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**-RESEARCH ARTICLE-**

# FOREIGN DIRECT INVESTMENT AND INTER-FIRM WAGE DISPARITIES IN VIETNAM: AN ANALYSIS OF HORIZONTAL AND VERTICAL SPILLOVERS EFFECTS

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**—Abstract—**

Using micro-level data from Vietnam's manufacturing sector spanning 2005 to 2015, this study systematically examines the pathways through which Foreign Direct

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Investment (FDI) affects the wage disparity between foreign-owned and domestic firms, with particular attention to both horizontal and vertical spillover effects. A two-way fixed effects panel model was constructed to empirically assess how FDI-induced technology spillovers influence firm-level average wages. The analysis simultaneously evaluates the intensity of three distinct spillover channels: horizontal spillovers, forward vertical spillovers, and backward vertical spillovers. Additionally, the study investigates the mediating role of these spillovers in driving wage growth by enhancing firms' total factor productivity (TFP). To address potential endogeneity and ensure the robustness of the results, a Heckman two-stage model was applied. A heterogeneity analysis was also conducted along the industrial chain to identify marginal variations in the effects of FDI. The results indicate that FDI substantially elevates firm wage levels. In particular, horizontal spillovers and backward vertical spillovers exert the most significant influence on wage growth, with these effects being especially pronounced among domestic firms. FDI also indirectly stimulates wage increases by improving firm productivity, supporting the mechanism whereby technology diffusion enhances efficiency and subsequently raises wages. This effect is particularly evident in firms situated in the downstream segments of the industrial chain. The findings offer policy guidance for Vietnam regarding the coordinated development of FDI alongside local enterprises and strategies to reduce the wage gap between foreign-invested and domestic firms.

**Keywords:** Foreign Direct Investment (FDI), Wage Gap, Horizontal Spillover Effects, Vertical Spillover Effects, Vietnam.

## INTRODUCTION

As Vietnam increasingly integrates into the global economy and attracts foreign investment, the influence of FDI on the country's labour market structure and income distribution has drawn heightened attention from policymakers and scholars. Since the enactment of the Law on Foreign Investment, Vietnam has successfully secured substantial manufacturing FDI from countries such as China, South Korea, and Japan by enhancing its investment climate and offering preferential policies. The effect of FDI on the host nation's labour market, particularly its role in shaping wage disparities among firms, has remained a central focus in labour and development economics. Existing research demonstrates that although FDI brings capital, technology, and managerial expertise, it can also widen wage gaps between foreign and domestic firms by attracting high-skilled domestic labour through elevated wages (Feenstra & Hanson, 1997; Markusen & Venables, 1997). Consequently, foreign-invested enterprises (FIEs) often possess higher technological and capital intensity, reinforcing structural differences that exacerbate labour market segmentation (Figini & Görg, 1999).

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Concerning the mechanisms of impact, some studies indicate that FDI may enhance domestic firm productivity through technology spillovers, thereby narrowing wage disparities between FIEs and local enterprises (Tan et al., 2023). For instance, evidence suggests that domestic firms in Bangladesh predominantly gain productivity via horizontal linkages within the same industry, whereas Vietnamese firms benefit chiefly from backward linkages with foreign firms (Arif-Ur-Rahman & Inaba, 2021). Accordingly, FDI's influence on wage gaps is neither linear nor unidirectional; rather, it represents a dynamic, stage-dependent process shaped by factors such as domestic firms' absorptive capacity, the institutional environment, and industrial structure (Ackerberg et al., 2015).

While FDI fosters economic growth and industrial upgrading, it may also generate or intensify wage disparities among enterprises. Prior studies suggest that FDI's impact on wage gaps operates primarily through two mechanisms. The first, the labour reallocation effect, occurs as highly skilled workers migrate towards FIEs, leading to a relative decline in the quality of human capital within domestic firms. The second, the technology spillover effect, arises as foreign firms' technological advantages diffuse to domestic enterprises via demonstration, competition, and collaboration, thereby indirectly improving domestic firms' productivity and wage-paying capacity (Jude, 2016). Regarding spillover channels, the literature distinguishes between horizontal and vertical effects. Horizontal spillovers refer to influences within the same industry, such as learning and imitation of technological advancements, whereas vertical spillovers involve cross-industry effects, including forward linkages (where foreign firms supply intermediate inputs to domestic firms) and backward linkages (where foreign firms source local products and provide technical support) (Liu & Zhang, 2025). Empirical evidence suggests that backward vertical spillovers are particularly effective in enhancing domestic firms' technological capabilities, potentially fostering wage growth (Le & Pomfret, 2011).

Much of the existing literature focuses on major developing economies such as China and India, while systematic analyses of Vietnam remain comparatively scarce. Although prior studies confirm that FIEs generally offer higher wages than domestic firms, there is limited research exploring how FDI-induced technology spillovers influence inter-firm wage disparities through multiple channels (Yokota & Tomohara, 2010). Studies integrating both horizontal and vertical spillovers within a single analytical framework are particularly rare (Wang & Zhao, 2008). In response, this study examines the mechanisms and magnitude of FDI's impact on wage gaps within Vietnam's manufacturing sector, emphasising technology spillovers (Van Thanh & Hoang, 2010). Specifically, the research makes three primary contributions: first, it develops a theoretical framework that systematically traces the pathways through which FDI affects wage disparities via labour reallocation and horizontal and vertical technology spillovers; second, using firm-level panel data from Vietnam, it applies the Oaxaca–Blinder decomposition and Shapley value decomposition to quantify

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technology spillovers contribution to inter-firm wage differentials; third, a heterogeneity analysis is conducted to investigate how variations in FDI's technological intensity and firms' positions within the industrial chain shape wage inequality.

