables (including both domestic M&A and overseas M&A); X_{it} represents a set of control variables; σ_i represents firm-fixed effects; ρ_t represents a set of year dummies; ϑ_{it} represents the error term.

First, I estimated a fixed-effects panel model in the whole sample. Then, I split the whole sample into "high-tech" sub-sample and "low-tech" sub-sample, and estimated the same model in each-subsample. This will give us an idea about how sectors matter in the M&A-productivity linkage. According to the hypotheses, I expect to see that in the "high-tech" sub-sample, overseas M&A are positively associated with productivity, whereas in "low-tech" sub-sample, domestic M&A are positively associated with productivity.

Second, I further split each of the two sub-samples into "leaders" and "laggards". According to the hypotheses, I expect to see that in high-tech sectors, the positive association between overseas M&A and productivity mainly exists among "leaders", whereas in low-tech sectors, the positive association between domestic M&A and productivity mainly exists among "laggards".

Additional analyses on mechanisms

To understand the mechanisms through which M&A affect productivity, I further divided overseas M&A into G7 M&A and non-G7 M&A, and further divided domestic M&A into within-region M&A and cross-region M&A. If "technological progress" is a mechanism that drives productivity gains from overseas M&A, I expected to see a stronger association between G7 M&A and firms' productivity in high-tech sectors. If "enhanced operating efficiency" or

"enhanced market power" is a mechanism through which domestic M&A increase firms' productivity in low-tech sectors, then I expected to see a strongly positive association between within-region M&A and productivity among lagging firms in low-tech sectors. The geographic proximity between two firms, on the one hand, might bring a greater scale-related efficiency gain, while on the other hand, might induce a greater anti-competition effect.

In addition, I further examined the impacts of different types of M&A on four additional dependent variables, including sales (adjusted by firm size), operating efficiency, R&D intensity, and market share for the purpose of better understanding the value-creation mechanisms of M&A.

Sensitivity analyses on endogeneity

I employed two approaches to mitigate endogeneity concerns, including a standard instrumental variable approach and a GMM dynamic panel approach.

Standard instrumental variable approach: First, I implemented a standard instrumental variable approach by estimating a two-stage least squares (2SLS) model. A good instrument variable should be correlated with the suspected endogenous variable, but have no direct impact on the dependent variable (Wooldridge, 2012). Institutional theory suggests that firms tend to imitate the strategic behaviors of other firms within a peer group (DiMaggio & Powell, 1983, Haunschild & Miner, 1997). And, such imitation behaviors have already been found to exist in the context of making M&A decisions (Yang & Hyland, 2006). Based on this literature, I use the percentage of firms in a peer group which have adopted the overseas (domestic) M&A strategy in a year as an instrument for the focal firm's adoption of the overseas (domestic) M&A in that year. Here, a peer group refers to a group of firms in the same industry and the same region. These firms tend to be close competitors. Therefore, their M&A strategies might be a result of

monitoring and imitating the common practice within the peer group. However, there is little reason to believe that the adoption of certain M&A strategies at the peer group level would have a direct impact on a specific firm' productivity.

The specification of the 2SLS models is described below:

$$Domestic\ M\&A_{it} = \beta_1 PeerGroupDomesticMA_{jt} + \gamma X_{it} + \rho_t + \vartheta_{it}$$

$$Overseas\ M\&A_{it} = \beta_2 PeerGroupOverseasMA_{jt} + \gamma X_{it} + \rho_t + \vartheta_{it}$$

$$Productivity_{i,t+k} = \beta_3 Domestic\ M\&A_{it} + \beta_4 OverseasM\&A_{it} + \gamma X_{it} + \rho_t + \vartheta_{it}$$

Where $PeerGroupDomesticMA_{jt}$ refers to the percentage of firms in peer group *j* which have adopted the domestic M&A strategy in year *t*, and $PeerGroupOverseasMA_{jt}$ refers to the percentage of firms in peer group *j* which have adopted the overseas M&A strategy in year *t*.

