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Analyses of topical policy issues

Covid-19 pandemic, firms’ responses, and unemployment in the ASEAN-5

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ARTICLE INFO

Article history:
Received 8 August 2022
Received in revised form 24 August 2022
Accepted 25 August 2022
Available online 1 September 2022

JEL classification:
D22
L2
L6
L8

Keywords:
Covid-19 pandemic
Firms’ response
Employment
Cost adjustments

ABSTRACT

Numerous studies have explored the impact of the Covid-19 pandemic on firms’ financial performance, but the link between such performance and employment has rarely been estimated rigorously. Using the ASEAN-5 firms’ data from Q1-2018 to Q3-2021, this study shows how the pandemic affects firms’ revenue, cost, profitability, and employment heterogeneously across countries. It is argued that while revenue losses are the main challenge, widespread and prolonged restrictions in some countries have created extra complications in idle inventories and labour. In response to the revenue shocks, firms reduce their employment with an elasticity of around 0.10, indicating that a 10 per cent revenue decline is associated with a 1 per cent headcount reduction in the short run. A further examination using event analyses reveals that the path of labour adjustment is diverse across countries and industries, reflecting the degree of pandemic severity and countries’ structural issues.

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1. Introduction

This study investigates the heterogeneous impact of the Covid-19 pandemic on firms’ performance and employment in ASEAN-5 countries around two years after the outbreak, hypothesising that different level of restriction affects firms’ performances differently. Not only across countries, but we also investigate how different the impact is among sectors which we classify into contact-intensive (CI) and non-contact-intensive (non-CI). In addition, as the restrictions vary over time, we illustrate the evolution of firms’ performance, mainly revenue, cost of production, profit, and employment. The impact of revenue on employment and its path over time are also investigated.

Compared to the previous works on the Covid–19 pandemic and firms’ performance, this study offers added value by using the listed firms’ data to link revenue to employment. Following the pandemic outbreak in Q1-2020, various studies have tried to provide an immediate empirical assessment of the pandemic’s impact using firms’ financial market data. Their objective is to see the market sentiment and the stock price fluctuation across industries after the virus spread and the government-imposed restrictions, see Baker et al. (2020a,b), Topcu and Gulal (2020), He et al. (2020a,b), Narayan et al. (2021). Later studies using financial firms’ performance data tried to estimate the impact of the pandemic on firms’ performance, especially their profit and liquidity (see e.g. Shen et al., 2020 and Hu and Zhang, 2021). This study is similar to the latter in using listed firms’ data, but we further investigate how the pandemic affects firms’ revenue, cost adjustments, profit, and employment. In these areas, the objective of this study is more similar to the works of Chetty et al. (2020), Bloom et al. (2021), Bartik et al. (2020a,b) and some survey-based analyses conducted by multilateral institutions such as...
the World Bank and ILO in estimating the impact of the pandemic to employment. Differently, we estimate the revenue impact on employment carefully under the strict and weakly exogeneity assumption using the fixed effect (FE) and the generalised method of moments (GMM) and the path of the impact using the multi-period difference in difference (DiD).

Unlike the literature that uses a short period of data, this study utilises data from Q1-2018 to Q3-2021 to illustrate the evolution of the Covid impact on firms’ performance over time. Studies by Chetty et al. (2020a,b) and Bartik et al. (2020a,b) investigate the impact of the pandemic on firms’ performance and link it to the public policy issues such as employment in the first year of the pandemic. These studies guide the policymakers to prescribe an immediate response to mitigate the impact of the pandemic on the economy using high-frequency or quick survey data. Meanwhile, some multilateral organisations such as World Bank, ILO, and ADB try to investigate the impact of the pandemic on the labour market across country by conducting surveys. Due to the country’s heterogeneities, one of their challenges is dealing with different respondents’ distribution and survey periods (e.g. Kamis, 2021). We complement these analyses by using standardised format data across countries in a more extended period to show how the pandemic affects employment during different waves of the outbreak.

We try to answer two main questions in this study. The first main question is how firms in the ASEAN-5 perform during the pandemic. We use the fixed effect (FE) approach to see the impact of the pandemic on firms’ indicators, including revenue, production cost, profitability, and employment, both in the headcount and income per worker. FE is appropriate as our goal is to see the firms’ performance as a function of time during the pandemic while time is exogenous. To distinguish the impact among sectors without overwhelming the analyses, we follow the framework of Guerrieri et al. (2022) to see the heterogeneous impact in contact-intensive and non-contact intensive sectors.

The second question is how firms’ revenue affects employment. We use three approaches to answer this question to ensure the robustness of the estimation. The first approach is the two-way fixed effect (TWFE) which eliminates the unobserved heterogeneity after ensuring that the strictly exogenous assumption is satisfied. To ensure that the result is robust from reverse causality bias, we apply the GMM method as the second approach. Lastly, an event analysis based on the multi-periods difference-in-difference (DiD) that we use also shows a similar conclusion with additional information on the path of the impact. In addition to these two primary analyses, we also discuss the evolution of the Covid cases, government restrictions, and mobility restrictions in the ASEAN-5.

We offer two notable findings. First, the impact of the Covid-19 pandemic is heterogeneous across countries, where a higher degree of restriction is associated with a more significant drop in revenue. However, a deeper examination suggests that when restrictions are imposed selectively, such as in Malaysia, Vietnam, and Thailand, the firms’ performance is better in terms of lower revenue decline and faster inventory and labour costs adjustment.\footnote{Malaysia, Thailand, and Vietnam relaxed their lockdown in June 2020, allowing most businesses in CI and non-CI industries to operate. Vietnam imposed epicentre-focused lockdowns rather than widespread ones during the pandemic. We discuss the restriction implementation across ASEAN-5 in Section 5.} In contrast, the extensive and prolonged restrictions in the Philippines and Indonesia cause a double shock: abrupt revenue drop and surging costs. In both countries, the inventory-to-revenue ratios were consistently above their average pre-pandemic level as firms could not sell their product stocks. The revenue drop and firms’ inability to adjust their costs are associated with higher levels of unemployment during the pandemic.

Second, the drop in revenue affects the firm’s decision to lay off employees. Every 10% increase (decrease) in firms revenue translates into around a 1% increase (decrease) in the number of workers contemporaneously. We do not find sufficient evidence that the short-run impact of revenue on employment is different across country and sector, indicating that firms’ employment decision is driven by their revenue changes. However, our event studies show that the paths of labour adjustment during the pandemic are heterogeneous across countries and industries in response to the revenue changes, reflecting the different degrees of restriction and labour market flexibility. In Indonesia, the labour reduction is slower, especially among the contact-intensive sectors, starting from one quarter after the shock and continuing until three quarters. In contrast, the adjustment in Vietnam began at the same time but was completed faster. We argue that Indonesia’s more stringent hiring and firing regulation contributes to the slower adjustment.\footnote{Since Q1-2021, the Indonesian government has relaxed labour regulations, including hiring and firing. The result here shows the rigidity before the deregulation.}

This study contributes to the literature by first providing insights into the heterogeneous impacts of the Covid pandemic on firms’ performance and the firms’ employment sensitivity on revenue. The first heterogeneity comes from the different industries and countries, while the second one is from the evolution of the pandemic impact over time. Secondly, we show how firms utilise the intensive and extensive margin in employment decisions. The extensive margin utilised by the firms is then generalised in the employment elasticity of revenue and the impact path.

The remainder of this paper is organised as follows. Section 2 summarises previous relevant studies on the impact of Covid on firms’ performance and employment. Section 3 explains the theoretical framework and the empirical strategy, followed by the data descriptions in Section 4. Section 5 discusses the results, and Section 6 concludes with some caveats.

### 2. Previous studies

As governments worldwide impose restrictions differently across industries in their countries, there is a high degree of heterogeneity of the Covid-19 pandemic’s impact on the real economy. An early study by Koren and Petó (2020) models...
the highly interaction-intensive industries based on the communication nature between workers and their coworkers, workers with customers, and the physical presence requirement in the workplace. They projected that the pandemic would primarily hit the retail trade, accommodation and food services, art, entertainment and recreation, other services, and educational services. Another early simulation conducted by Barrot et al. (2020) based on the French government restriction projected that the impact of the restriction is concentrated on hotels & restaurants, art and leisure, wholesale and retail, and social work. Comparing their sectoral shock model with the insurance claims data in New York state, Danieli and Olmstead-Rumsey (2020) illustrate that the sector with the most significant unemployment claims is from the accommodation and food, retail trade, and construction & utilities. Their model shares similarities with Guerrieri et al. (2022), which we use as the theoretical framework for multi-sector approaches. Magistretti and Pugacheva (2021) qualitatively classify the affected sectors based on the impact on demand and supply collapse and show that those hit worst by the pandemic suffered from the collapse in both supply and demand, such as hotels & restaurants, transportation, and traditional retailers.

Evidence from empirical studies shows that the pandemic impact is heterogeneous across and within industries, with size, location, and product deliverance being the contributing factors, among other things. Using the high-frequency data from the payment system, small business survey, and payroll data in the US, Chetty et al. (2020) show that business spending dropped by 25% on average, with a higher decline amounted to almost 100% in barbers/beauty shops and airlines and below 75% for restaurants. Differently, Bartik et al. (2020a,b) estimate the impact of Covid based on small business closures during March–April 2020, with personal services, arts and entertainment, tourism/lodging, and restaurant/bar being the top four sectors with the highest probability of closure. The average incidence of closure is 45%. A later study by Bloom et al. (2021) with a longer data span produces similar estimates to Chetty et al. (2020): around 29% revenue decline over Q2 and Q3-2020. They report that firms at the 25th percentile lost 60% of their sales, while those at the 75% percentile were not impacted. They further show that the online platform has helped firms reduce their revenue loss: online-dominated businesses lost 6.6% of their revenue while the offline-dominated platform lost their revenue by around 18.4%. It aligns with Chetty et al. (2020), who show that household online spending increased by around 37%. Further, Chetty et al. (2020) also show that geographic dispersion exists as Covid spreads differently across the region.

Beyond the border, the variation of the pandemic impact is observable across countries as the spread of the virus, the degree of the government restriction, and the supply shock vary. Based on the World Bank survey in 51 countries, Apedo-Amah et al. (2020) show that business sales dropped by around 49%, heterogeneous across industries, countries, and times globally. In line with the studies in the US above, industries with the most significant loss in revenue are tourism-related businesses such as accommodation and food and beverages services. Geographically, the countries that suffered more are South Africa, Bangladesh, Sri Lanka, Tunisia, and Nepal, while among ASEAN-5 countries, firms’ revenue in the Philippines, Indonesia, and Vietnam dropped by 57%, 48%, and 37%. Across time the most significant drop occurs just after the peak of the cases, at an average of around 79%.

Further, their report reveals that country, industry, and size contribute to 20% of the impact variation, while the rest, 80%, is attributed to unobservable factors such as management capability. A potential source of heterogeneity is supply chain disruption, as documented by AmCham Indonesia and ERIA (2020) and Oikawa et al. (2021). They show that a significant portion of firms in Southeast Asia and India experienced slight to significant disruptions in their supply chain, primarily because of the difficulties in obtaining inputs from local or import markets.

In addition, firms also suffer from per-unit cost increases, so they must adjust their production factors such as employment, investment, and product prices. Using firms’ survey data from the UK, Bloom et al. (2022) illustrate that as sales fall by more than 30%, UK firms reduce their working hours by more than 40%, followed by reductions in investments by more than 35%, while the reduction in employment is slight at around 5% started from Q2-2020 and lasted until Q1-2021. On the employment side, the picture aligns with Apedo-Amah et al. (2020). They show that firms utilise intensive margins such as granting leaves, reducing working hours and wages, and laying off workers as the first coping strategy to cope with the pandemic. While 19% of firms lay off workers, only 7% use headcount reductions as the only strategy to deal with the pandemic. Using the available layoff data, they then estimate that the firms’ employment elasticity of revenue is around 8%. However, they do not discuss the heterogeneity of the elasticity and the endogeneity between revenue and employment.