## THEORETICAL ANALYSIS AND RESEARCH HYPOTHESES

### Theoretical Analysis

Although FDI fosters economic growth in host countries, its significant influence on wage structures has been widely debated. As noted, FDI shapes inter-firm wage disparities primarily through two mechanisms: the labour reallocation effect and the technology spillover effect (Kopiński, 2023). This study constructs a theoretical framework specifically designed to analyse the dynamics and characteristics of Vietnam's manufacturing sector.

### Basic Mechanism: Labour Reallocation Effect

Foreign-invested enterprises typically possess superior technological capabilities and offer higher wages, thereby attracting a substantial share of high-skilled labour (Golob Šušteršič & Zajc Kejžar, 2020). This dynamic can result in a talent drain from domestic firms, initially widening the wage gap between foreign and domestic enterprises (Bellak, 2004). Over time, as FDI becomes more entrenched, domestic firms tend to raise wages to retain their skilled workforce. As a result, the wage disparity between foreign and domestic firms often follows an inverted U-shaped pattern (Cruz et al., 2023). For an economy consisting solely of foreign-invested firms (F) and domestic firms (D), let HF and HD represent the quantities of high-skilled labour employed by these respective firm types. Wages are determined by the marginal product of labour, with the production function defined as follows (Hellerstein & Neumark, 2006; Trenczek & Wacker, 2023):

$$Y_F = A_F H_F^{\alpha} L_F^{1-\alpha}$$
$$Y_F = A_F H_F^{\alpha} L_F^{1-\alpha}$$

Labour is assumed to be perfectly mobile within the market, and since wages are set according to the marginal product of labour, the wage of high-skilled labour satisfies the following market-clearing condition:

$$W_H^F = \frac{\partial Y_F}{\partial H_F} = \alpha A_F H_F^{\alpha-1} L_F^{1-\alpha}$$
$$W_H^D = \frac{\partial Y_D}{\partial H_D} = \beta A_D H_D^{\beta-1} L_D^{1-\beta}$$

In the early stages of FDI inflows into the host country, FIEs, due to their stronger appeal, secure a larger share of high-skilled labour that is, HF>HD (Rizvanolli, 2012).

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Consequently, the human capital of domestic firms is relatively weakened, leading to an expansion of the wage gap between the two types of firms($W_H^F > W_H^D$). As FDI becomes more entrenched, domestic firms increasingly raise wages in response to external competitive pressures to attract and retain skilled labour (Becker et al., 2020). This adjustment promotes a more balanced distribution of labour, thereby reducing the wage gap between foreign and domestic enterprises (Chen et al., 2011). Consequently, the evolution of wage disparities is expected to follow an inverted U-shaped pattern, which can be expressed as:

$$\Delta W = W_H^F - W_H^D$$
$$\frac{d(\Delta W)}{dt} > 0 \text{ (Initial Stage)}, \frac{d(\Delta W)}{dt} < 0 \text{ (Later Stage)}$$

**Reinforcing Mechanism: Technology Spillovers Effect**

Foreign-invested enterprises not only directly attract high-skilled labour but also influence domestic firms over the long term through various technology spillover channels, thereby indirectly affecting wage structures (Nguyen et al., 2020). These effects primarily occur through demonstration effects, horizontal spillovers, and vertical spillovers. Within vertical spillovers, the mechanisms further include both forward and backward linkages. FIEs generally embody the most advanced technological and managerial practices within an industry, providing local firms with benchmarks for imitation (Zhang & Han, 2025). Domestic enterprises can enhance their technological capabilities by observing and adopting FIEs' operational procedures, production management systems, and equipment utilisation strategies, often without substantial direct investment in research and development (Shi, 2001). Within the production function w, this process can be formalised as an increase in the effective technological level of domestic enterprises, which rises from an initial AD to a higher level under the influence of FDI's demonstration effect.

$$\acute{A_D} = A_D(1 + \theta_1 S_1)$$

Here, $S_1$ denotes the intensity of the demonstration effect (e.g., the proportion of FIEs in the industry, or regional FDI density), and $\theta_1$represents the coefficient of absorptive sensitivity. Thus,the new production function of domestic firms can thus be expressed as:

$$Y_D = A_D(1 + \theta_1 S_1)H_D^{\gamma} L_D^{1-\gamma}$$

As a result, the marginal product of high-skilled labour is modified as follows:

$$W_{H_D}^{(1)} = \frac{\partial Y_D}{\partial H_D} = \gamma A_D(1 + \theta_1 S_1)H_D^{\gamma-1} L_D^{1-\gamma}.$$

In comparison, the wage expression without accounting for technology spillovers is

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given by:

$$w_{H_D}^0 = \gamma A_D H_D^{\gamma-1} L_D^{1-\gamma}.$$

Hence, it can be inferred that:

$$\frac{w_{H_D}^{(1)}}{w_{H_D}^{(0)}} = (1 + \theta_1 S_1) > 1.$$

Thus, it is evident that a stronger demonstration effect raises wage levels within domestic firms, thereby mitigating the wage advantage of FIEs and narrowing the gap between the two types of enterprises (Thangavelu, 2013). The analysis now turns to horizontal spillover effects. When FIEs enter a specific industry in the host country, they not only shift the technological frontier of that industry but also influence the production behaviour of domestic firms through competition in production efficiency, labour market pressures, and process benchmarking (Knell, 2000). This mechanism is referred to as the horizontal spillover effect. Its defining feature is that, even in the absence of direct technological collaboration, FDI can stimulate autonomous technological improvements and wage growth in domestic firms through intra-industry competitive dynamics. Consider an industry with n firms, where the proportion of FIEs is $\phi \in (0,1)$. In the host country, all enterprises shared high-skilled labour market. Given their higher productivity $A_F$, FIEs establish an efficiency benchmark within the industry, compelling domestic firms to improve and narrow the efficiency gap to retain employees and maintain market share (Denhere et al., 2025).