GMM approach: In addition, I employed a GMM dynamic panel model (Arellano & Bond, 1991, Arellano & Bover, 1995, Blundell & Bond, 1998), which controlled for reverse causality by including a lagged dependent variable without incurring much dynamic bias. The fundamental insight of this approach is that, assuming there is no second-order autocorrelation, lagged values of explanatory variables could be used as valid instruments for first-differenced equations (Arellano & Bover, 1995). For example, supposing we have the following model, where *Productivity* is our dependent variable, *MA* is the M&A variable, and *X* is a set of control variables:

$$\text{Productivity}_{it} = \alpha Productivity_{i,t-1} + \beta_1 MA_{i,t-1} + \beta_2 MA_{i,t-2} + \beta_3 MA_{i,t-3} + \gamma X_{i,t} + \mu_i + \nu_{it}$$

Transforming the above equation by first-differencing would eliminate time-invariant, unobserved heterogeneity, μ_i, which would give us the following equation:

$$\Delta\text{Productivity}_{it} = \alpha\Delta Productivity_{i,t-1} + \beta_1\Delta MA_{i,t-1} + \beta_2\Delta MA_{i,t-2} + \beta_3\Delta MA_{i,t-3} + \gamma\Delta X_{it} + \Delta v_{it}$$

Supposing there is no second-order autocorrelation, both $Productivity_{i,t-2}$ and $\Delta Productivity_{i,t-2}$ are mathematically correlated with $\Delta Productivity_{i,t-1}$(which equals $Productivity_{i,t-1} - Productivity_{i,t-2}$) but uncorrelated with Δv_{it} (which equals $v_{it} - v_{i,t-1}$), which makes them valid instruments for $\Delta Productivity_{i,t-1}$.

Blundell and Bond (2000) further advanced this approach by adding lagged first-differences as instruments for equations in levels, which makes it a "system GMM dynamic panel" method.

I implemented a two-step systematic GMM dynamic panel model with the "xtabond2" command developed by Roodman (2009). The lagged dependent variable and M&A variables have been instrumented by following Bertrand and Betschinger (2012).

Results

Table 3 and Table 4 show us the results from main analyses. Table 5 to Table 7 show us the results from additional analyses on mechanisms. Table 8 to Table 10 show us the results from sensitivity analyses on endogeneity.

Table 3 presents the comparison between high-tech sectors and low-tech sectors. Here, model 1 shows the estimation for the whole sample. Unlike what is widely believed in the latecomer perspective, there is no significant association between overseas M&A and firms' productivity in the whole sample. However, after I divided the whole sample into "high-tech" sub-sample and "low-tech" sub-sample, we can see that overseas M&A are positively associated

with firms' productivity in high-tech sectors, whereas domestic M&A are positively associated with firms' productivity in low-tech sectors. This provides some initial support for H1 and H2.

Insert Table 3 here

Table 4 presents the comparison between leaders and laggards in each sub-sample. As model 1 and model 2 suggest, there are significantly positive associations between overseas M&A and productivity among leading firms in high-tech sectors. However, the associations between overseas M&A and productivity are insignificant among lagging firms in high-tech sectors. Model 3 and model 4 show us how the M&A-productivity link varies between leaders and laggards in low-tech sectors. From model 4, we can see that there are significantly positive associations between domestic M&A and productivity among lagging firms in low-tech sectors. From model 3, we can see that, although there is also a positive association between domestic M&A and productivity among leading firms in low-tech sectors, the association seems to be weaker in terms of both the significance level and the economic magnitude, compared with the associations among lagging firms in low-tech sectors. Therefore, the results in Table 4 provide further support for H1 and H2.

Insert Table 4 here

Table 5 shows that G7 M&A are strongly correlated with firms' productivity among leading firms in high-tech sectors, but not among lagging firms in low-tech sectors. Instead, within-region M&A and cross-region M&A are predominately correlated with firms'

productivity among lagging firms in low-tech sectors. This provides support for previous explanations that in high-tech sectors, M&A tend to increase firms' productivity because of "technological progress", whereas in low-tech sectors, M&A tend to increase firms' productivity because of "operating efficiency" or "market power".