Studies on the effect of the pandemic on employment come with different results. Bartik et al. (2020a,b) show that significant layoff has happened in the US just a few weeks after the business closure, reducing full-time and part-time employment by around 17% and 34%, respectively. Compared with other estimates from Altig et al. (2020), which show a 10% decline in employment. Bartik et al. (2020a,b) argue that their numbers are higher because they cover small and new firms. Employment heterogeneity also exists among low and high-wages workers, as Chetty et al. (2020) documented. They show that the pandemic affects low-wage workers more than high-wage workers because they primarily work in the high-contact intensive sectors affected by the pandemic. This result is in line with a study by Heathcote et al. (2010), who find that low-skilled workers’ incomes are typically more sensitive to business cycle fluctuations, leading them to conclude that income inequality tends to rise in recessions. Meanwhile, cross-country heterogeneity in unemployment is

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3 They refer to Hall (2005) to show that firing employees are not the firms’ immediate response in dealing with adverse shock.

4 The number is from businesses that are still operating. The magnitude is higher when the sample includes firms no longer operating: 57% reduction in part-time employment and 32% in full-time employment or 39% overall.
reported by Khamis et al. (2021) based on the World Bank’s High-Frequency Phone Survey (HFPS) conducted after the outbreak of the pandemic (April 2020) from 39 countries with a conclusion that the pandemic has created job losses at an average of 34%.

In most cases, the real impact of Covid-19 on the labour market is transmitted through the workers’ income drop as the working hours decline, whereas reductions in the number of employees are a less critical channel. Based on Khamis et al. (2021), although the number of workers in ASEAN-5 countries such as Indonesia and Vietnam who stopped working was 23% and 3%, the portion of workers who experienced significant income declines amounts to 57% in Indonesia and 12% in Vietnam. The “missing hours” of work and layoffs are comparable to the US case as reported by Bartik et al. (2020a,b) but different from the ILO estimates as reported by Viegelahn and Huynh (2021), who show that in ASEAN, the working hours fell by 8.4% in 2020 and 7.4% in 2021. The reduction caused an income loss of around 7.8% in 2020 and 5.7% in 2021.

The figures from Viegelahn and Huynh (2021) are not precisely comparable to the ones from Khamis et al. (2021), as the former measure the impact for the whole year, while the latter shows the figure in April 2020, when the pandemic hit the worst. The other country, such as the Philippines, recorded the highest number of hours reduction, 13.6%, while the figure for Thailand is slightly above 4%. Viegelahn and Huynh (2021) argue that the heterogeneous impact across countries depends on the pandemic management, government restrictions, and the country’s economic structure. Countries with a large share of workers in agriculture suffer less as this sector is less contact-intensive and less restricted by the lockdown.

Countries’ different labour regulations in the ASEAN-5 also potentially affect the firms’ firing behaviour during an adverse shock, with a higher level of employment protection associated with higher firing costs and slower adjustments. Such a pattern has been extensively studied, for example, by Sims et al. (1974), Rosen and Nadiri (1974), Epstein and Denny (1983), and Saphiro (2007) using the US data. A later study by Bentolila and Saint-Paul (1994) provides a theoretical framework relating the hiring and firing cost with labour adjustment that was empirically tested, for example, by Holden and Wulfsberg (2008) and Banker et al. (2013).

Consequently, labour adjustment during a recession is less likely to be instantaneous, leading to labour hoarding, which might be beneficial in smoothing out unemployment but potentially sacrifice the productivity necessary for long-term growth. Möller (2010) shows that firms in Germany hoard labour during the post-GFC period to anticipate future demands as hiring and firing in the country is costly. Möller argues that it explains why the unemployment in Germany during GFC is low compared to other OECD countries. However, although labour hoarding might help firms keep their productivity level in the short run, Van den bosch and Vanormelingen (2022) find that labour hoarding does not improve firms’ long-term productivity based on the Belgian data. They also show that labour hoarding is more likely to be done by firms in service industries that generally have higher productivity than those in the manufacturing industries.⁵

3. Theoretical framework & empirical strategy

3.1. Theoretical framework

We adopt the theoretical framework proposed by Guerrieri et al. (2022) to support our analyses. There are at least three features of their work that we highlight here due to their relevance to our study. First, the supply shock in the contact-intensive sector (Sector A) causes the decline of aggregate demand, a phenomenon Guerrieri et al. (2022) call Keynesian supply shock (KSS). The supply shock in Sector A propagates to the non-restricted sector (Sector B) due to the intertemporal elasticity of consumption, the consumption elasticity between two sectors, and the financial constraints. Second, assuming the complete lockdown is implemented, the workers’ income decline in sector A affects employment and product demand in Sector B as some workers face financial constraints to support their consumption. When a partial lockdown is implemented, the demand for Sector B products can decline further if the price of products from Sector A increases. Third, involuntary unemployment increases as the lockdown in Sector A create inactive firms in Sector B, a phenomenon that Guerrieri et al. (2022) refer to as a business exit multiplier.

Regarding the first feature above, when full restrictions are imposed, the workers’ income in Sector A is zero, \( n_B = Y_B = 0 \), reducing their demand for the product from Sector B. As wages are rigid and the nominal rates are unchanged, the demand decline will induce involuntary unemployment in sector B. The magnitude depends on the intertemporal elasticity of substitution (\( \sigma \)), the elasticity of substitution between two sectors (\( \epsilon \)), the share of workers in the restricted sector (\( \varnothing \)) and the share of the constrained group (\( \mu \)). The relationship among the parameter is illustrated in Proposition 4 of Guerrieri et al. (2022), p. 1451, which we rewrite in Eq. (1) below.

\[
n_B = \frac{Y_B}{Y^*_B} = (1 - \mu \varnothing) (1 - \varnothing)^{\frac{\sigma - 1}{\epsilon}} < 1
\]

Where \( n_B \) is the employment in sector B; \( Y_B \) is aggregate demand in sector B at \( t = 0 \); \( Y^*_B \) is the potential consumption of product from sector B; \( \mu \) is the share of workers who are financially constrained⁶; \( \varnothing \) is the share of workers in Sector A (restricted sector); \( \sigma \) is the intertemporal elasticity of consumption; \( \epsilon \) is the consumption elasticity between two sectors.

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⁵ Further, they argue that the service industries capable of hoarding labour during a recession might not need the government incentives to retain labour.

⁶ A family is financially constrained if they have no financial access to support their consumption when their income is gone or declined.
If the intertemporal elasticity of substitution is equal to the elasticity between two sectors, or $\sigma = \epsilon$, and market is complete ($\mu = 0$), the aggregate demand in sector $B$ is unaffected, and the number of workers in sector $B$ is unchanged, $n_{B0} = 1$. The aggregate demand in the economy $\frac{Y_{B0}}{P_0}$ is then equal to 1. In this case, Sector $B$ has no excess demand, demand shortage, or involuntary unemployment. In a complete market ($\mu = 0$), the Keynesian supply shock happens if the intertemporal elasticity of consumption is higher than the consumption elasticity between two sectors, or $\sigma > \epsilon$. Consequently, the interest rate should be lowered to boost demand, as described in Proposition 1 in Guerrieri et al. (2022), p. 1445.\(^7\) When financial constraints exist ($\mu = 1$), the Keynesian supply shock can happen even if $\sigma < \epsilon$, but applied in the case when the intertemporal elasticity of consumption ($\sigma$) and consumption elasticity between two goods ($\epsilon$) are both above 1, satisfy the Proposition 3 in Guerrieri et al. (2022), p. 1450.\(^8\)

Further, Guerrieri et al. (2022) also show that even a partial lockdown in Sector $A$ will reduce the aggregate demand in Sector $B$ through the price, financial constraint, and income channel. The analyses impose additional assumptions: (i) the price of product $A$ increases to be above their steady-state level, $P_{B0} > W^*$, and (ii) the price of product $B$ remains unchanged $P_{B0} = W^*$. Under these assumptions, a partial lockdown will reduce the number of workers in Sector $A$ to $n_{B0} = 1 - \delta$, while the number of workers in Sector $B$ will be less than the equilibrium level, $n_{B0} < 1$. The aggregate demand in Sector $B$ follows Eq. (2) which is part of equation 16 in Guerrieri et al. (2022).

$$Y_{B0} = (1 - \varnothing)(\frac{W^*}{P_0})^{-\sigma}(\mu\Phi W^* P_0 (1 - \delta) + (1 - \mu\Phi)(\frac{P_0}{W^*})^{-\sigma})$$

Where $Y_{B0}$ is aggregate demand in sector $B$ at $t = 0$; $\varnothing$ is the share of workers in Sector $A$; $W^*$ is the wage at the steady-state, which is rigid, so $W^* = W_{B0} = W_0 = 1$ at $t = 0$; $P_0$ is CPI at $t = 0$; $\delta$ is the level of restriction; $\mu$ is the share of workers who are financially constrained.

In the case of partial lockdowns, the KSS is possible even if $\sigma < 1$ and $\epsilon < 1$, but the relationship between the two should satisfy Proposition 5 in Guerrieri et al. (2022), p. 1455.\(^9\) Based on (2), the aggregate demand in Sector $B$ will decline depending on some factors. First, the decline in Sector $B$ will be higher as the share of labour in the restricted sector ($\varnothing$) is higher, which will cause a higher income decline from Sector $A$. Second, the aggregate demand from Sector $B$ will decrease if the partial lockdown in Sector $A$ increases the price ($\frac{W^*}{P_0}$). Third, the other factors contributing to the output and employment decline are the degree of restriction ($\delta$) and level of financial constraint ($\mu$).

The third feature of Guerrieri et al. (2022) that we use to support our analyses is the business exit multiplier that they describe in their equation (28) and (29). They show that output and income declines in sector $A$ cause a demand decline in Sector $B$. The output reduction in Sector $B$ increases the number of inactive firms, from firms that directly suffer from the shutdown in Sector $A$, $1 - \varnothing$, to $1 - \Phi$, which includes inactive firms due to demand declines in Sector $B$. Further, as workers’ income from inactive firms declines, their demand for the product from the unrestricted sector, $\frac{Y_{B0}}{Y^*_B}$, declines.

We rewrite the relationship into Eqs. (3) and (4) below.

$$1 - \Phi = (1 - \varnothing)F(\frac{Y_{B0}}{Y^*_B})$$

$$\frac{Y_{B0}}{Y^*_B} = (1 - \Phi)^{\frac{\varnothing - \mu}{\varnothing - 1}}(1 - w\mu\Phi)$$

Where $\Phi$ is the number of inactive firms; $\Phi = \varnothing$, if shutdown in Sector $A$ does not creates inactive firms in Sector $B$, but here $\Phi$ is endogenous; $w$ is real wages.

Due to the business exit multiplier, the output declines and the number of inactive firms will increase unemployment. From (3) and (4), we can see that the endogenous relationship is determined by the share of workers in the restricted sector ($\varnothing$), the level of financial constraints ($\mu$), the real wages ($w$), the intertemporal elasticity of consumption ($\sigma$), and the consumption elasticity between two sectors ($\epsilon$).

3.2. Identification and empirical strategy

3.2.1. Identification

In this study, we investigate the impact of the Covid-19 pandemic on firms’ performance in ASEAN-5 countries and how firms’ adjustment affects their employment. We divide the analyses into three parts, each addressing a different question. First, how do the pandemic and the restrictions evolve in ASEAN-5 countries and affect economic activities? Second, how does the Covid pandemic affect firms’ performance in the contact-intensives and non-contact intensives sectors? Third, how does revenue decline impact firms’ employment?

Our identification is motivated by the theoretical framework developed by Guerrieri et al. (2022), which shows that shock in the unrestricted sector will propagate to the unrestricted sector because of the intertemporal elasticity of

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\(^7\) Interest rate affects the decision to consume now or later

\(^8\) Or intuitively shown in Fig. 3 in Guerrieri et al. (2022), p. 1451.

\(^9\) As shown in Figure 5 in Guerrieri et al. (2022), p. 1455
substitution ($\sigma$), the elasticity between two sectors ($\epsilon$), the market incompleteness ($\mu$) and the price changes ($\frac{w^*}{p_0}$). The magnitude of the shock and its propagation will also depend on whether the restriction is fully ($\varnothing$) or partially implemented ($\delta$). Assuming that the elasticities ($\sigma, \epsilon, \mu$) and the financial constraint ($\mu$) are constant in every country, then the degree of restriction ($\varnothing, \delta$) and the price level ($\frac{w^*}{p_0}$) will affect output in the unrestricted sector and eventually decline the labour demand as simplified in Eq. (5).

$$n_{B0} = F(Y_{B0}|Y_{A0}) = F(\varnothing, \delta, \frac{W^*}{p_0})$$

We use the proposition in Guerrieri et al. (2022) as a framework to compare the performance of the restricted (contact-intensive or Sector A) and the unrestricted firm (non-contact-intensives or Sector B). We expect $Y_{A0}, Y_{B0}$ and $N_{A0}, N_{B0}$. Further, their propositions also motivate us to compare the firms’ performance across countries where the degrees of restriction are different. In the implementation, we use the country classification to reflect the degree of restrictions ($\delta$).