Assuming each domestic enterprise possesses a technical efficiency of $A_D$. Every enterprise has the capacity to enhance its efficiency at a cost c(e), where e denotes the degree of effort exerted ($c'(e)>0, c''(e)>0$). A larger presence of FIEs within an industry generates greater competitive pressure and stronger incentives for domestic firms to enhance performance.

Let the production function for domestic enterprises be expressed as:

$$A_D(e) = A_0 + \mu \cdot \phi \cdot e$$

Here, $A_0$ represents the initial technological level, $\phi$ denotes the extent of FDI penetration in the industry, $\mu$ reflects the responsiveness of efficiency gains to competitive pressure, and e indicates the effort level exerted by the firm to improve efficiency, which depends on the competitive incentives present in the industry. The marginal product of high-skilled labour is then expressed as:

$$W_{H_D}^{(2)} = \gamma A_D(e) H_D^{\gamma-1} L_D^{1-\gamma} = \gamma(A_0 + \mu\phi e) H_D^{\gamma-1} L_D^{1-\gamma}$$

To maximize profit, enterprises choose $e*$such that their marginal revenue is

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equivalent to their marginal cost:

$$\frac{\partial \Pi}{\partial e} = \frac{\partial Y_D}{\partial A_D} \cdot \frac{\partial A_D}{\partial e} - \acute{C_D}(e) = \mu \cdot \frac{\partial Y_D}{\partial A_D} - \acute{C_D}(e) = 0$$

That is, $\mu \cdot \frac{\partial Y_D}{\partial A_D} = \acute{C_D}(e)$.

Since, $\frac{\partial Y_D}{\partial A_D} = H_D^{\gamma} L_D^{1-\gamma}$, it follows that:

$$\mu H_D^{\gamma} L_D^{1-\gamma} = \acute{C_D}(e^*)$$
$$e^* = (\acute{c})^{-1}(\mu H_D^{\gamma} L_D^{1-\gamma})$$

Substituting into the productivity function yields:

$$A_D^* = A_0 + \mu\phi e^* = A_0 + \mu\phi \cdot (\acute{c})^{-1}(\mu H_D^{\gamma} L_D^{1-\gamma})$$

The resulting wage for high-skilled labour is:

$$W_{H_D}^{(2)} = \gamma A_D^* H_D^{\gamma-1} L_D^{1-\gamma}.$$

The preceding analysis demonstrates that a greater share of FIEs within an industry intensifies competitive pressures, enhancing domestic firms' incentives to improve efficiency and thereby raising wage levels within these enterprises (Cuñat & Guadalupe, 2009). Next, the vertical spillover effect is examined. As FIEs become more deeply integrated into the local industrial chain, they typically promote capability enhancements among both upstream and downstream domestic firms. This effect can be further divided into forward and backward linkages. Forward linkages arise when domestic firms purchase intermediate goods from FIEs, gaining access to advanced supporting technologies. Backward linkages occur when domestic firms, acting as suppliers to FIEs, participate in joint standard setting, quality control, and technological collaboration.

When domestic firms engage in backward or forward linkages with FIEs, improvements in production efficiency are no longer driven solely by the presence of foreign firms but are amplified through ongoing collaborative interactions (Ni et al., 2017). To capture this dynamic, a feedback enhancement function f(C) is introduced, where C represents the intensity of cooperation between domestic firms and FIEs. In practice, C is typically measured using indicators such as supply share or frequency of technological collaboration. Accordingly, the enhancement of domestic firms' technological capabilities through dynamic learning can be expressed as:

$$\acute{A_D} = A_D + \lambda A_F f(C)$$

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The updated production function can be expressed as:

$$Y_D = [A_D + \lambda A_F f(C)] H_D^{\gamma} L_D^{1-\gamma}$$

The marginal product of high-skilled labour is therefore given by:

$$W_{H_D}^{(3)} = \gamma [A_D + \lambda A_F f(C)] H_D^{\gamma} L_D^{1-\gamma}.$$

In comparison, the wage level in the initial state (without collaboration, C = 0) can be expressed as:

$$\frac{W_{H_D}^{(3)}}{W_{H_D}^{(0)}} = \frac{A_D + \lambda A_F f(C)}{A_D} = 1 + \frac{\lambda A_F}{A_D} f(C)$$

Given that f(C) is a convex function, it follows that as the intensity of collaboration (C) increases, the marginal wage level demonstrates an accelerating growth pattern. Within this framework, forward spillovers arise when domestic firms improve their capabilities by progressively adopting new technical interfaces and processing standards through the procurement of intermediate goods from FIEs, while continually adapting to evolving requirements. In contrast, backward spillovers occur as domestic firms, acting as suppliers to FIEs, iteratively refine their delivery quality, process standards, and technical interfaces, thereby accumulating "learning-by-doing" experience. In the manufacturing sector, such interactions are typically characterised by rapid cycles and frequent feedback, which foster deeper synergies and cumulative capability development. Consequently, wage growth follows a non-linear trajectory, exhibiting an endogenous, accelerating pattern rather than a simple linear progression.