Insert Table 5 here

Table 6 and Table 7 show us the associations between different types of M&A and four additional outcome variables (sales, operating efficiency, R&D intensity, and market share). If M&A increases firms' productivity through "technological progress", I expected to observe positive associations between M&A variables and R&D intensity, and also positive associations between M&A variables and sales. Instead, if M&A increases firms' productivity through "enhanced operating efficiency" or "enhanced market power", I expect to see negative associations between M&A variables and operating efficiency (here, operating efficiency is an inverse measure), and positive associations between M&A variables and market share. As expected, Table 6 shows us a positive association between overseas M&A and firms' sales among leading firms in high-tech sectors. However, the associations between overseas M&A and productivity are insignificant (although predominantly positive)[4]. Consistent with the theory, Table 7 shows us significant associations between domestic M&A and operating efficiency (and also, market share) among lagging firms in low-tech sectors.

[4] Considering the large number of missing values in the R&D intensity measure, the lack of significant associations might be a matter of statistical power.

Insert Table 6 and Table 7 here

Table 8 shows the results of further investigation on H1 with a standard instrumental variable approach. From the first stage estimation, we can see that firms' adoption of a certain M&A strategy is strongly correlated with the percentage of firms in the peer group which have adopted the same M&A strategy. From the second stage estimation, we can see that the results are consistent with previous findings. Overseas M&A tend to be an effective productivity-enhancing strategy for leading firms in high-tech sectors.

Insert Table 8 here

Similarly, Table 9 shows the results of further investigation on H2 with a standard instrumental variable approach. The results are also consistent with previous findings. Domestic M&A tend to be an effective productivity-enhancing strategy for lagging firms in low-tech sectors.

Insert Table 9 here

Lastly, Table 10 shows the results of re-examining the hypotheses with a GMM dynamic panel model. Again, the results confirmed previous findings.

Insert Table 10 here

Discussion

The rapid increase of OFDI from emerging economies has attracted a great deal of attention from IB scholars. One distinctive pattern of emerging market firms is their rapid adoption of M&A as the primary entry mode (Madhok & Keyhani, 2012, Peng, 2012). One widely accepted explanation for emerging market firms' overseas acquisitions is that these firms can use overseas M&A as a catch-up strategy for enhancing their capabilities (Child & Rodrigues, 2005, Luo & Tung, 2007). However, such logic has rarely been rigorously tested (Deng, 2013, Peng, 2012). In fact, the ambiguous findings in the strategy literature on the M&A-productivity link cast doubts on the effectiveness of cross-border M&A as a catch-up strategy for improving emerging market firms' productivity. This paper contributes to this conversation by asking when certain type of M&A strategies (cross-border and/or domestic) would be an appropriate productivity-enhancing strategy for emerging market firms. I submit that, whether certain types of M&A strategies can enhance firms' productivity, largely depends on sectors and firms' prior productivity.

After analyzing both domestic and cross-border M&A conducted by Chinese listed firms during 2000-2013, I find that, in high-tech sectors, overseas M&A tend to be an appropriate productivity-enhancing strategy. This is because in high-tech sectors, "technological progress" might be a primary reason through which M&A could increase firms' productivity. And, overseas M&A may lead to such "technological progress" in high-tech sectors. However, making "technological progress" through overseas M&A is not equally feasible for all firms in high-tech

sectors. It seems that leading firms tend to have adequate capabilities to enhance their productivity by leveraging on the foreign knowledge from overseas M&A. Instead, lagging firms in high-tech sectors seem to lack the crucial capabilities to enhance their productivity from overseas M&A.

By contrast, in low-tech sectors, domestic M&A tend to be an appropriate productivity-enhancing strategy. This is because in low-tech sectors, "enhancing operating efficiency" might be a primary mechanism through which M&A could enhance firms' productivity. This mechanism tends to be more effective for lagging firms in low-tech sectors whose prior productivity was relatively low.

Contributions

The contribution of this paper is two-fold. First, this paper contributes to the IB literature on emerging market firms' internationalization by bringing new empirical evidence to the "latecomer perspective". Although many scholars have theoretically argued that emerging market firms could enhance their capabilities by conducting overseas M&A (Child & Rodrigues, 2005, Luo & Tung, 2007, Madhok & Keyhani, 2012), the performance outcome of such logic has rarely been empirically tested (Deng, 2013, Peng, 2012). Instead of asking whether cross-border M&A is a "good" or "bad" catch-up strategy for EMNEs, this paper asks when cross-border M&A is an appropriate catch-up strategy by studying the productivity impacts of both cross-border and domestic M&A.