The propositions from Guerrieri et al. (2022) that we simplify in Eq. (5) above are consistent with the micro foundation. Following Bond and Van Reneen (2007), we consider a firm’s production function with constant elasticity of the substitution (CES) as follows:

$$Y_t = F(K_t, L_t) = (a_t K_t^\sigma + a_t L_t^{1-\sigma})^{\frac{1}{\sigma}}$$

Where $\sigma = \frac{\epsilon}{\sigma - 1}$ and $\sigma$ is the elasticity of substitution between capital and labour.

Under the assumption that there is some degree of monopolistic competition and the firm faces a downward sloping demand curve, a firm’s employment can be stated as a function of its revenue as follow:

$$\ln L_t = \sigma \ln a_t \left( 1 - \frac{1}{\eta^P} \right) + \ln Y_t - \sigma \ln \left( \frac{w}{p} \right)$$

Where $L_t$ is employment; $a_t$ is the share of labour in the production function; $\eta^P$ is the price elasticity of product demand; $Y_t$ is firms revenue; $w/p$ is the real wage.

Assuming that the elasticities are constant, we can write employment as a function of revenue and prices or $L_t = F(Y_t, \frac{w}{p})$. We use Eq. (7) to estimate the impact of firms’ revenue on employment by regressing employment on the actual revenue after dealing with the endogeneity issue carefully following the empirical strategy discussed in Section 3.2.2.11

### 3.2.2. The empirical strategy to estimate the impact of the pandemic on firms’ performance

We address the first question qualitatively by utilising data from the Covid cases, government restrictions, and Google mobility. We discuss these factors to illustrate the restriction degree ($\delta$) that varies across countries. We expect the different degrees of restriction will affect firms’ financial performance in each country differently.

For the second question, we use event analyses utilising a two-way fixed effect following Eq. (8). As the degree of restriction is country-specific, we estimate the impact of the Covid pandemic on firms’ performance separately in each country. Further, we capture the evolution of the restriction as a function of time.

$$Y_{i,t} = a_t + \sum_{t \in T} \beta_{t} D_{i,t} + \sum_{q \in Q} \beta_{q} Q_{i,t} + u_{it}$$

Where, $Y_{i,t}$ is a vector of firms’ performance and the balance sheet, such as revenue, cost of goods sold, labour cost, inventory cost, profit, and the number of employees; $a_t$ is firm-specific fixed effect; $D_{i,t}$ is time fixed effect dummy variables with $T = \{2019q1, ..., 2021q3\}$; $Q_{i,t}$ defines quarter of the year, $Q = \{1, 2, 3, 4\}$; and $u_{it}$ is the unobservable. The firms’ performance indicators are measured in log.

As the time dummies included are for Q1-2019 to Q3-2021, while the estimations use all observations from Q1-2018 to Q3-2021, the $\beta_t$ represents the firms’ performance relative to their 2018 level. We include $Q_{i,t}$ to control for the seasonality but $\beta_q$ is not of our interest. Meanwhile, to control the price level to satisfy equations (5) and (7), we deflate firms’ financial performance by each country’s consumer price index (CPI). If firms’ performances in 2019 are not different from their 2018 level, or $\beta_t = 0$ for $T \in \{2019q1, \ldots, 2019q4\}$, then it will give us the confidence to conclude that $\beta_t$ for $T \in \{2020q1, \ldots, 2021q3\}$ reflects the impact of the pandemic.

### 3.2.3. The empirical strategy to estimate the impact of revenue on employment

To answer the third question on how revenue decline affects firms’ employment, we utilise FE, GMM, and multi-period DiD. This section discusses the exogeneity assumption to validate the use of the FE for the estimations. The following section discusses the identification and the empirical strategy using the multi-period DiD to see the path of the revenue impact on employment.

FE can eliminate omitted variable biases from time-invariant unobservables, but it is inappropriate to deal with the reverse causality bias (Angrist and Pischke, 2009). In other words, FE is suitable if the strict exogeneity assumption is

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10 We include the detailed exposition in the Appendix

11 The actual (real) revenue is nominal revenue deflated by each country’s CPI.
satisfied. To test the exogeneity assumption, we apply the approach suggested by Wooldridge (2002, Chapter 10) by regressing the dependent variable on the explanatory variable and its lead variable.

We also argue that based on the nature of the shock during the pandemic, the strictly exogenous assumption of revenue on employment is satisfactory as the mobility restriction reduces firms’ revenue which is then translated to employment. Particularly, the causal direction between revenue on employment is single-directional from revenue to employment and not bidirectional as it usually happens during a normal period. Later, in the result, we show that the exogenous assumption is satisfied when we only use the pandemic data from Q1-2020 to Q3-2021 but not satisfied when the data from Q1-2018 to Q3-2021 is used.

Given the exogeneity of the revenue, we apply FE estimations using Eq. (9) for the data from Q1-2020 to Q3-2021.

\[
EmpF_{i,t} = a_i + \beta_t \cdot Rev_{i,t} + \sum_{t \in T} \beta_t \cdot D_{i,t} + u_{it}
\]

(9)

Where, \( EmpF_{i,t} \) is the natural log of the number of full-time employees of firm \( i \) at quarter \( t \); \( a_i \) is firm-specific fixed effect; \( Rev_{i,t} \) is the log of the number of full-time employees; \( D_{i,t} \) is time dummy variables with \( T = \{2020q1,...,2021q3\} \).

Based on Eqs. (5) and (7), \( \beta_t \) is unbiased if the \( E(Y_{i,t}, u_{it}) = 0 \), or if the omitted variables bias and the reverse causality have been carefully considered. We also conduct an estimation when \( T = \{2018q1,...,2021q3\} \) to test the exogeneity assumption.

To ensure the robustness of the FE estimation, especially from the reverse causality problem, we also utilise the generalised method of moments (GMM) approach. As shown in the result section, the coefficient from the FE and the GMM estimations are similar. We implement the GMM estimations by regressing the number of employees on its lag. Eq. (10) represents the GMM estimation equation.

\[
EmpF_{i,t} = a_i + \gamma_1 EmpF_{i,t-1} + \beta_1 Rev_{i,t} + \sum_{s=2}^{T} \delta_s d_{i,t}^s + \epsilon_{i,t}
\]

(10)

Where \( EmpF \) is the number of full-time employees (ln); \( Rev \) is the real value of revenue (ln); \( d_{i,t}^s \) are time dummies with \( s \in \{2, 3, ..., T\} \) represents the quarter from 2018q2–2021q3; and \( \epsilon_{i,t} \) are disturbances. Unlike the FE estimation, we use the whole observation (2018–2021) for the GMM estimation.

The regressor \( Rev_{i,t} \) is treated as endogenous if \( E(Rev_{i,t}, \epsilon_{i,t}) \neq 0 \) for \( t = 2, 3, ..., 21 \), and as predetermined if \( E(EmpF_{i,t}, \epsilon_{i,t}) \neq 0 \) for \( t = 1, 2, ..., 21 \). We follow Kiviet (2020) and Kripfganz (2020) to choose the appropriate model specification and Windmeijer (2021) to test the predictability power of instruments that justify their validity.\(^{12}\)

3.2.4. The identification and empirical strategy for the path of revenue impact on employment

As the degree of the restriction varies over time, there is a potential heterogeneity in the revenue impact on employment. To analyse the path of the revenue impact on employment, we implement event analyses based on the multi-period difference in difference (DiD) proposed by Callaway and Sant’Anna (2021). The approach implementation requires an intervention that classifies the samples into treated and control groups based on the identification we discuss later in this section.

As revenue impacts on firms’ employment are likely to be heterogeneous over time, using a standard two-way fixed effect in a staggered setting potentially creates bias. Ideally, the causal inference is based on the outcome of the treated and never-treated groups. However, the staggered treatment creates heterogeneous observation groups such as never-treated, not-yet-treated–but-eventually-treated, and already-treated. The standard two-way fixed effect (TWFE) will create a bias if the treated unit in time \( t+2 \), for example, is compared to the already-treated group in time \( t \). We follow Borusyak and Jaravel (2017), De Chaisemartin and d’Haultfoeuille (2020), Goodman-Bacon (2021), and Sun and Abraham (2021).

The multi-period DiD can estimate group-specific average treatment effect on the treated \( ATT(g,t) \) in time \( t \) for the specific group treated at \( g \). The counterfactual is the group that never received treatment. The impact is specified as follows:

\[
ATT(g,t) = E[Y_t(1) - Y_t(0) | G_g = 1]
\]

(11)

Where \( Y_t(1) \) is the outcome variable at time \( t \) for treated units, \( Y_t(0) \) is the outcome of the units if they had not been treated, and \( G_g \) is the dummy variable equal to 1 if the unit is treated since time \( g \). As \( Y_t(0) \) is not observable after period \( g \), the DiD approach uses the never-treated group to construct the counterfactual (C). In this study, \( Y_t(1) \) refers to the number of full-time employees (ln) of the treated.

Under the assumption that the parallel trend holds, Callaway and Sant’Anna (2021) show that:

\[
ATT(g,t) = E[Y_t - Y_{g-1} | G_g = 1] - E[Y_t - Y_{g-1} | C = 1]
\]

(12)

\(^{12}\) We run the under-identification test using the code developed by Schaffer and Windmeijer (2020).
The first term on the right-hand side refers to the difference before and after the treatment for the treated (first difference), while the second term refers to the control group’s difference in the two periods (second difference).

\[
Firms = \begin{cases} 
1 \quad & \text{Treated}, \, rev_{t+1} < 0.9 \times \text{median} (rev_{t-1}) \\
0 \quad & \text{Control}, \, rev_{t+1} > 0.9 \times \text{median} (rev_{t-1})
\end{cases}
\]  

(13)

We classify firms into treated and control groups based on their revenues following identification in Eq. (13). The control group includes firms whose revenues during the pandemic (Q1-2020 to Q3-2021) consistently do not fall below 90% of their average pre-pandemic level (Q1-2018 to Q4-2019). Meanwhile, the treated group comprises firms whose revenue during the pandemic were below 90% of their average pre-pandemic level. With this classification, we expect negative coefficients, which reflect the lower employment rate of the treated from the control group.

We acknowledge that the result is likely sensitive to the threshold level. To illustrate, a firm whose revenue during the pandemic is 89% below its average pre-pandemic level potentially has no different employment than those whose revenues during the pandemic are 91% below its average pre-pandemic level. As an alternative, we also compare the employment between firms whose post revenues are above 90% of their pre-pandemic revenue (control) and those whose revenues are below 80% of the pre-pandemic level revenue (treated). We will show that our result is not sensitive to the threshold used.

A DiD estimation is valid if it satisfies some criteria such as (1) parallel trend, (2) irreversibility, (3) randomly drawn population, and (4) limited treatment anticipation if the impact horizon is known (Callaway and Sant’Anna, 2021). The first argument assumes that the employment between the treated and the control would have been the same without revenue growth difference. However, this assumption is partly testable in such a way that we can only provide evidence that before the pandemic, the employment trend between the two is not significantly different.\(^\text{13}\)

To satisfy the irreversibility criteria, we only use samples whose performance during the pandemic is always above the threshold for the control and consistently below the threshold for the treated group. This treatment leads to a comparison between persistently good performers and persistently bad performers. For assumption number (3), we argue that the total sample is large enough. Using the Q1-2018 to Q4-2020 observations, the number of the treated firm is 569, while that of the control group is 983. We acknowledge that the result might not be representative when we disaggregate the analyses by country and sector as the number of observations is limited. For criteria (4), the robustness test of multi-period DiD is different from the canonical DiD with a 2 × 2 setup. The placebo test potentially produces a significant estimate if the impact of treatment lasts for more than 1 period.