**Research Hypotheses**

Within the theoretical framework outlined above, FDI affects wage disparities among Vietnamese manufacturing firms through two principal channels. The first is the labour mobility effect, whereby FIEs attract high-skilled labour with superior remuneration, generating a short-term imbalance in human capital and widening wage gaps across firms. The second is the technology spillover effect, which encompasses horizontal spillovers arising from employee movement and imitation, as well as forward and backward vertical spillovers stemming from supply and demand linkages within the industrial chain. Over time, these technology spillovers enhance the production efficiency and wage-paying capacity of domestic firms, gradually raising their wages and reducing the gap with FIEs. Viewed dynamically, FDI's impact on wage disparities is non-linear, typically following an inverted U-shaped trajectory. In the early stages of FDI inflows, the labour mobility effect predominates, resulting in a marked widening of wage gaps. As FDI deepens, the technology spillover effect becomes increasingly influential. Domestic firms progressively improve their

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technological capabilities through learning and collaboration, ultimately elevating their wages and narrowing the disparity with foreign-invested enterprises. Drawing on this theoretical analysis, the study formulates the following research hypotheses:

**H1:** *The entry of FDI significantly widens the wage gap between foreign and domestic firms in Vietnam's manufacturing sector in the short term due to the labour mobility effect, but this gap may converge in the long term.*
**H2:** *The horizontal technology spillover effect of FDI can enhance the technological level of domestic firms, thereby narrowing the wage gap between foreign and domestic firms.*
**H3:** *The vertical technology spillover effect of FDI helps drive technological progress in domestic firms, consequently mitigating the wage gap to some extent.*

## Research Methodology

### Model Design

Having established a preliminary theoretical discussion on the relationship between FDI and average wages, this study proceeds to empirically investigate whether a significant quantitative association exists between the two. Following the methodology, a baseline regression model is constructed for empirical testing as follows:

$$LnW_{ijt} = \alpha_0 + \alpha_1 H_{jt} + \alpha_2 B_{jt} + \alpha_3 F_{jt} + \alpha_4 X_{it} + \mu_i + \lambda_t + \nu_j + \varepsilon_{ijt} (1)$$

Here, $LnW_{ijt}$denotes the average wage of firm i in industryj during year t;$H_{jt}$, $B_{jt}$, $F_{jt}$ respectively represent the horizontal spillover effect, backward vertical spillover effect, and forward vertical spillover effect of FDI, whose construction method refers to Javorcik (2004). $X_{it}$ signifies a set of control variables; $\mu_i, \lambda_t, \nu_j, \varepsilon_{it}$ denotes the enterprise-specific fixed effect, year fixed effect, industry fixed effect, and random disturbance term, respectively.

### Variable Selection

In Equation (1), the dependent variable, average wage (LnW), is defined as the natural logarithm of the total wage expenditure of enterprise *i* within industry *j* in year *t*. For the key explanatory variables, this study follows the approach of Javorcik (2004) to construct measures of horizontal spillover effects, backward vertical spillovers, and forward vertical spillovers. This framework enables a detailed examination of how FDI influences wage disparities between foreign-invested and domestic enterprises in Vietnam. Among them, the horizontal spillover effect, denoted as $H_{jt}$, represents the degree of foreign participation in industry j, capturing the influence of foreign-invested firms on other firms within the same industry in Vietnam's manufacturing

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sector. The corresponding calculation formula is given by:

$$H_{jt} = \frac{\sum_{i \in j} \text{ForeignShare}_{it} \times \text{Output}_{it}}{\sum_{i \in j} \text{Output}_{it}}$$

In this equation, $\text{ForeignShare}_{it}$ denotes the share of foreign ownership in the firm, while $\text{Output}_{it}$ represents output, measured by the firm's total revenue.

Regarding the backward vertical spillover effect $B_{jt}$, it measures the extent to which industry j is influenced by foreign investment from its downstream industries k, reflecting the driving effect of foreign-invested firms on domestic suppliers, the formula is expressed as:

$$B_{jt} = \sum_{k \neq j} \alpha_{jk} \cdot H_{kt}$$

Here, $\alpha_{jk}$ represents the proportion of intermediate goods supplied by industry *j* to industry *k*, which matched with Vietnam's input-output table. $H_{kt}$ denotes the degree of foreign participation in the downstream industry.

Lastly, the forward vertical spillover effect $F_{jt}$ is used to measure the technological impact received by industry *j* when it obtains intermediate input from upstream FIEs, thereby illustrating the technological transmission from foreign capital via the upstream supply chain to domestic downstream firms, expressed as:

$$F_{jt} = \sum_{m \neq j} \theta_{jm} \left( \frac{\sum_{i \in m} \text{ForeignShare}_{it} \cdot (\text{Output}_{it} - \text{Export}_{it})}{\sum_{i \in m} (\text{Output}_{it} - \text{Export}_{it})} \right)$$

Here, $\theta_{jm}$ represents the input share of intermediate goods acquired by industry j from industry m, while $\text{Export}_{it}$ denotes the firm's export value, used to exclude the portions not involved in domestic spillovers.