Second, this paper contributes to the strategy literature by shedding additional light on the complex relationship between M&A and productivity. Due to multiple mechanisms through which M&A could affect firms' productivity, prior literature on the M&A-productivity link has shown us inconclusive results (Bertrand & Capron, 2014, Bertrand & Zitouna, 2008). This paper

shows that the productivity impacts of different types of M&A strategies vary according to sectors and firms' prior productivity.

Limitations

This study has several limitations. First, I constructed the dependent variable, labor productivity, by using accounting-based measures (e.g., operating revenue). As a result, such revenue-based productivity deviates from the traditional conceptualization of productivity as "efficiency in production" (Syverson, 2011). Although revenue-based productivity might not reflect the true variations in firms' technical efficiency, it is more relevant for firms' survival compared with physical output-based productivity measures (Foster, Haltiwanger, & Syverson, 2005). In fact, our productivity measure tends to better capture a firm's capability of value-creation (Bryan, 2007).

Second, given that many of the target firms are private firms (or even subsidiaries), I do not have enough information to control for target firms' characteristics. The productivity impacts might differ according to the characteristics of target firms. This is a common problem in prior studies (e.g., (Bertrand & Capron, 2014)). I tried to mitigate the problem by distinguishing where the target firms come from, but this requires the assumption that target firms' characteristics are correlated with their country of origin.

Third, although I tried to mitigate the endogeneity problem by employing a standard instrumental variable approach and a GMM dynamic panel approach, endogeneity is a concern. I could not explore any exogenous shocks.

Last but not least, I only explored one type of firm heterogeneity, which was firms' prior productivity. Other types of firm heterogeneity might also matter in the M&A-productivity

linkage. For example, sate-owned enterprises (SOE) and non-SOE have often been compared in the Chinese context (Guo & Clougherty, 2015).

Conclusions

This paper examines when certain types of M&A strategies (cross-border or domestic) could be an appropriate productivity-enhancing strategy for emerging market firms. The analyses based on sectors and firms' prior productivity suggest that, cross-border M&A tend to be an appropriate productivity-enhancing strategy in high-tech sectors, especially for leading firms in high-tech sectors. By contrast, domestic M&A tend to be an appropriate productivity-enhancing strategy in low-tech sectors, especially for lagging firms in low-tech sectors. The findings from this study might invoke further thinking among scholars and practitioners regarding how emerging market firms should formulate their catch-up strategies.

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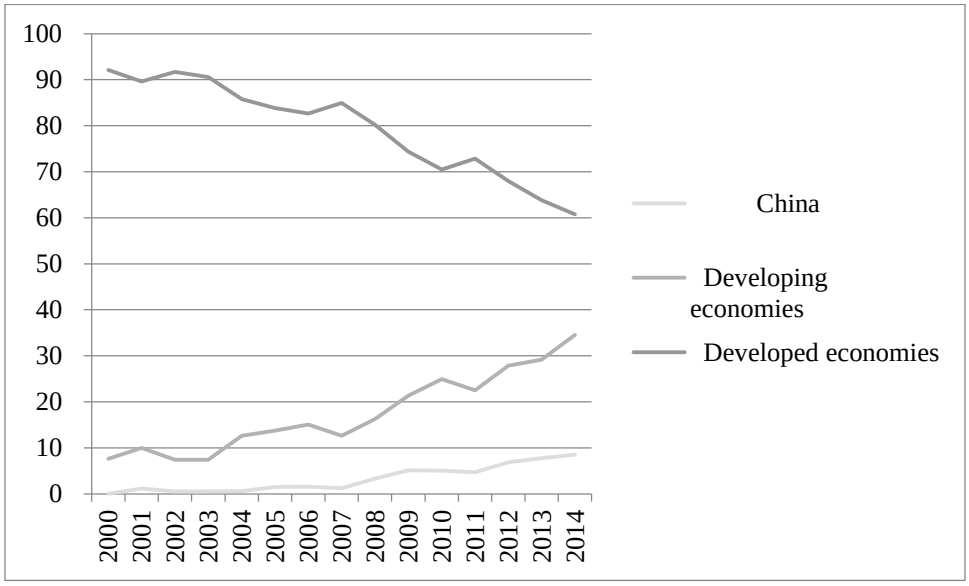
Figure 1. Outward FDI flows in 2000-2014 measured by "percentage of total world"