4. Data

To estimate the impact of the Covid pandemic on firms’ performance in ASEAN-5 countries, we use the listed firm’s data from Refinitiv Eikon (2022a,b).\(^\text{14}\) The total number of the listed firms in the regions available from the data provider is around 4,500. For the primary analyses and to follow the framework of Guerrieri et al. (2022), we classify firms into contact-intensives (CI) and non-contact-intensives (non-CI) sectors. The classification into CI and non-CI is defined based on the contact intensity between customer and product provider. This sector includes hotels, restaurants, recreation, retailers, and transportation industries (see Table 1). During the lockdown, these sectors are the most restricted and hence experience a significant decline in their revenue. Our CI classification is aligned with previous studies discussed in Section 2 and also with the study based on the probability of default, such as one by S & P Intelligence.\(^\text{15}\)

For non-contact intensives sectors (non-CI), we include firms in basic materials, industrial, cyclical consumer, and non-cyclical consumer industries. In addition to CI and non-CI groups, we create different groups: energy, utilities, technology, healthcare (EUTH) and real estate. The exclusion of EUTH from CI and non-CI is due to the sector’s different behaviour during Covid-19. We compare the performance between CI and non-CI to show the difference in performance between sectors, but we use firm data from all sectors to estimate the impact of revenue on employment.

To avoid the result across time being affected by the missing observations, we only keep the information from the firms with complete revenue data. We use revenue as an anchor because some indicators are standardised to revenue (see Table 2 for variable definition) to reduce the measurement bias from different currencies used. The omission of the firm with missing revenue data dropped the observation to 2,493 firms with the sample distribution is shown in Fig. 1 Panels a and b. To ease the interpretation of the pandemic impacts on firms’ performances, we convert firms’ indicators into logarithmic forms. The data descriptive is presented in Table 3.

\(^\text{13}\) We run the estimation using code developed by Rios-Avila et al. (2021) that also provides the pre-trend test, aggregate impact, and heterogeneous impact over time.

\(^\text{14}\) Eikon is a financial information product provided by Refinitiv, an American–British global financial data provider. Eikon was launched by Thomson Reuters in 2010 and transferred to Refinitiv in 2018. Refinitiv-Eikon market share is the second largest after Bloomberg based on Burton-Taylor International Consulting 2020 Financial Market Data Report.

\(^\text{15}\) https://www.spglobal.com/marketintelligence/en/news-insights/blog/industries-most-and-least-impacted-by-covid19-from-a-probability-of-default-perspective
Table 1
Classification into contact intensive (CI) and non-contact-intensives (non-CI).

| Economic sector | Contact Intensive (CI) | Non-contact-intensive (Non-CI) | EUTH (Energy, Utilities, Technology, Healthcare) |
|-----------------|-----------------------|---------------------------------|--------------------------------------------------|
| 50 – Energy     | ■ Renewables          | ■ Non-renewables                |                                                  |
| 51 – Basic material | ■ Chemicals        | ■ Mineral resources             |■ Paper & wood product                          |
| 52 – Industrials | ■ Passenger transportation services | ■ Manufacturing products, e.g., machines |■ Construction & engineering Freight & logistics transportation |
| 53 – Consumer cyclical | ■ Hotels, restaurants, casino | ■ Textiles, apparel, & footwear |■ Homebuilding |■ Household appliances |
| 54 – Consumer non-cyclical | ■ Food, beverages, tobacco |■ Personal HH products |■ Food & drug retailers |
| 56 – Healthcare | ■ Healthcare equipment & supplies |■ Healthcare provider & services |■ Pharmaceutical |■ Biotechnology |
| 57 – Technology | ■ Technology equipment |■ Software & IT services |■ Telecommunication services |
| 58 – Utilities  | ■ Electric, gas, water |                                                  |                                                  |

*Based on The Refinitiv Business Classification (TRBC).

Table 2
Variable definition.

| No | Variables | Measurement |
|----|-----------|-------------|
| 1. | Revenue | Total receipt from goods and services sales after discounts, excise tax, sales returns, and allowances. |
| 2. | Cost of production or cost of revenue | The cost of revenue includes the total cost of goods and services, including material expenses, labour and related expenses, and other direct property and amortisation expenses. Measured relative to revenue: Cost of revenue = Cost of revenue Revenue |
| 3. | Labour cost | Labour and related expenses include expenses paid to employees in the form of salaries, wages, fees, benefits, or any other form of compensation. Measured relative to revenue: Labour cost = Labour cost Revenue |
| 4. | Inventory | Total inventory includes finished goods, work in progress, raw material, and other inventories for production. Measured relative to revenue: Total inventory = Total inventory |
| 5. | Net income before tax (NIBT) | Reported income after all operating and non-operating expenses before the deduction of income tax. |
| 6. | Total fixed assets | The difference between firms' total assets with their current assets. It includes assets such as land, property, plant, machines, equipment, and other long-term assets. |
| 7. | Total assets | It represents the total assets reported by a company. If not reported, it will be the sum of total current assets and non-current assets. |
| 8. | Full-time employees | Number of full-time employees at the end of the fiscal period (quarterly) |
| 9. | Return on assets | NIBT / Total Assets |

(continued on next page)
Table 2 (continued).

| No | Variables                        | Measurement                                                                                           |
|----|----------------------------------|--------------------------------------------------------------------------------------------------------|
| 10 | Income per workers               | It measures the total labour cost per employee. Due to the data availability, it is measured in:      |
|    |                                  |Labour cost                                                                                           |
|    |                                  | = No. of full time employees                                                                         |
| 11 | Days of inventories (DoI)        | Days firms take to convert inventories into sales                                                     |
|    |                                  | Average inventories                                                                                  |
|    |                                  | = Cost of revenue                                                                                    |
|    |                                  | Average inventories                                                                                  |
|    |                                  | = Inventories + 1.1.inventories                                                                       |
|    |                                  | = Average inventories × 365                                                                             |
| 12 | Capital intensity                | The level of firm capital intensity before the pandemic (Q1-2018 to Q4-2019)                          |
|    |                                  | = Total fixed asset (adjusted for CPI)                                                                 |
|    |                                  | = Total revenue (adjusted for CPI)                                                                    |

5. Results

Our qualitative and event analyses show that the impact of Covid-19 on firms’ performances in ASEAN-5 is heterogeneous, depending on the Covid case incidences, the degree of mobility restrictions, and the country’s structural issues. Although we do not formally test the causal impact of the government restriction on firms’ performance, we show that the restriction levels are highly correlated with community mobility and firms’ revenue, especially in 2020. In a country where the restrictions are tight and prolonged such as in the Philippines, firms suffer more as they lose their flexibility to anticipate the sudden revenue loss and the surging cost. As their revenues drop while their cost relative to revenue increases, firms eventually reduce the labour cost by cutting the working hours and the number of employees, affecting the workers’ income and headcount employment. Our event study shows a lagging employment adjustment, especially in a country with tighter labour regulations.

5.1. Covid, mobility restriction, and firms performance

Since the first Covid cases were identified in early 2020, the spread has been heterogeneous among the ASEAN-5 countries, depending on each country’s approach. Fig. 2 (left panel) shows that after the outbreak in the first quarter of 2020, the virus was relatively contained until the end of the second quarter but began accelerating in the Philippines, Indonesia, and Malaysia in the next quarters. In contrast, Thailand and Vietnam were able to mitigate the spread of the virus, at least in 2020. In 2021, the next wave of the virus hit the region again, with the highest record in Malaysia, followed by Thailand and Vietnam in the third quarter of 2021.

In response to the outbreak, most ASEAN-5 countries initially imposed stringent lockdowns, which eventually became country-specific in the subsequent periods depending on the Covid cases and political and public views in the country, as discussed by Djalante et al. (2020). We present the level of restriction based on Oxford’s stringency index in Fig. 3 and

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The Covid case data is obtained from the Our World in Data website (Ritchie et al., 2020).
the selected detail of the implementation in Table 4. In general, the stringent and prolonged restrictions in the centre of economic activities can be seen in the Philippines with tight enforcement from the authority. Similarly, large-scale restrictions were also implemented in many big cities in Indonesia, affecting businesses operation. In contrast, Malaysia, Thailand, and Vietnam applied restrictions selectively, conditional on the risk level. With the low number of Covid cases, Vietnam imposed epicentre-focused instead of a large-scale lockdown allowing contact-intensive industry to operate for most of 2020. This country also resumed international flights early, especially for business purposes. Similarly, Thailand and Malaysia also selectively relaxed the restrictions started from Q2-2020.\textsuperscript{17}

As the government restriction was in place, the people’s mobility declined, and the economic activity dimmed. Fig. 4 panel (a) shows the mobility declines in the workplace sites indicating that people reduce their economic activities. The contraction of such activities was then reflected in slower GDP growths in the ASEAN-5 (Fig. 4 panel b). The GDP growth in the Philippines, Malaysia, Thailand, and Indonesia, where the restrictions were initially stringent, plunged in Q2-2020. The restriction relaxation in Malaysia and Thailand improved the growth in the subsequent periods. In contrast, the consistently strict restriction in the Philippines was correlated with a deeper recession in this country. On the other hand, the mobility in Vietnam was still positive in most of 2020, keeping their aggregate economy growing. Vietnam’s effective public response to contact tracing and testing,\textsuperscript{18} allows them to adopt a less restricted policy.

In Table 5, we show that the government restrictions significantly affect mobility. Across countries, the correlations of the restriction with mobility in the workplace and public transport sites are very high in the Philippines, Indonesia, and Thailand. It implies that the imposed restriction effectively affects community mobility in the centre of economic

\textsuperscript{17} The detail are summarised primarily from the CSIS’s National Responses to Covid in Southeast Asia (2022). A similar detail can be found in Hale et al. (2021).

\textsuperscript{18} See Pollack et al. (2021), Emerging Covid 19 success stories: Vietnam commitment to containment available in https://ourworldindata.org/covid-exemplar-vietnam.
Table 3
Data descriptive.

| Countries | Statistics | ASEA | IDN | MYS | PHL | THA | VNM |
|-----------|------------|------|-----|-----|-----|-----|-----|
|           |            | Non-Cl | Cl  | Non-Cl | Cl  | Non-Cl | Cl  | Non-Cl | Cl  | Non-Cl | Cl  | Non-Cl | Cl  |
| Revenue (real value) | Ob | 33,696 | 3,705 | 5,115 | 750 | 7,995 | 690 | 2,295 | 375 | 8,280 | 909 | 10,005 | 990 |
|               | Mean | 33,696 | 3,705 | 5,115 | 750 | 7,995 | 690 | 2,295 | 375 | 8,280 | 909 | 10,005 | 990 |
|               | St.dev | 1,726 | 0.8 | 0.2 | 0.3 | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 | 0.3 | 0.1 | 0.3 |
| COGS to revenue | Ob | 31,086 | 3,375 | 5,068 | 747 | 6,028 | 485 | 1,842 | 270 | 8,259 | 883 | 9,889 | 990 |
|               | Mean | 31,086 | 3,375 | 5,068 | 747 | 6,028 | 485 | 1,842 | 270 | 8,259 | 883 | 9,889 | 990 |
|               | St.dev | 4,860 | 0.1 | 0.2 | 0.3 | 0.1 | 0.2 | 0.3 | 0.1 | 0.2 | 0.3 | 0.1 | 0.2 |
| Labor cost to revenue | Ob | 8,042 | 1,310 | 1,700 | 584 | 288 | 60 | 654 | 176 | 541 | 75 | 2,461 | 411 |
|               | Mean | 8,042 | 1,310 | 1,700 | 584 | 288 | 60 | 654 | 176 | 541 | 75 | 2,461 | 411 |
|               | St.dev | 8,042 | 1,310 | 1,700 | 584 | 288 | 60 | 654 | 176 | 541 | 75 | 2,461 | 411 |
| Inventory to revenue | Ob | 30,996 | 3,358 | 4,976 | 689 | 7,452 | 619 | 1,700 | 258 | 7,343 | 827 | 9,620 | 965 |
|               | Mean | 30,996 | 3,358 | 4,976 | 689 | 7,452 | 619 | 1,700 | 258 | 7,343 | 827 | 9,620 | 965 |
|               | St.dev | 29,903 | 1,310 | 1,700 | 584 | 288 | 60 | 654 | 176 | 541 | 75 | 2,461 | 411 |
| Return on assets (RoA) | Ob | 33,692 | 3,659 | 5,155 | 750 | 7,995 | 690 | 2,295 | 375 | 8,280 | 909 | 10,005 | 990 |
|               | Mean | 33,692 | 3,659 | 5,155 | 750 | 7,995 | 690 | 2,295 | 375 | 8,280 | 909 | 10,005 | 990 |
|               | St.dev | 2.8 | 0.1 | 0.2 | 1.3 | 0.1 | 0.2 | 1.3 | 0.1 | 0.2 | 1.3 | 0.1 | 0.2 |
| Full-time workers (headcount) | Ob | 6,094 | 895 | 4,059 | 574 | 1,822 | 297 | 3,594 | 3,102 | 4,349 | 4,066 | 4,066 | 3,594 |
|               | Mean | 6,094 | 895 | 4,059 | 574 | 1,822 | 297 | 3,594 | 3,102 | 4,349 | 4,066 | 4,066 | 3,594 |
|               | St.dev | 10,264 | 5,556 | 8,034 | 5,626 | 4,345 | 6,197 | 4,345 | 6,197 | 4,345 | 6,197 | 4,345 |
| Income per worker (real value) | Ob | 5,274 | 793 | 4,011 | 571 | 1,203 | 226 | 3,594 | 3,102 | 4,349 | 4,066 | 4,066 | 3,594 |
|               | Mean | 5,274 | 793 | 4,011 | 571 | 1,203 | 226 | 3,594 | 3,102 | 4,349 | 4,066 | 4,066 | 3,594 |
|               | St.dev | 45.5 | 40.6 | 44.8 | 46.6 | 50.2 | 25.5 | 184.0 | 41.9 | 184.0 | 41.9 | 184.0 | 41.9 |
| Total fixed asset to revenue | Ob | 17,287 | 1,956 | 2,174 | 397 | 4,222 | 367 | 1,040 | 192 | 4,093 | 478 | 5,218 | 522 |
|               | Mean | 17,287 | 1,956 | 2,174 | 397 | 4,222 | 367 | 1,040 | 192 | 4,093 | 478 | 5,218 | 522 |
|               | St.dev | 157.26 | 55.67 | 23.69 | 95.48 | 65.94 | 91.93 | 237.05 | 57.97 | 999.94 | 26.82 | 999.94 | 26.82 |
| Fixed Asset (real value)/employee | Ob | 1,586 | 197 | 4,399 | 387 | 1,080 | 293 | 194.8 | 127.8 | 194.8 | 127.8 | 194.8 | 127.8 |
|               | Mean | 1,586 | 197 | 4,399 | 387 | 1,080 | 293 | 194.8 | 127.8 | 194.8 | 127.8 | 194.8 | 127.8 |
|               | St.dev | 543.9 | 121.2 | 639.5 | 571.1 | 976.2 | 700.4 | 976.2 | 700.4 | 976.2 | 700.4 | 976.2 | 700.4 |