To account comprehensively for external factors affecting average wages, the study draws on the methodology and the regression model incorporates control variables covering enterprise characteristics, corporate governance attributes, and industry-specific factors. Specifically, the controls include Export Proportion (Export), Capital Leverage Ratio (CLR), Company Size (Size), Asset-Liability Ratio (Lev), Enterprise Age (Age), Return on Total Assets (ROA), Total Asset Turnover (ATO), Cash Flow Ratio (Cashflow), and Operating Revenue Growth Rate (Growth).

**Data Sources**

The firm-level panel dataset employed in this study spans the period from 2005 to

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2015 and was compiled by the General Statistics Office of Vietnam (GSO). Beyond basic firm characteristics, the dataset provides detailed information on employment by job category, R&D expenditures, sales, and trade activities. To capture inter-industry linkages and the degree of foreign capital participation, the study also utilises Vietnam's Input–Output Table and relevant industry statistical yearbooks, both sourced from the GSO. Additional data were drawn from the Labour and Employment Survey and the World Bank to ensure the dataset's reliability and comparability.

## EMPIRICAL ANALYSIS

### Descriptive Statistics

Table 1 reports the descriptive statistics for the key variables in this study. The dependent variable, average wage (LnW), has a mean of 4.923, a standard deviation of 7.491, a maximum of 20.75, and a minimum of 0, reflecting considerable variation in per capita wages across enterprises, with the overall distribution exhibiting right-skewed characteristics. While firm size (Size) and profitability (ROA) remain relatively stable, indicators such as the asset-liability ratio (Lev) and growth rate (Growth) display substantial variability, highlighting significant heterogeneity among the sampled enterprises in terms of financial structure and expansion capacity.

**Table 1: Descriptive Statistical Analysis**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| **VARIABLES** | **N** | **Mean** | **SD** | **Min** | **Max** |
| LnW | 39,240 | 4.923 | 7.491 | 0 | 20.75 |
| Size | 39,240 | 22.21 | 1.281 | 19.58 | 26.44 |
| Lev | 39,240 | 0.412 | 0.205 | 0.0319 | 0.925 |
| Age | 39,240 | 2.050 | 0.931 | 0 | 3.434 |
| ROA | 39,240 | 0.0400 | 0.0666 | -0.375 | 0.254 |
| ATO | 39,240 | 0.634 | 0.426 | 0.0546 | 2.891 |
| Cashflow | 39,240 | 0.0467 | 0.0684 | -0.199 | 0.266 |
| Growth | 39,240 | 0.150 | 0.379 | -0.653 | 3.808 |
| Export | 39,240 | 0.743 | 0.0963 | 0.476 | 0.996 |
| CLR | 39,240 | 0.771 | 0.617 | 0.0177 | 2.969 |

### Baseline Regression Analysis

Table 2 presents the regression results examining the impact of three types of FDI-induced technological spillovers on wage levels in Vietnam's manufacturing firms. Across the full sample, the horizontal spillover variable (H) demonstrates a statistically significant positive coefficient of 0.054 at the 1% level ($p < 0.01$), indicating that a higher proportion of FIEs within an industry significantly drives wage growth. This finding supports Hypothesis H2, suggesting that FDI facilitates the technological advancement of domestic firms through mechanisms such as labour mobility and imitative learning, thereby enhancing their capacity to offer higher

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wages. Further analysis by firm ownership reveals that horizontal spillovers (H) are significantly positive for both domestic and foreign firms, although the estimated coefficients are relatively modest. This indicates that while the expansion of foreign presence generally promotes wage growth at the industry level, the marginal effect is moderate, reflecting the gradual nature of technological diffusion.

**Table 2: Baseline Regression Analysis**

| | (All Industries) | (Domestic Firms) | (FIEs) |
|---|---|---|---|
| **VARIABLES** | **LnW** | **LnW** | **LnW** |
| H | 0.054*** | 0.018** | 0.016** |
| | (6.74) | (2.42) | (2.07) |
| B | 0.139*** | 1.680*** | 0.358** |
| | (17.43) | (19.51) | (2.24) |
| F | 0.017** | 0.336*** | 1.330* |
| | (2.13) | (5.94) | (1.88) |
| Size | 0.911*** | 0.954*** | 0.931*** |
| | (6.50) | (7.50) | (6.73) |
| Lev | 0.017 | -0.003 | 0.107 |
| | (0.11) | (-0.01) | (0.24) |
| Age | 0.489*** | 0.507*** | 0.472*** |
| | (3.56) | (4.06) | (3.27) |
| ROA | 0.862 | 0.866 | 0.887 |
| | (1.24) | (1.27) | (1.30) |
| ATO | 0.087 | 0.090 | 0.133 |
| | (0.31) | (0.36) | (0.55) |
| Cashflow | -1.439*** | -1.451*** | -1.501*** |
| | (-2.81) | (-2.85) | (-2.97) |
| Growth | 0.048 | 0.052 | 0.024 |
| | (0.61) | (0.64) | (0.30) |
| Export | 0.052 | 0.057 | 0.329 |
| | (0.05) | (0.06) | (0.36) |
| Indep | 0.014 | 0.019 | 0.021* |
| | (1.47) | (1.52) | (1.76) |
| Dual | 0.147 | 0.151 | 0.168 |
| | (1.19) | (1.24) | (1.39) |
| CLR | -0.182 | -0.180 | -0.194 |
| | (-1.27) | (-1.24) | (-1.36) |
| Constant | -18.324*** | -18.981*** | -18.685*** |
| | (-6.07) | (-6.72) | (-6.03) |
| Firm | YES | YES | YES |
| Industry | YES | YES | YES |
| Year | YES | YES | YES |
| N | 38,945 | 38,945 | 38,945 |
| R-Squared | 0.649 | 0.654 | 0.657 |