Source: UNCTAD, FDI database

Table 1. Sample description: number of cross-border/domestic M&A deals by year

	Number of cross-border deals	Number of domestic deals
2000	0	4
2001	0	10
2002	1	5
2003	3	17
2004	8	51
2005	7	57
2006	4	101
2007	14	160
2008	12	177
2009	13	262
2010	8	290
2011	21	249
2012	31	261
2013	30	319
Total	152	1963

Notes: Some firms conducted multiple M&A in the same year.

Table 2. Summary statistics and correlation table

		-1	-2	-3	-4	-5	-6	-7	-8	-9	-10	-11	-12	-13	-14	-15	-16	-17
-1	Productivity	1																
-2	Overseas MA	0.02	1															
-3	Domestic MA	0.07	0.05	1														
-4	G7 MA	0.01	0.72	0.03	1													
-5	Non-G7 MA	0.02	0.75	0.04	0.07	1												
-6	Within-region MA	0.05	0.01	0.7	0.01	0.01	1											
-7	Cross-region MA	0.06	0.04	0.66	0.03	0.03	0.07	1										
-8	Capital intensity	0.4	0.01	0.02	0	0.01	0.01	0	1									
-9	Debt intensity	-0.08	0	0.01	-0.01	0.01	0.01	0	0.16	1								
-10	Employees	-0.32	0.07	0.07	0.04	0.06	0.05	0.04	-0.15	0.05	1							
-11	Average wage	0.72	0.03	0.08	0.02	0.02	0.06	0.06	0.41	-0.08	-0.26	1						
-12	Sales (per employee)	0.81	0.03	0.07	0.01	0.03	0.05	0.05	0.45	0.05	-0.24	0.72	1					
-13	Operating Efficiency	-0.35	0	-0.01	0	0.01	0	-0.02	0.03	0.16	0.11	-0.07	0.06	1				
-14	R&D Intensity	0	0	0	0	0	0.01	0	-0.05	-0.06	-0.02	0	-0.08	-0.09	1			
-15	Market Share	-0.09	0.02	0.01	0.01	0.03	-0.01	0	0.06	0.09	0.21	-0.17	-0.06	0.03	-0.06	1		
-16	Peer group adoption of overseas MA	0.02	0.59	0.03	0.44	0.43	0.02	0.02	0	-0.01	0.06	0.03	0.03	0	0.01	-0.01	1	
-17	Peer group adoption of domestic MA	0.1	0.03	0.56	0	0.04	0.39	0.36	0.03	0.01	0.04	0.13	0.1	-0.02	0.01	-0.04	0.03	1
	Mean	11.9	0.01	0.09	0	0	0.04	0.03	12.41	-1.16	7.39	10.9	13.42	0.74	0	0.38	0.59	6.98
	S.D.	1.21	0.09	0.36	0.06	0.07	0.23	0.21	1.22	1.45	1.4	0.91	1.17	0.25	0.03	0.39	4.88	16.55

Notes: R&D intensity is calculated based on R&D expenses divided by operating revenue. R&D expenses are only available from 2007 onwards. Even since then, 81.7% of total observations reported "0" R&D expenses.

Table 3. Main Analyses: Comparison between high-tech sectors and low-tech sectors

VARIABLES	(1) Whole sample	(2) High-tech sectors	(3) Low-tech sectors
Overseas MA (t-1)	0.046	0.069	0.038
	(0.033)	(0.056)	(0.040)
Overseas MA (t-2)	0.015	-0.003	0.030
	(0.040)	(0.072)	(0.046)
Overseas MA (t-3)	0.053	0.108**	0.020
	(0.039)	(0.053)	(0.051)
Domestic MA (t-1)	0.040***	0.018	0.047***
	(0.011)	(0.018)	(0.014)
Domestic MA (t-2)	0.047***	0.032	0.051***
	(0.015)	(0.020)	(0.019)
Domestic MA (t-3)	0.041***	0.017	0.047***
	(0.014)	(0.020)	(0.018)
Capital intensity	0.100***	0.183***	0.081***
	(0.022)	(0.037)	(0.025)
Debt intensity	-0.066***	-0.079***	-0.062***
	(0.010)	(0.015)	(0.013)
Employees	-0.103***	0.064	-0.160***
	(0.029)	(0.040)	(0.036)
Average wage	0.817***	0.813***	0.810***
	(0.036)	(0.046)	(0.045)
Observations	15,024	5,438	9,586
R-squared	0.461	0.437	0.478
Number of firms	2,166	899	1,267
Year dummies	Included	Included	Included
Firm fixed effects	Included	Included	Included