Notes: Abbreviation: COGS=Cost of goods sold (production cost); CI=contact intensive; IDN=Indonesia, MYS=Malaysia, PHL=Philippines, THA=Thailand, VNM=Vietnam. 2. Real value refers to the value of a specified variable adjusted for the consumer price index (CPI). 3. Blank or shaded columns indicate potential insufficient samples with the number of observations less than 450 (15 quarters x 30 firms), or data should not be aggregated (dark grey-shaded).

(a) Mobility decline  
(b) Economic activity decline

Fig. 4. The mobility and GDP growth in ASEAN countries. Source: (a) Google COVID-19 Community Mobility Reports (Google LLC, 2022). The quarter data is a weighted average of day-to-day changes relative to the daily average of January–February 2020. (b) Collected from CEIC.

activities. Meanwhile, the correlations are relatively lower in Malaysia and Vietnam, suggesting that the restriction has less impact on the economic activity in these countries. The lower correlation in Vietnam and relatively high mobility in the country (Fig. 4) compared to other countries suggests that the restriction is selectively implemented. Over time, the correlations weakened in 2021 as most countries had relatively adapted to the pandemic and rolled out their vaccination
Table 4
Selected restrictions in the ASEAN-5 countries in 2020.

Sources: Collated from various sources, mainly CSIS’s National Responses to Covid in Southeast Asia, retrieved March 2022. Additional information is sourced from the country’s public health ministry, Kompas Indonesia, South China Morning Post, Luong et al. (2020), PWC’s GCQ quick guide, and Thailand Institute of Justice.

| A. Restrictions | Indonesia | Malaysia | Philippines | Thailand | Vietnam |
|-----------------|-----------|----------|-------------|----------|---------|
| 1. Lockdowns    | • A temporary ban on foreign arrival and public health emergency declaration on Mar 31, allowing regional administration to close schools and workplaces. • Work from home calls (Jul 29). • Large scale restriction in many big cities (Apr–Oct). • Public activities restrictions in Jakarta and other cities in Java and Bali until Feb 2021 (early Jan 2021). | • The movement control order (MCO) was enacted (Mar 18). • The conditional MCO was implemented, relaxing some restrictions (May 4). • A more relaxed recovery MCO replaced conditional MCO till Des (Aug 28). • Lockdowns are imposed in the selected state due to the Covid cases increases (Sep). • Working from home implemented with exceptions to industrials, some commercial and public services (Oct 21) • A state emergency was declared on Jan 12, 2021. | • Enhanced community quarantine (ECQ) was imposed in Manila and broader Luzon (Mar 16). • In Aug, a stricter modified ECQ was reimposed in Manila. A face shield is required in addition to masks. • A nationwide state of calamity is extended over the entire country for the whole year (Sep 13) under General Community Quarantine (GCQ). | • The state of emergency was declared on Mar 26. • Extension of state of emergency with relaxation for most businesses (Jun 29). Extensions were done several times until the end of 2020. • Control zoning instead of national lockdown policy (Dec 24). | • State of emergency declared. • A national lockdown began on Apr 1. • The government announced the plan to adopt a localised (epicentres-focused) lockdown instead of a widescale one (Aug 3). • Stay at home for two schools (Dec 1) |
| 2. Enforced by police, military forces, government regulation | • Army and police deployment to discipline citizens (May 26). | • Police and army deployment for enforcement (Mar 20). | • Police and the military were allowed to shoot violators (Apr 1). • House to house search by policy & police arrest for people not wearing masks (Jul 20) | • Police deployment for compliance. • Tightening security and border control with neighbouring countries. | • Police and security forces were deployed to control, monitor, and limit community transmission. |
| 3. Initial international travel ban | • A temporary ban on Mar 31. Bali was closed to foreign tourists for 2020 (Aug 24) | • Cross-border travel ban under MCO. • A selected ban was imposed on high-risk countries (Sep). | • Foreign and national arrival banned from Mar 20 until Apr 19. | • Border closing and foreign entry were banned (Mar 22). | • All flights from China were banned (Feb 1). • Some border points with China are open later (May) |
| 4. Contact intensive industries restrictions | • Allowed to operate but affected by a stay-at-home regulation from the large-scale restriction. | • Restaurants resumed full operations on Jun 30. • The restriction on the maximum number of people dining in was lifted (Dec 7) | • ECQ is stay-at-home orders, basically a complete lockdown. Under GCQ, some businesses are allowed to open partially (30%-50%). Gyms, entertainment, and parks are closed. | • Mostly restricted under the first lockdown but allowed to open since the relaxation on May 3. Social gatherings are restricted. | • Restaurants were still open, with mandatory social distancing and face masks (Aug 19). |

(continued on next page)
Table 4 (continued).

| B. Restriction easing and vaccination | Indonesia | Malaysia | Philippines | Thailand | Vietnam |
|--------------------------------------|-----------|----------|-------------|----------|---------|
| 1. International and domestic movement | - The domestic flight resumed (Jun 10).  
- Travel corridor with South Korea (Aug 17).  
- The e-visa system is prepared for foreign arrival (Oct 2).  
- Green lane with Singapore for diplomats and business trips (Oct 27). | - Borders are open for tourists and international students (Jun 19).  
- Opening border with Singapore (Aug 17).  
- The inter-state movement was allowed without any permit (Dec 7). | - The non-essential outbound travel restriction was lifted, but foreigners were banned from entry (Jul 7), reimposed again on Jul 24.  
- Non-essential overseas travels were allowed, and some tourist destinations were open partially (Oct)  
- Foreigners using investment visas are allowed on Nov 1.  
- Eased lockdown in Manila after 76 days; most business and domestic flights were allowed to resume (Jun 1). | - Travel from and to South Korea, China, Hong Kong, and Macau was allowed (May 15)  
- Businesses were reopened gradually, including department stores and shopping malls (May 17)  
- Provincial & international travel allowed (Jul 1).  
- Foreign residential and work permit holders are allowed to come back (Aug 4).  
- Tourist destinations reopened gradually in Phuket (Sep 28).  
- Border opening for tourists under health and safety protocols. | - Public and commercial transport was allowed to operate (May 7).  
- Government open the border with China (May).  
- Flights between Vietnam and Japan resumed in June.  
- E-visa issuance from 80 countries resumed (Jul 1)  
- No quarantine obligations for foreign experts, investors, and diplomats entering Vietnam for less than 14 days (Sep 2).  
- Passenger flights from/to Guangzhou, Seoul, Tokyo, Taipei, Phnom Penh, and Vientiane resumes.  
- An agreement with South Korea for a short business trip without quarantine (Dec 7). |
| 2. Vaccination start | Jan 2021. | February 2021. | March 2021. | February 2021. | March 2021. |
Table 5
The correlations of the government restriction with community mobilities in different places.

| Workplace | Public transport | Retail |
|-----------|------------------|--------|
|           | YR-2020 ALL      | YR-2020 ALL | YR-2020 ALL |
| IDN       | −0.92            | −0.83    | −0.92      | −0.69    | −0.80 | −0.35 |
| MYS       | −0.75            | −0.76    | −0.83      | −0.86    | −0.67 | −0.69 |
| PHL       | −0.97            | −0.90    | −0.98      | −0.93    | −0.97 | −0.86 |
| THA       | −0.92            | −0.85    | −0.90      | −0.78    | −0.67 | −0.67 |
| VNM       | −0.64            | −0.56    | −0.64      | −0.64    | −0.70 | −0.63 |

Notes: IDN=Indonesia, MYS=Malaysia, PHL=Philippines, THA=Thailand, VNM=Vietnam. The mobility data is obtained from Google LLC (2022), while the restriction data (stringency index) is from Oxford Covid-19 Government Response Tracker.

Table 6
The correlations of firms’ revenue with the government restrictions and community mobilities.

| Period | IDN | MYS | PHL | THA | VNM |
|--------|-----|-----|-----|-----|-----|
| A. CONTACT INTENSIVES |
| With government restriction indicator (Oxford COVID-19 Government Response Tracker) |
| 1. Stringency index |
| 2020 | −0.96 | −0.90 | −0.98 | −0.95 | −0.72 |
| 2020–2021 | −0.57 | −0.85 | −0.95 | −0.90 | −0.44 |
| 2. Workplace closure |
| 2020–2021 | −0.94 | −0.76 | −1.00 | −0.94 | −0.32 |
| 3. Public transport closure |
| 2020–2021 | −0.92 | −0.76 | −0.95 | −0.91 | −0.35 |
| With community mobility (Google mobility) |
| 1. Mobility at workplace |
| 2020 | 0.98  | 0.91  | 0.91  | 0.82  | 0.90 |
| 2020–2021 | 0.70  | 0.82  | 0.86  | 0.64  | 0.57 |
| 2. Mobility at public transport |
| 2020–2021 | 0.99  | 0.95  | 0.96  | 0.81  | 0.82 |
| 3. Mobility at retail & recreation |
| 2020–2021 | 0.95  | 0.87  | 0.90  | 0.52  | 0.92 |
| B. NON-CONTACT INTENSIVES |
| With government restriction indicator (Oxford COVID-19 Government Response Tracker) |
| Stringency index |
| 2020–2021 | 0.10  | 0.24  | 0.68  | −0.23 | 0.20 |
| Workplace closure |
| 2020–2021 | −0.93 | −0.10 | −0.95 | −0.97 | 0.22 |
| Public transport closure |
| 2020–2021 | −0.21 | 0.39  | −0.78 | −0.97 | 0.25 |
| With community mobility (Google mobility) |
| Mobility - Workplace |
| 2020–2021 | 0.91  | 0.93  | 0.98  | 0.97  | 0.45 |
| Mobility - Public transport |
| 2020–2021 | 0.12  | 0.15  | 0.92  | 0.15  | −0.31 |
| Mobility - Retail & recreation |
| 2020–2021 | 0.86  | 0.73  | 0.95  | 0.94  | 0.74 |

Notes: IDN=Indonesia, MYS=Malaysia, PHL=Philippines, THA=Thailand, VNM=Vietnam. The firms revenues are indexed from their seasonally-adjusted actual revenue with 2018=100. The mobility data is obtained from Google LLC (2022), while the restriction data is from Oxford Covid-19 Government Response Tracker. Year 2020 refers to Q1-2020 to Q4-2020, Year 2020–2021 refers to Q1-2020 to Q3-2021.