Regarding vertical spillovers, the coefficient for backward spillovers (B) is significantly positive in all regressions, particularly for domestic firms, where it

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reaches 1.680 ($p < 0.01$), substantially exceeding that for FIEs (0.358). This supports Hypothesis H3, indicating that supply chain collaboration with FIEs markedly enhances the technological capabilities and bargaining power of domestic suppliers, thereby strongly promoting higher wages. Forward spillovers (F) also exhibit a significant positive effect for both domestic and foreign firms; however, the coefficient for FIEs (1.330) is considerably larger than that for domestic firms (0.336), suggesting that FIEs derive greater benefit from access to high-quality intermediate goods, which enhances their overall value creation and employee compensation.

**Robustness Check**

Table 3 illustrates that in Column (1), to further assess the dynamic impact of FDI on wages, the dependent variable is replaced with the wage growth rate and the model is re-estimated. The results indicate that the coefficient of horizontal spillovers is 0.055 and remains significantly positive at the 1% level, confirming that FDI continues to exert a substantial positive influence on wage growth. The coefficient for forward vertical spillovers is 0.031 and also significantly positive, providing additional evidence that FDI promotes wage increases via the transmission of high-quality intermediate inputs.

Although the coefficient for backward spillovers is statistically significant, its magnitude is relatively small, suggesting a limited marginal contribution to wage growth. To verify the robustness of these findings, and considering potential external shocks affecting later years, the model is re-estimated over alternative time windows. In Column (2), certain years are excluded and the regression is conducted on a restricted sample period. The results show that the coefficient of horizontal spillovers (H) remains significantly positive, indicating that FDI's positive effect on wages is stable across different time intervals. Estimates for vertical spillovers are consistent with the baseline regression, suggesting that the conclusions are robust to the choice of sample periods.

Columns (3) through (5) relax assumptions regarding the treatment of standard errors, employing industry-clustered, region-clustered, and industry×region double-clustered estimation methods, respectively. Across all specifications, the coefficient of the horizontal spillover effect (H) remains approximately 0.016 and is significant at the 5% level. The coefficient for forward spillovers (F) also remains significantly positive, demonstrating that the FDI spillover mechanism via upstream and downstream channels is robust even under multi-dimensional clustering.

While the backward spillover effect (B) loses statistical significance under these alternative specifications, its sign remains positive, suggesting that backward spillovers may exhibit substantial structural heterogeneity across industries.

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**Table 3: Robustness Check**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | **Replace Per Capita Wage** | **Adjust Sample Period** | **Industry Clustering** | **Region Clustering** | **Industry-Region Clustering** |
| Variable | WGR | LNW | LNW | LNW | LNW |
| H | 0.055*** | 0.022** | 0.016** | 0.016** | 0.016** |
| | (37.03) | (2.15) | (2.39) | (2.16) | (2.04) |
| B | 0.005*** | 0.001*** | -0.005 | -0.005 | -0.005 |
| | (5.28) | (3.54) | (-0.58) | (-0.86) | (-0.79) |
| F | 0.031** | 0.033** | 1.330** | 1.330* | 1.330* |
| | (1.84) | (1.99) | (2.53) | (1.93) | (1.92) |
| Size | 0.051** | 0.892*** | 0.931*** | 0.931*** | 0.931*** |
| | (2.54) | (5.33) | (5.66) | (5.45) | (6.74) |
| Lev | -0.043 | -0.490 | 0.107 | 0.107 | 0.107 |
| | (-0.65) | (-0.84) | (0.18) | (0.21) | (0.23) |
| Age | 0.064*** | 0.384* | 0.472*** | 0.472*** | 0.472*** |
| | (2.81) | (1.90) | (2.90) | (3.28) | (3.25) |
| ROA | 0.065 | -0.142 | 0.887 | 0.887 | 0.887 |
| | (0.61) | (-0.16) | (1.11) | (1.14) | (1.25) |
| ATO | -0.021 | 0.152 | 0.133 | 0.133 | 0.133 |
| | (-0.64) | (0.50) | (0.49) | (0.57) | (0.56) |
| Cashflow | -0.227*** | -1.116* | -1.501** | -1.501*** | -1.501*** |
| | (-2.93) | (-1.85) | (-2.29) | (-2.80) | (-2.80) |
| Growth | -0.012 | -0.057 | 0.024 | 0.024 | 0.024 |
| | (-1.02) | (-0.58) | (0.29) | (0.29) | (0.29) |
| Export | -0.161 | -0.356 | 0.329 | 0.329 | 0.329 |
| | (-1.09) | (-0.32) | (0.39) | (0.38) | (0.36) |
| Indep | 0.000 | 0.016 | 0.021* | 0.021* | 0.021* |
| | (0.19) | (1.07) | (1.74) | (1.71) | (1.68) |
| Dual | -0.005 | 0.350** | 0.168 | 0.168 | 0.168 |
| | (-0.27) | (2.21) | (1.07) | (1.13) | (1.33) |
| CLR | -0.049** | -0.145 | -0.194 | -0.194 | -0.194 |
| | (-1.98) | (-0.80) | (-1.24) | (-1.08) | (-1.34) |
| Constant | -0.224 | -16.188*** | -18.685*** | -18.685*** | -18.685*** |
| | (-0.48) | (-4.28) | (-5.38) | (-4.97) | (-6.08) |
| Firm | YES | YES | YES | YES | YES |
| Industry | YES | YES | YES | YES | YES |
| Year | YES | YES | YES | YES | YES |
| N | 38,944 | 22,357 | 38,944 | 38,944 | 38,944 |
| R-Squared | 0.810 | 0.697 | 0.657 | 0.657 | 0.657 |