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is productivity.

Table 4. Main Analyses: Comparison between leaders and laggards

	(1)	(2)	(3)	(4)
	High-tech sectors		Low-tech sectors	
VARIABLES	Leaders	Laggards	Leaders	Laggards
Overseas MA (t-1)	0.129*	0.013	0.037	-0.012
	(0.075)	(0.072)	(0.042)	(0.146)
Overseas MA (t-2)	0.056	-0.090	0.083*	-0.200
	(0.110)	(0.076)	(0.047)	(0.121)
Overseas MA (t-3)	0.298***	-0.073	0.071	-0.223
	(0.065)	(0.056)	(0.056)	(0.136)
Domestic MA (t-1)	-0.014	0.032	0.021	0.069***
	(0.021)	(0.029)	(0.018)	(0.020)
Domestic MA (t-2)	-0.000	0.049*	0.032	0.074***
	(0.027)	(0.030)	(0.025)	(0.024)
Domestic MA (t-3)	0.009	0.023	0.058**	0.031
	(0.034)	(0.025)	(0.026)	(0.029)
Capital intensity	0.188***	0.180***	0.075**	0.081*
	(0.048)	(0.057)	(0.032)	(0.042)
Debt intensity	-0.076***	-0.093***	-0.043**	-0.068***
	(0.017)	(0.031)	(0.017)	(0.020)
Average wage	0.768***	0.843***	0.705***	0.925***
	(0.063)	(0.074)	(0.058)	(0.072)
Employees	0.033	0.116*	-0.194***	-0.149***
	(0.060)	(0.060)	(0.054)	(0.051)
Observations	2,761	2,410	5,014	4,034
R-squared	0.545	0.359	0.472	0.484
Number of firms	491	373	681	526
Year dummies	Included	Included	Included	Included
Firm fixed effects	Included	Included	Included	Included

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is productivity.

Table 5. Additional analyses on mechanisms: Part 1

VARIABLES	(1) Leaders in high-tech sectors	(2) Laggards in low-tech sectors
G7 MA (t-1)	0.171	0.198
	(0.107)	(0.179)
G7 MA (t-2)	0.131	-0.077
	(0.104)	(0.110)
G7 MA (t-3)	0.332***	-0.131
	(0.055)	(0.101)
Non-G7 MA (t-1)	0.034	-0.226
	(0.090)	(0.160)
Non-G7 MA (t-2)	-0.111	-0.381*
	(0.239)	(0.203)
Non-G7 MA (t-3)	0.162	-0.375
	(0.100)	(0.269)
Within-region MA (t-1)	0.005	0.082**
	(0.035)	(0.038)
Within-region MA (t-2)	0.039	0.087*
	(0.043)	(0.045)
Within-region MA (t-3)	0.008	0.065
	(0.050)	(0.049)
Cross-region MA (t-1)	-0.065*	0.068**
	(0.038)	(0.031)
Cross-region MA (t-2)	-0.065	0.103***
	(0.044)	(0.037)
Cross-region MA (t-3)	-0.025	0.066
	(0.052)	(0.044)
Capital intensity	0.187***	0.081*
	(0.048)	(0.042)
Debt intensity	-0.077***	-0.069***
	(0.016)	(0.020)
Average wage	0.768***	0.925***
	(0.063)	(0.072)
Employees	0.037	-0.150***
	(0.060)	(0.051)
Observations	2,761	4,034
R-squared	0.547	0.485
Number of firms	491	526
Year dummies	Included	Included
Firm fixed effects	Included	Included

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is productivity.