The correlations between the government restrictions with mobility in the Philippines are high in all periods suggesting that restrictions were kept rigid until 2021.

The government restriction that reduces community mobility affects firms’ revenue in the CI and non-CI industries (Table 6). Using firms sample data, we show that the government restrictions and mobility are highly correlated with firms’ revenue in the CI industry in all countries, especially in 2020. The stringency index captures the association between the government restriction and firms’ revenue with a correlation coefficient above 0.9 for all countries except for Vietnam. Individually, the workplace closure is more related to the firms’ revenue than the public transport closure. For non-CI industries, the correlation between government restrictions and firms’ revenue is also high in Indonesia, the Philippines, and Thailand in 2020, with coefficients above 0.95 suggesting the contribution of restrictions on the program.\(^{19}\)

For example, the Indonesian government open their border for foreign visitor after the health protocol are set up including e-visa approval in October 2020. Some shopping centre are also allowed to operate with the requirement for first dose of vaccination. In comparison, Vietnam has selectively open their border since May 2020 and resumed e-visa application service in July 2020. See for example National Responses to Covid-19 in Southeast Asia (CSIS, 2022).

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\(^{19}\) For example, the Indonesian government open their border for foreign visitor after the health protocol are set up including e-visa approval in October 2020. Some shopping centre are also allowed to operate with the requirement for first dose of vaccination. In comparison, Vietnam has selectively open their border since May 2020 and resumed e-visa application service in July 2020. See for example National Responses to Covid-19 in Southeast Asia (CSIS, 2022).
whole firms’ performance. Differently, in Malaysia and Vietnam, non-CI firms’ revenues are less correlated with the stringency index, suggesting that the government restrictions are less binding for non-CI firms. The correlation between the government restriction with firms’ revenue is also shown in Fig. 5.

As workplace utilisation is restricted, firms cannot generate sufficient revenue, and the employee must forgo their employment in terms of working hours or permanent job loss. Fig. 6 shows the unemployment surge dramatically in the Philippines, where the restriction is the tightest. Before the Covid-19 pandemic hit, the unemployment level was consistently below 6%, surging to 17.6% in Q2-2020 before going down to the below 10% level in the next quarter. Although the unemployment pattern follows the level of the country’s restriction, we do not try to infer the causation between the two indicators. Unemployment would probably have increased following the number of cases as the public is concerned.
about their health. A study by Aum et al. (2021) in South Korea suggest that every 100 thousand increase in infection causes a 2%–3% drop in local employment.

5.2. The impact of the covid-19 pandemic on firm performance (event analyses)

The revenue declines after the outbreak reflect the public concern about their health and the degree of restrictions following different waves of the Covid variant spread across countries. Fig. 7 (left panel) shows that in Q1-2020, the firm’s revenue declined slightly as most countries imposed the restrictions at the end of March 2020. The magnitude varies across industries, 10% overall, 8% for non-CI firms, and 18% for CI firms. After the restriction was implemented, the revenue dropped sharply: 40% overall, 27% for the non-CI firms, and around 100% for CI firms. After slight improvement at the end of 2020 and the beginning of 2021, the firm’s revenue was hit again by the Covid cases surge due to the Delta and Omicron variant. The story is in line with Guerrieri et al. (2022), who project that supply shocks in CI industries will propagate to non-CI industries depending on complementarities, financial constraints, and intertemporal elasticities. Table 7 provides detailed figures for firms’ revenue.

Across countries, the evolution of firms’ revenue is in line with the Covid cases and the government restrictions (Fig. 7, right panel). In Q2-2020, the Philippines firms, which suffered from the worst outbreak and rigid lockdowns, recorded a sharp decline in revenue, around 79%. In other countries where the restrictions are also tight, such as Malaysia and Indonesia, the firms’ revenue dropped by more than 50%. On the other hand, the declines in Thailand and Vietnam were smaller as the number of cases was low and the restriction was more relaxed. However, as the Delta variant spread at the end of 2021, firms in all countries recorded a significant decline in revenue as almost all countries struggled to contain the outbreak.
As the pandemic hit the economy unexpectedly, firms could hardly adjust their production cost during the first and second pandemic waves, with average adjustments for all firms taking place up to two quarters. As shown in Fig. 8 (left panel), the ratios of revenue cost to revenue of the CI firms after the outbreak were persistently above their pre-pandemic level, reflecting the firm’s inflexibility to adjust the production cost. If firms were very flexible, the revenue drop should have been followed by cost reduction. In fact, the adjustment of production costs in material and labour takes at least 1 quarter for non-CI firms to balance the sudden revenue drop. In contrast, the production cost of CI firms was consistently above their pre-pandemic level in the whole period (left panel of Fig. 8). Across countries, the firms’ inflexibility to adjust their production cost is more clearly seen in the Philippines and Indonesia based on the magnitude and the duration. The cost-to-revenue ratio in the Philippines increased by around 20% in Q2-2020 and stayed above its pre-pandemic level until Q3-2020. The figure for Indonesia is lower, 13%, but persistently above their pre-pandemic level until the end of 2020. In contrast, the production cost increases in Thailand, Malaysia and Vietnam were relatively modest and brief (see Table 8 for detailed numbers).

The labour and inventory costs surge reflects the firm’s inflexibility to respond to abrupt revenue drops during the pandemic. The left panel of Fig. 9 shows that the labour-cost-to-revenue ratios in the Philippines and Indonesia were consistently above their pre-pandemic level during 2020. The rigidities are more recognisable in the inventory-cost-to-revenue ratios, which were above their pre-pandemic level in the whole period of observations in these two countries (Fig. 9, right panel). The significant and prolonged restrictions give minimal flexibility for firms to sell their product, piling up unsold inventories and unprocessed material input. The detailed numbers are available in Tables 9 and 10.

As a result of revenue declines and cost rigidities, firms’ profitability started to drop significantly since Q1-2020. The return on assets (RoA) of non-CI firms improved in two quarters, while the ratios for CI firms were persistently below the pre-pandemic level (Fig. 10, left panel). The profitability deteriorations are apparent in all countries, although the timing
and magnitude differ. In general, the RoA drop by from around 24% to 64%, with the mildest figure from the Thai samples and the worst drop from the Philippines samples (based on the Q1-2020 figure in Table 11).

In response to the deteriorating performance, firms alter their costs by reducing the working hour and the number of employees. In line with the study by Khamis et al. (2021), the firms in the CI industry utilise intensive margin in labour adjustment, as shown by the real income per employee declines in the left panel of Fig. 11. It indicates labour hoarding behaviour as studied by Möller (2010) and Van den Bosch and Vanormelingen (2022). There was no observable heterogeneity across countries, as this result is driven by non-CI firms whose real income per employee was not different from their pre-pandemic level. Conversely, Table 12 shows that the income per worker dropped in the CI industry in both Indonesia and Vietnam.

The notion of labour hoarding behaviour in the CI industries is supported by Fig. 12 (left panel). Until Q3-2020, the headcount declines in the CI industries were not statistically significant. Instead, the CI firms try to limit the working hours reflected by the reduction in the real income per employee (Fig. 11, left panel). Differently, the non-CI firms cope with the pandemic by reducing the number of workers faster, keeping the income per worker unchanged. The distinct behaviour between CI and non-CI firms is more evident in Indonesia, where the headcount reduction in CI firms started in Q4-2020 (Table 13). In contrast, a similar adjustment in the non-CI industry began earlier in Q2-2020. In both the Indonesian and Vietnamese samples, the non-CI industry (dominated by the manufacturing industry) is more capital intensive than the CI industries (dominated by services industries), as illustrated in Table 3.

The employment analyses only uses samples from Indonesia and Vietnam due to data availability.
| Quarter | ASEAN | MYS | PHL | THA | VNM |
|---------|-------|-----|-----|-----|-----|
|         | All   | Non-CI | CI | All | Non-CI | CI | All | Non-CI | CI | All | Non-CI | CI | All | Non-CI | CI | All | Non-CI | CI |
| q1 2019 | 0.00  | 0.01  | -0.01 | 0.02 | 0.02 | 0.06 | -0.02 | 0.01 | -0.05 | 0.09 | 0.12 | 0.13 | 0.02 | 0.05** | 0.01 | -0.01 | 0.01 | -0.12 |
| q2 2019 | -0.01 | -0.01 | 0.00 | -0.07 | -0.05 | -0.01 | -0.01 | 0.01 | -0.04 | 0.05 | 0.06 | 0.15 | -0.02 | -0.02 | -0.03 | 0.03 | 0.02 | 0.02 |
| q3 2019 | -0.01 | -0.01 | -0.01 | -0.06 | -0.08** | -0.02 | -0.01 | 0.03 | -0.01 | 0.05 | -0.01 | 0.09 | -0.05* | -0.04 | -0.06 | 0.03 | 0.03 | 0.01 |
| q4 2019 | -0.04** | -0.04** | -0.04 | -0.10** | -0.07* | 0.04 | -0.01 | 0.07 | 0.02 | -0.00 | -0.05* | -0.03 | -0.04 | -0.06 | -0.05 | -0.06 |
| q1 2020 | -0.10*** | -0.08*** | -0.18*** | -0.12*** | -0.11*** | -0.07 | -0.08** | -0.04 | -0.24* | 0.02 | -0.01 | -0.04 | -0.09*** | -0.04 | -0.17 | -0.13*** | -0.11*** | -0.28*** |
| q2 2020 | -0.40*** | -0.27*** | -1.10*** | -0.57*** | -0.38*** | -1.29*** | -0.45*** | -0.31*** | -1.42*** | -0.79*** | -0.54*** | -1.75*** | -0.33*** | -0.20*** | -0.95*** | -0.24*** | -0.17*** | -0.65*** |
| q3 2020 | -0.19*** | -0.10*** | -0.66*** | -0.45*** | -0.32*** | -0.10*** | -0.05 | 0.02 | -0.53* | -0.42*** | -0.28*** | -1.15*** | -0.20*** | -0.12*** | -0.51*** | -0.11*** | -0.05*** | -0.46*** |
| q4 2020 | -0.17*** | -0.10*** | -0.59*** | -0.40*** | -0.30*** | -0.88*** | -0.05* | 0.04 | -0.67*** | -0.27*** | -0.19*** | -0.92*** | -0.17*** | -0.11*** | -0.49*** | -0.12*** | -0.08*** | -0.27*** |

Notes: Constants and quarter dummies are not reported for simplicity; t-statistics in parentheses; The significance level indicates the relative position compared to the 2018 figures.

* ***p < 0.01.
** **p < 0.05.
* *p < 0.1.
### Table 8
Heterogeneity in production cost adjustments (cost of revenue/revenue, ln).