## Endogeneity Test

To address potential sample selection bias in firm wage levels—such as higher-wage firms being more likely to be observed—this study utilises the Heckman two-stage model to test for endogeneity. The results are summarised in Table 4.

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## Table 4: Endogeneity Test

| | (1) | (2) |
|---|---|---|
| **VARIABLES** | **Heckman Stage 1** | **Heckman Stage 2** |
| | LNW_dum | LNW |
| H | | 0.017** |
| | | (2.13) |
| B | | 0.028** |
| | | (2.02) |
| F | | 0.931*** |
| | | (6.73) |
| WOR | | |
| Size | 0.139*** | 2.285*** |
| | (17.43) | (5.64) |
| Lev | 0.303*** | 3.061*** |
| | (6.07) | (3.33) |
| Age | 0.052*** | 1.097*** |
| | (4.41) | (5.10) |
| ROA | -0.027 | 0.541 |
| | (-0.18) | (0.79) |
| ATO | -0.158*** | -1.377*** |
| | (-7.42) | (-2.84) |
| Cashflow | 0.109 | -0.393 |
| | (0.88) | (-0.69) |
| Growth | 0.037* | 0.376*** |
| | (1.81) | (2.98) |
| Export | 0.046 | 0.884 |
| | (0.47) | (0.97) |
| Indep | -0.003** | -0.009 |
| | (-1.97) | (-0.58) |
| Dual | -0.106*** | -0.884*** |
| | (-6.27) | (-2.87) |
| CLR | -0.069*** | -0.856*** |
| | (-5.53) | (-3.65) |
| Mshare | -0.003*** | -0.040*** |
| | (-7.31) | (-3.54) |
| Top10 | -0.003 | 1.201* |
| | (-0.04) | (1.69) |
| IMR | | 13.556*** |
| | | (3.79) |
| Constant | -3.476*** | -65.000*** |
| | (-16.96) | (-5.00) |
| Firm | YES | YES |
| Industry | YES | YES |
| Year | YES | YES |
| N | 39,189 | 38,894 |
| R-Squared | 0.148 | 0.658 |

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In the first-stage selection equation, the dependent variable is defined as whether a firm's average wage exceeds the industry mean in the same year, and a Probit model is employed to estimate the probability of a firm belonging to the high-wage group. The findings indicate that most firm-specific variables significantly influence wage selection at either the 1% or 5% level, highlighting the existence of a notable selection mechanism in wage determination. In the second-stage wage regression, the inverse Mills ratio (IMR) derived from the first stage is included to control for sample selection bias. The results show that the IMR coefficient is significantly positive, confirming the presence of sample selection effects. Crucially, even after adjusting for this selection mechanism, the positive impact of all three types of FDI-induced technology spillovers on wage growth remains robust, further reinforcing the validity of the study's main conclusions.

## Heterogeneity Analysis

To examine whether the effect of FDI-induced technological spillovers on wage disparities varies across different positions within the value chain, the sample is divided into three segments based on firms' roles: upstream (provision of resources and raw materials), midstream (processing and manufacturing), and downstream (assembly and sales). The interaction between the three types of FDI spillovers and wage levels is then analysed for each segment. As presented in Table 5, horizontal spillovers exhibit significantly negative coefficients for midstream and downstream firms, suggesting that FIEs in these segments exert substantial competitive pressure on domestic firms, potentially constraining their wage growth. In contrast, the coefficient for upstream firms is not significant, indicating that a clear intra-industry technology transfer mechanism has yet to materialise in this segment.

Backward vertical spillovers demonstrate marked heterogeneity across the value chain. They are significantly negative in both upstream and midstream segments, implying that local suppliers of raw materials and intermediate goods have not effectively captured technological benefits through collaboration with FIEs. This may reflect weakened bargaining power, leading to compressed profit margins and lower wages. Conversely, for downstream firms, the coefficient of B×FOEB is 1.332 and significant at the 5% level, indicating that when foreign firms procure supporting services locally, they transfer part of their technological advantages to downstream enterprises, thereby promoting wage growth. Forward vertical spillovers are positive and significant only for upstream firms, suggesting that FIEs, as suppliers of intermediate goods and capital equipment, substantially enhance technological capabilities and wages in this segment. However, in midstream and downstream segments, the effect turns negative and highly significant, reflecting a "locking-in" effect or technological substitution, whereby FIEs may hinder local firms' technological adoption through direct control or high technological barriers.

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In summary, FDI's technological spillovers exhibit pronounced heterogeneity across the industrial chain. Forward spillovers primarily benefit upstream firms, backward spillovers are advantageous for downstream firms but detrimental in upstream segments, and horizontal spillovers exert significant negative effects in midstream and downstream segments, revealing the suppressive influence of foreign enterprises on domestic competitors via intra-industry competition. These results support Hypothesis 3, highlighting the path-dependent heterogeneity of vertical spillovers in shaping wage disparities.