Table 6. Additional analyses on mechanisms: Part 2

VARIABLES	(1)	(2)	(3)	(4)
	Leaders in high-tech sectors			
	Sales per employee	Operating Efficiency	R&D Intensity	Market Share
Overseas MA (t-1)	-0.001	-0.002	0.002	0.019
	(0.043)	(0.010)	(0.002)	(0.017)
Overseas MA (t-2)	0.068	0.003	0.003	-0.027
	(0.047)	(0.009)	(0.002)	(0.028)
Overseas MA (t-3)	0.138***	-0.004	-0.002	0.026
	(0.050)	(0.009)	(0.003)	(0.018)
Domestic MA (t-1)	0.011	0.002	0.000	0.001
	(0.017)	(0.004)	(0.000)	(0.007)
Domestic MA (t-2)	0.017	0.001	0.000	0.008
	(0.019)	(0.004)	(0.000)	(0.008)
Domestic MA (t-3)	0.036	0.007*	0.000	0.012
	(0.027)	(0.004)	(0.000)	(0.010)
Capital intensity	0.210***	0.008	-0.000	-0.006
	(0.044)	(0.007)	(0.001)	(0.010)
Debt intensity	-0.023	0.011***	0.001*	-0.007**
	(0.015)	(0.002)	(0.000)	(0.004)
Average wage	0.724***	-0.005	0.000	0.053***
	(0.061)	(0.010)	(0.002)	(0.013)
Employees	-0.031	-0.010	-0.001	0.052***
	(0.061)	(0.009)	(0.001)	(0.013)
Observations	2,801	2,801	2,144	2,801
R-squared	0.677	0.074	0.011	0.391
Number of firms	493	493	486	493
Year dummies	Included	Included	Included	Included
Firm fixed effects	Included	Included	Included	Included

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7. Additional analyses on mechanisms: Part 3

VARIABLES	(1)	(2)	(3)	(4)
	Laggards in low-tech			
	Sales per employee	Operating Efficiency	R&D Intensity	Market Share
Overseas MA (t-1)	0.069	0.037*	0.000	-0.087
	(0.093)	(0.019)	(0.001)	(0.053)
Overseas MA (t-2)	-0.058	0.050***	0.002*	-0.046
	(0.099)	(0.017)	(0.001)	(0.053)
Overseas MA (t-3)	-0.010	0.051***	0.001	0.002
	(0.129)	(0.019)	(0.001)	(0.062)
Domestic MA (t-1)	0.065***	-0.005	0.000	0.002
	(0.020)	(0.004)	(0.000)	(0.006)
Domestic MA (t-2)	0.066***	0.003	0.000	0.015**
	(0.020)	(0.005)	(0.000)	(0.006)
Domestic MA (t-3)	0.036	-0.010*	0.000	0.006
	(0.027)	(0.005)	(0.000)	(0.010)
Capital intensity	0.146***	0.022***	0.000	0.002
	(0.035)	(0.007)	(0.001)	(0.006)
Debt intensity	0.012	0.016***	0.000	0.003
	(0.015)	(0.003)	(0.000)	(0.004)
Average wage	0.737***	-0.055***	-0.001	0.047***
	(0.054)	(0.014)	(0.001)	(0.012)
Employees	-0.141***	0.011	0.001*	0.042***
	(0.046)	(0.010)	(0.000)	(0.010)
Observations	4,134	4,134	2,853	4,135
R-squared	0.562	0.081	0.012	0.452
Number of firms	526	526	514	526
Year dummies	Included	Included	Included	Included
Firm fixed effects	Included	Included	Included	Included

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Following Moatti et al. (2015), operating efficiency is measured as operating expenses divided by operating revenue. Thus, a negative sign actually indicates a positive impact on real operating efficiency.