| Quarter | ASEAN All | ASEAN Non-CI | ASEAN CI | IDN All | IDN Non-CI | IDN CI | MYS All | MYS Non-CI | MYS CI | PHL All | PHL Non-CI | PHL CI | THA All | THA Non-CI | THA CI | VNM All | VNM Non-CI | VNM CI |
|---------|-----------|-------------|---------|--------|-----------|-------|--------|-----------|-------|--------|-----------|-------|--------|-----------|-------|--------|-----------|-------|
| q12019  | 0.00      | 0.00        | 0.01    | -0.01  | -0.01     | 0.00  | 0.02   | -0.00     | 0.01  | -0.03  | -0.01     | -0.04 | 0.01   | 0.01      | 0.01  | 0.01   | -0.00     | 0.02  |
| q2019   | 0.01      | 0.01*       | -0.00   | 0.00   | 0.02      | -0.01 | 0.02   | 0.03      | -0.04 | -0.00  | 0.01      | -0.07 | 0.01   | 0.01      | 0.04  | 0.02   | 0.03**    | 0.01  |
| q32019  | 0.01      | 0.01        | -0.00   | 0.01   | 0.02      | 0.02  | 0.02   | -0.00     | 0.01  | 0.01   | 0.01      | 0.03  | 0.01   | 0.02      | 0.02  | 0.01   | -0.00     | 0.00  |
| q42019  | -0.02**   | -0.02**     | -0.01  | 0.02   | 0.02      | -0.01 | -0.03  | -0.03*    | -0.06 | -0.10* | -0.03     | -0.03 | -0.01  | -0.01     | 0.01  | -0.02  | 0.02*      | 0.06  |
| q12020  | 0.02***   | 0.01*       | 0.07*** | 0.02   | 0.00      | 0.08  | 0.02   | 0.01      | 0.05  | -0.03  | -0.04*     | 0.02  | 0.03***| 0.03***   | 0.08  | 0.02   | 0.01      | 0.08  |
| q22020  | 0.08***   | 0.04***     | 0.35*** | 0.13***| 0.10***   | 0.37***| 0.06***| 0.04***   | 0.22***| 0.21***| -0.02     | 0.67***| 0.09***| 0.04***   | 0.48***| 0.05***| 0.03***   | 0.20***|
| q32020  | 0.04***   | 0.01*       | 0.21*** | 0.10***| 0.07***   | 0.34***| -0.00  | 0.01      | 0.00  | 0.12***| -0.01     | 0.47***| 0.03***| 0.02      | 0.20***| 0.02   | -0.01     | 0.17***|
| q42020  | 0.01      | -0.02***    | 0.15***| 0.09***| 0.05***   | 0.24***| -0.02  | -0.04*    | 0.16***| -0.02  | -0.03*    | 0.23***| -0.00  | 0.01      | 0.15***| -0.01  | -0.03***  | 0.05***|
| q12021  | 0.02**    | -0.01*      | 0.16***| 0.03   | 0.01      | 0.13* | 0.01   | -0.01     | 0.12  | -0.01  | -0.05     | 0.16   | 0.02   | -0.00     | 0.24***| 0.02   | -0.01     | 0.13***|
| q22021  | 0.02***   | 0.00*       | 0.15***| 0.03   | 0.02      | 0.10***| 0.01   | 0.02      | 0.05  | 0.05   | -0.02     | 0.17***| 0.03***| 0.01      | 0.29***| 0.02   | 0.00*      | 0.11***|
| q32021  | 0.04***   | 0.00*       | 0.29***| 0.04   | 0.00      | 0.21***| 0.02   | 0.00      | 0.07  | 0.08   | 0.01      | 0.22***| 0.06***| 0.02      | 0.42***| 0.05***| -0.02     | 0.35***|
| Observations | 23,126  | 19,761      | 3,365  | 3,998  | 5,056      | 741   | 4,428  | 5,999      | 483   | 1,181  | 1,820      | 268   | 5,893  | 8,238      | 983   | 7,622  | 9,866      | 989   |
| R-squared | 0.65    | 0.67        | 0.62   | 0.68   | 0.77       | 0.66  | 0.77   | 0.79       | 0.76  | 0.57   | 0.79       | 0.59  | 0.62   | 0.87        | 0.55  | 0.48   | 0.54        | 0.52  |

Notes: Constants and quarter dummies are not reported for simplicity; t-statistics in parentheses; The significance level indicates the relative position compared to the 2018 figures.  
***p < 0.01.  
**p < 0.05.  
*p < 0.1.
Table 9
Heterogeneity in labour cost adjustment (labour cost/revenue, ln).

| Quarter | ASEAN | IDN | MYS | PHL | THA | VNM |
|---------|-------|-----|-----|-----|-----|-----|
|         | All   | Non-CI | Cl | All | Non-CI | Cl | All | Non-CI | Cl | All | Non-CI | Cl | All | Non-CI | Cl | All | Non-CI | Cl | All | Non-CI | Cl |
| q1 2019 | -0.02 | -0.02 | -0.01 | 0.01 | -0.00 | 0.02 | 0.05 | -0.04 | 0.03 | -0.06 | -0.12 | -0.07 | -0.27 | -0.20 | -0.07 | 0.03 | -0.04 | -0.03 |
|         | 0.08** | 0.09* | 0.04 | 0.09* | 0.07* | 0.06 | -0.09 | -0.15 | 0.08 | 0.05 | 0.06 | -0.03 | 0.17 | 0.25 | 0.24 | 0.07 | 0.10 | -0.01 |
| q2 2019 | 0.01 | 0.02 | -0.05 | 0.06 | 0.13*** | -0.23* | -0.03 | -0.20 | -0.08 | 0.12 | 0.12 | 0.14 | -0.19 | -0.14 | 0.42 | -0.04 | -0.04 | 0.03 |
| q3 2019 | 0.04 | 0.05 | -0.00 | 0.04 | 0.01 | -0.06 | 0.70** | 0.46** | -0.11 | -0.00 | 0.01 | 0.03 | -0.04 | -0.15 | 0.07 | 0.02 | 0.06 | 0.05 |
| q4 2019 | 0.06 | 0.04 | 0.10 | 0.10*** | 0.11 | 0.11 | 0.01 | 0.25 | -0.02 | -0.03 | -0.02 | -0.20 | -0.28 | 0.50 | 0.07 | 0.04 | 0.02 |
| q1 2020 | 0.06 | 0.04 | 0.10 | 0.10*** | 0.11 | 0.11 | 0.01 | 0.25 | -0.02 | -0.03 | -0.02 | -0.20 | -0.28 | 0.50 | 0.07 | 0.04 | 0.02 |
| q2 2020 | 0.22** | 0.13** | 0.57*** | 0.26*** | 0.22*** | 0.51*** | 0.03 | -0.22 | 0.63 | 0.34*** | 0.11 | 0.76*** | 0.12 | -0.08 | 0.66 | 0.18*** | 0.09 | 0.47*** |
| q3 2021 | 0.18*** | 0.08* | 0.59*** | 0.12** | 0.07** | 0.35*** | 0.26 | -0.25 | 1.77*** | 0.31*** | 0.13 | 0.58** | -0.07 | -0.23 | 0.60 | 0.31*** | 0.17** | 0.76*** |
| q4 2021 | 0.07 | 0.01 | 0.27*** | 0.10** | 0.03 | 0.33** | -0.07 | -0.12 | 0.54 | 0.08 | 0.17 | 0.29 | -0.22 | -0.32* | 0.85 | 0.09 | 0.03 | 0.05 |
| q1 2022 | 0.07 | 0.01 | 0.27*** | 0.10** | 0.03 | 0.33** | -0.07 | -0.12 | 0.54 | 0.08 | 0.17 | 0.29 | -0.22 | -0.32* | 0.85 | 0.09 | 0.03 | 0.05 |
| q2 2022 | 0.10** | 0.05 | 0.29*** | 0.06 | 0.02 | 0.32** | -0.05 | -0.09 | 0.48 | 0.33** | 0.34** | 0.56* | 0.11 | -0.01 | 0.31 | 0.14* | 0.13* | 0.16 |
| q3 2022 | 0.18*** | 0.08* | 0.59*** | 0.12** | 0.07** | 0.35*** | 0.26 | -0.25 | 1.77*** | 0.31*** | 0.13 | 0.58** | -0.07 | -0.23 | 0.60 | 0.31*** | 0.17** | 0.76*** |
| Observations | 6,197 | 4,913 | 1,284 | 3,047 | 3,985 | 590 | 202 | 280 | 60 | 476 | 641 | 168 | 510 | 618 | 67 | 1,962 | 2,426 | 399 |
| R-squared | 0.82 | 0.82 | 0.79 | 0.79 | 0.82 | 0.79 | 0.71 | 0.81 | 0.73 | 0.84 | 0.75 | 0.85 | 0.82 | 0.86 | 0.76 | 0.76 | 0.74 | 0.67 |

Notes: Constants and quarter dummies are not reported for simplicity; t-statistics in parentheses; The significance level indicates the relative position compared to the 2018 figures.

***p < 0.01.
**p < 0.05.
*p < 0.1.
| Quarter | ASEAN All | ASEAN Non-CI | ASEAN CI | IDN All | IDN Non-CI | IDN CI | MYS All | MYS Non-CI | MYS CI | PHL All | PHL Non-CI | PHL CI | THA All | THA Non-CI | THA CI | VNM All | VNM Non-CI | VNM CI |
|---------|-----------|-------------|---------|--------|-----------|-------|--------|-----------|-------|--------|-----------|-------|--------|-----------|-------|--------|-----------|-------|
| q12019  | 0.06***   | 0.06***     | 0.07    | 0.06   | 0.07      | 0.09  | 0.07   | 0.04      | 0.05  | −0.01  | 0.03      | −0.05 | −0.00  | −0.02     | 0.04  | 0.10**  | 0.08**     | 0.14 |
| q22019  | 0.00      | 0.01       | −0.01   | 0.09*  | 0.08*     | 0.01  | 0.02   | −0.02     | 0.17  | 0.00   | −0.01     | −0.07 | 0.02   | 0.02       | 0.15  | −0.03   | 0.03       | −0.27 |
| q32019  | −0.03     | −0.02      | −0.11   | 0.02   | 0.00      | −0.17 | −0.03  | −0.10***  | −0.07 | −0.12  | −0.10      | −0.10 | −0.01  | −0.03      | 0.16  | −0.05   | 0.02       | −0.33*|
| q42020  | 0.11***   | 0.11***    | 0.14*   | 0.15***| 0.15***   | −0.03 | 0.14***| 0.07      | 0.23* | 0.08   | 0.11       | 0.13  | 0.07** | 0.06       | 0.28**| 0.10**  | 0.11***     | 0.08 |
| q22020  | 0.35***   | 0.25***    | 0.95*** | 0.50***| 0.38***   | 0.99***| 0.45***| 0.30***   | 1.41***| 0.74***| 0.50***     | 1.63***| 0.31***| 0.19***    | 1.06***| 0.17*** | 0.16***     | 0.34**|
| q32020  | 0.10***   | 0.03       | 0.47*** | 0.30***| 0.26***   | 0.54***| −0.02  | −0.09***  | 0.48***| 0.42***| 0.26***     | 1.00***| 0.10***| 0.04       | 0.54***| 0.03    | 0.01        | 0.19 |
| q42020  | 0.04      | −0.00      | 0.30*** | 0.18***| 0.19***   | 0.49***| 0.00   | −0.11***  | 0.51***| 0.18***| 0.08       | 0.68***| 0.05   | −0.03      | 0.47***| −0.03   | 0.02       | −0.23 |
| q12021  | 0.08***   | 0.02       | 0.45*** | 0.15***| 0.12***   | 0.43***| 0.04   | −0.07     | 0.59***| 0.19***| 0.17***     | 0.57***| 0.09   | −0.02      | 0.61***| 0.06    | 0.05        | 0.22 |
| q22021  | 0.10***   | 0.04*      | 0.50*** | 0.13***| 0.10***   | 0.38***| 0.10***| 0.00      | 0.77***| 0.34***| 0.26***     | 0.69***| 0.16***| 0.01       | 0.72***| 0.02    | 0.02        | 0.16 |
| q32021  | 0.25***   | 0.16***    | 0.81*** | 0.22***| 0.12***   | 0.63***| 0.19***| 0.06***   | 0.78***| 0.19***| 0.21***     | 0.53***| 0.26***| 0.12***    | 0.97***| 0.32*** | 0.23***     | 0.89***|
| Observations | 23,587 | 20,214 | 3,373 | 3,870 | 4,866 | 686 | 5,624 | 7,425 | 613 | 1,098 | 1,703 | 286 | 5,613 | 7,313 | 961 |
| R-squared | 0.86 | 0.86 | 0.86 | 0.88 | 0.90 | 0.88 | 0.88 | 0.89 | 0.91 | 0.90 | 0.93 | 0.81 | 0.88 | 0.90 | 0.87 | 0.84 | 0.86 | 0.83 |

Notes: Constants and quarter dummies are not reported for simplicity; t-statistics in parentheses; The significance level indicates the relative position compared to the 2018 figures.