**Table 5: Regression Results of Technology Spillover Effects on Wage Gaps, Grouped by Industrial Chain Position**

| | (Upstream) | (Midstream ) | (Downstream) |
|---|---|---|---|
| **VARIABLES** | **LnW** | **LnW** | **LnW** |
| H×FOE | -0.005 | -0.533** | -0.323*** |
| | (-0.83) | (-3.98) | (-2.02) |
| B×FOE | -1.321*** | -0.477*** | 1.332** |
| | (-2.79) | (-3.31) | (2.88) |
| F×FOE | 2.179** | -0.796*** | -2.334*** |
| | (2.56) | (-8.02) | (-4.49) |
| FOE | 0.005 | 0.028** | 0.056 |
| | (0.46) | (2.02) | (1.43) |
| Constant | -18.786*** | -18.711*** | -18.789*** |
| | (-6.06) | (-6.04) | (-6.06) |
| Firm | YES | YES | YES |
| Industry | YES | YES | YES |
| Year | YES | YES | YES |
| N | 38,944 | 38,944 | 38,927 |
| R-Squared | 0.657 | 0.657 | 0.657 |

## Mechanism Analysis

To further examine the transmission mechanism through which FDI influences wage levels via enhancements in firm productivity, this study introduces an interaction term between FDI spillovers and firm-level TFP to assess its moderating effect on wages. Table 6 presents the results of this mechanism test based on subsamples of domestic and foreign firms. The findings indicate that the interaction terms of all three types of spillovers with TFP are significantly positive for both domestic and foreign firms, suggesting that productivity improvements strengthen the capacity of FDI spillovers to drive wage growth. Specifically, for domestic enterprises, the coefficients of Horizontal Spillover × TFP, Backward Spillover × TFP, and Forward Spillover × TFP are 0.911, 0.734, and 0.342, respectively, all significant at the 1% level. This underscores the crucial role of productivity in amplifying the effect of technological spillovers on wages.

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By contrast, while the interaction terms remain significantly positive for foreign firms, their magnitudes are comparatively smaller, indicating that, given their already high productivity levels, additional improvements have a relatively moderate impact on wage growth. These results support Hypotheses H2 and H3, confirming that the effect of FDI spillovers depends on the heterogeneity of firms' absorptive capacities, with a more pronounced influence on domestic firms with lower initial productivity. The findings further imply that policymakers should prioritise enhancing domestic firms' abilities to absorb and transform technology to facilitate a broader diffusion of wage benefits.

**Table 6: Mechanism Test for Technology Spillover Effects on Firm Wages**

| | (Domestic Firm) | (FIEs) |
|---|---|---|
| **VARIABLES** | **LnW** | **LnW** |
| H×TFP | 0.911*** | 0.490*** |
| | (6.56) | (3.39) |
| B×TFP | 0.734*** | 0.247*** |
| | (12.82) | (15.40) |
| F×TFP | 0.342*** | 0.070** |
| | (3.28) | (2.51) |
| Control | YES | YES |
| Firm | YES | YES |
| Industry | YES | YES |
| Year | YES | YES |
| N | 38,944 | 38,944 |
| R-Squared | 0.583 | 0.657 |

## CONCLUSION AND POLICY RECOMMENDATIONS

Drawing on firm-level data from Vietnam's manufacturing sector over the period 2005–2015, this study systematically investigates the pathways through which FDI affects wage disparities between domestic and foreign firms, with a focus on horizontal and vertical spillovers. Firm productivity and heterogeneous groupings are further incorporated to clarify the underlying mechanisms. The principal findings are as follows:

First, FDI exerts a significant positive influence on firm wages, with a more pronounced wage premium observed in FIEs. Simultaneously, domestic firms also experience wage increases through technology spillovers from FDI. Second, the effects of FDI-induced technological spillovers differ across channels. Backward vertical spillovers are particularly influential for domestic firms, indicating that FIEs enhance wages by procuring local intermediate goods, whereas forward vertical spillovers primarily benefit foreign firms. Third, the mechanism analysis demonstrates that FDI raises wages through its complementary interaction with firm productivity, suggesting that technological spillovers amplify the productivity–wage transmission

channel. Fourth, heterogeneity analysis reveals that the wage effects of FDI vary across firm types, positions within the industrial chain, and market environments. In particular, firms situated at the downstream end of the value chain experience more pronounced wage gains, highlighting the importance of value-chain positioning in capturing spillover benefits.

Based on these findings, several policy recommendations are proposed to maximise the positive impact of FDI on wage growth. Policymakers should strengthen the wage-guiding role of FDI by promoting collaborative R&D and deeper integration of supply chains between foreign and domestic firms, thereby reinforcing backward vertical spillovers and enhancing domestic firms' capacity to absorb technology and translate it into higher wages. Additionally, FDI should be guided towards downstream segments and low-wage industries to optimise structural wage disparities. This could involve differentiated tax incentives and financing support to encourage technology-intensive FDI to enter local enterprises at the lower end of the value chain or with relatively low wages, achieving dynamic optimisation of wage structures and regional balance. Furthermore, mechanisms to enhance local firms' productivity should be strengthened through comprehensive measures such as workforce training, technology transfer, and managerial upgrading, thereby increasing total factor productivity and reinforcing the positive linkage between FDI spillovers and wage growth.

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