Table 8. Sensitivity analyses on endogeneity: Testing H1 with a 2SLS model

Second stage estimation (leaders in high-tech sectors)

VARIABLES	(1) Productivity (t+1)	(2) Productivity (t+2)	(3) Productivity (t+3)
Overseas MA	0.485**	0.428	0.710*
	(0.224)	(0.277)	(0.394)
Domestic MA	0.111	0.114	0.157
	(0.090)	(0.119)	(0.125)
Capital intensity	0.115***	0.080***	0.044
	(0.027)	(0.029)	(0.031)
Debt intensity	-0.072***	-0.065***	-0.054***
	(0.014)	(0.016)	(0.018)
Average wage	0.603***	0.541***	0.513***
	(0.038)	(0.042)	(0.046)
Employees	-0.058**	-0.051**	-0.036
	(0.024)	(0.026)	(0.028)
Year dummies	Included	Included	Included
Observations	3,574	3,101	2,682
R-squared	0.379	0.290	0.245

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

First stage estimation (leaders in high-tech sectors)

VARIABLES	(1) Overseas MA	(2) Domestic MA
Peer group adoption of Overseas MA	0.014***	0.001
	(0.002)	(0.002)
Peer group adoption of Domestic MA	0.000	0.012***
	(0.000)	(0.001)
Capital intensity	0.003	0.013*
	(0.002)	(0.007)
Debt intensity	-0.000	-0.004
	(0.001)	(0.004)
Average wage	0.005**	0.030***
	(0.002)	(0.011)
Employees	0.007***	0.032***
	(0.002)	(0.008)
Year dummies	Included	Included
Observations	3,574	3,574

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 9. Sensitivity analyses on endogeneity: Testing H2 with a 2SLS model

Second stage estimation (laggards in low-tech sectors)

VARIABLES	(1) Productivity (t+1)	(2) Productivity (t+2)	(3) Productivity (t+3)
Overseas MA	0.210	-0.084	0.312
	(0.190)	(0.174)	(0.662)
Domestic MA	0.191***	0.186**	0.147*
	(0.060)	(0.073)	(0.076)
Capital intensity	0.057**	0.042	0.026
	(0.029)	(0.031)	(0.035)
Debt intensity	0.004	0.003	0.017
	(0.017)	(0.019)	(0.023)
Average wage	0.839***	0.751***	0.651***
	(0.048)	(0.051)	(0.052)
Employees	-0.220***	-0.228***	-0.240***
	(0.022)	(0.025)	(0.027)
Year dummies	Included	Included	Included
Observations	5,045	4,545	4,063
R-squared	0.494	0.416	0.345

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

First stage estimation (laggards in low-tech sectors)

VARIABLES	(1) Overseas MA	(2) Domestic MA
Peer group adoption of Overseas MA	0.010***	0.000
	(0.001)	(0.001)
Peer group adoption of Domestic MA	0.000	0.012***
	(0.000)	(0.001)
Capital intensity	0.000	-0.004
	(0.001)	(0.007)
Debt intensity	0.000	0.004
	(0.000)	(0.004)
Average wage	0.000	0.017*
	(0.001)	(0.010)
Employees	0.001*	0.012**
	(0.000)	(0.005)
Year dummies	Included	Included
Observations	5,045	5,045

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10. Sensitivity analyses on endogeneity: Testing H1 and H2 with GMM dynamic panel models

VARIABLES	(1) Leaders in high-tech sectors	(2) Laggards in low-tech sectors
Overseas MA (t-1)	0.028	0.288
	(0.076)	(0.259)
Overseas MA (t-2)	0.023	0.071
	(0.064)	(0.232)
Overseas MA (t-3)	0.200***	0.117
	(0.074)	(0.225)
Domestic MA (t-1)	0.004	0.088***
	(0.021)	(0.027)
Domestic MA (t-2)	0.035**	0.099***
	(0.017)	(0.031)
Domestic MA (t-3)	0.026	0.067**
	(0.026)	(0.029)
Productivity (t-1)	0.550***	0.391***
	(0.067)	(0.060)
Capital intensity	0.054	0.110
	(0.059)	(0.130)
Debt intensity	0.016	-0.123*
	(0.048)	(0.068)
Average wage	0.438***	0.664***
	(0.131)	(0.176)
Employees	-0.054	-0.135**
	(0.044)	(0.067)
Observations	2,729	3,947
Number of firms	489	524
Year dummies	Included	Included
Hansen (p-value)	1.000	0.997
AR(1) (p-value)	0.000	0.000
AR(2) (p-value)	0.282	0.317

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is productivity. The models are estimated by two-step systematic GMM dynamic panel models with Windmeijer-corrected standard errors.