***p < 0.01.
**p < 0.05.
*p < 0.1.
### Table 11

Heterogeneity in Return on Assets (ROA).

| Quarter | ASEAN All | ASEAN Non-CI | ASEAN CI | IDN All | IDN Non-CI | IDN CI | MYS All | MYS Non-CI | MYS CI | PHL All | PHL Non-CI | PHL CI | THA All | THA Non-CI | THA CI | VNM All | VNM Non-CI | VNM CI |
|---------|-----------|--------------|----------|---------|-----------|--------|---------|-----------|--------|---------|-----------|--------|---------|-----------|--------|---------|-----------|--------|
| q1 2019 | −0.11***  | −0.09***     | −0.21**  | −0.03   | −0.04     | −0.25  | −0.16** | −0.11*    | −0.04  | −0.12   | −0.10     | −0.27  | −0.07   | −0.04     | −0.30** | −0.13** | −0.08     | −0.16  |
| q2 2019 | −0.16***  | −0.18***     | −0.02    | −0.17*  | −0.18**   | 0.06   | −0.14*  | −0.17**   | 0.03   | −0.18   | −0.16     | 0.05   | −0.24*** | −0.16***  | −0.35** | −0.12*  | −0.07     | 0.13   |
| q3 2019 | −0.10***  | −0.08***     | −0.18*   | −0.13   | −0.23***  | −0.16  | −0.09   | −0.05     | −0.27  | −0.15   | −0.05     | −0.35  | −0.14*  | −0.12*    | −0.12  | −0.06   | −0.02     | −0.15  |
| q4 2019 | −0.00     | 0.00         | −0.01    | 0.09    | −0.01     | 0.01   | 0.03    | −0.03     | 0.38   | 0.20    | −0.06     | 0.06   | 0.07    | −0.01     | 0.04   | −0.13   | −0.06     | −0.30**|
| q1 2020 | −0.35***  | −0.32***     | −0.58*** | −0.27** | −0.20     | −0.78** | −0.38** | −0.38**   | −0.19  | −0.64** | −0.32***  | −1.13** | −0.24   | −0.20***   | −0.78** | −0.39** | −0.31**   | −0.37**|
| q2 2020 | −0.20***  | −0.17***     | −0.45*** | −0.18   | −0.10     | −0.79** | −0.35** | −0.43**   | −0.58** | −0.62***| −0.49***  | −1.12** | −0.15** | −0.25***   | −0.51** | −0.15** | −0.13**   | −0.20**|
| q3 2020 | −0.07*   | −0.04        | −0.35*** | −0.28** | −0.35**   | −0.52**| 0.09    | 0.02      | −0.19  | −0.23   | −0.28**   | −0.20  | −0.11   | −0.14***   | −0.35** | −0.07   | −0.05     | −0.38**|
| q4 2020 | 0.05     | 0.09**       | −0.22**  | 0.12    | 0.11      | −0.43  | 0.19**  | 0.11*     | 0.11   | 0.11    | −0.30**   | −0.34  | 0.07    | 0.04      | −0.23  | −0.09   | −0.03     | −0.25  |
| q1 2021 | −0.01    | 0.04         | −0.36*** | 0.03    | −0.07     | −0.29  | 0.13*   | 0.06      | −0.15  | −0.22   | −0.23     | −0.85**| 0.10    | 0.05      | −0.51***| −0.15** | −0.07     | −0.24  |
| q2 2021 | −0.00    | 0.04         | −0.39*** | 0.02    | −0.04     | −0.43* | −0.01   | −0.06     | −0.56**| −0.27** | −0.10     | −1.14***| 0.05    | 0.03      | −0.38** | −0.02   | −0.02     | −0.11  |
| q3 2021 | −0.12*** | −0.08**      | −0.47*** | −0.08   | −0.15*    | −0.83**| −0.06   | −0.10     | −0.46**| −0.07   | −0.21*    | −0.34  | −0.02   | −0.02      | −0.53**| −0.27***| −0.21**   | −0.34**|

Observations: 18,279, 15,919, 2,360, 4,106, 5,680, 926, 4,192, 6,177, 559, 6,359, 8,389, 804

R-squared: 0.54, 0.53, 0.60, 0.47, 0.50, 0.51, 0.47, 0.50, 0.46, 0.56, 0.52, 0.50, 0.44, 0.43, 0.64, 0.63, 0.61, 0.68

Notes: Constants and quarter dummies are not reported for simplicity; t-statistics in parentheses; The significance level indicates the relative position compared to the 2018 figures.

***p < 0.01.

**p < 0.05.

*p < 0.1.
5.3. The impact of revenue decline on employment

As the pandemic affects their financial performance, firms gradually reduce the number of employees to cut costs. Fig. 13 shows that revenues explain more variation in the firms’ employment when the negative shock happens during the pandemic. In 2020, the correlation between revenue growth and employment growth was more substantial, as shown by the correlation coefficient and the R-squared. Across industries, the correlation between the two variables is more robust in the CI industry compared to the non-CI industry (see Figs. 14 and 15). However, such a relationship is suffered from omitted variables and reverse causality bias. In the following sections, we discuss the impact of revenue on employment after dealing with the endogeneity issue using three approaches: FE, GMM, and multi-period DiD. Our FE and GMM approaches suggest that the contemporaneous impact of revenue on employment is around 0.10, meaning that a 10% revenue decline is associated with approximately a 1% employment reduction. Further, our event analyses show a gradual adjustment with a heterogeneous path across countries and sectors.

5.3.1. The fixed-effect (FE) estimations

Table 14 presents the FE estimation using a different period of data to test the strict exogeneity assumption. The assumption is satisfied when we only use the observations during the pandemic period (post-pandemic) from Q1-2020 to Q3-2021. In column (1), where pre and post-pandemic observations are used, the strict exogeneity assumption is rejected as the joint test of the lead explanatory variable (revenue) is statistically significant. In other words, the future values of the revenue are correlated with employment, potentially creating reverse causality bias.
Table 13
Heterogeneity in the number of employees.

| Quarter | ASEAN | IDN | VNM |
|---------|-------|-----|-----|
|         | All Non-CI CI | All Non-CI CI | All Non-CI CI |
| q12019  | −0.00 −0.01 0.03 | 0.02 −0.00 0.04 | −0.04 −0.02 0.03 |
| q22019  | −0.02 −0.03 0.06 | −0.02 −0.02 0.05 | −0.00 −0.02 0.03 |
| q32019  | 0.01 0.00 0.05 | 0.01 0.03 0.02 | 0.01 −0.04 0.08 |
| q42019  | −0.01 −0.02 0.02 | 0.01 −0.00 0.02 | −0.07 −0.08 ** 0.02 |
| q12020  | −0.06*** −0.06*** −0.05 | −0.05** −0.05** −0.02 | −0.06* −0.04 −0.10* |
| q22020  | −0.07*** −0.08*** −0.04 | −0.06*** −0.07*** −0.04 | −0.09** −0.07* −0.02 |
| q32020  | −0.07*** −0.07*** −0.10** | −0.08*** −0.05*** −0.11* | −0.02 −0.05* −0.07 |
| q42020  | −0.08*** −0.08*** −0.10** | −0.07*** −0.08*** −0.12** | −0.10*** −0.10*** −0.01 |
| q12021  | −0.10*** −0.10*** −0.12*** | −0.12*** −0.11*** −0.15** | −0.07*** −0.09*** −0.09 |
| q22021  | −0.11*** −0.10*** −0.14*** | −0.10*** −0.09*** −0.18*** | −0.13*** −0.12*** −0.06 |
| Observations | 4,501 3,613 888 | 3,067 4,050 574 | 1,351 1,789 291 |
| R-squared | 0.98 0.98 0.98 | 0.98 0.98 0.98 | 0.98 0.98 0.99 |

Notes: Constants and quarter dummies are not reported for simplicity; t-statistics in parentheses; The significance level indicates the relative position compared to the 2018 figures.

***p < 0.01.
**p < 0.05.
*p < 0.1.

In contrast, when we only use the post-pandemic observations, such as in columns (2) to (6), the strict exogeneity assumption is satisfied. The joint tests suggest the absence of reverse causality between revenue and employment. Arguably, the relationship between these variables during the pandemic is one way: the pandemic affects firms’ revenue which is then translated into employment but not vice versa.

In columns (2) and (3), the impacts of revenue on employment are both 0.10, meaning every 10% change in revenue will change the number of employees by around 1%. The difference between the two estimations is the inclusion of interactions between revenue and time in column (3). The estimates are close to the figure from Apedo-Amah et al. (2020), who find that the employment elasticity to revenue during the pandemic is around 0.08. Differently, their study covers more countries but did not discuss the endogeneity issue prominently.

Further, we analyse if the impact of revenue on employment is heterogeneous across countries and sectors. Column (4) suggests that such an impact in Indonesia is higher than in Vietnam. The coefficient for Vietnam (IDN=0) is around

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Fig. 13. Correlation between revenues and employment (All Samples).
Source: Author’s calculation.
0.07, while the predicted coefficient for Indonesia (margins when IDN=1) is around 0.11. However, the linear combination test suggests that the difference is not statistically different, as shown in the bottom row in Table 14. The statistical difference between the coefficient is 0.05, with a p-value is 0.28, indicating there is not enough evidence to conclude that the employment elasticity of the Indonesian and the Vietnamese samples differ.

The coefficient for Indonesia from this estimation is very close to the one from Ardiyono and Patunru (2022b), who study the foreign shock’s impact on employment post-GFC by applying the instrumental variables (IV) and the GMM. Further, they show that capital intensity plays a significant role in employment elasticity, potentially explaining the different coefficients between the Indonesian and Vietnamese samples. Table 3 shows that the samples from Vietnam are more capital intensive than the Indonesian samples based on the ratios of total fixed asset to revenue and total fixed asset per employee.

To test if capital intensity affects the employment elasticity to revenue, we interact revenue with the capital intensity group. To implement this approach, we first calculate the firm’s capital intensity by dividing the total fixed asset by total revenue for each quarter before the pandemic (Q1-2018 to Q4-2019). Then, we calculate the firm’s average level of capital intensity before the pandemic and classify them into three different groups for each country. Firms with low capital intensity (around 33 percentiles) are classified into group 1, medium intensity (about 33 to 66 percentile) into group 2, and high intensity into group 3. Lastly, we regress employment on the revenue and capital intensity interaction. The result in Table 14 column (6) shows that the coefficient for the low capital-intensive firms is higher than those of
Table 14
The impact of revenue on employment using FE.

| Dependent variable                  | Number of full-time employees (ln) |
|-------------------------------------|------------------------------------|
|                                     | (1) | (2) | (3) | (4) | (5) | (6) |
| Revenue (ln, real value)           | 0.15*** (10.61) | 0.10*** (3.39) | 0.10*** (3.24) | 0.07*** (3.79) | 0.11*** (2.79) | 0.10*** (2.79) |
| Revenue x D.IDN=0                  | 0.07*** (3.79) | 0.10*** (2.79) | 0.09*** (3.03) | 0.20** (2.57) | 0.07*** (3.52) | 0.05** (2.42) |
| Revenue x D.Non-CI                 | 0.11*** (2.79) | 0.10*** (2.79) | 0.09*** (3.03) | 0.20** (2.57) | 0.07*** (3.52) | 0.05** (2.42) |
| Revenue x D.CI                     | 0.07*** (3.79) | 0.10*** (2.79) | 0.09*** (3.03) | 0.20** (2.57) | 0.07*** (3.52) | 0.05** (2.42) |
| Revenue x D.Low capital intensity   | 0.11*** (2.79) | 0.10*** (2.79) | 0.09*** (3.03) | 0.20** (2.57) | 0.07*** (3.52) | 0.05** (2.42) |
| Revenue x D.Medium capital intensity| 0.07*** (3.79) | 0.10*** (2.79) | 0.09*** (3.03) | 0.20** (2.57) | 0.07*** (3.52) | 0.05** (2.42) |
| Revenue x D.High capital intensity  | 0.05** (2.42) | 0.07*** (3.52) | 0.05** (2.42) | 0.20** (2.57) | 0.07*** (3.52) | 0.05** (2.42) |

Firm & Time FE Y Y Y Y Y Y
Revenue x time N N Y N N N
Period1 Pre & post Post Post Post Post
Observations 6,704 3,262 3,262 3,262 3,262 3,262
No of unit 572 554 554 554 554 554
Adjusted R2 0.98 0.99 0.99 0.99 0.99 0.99
Adjusted R2 within 0.12 0.08 0.08 0.09 0.08 0.11

Strict exogeneity test
Joint test (F1.Rev & F2.Rev) F-Stat 37.68 1.36 1.36 1.36 1.36 1.36
- p-value 0.00 0.26 0.26 0.26 0.26 0.26

Difference between group4 0.05 0.01 0.14*
- p-value 0.28 0.75 0.07

Notes: (1) IDN=0 refer to the Vietnamese firms. (2) Capital intensity=Total fixed asset (real value)/revenue, classified into 3 group. Q1=Low, Q2=Medium, Q3=High. (3) Pre=Q1-2018 to Q4-2019; Post=Q1-2020 to Q3-2021. 4) Between 0 and 1 in columns (4) and (5), between Low and High in column (6). All estimations include constant. Robust t-statistics in parentheses.
***p < 0.01.
**p < 0.05.
*p < 0.1.

medium and high capital-intensive firms. The linear combination test shows that the coefficient difference between the high-capital and the low-capital firms is around 0.14, significant at the 10% level.

Further, we test if the heterogeneity is evident across sectors. During the pandemic, the employment elasticity to revenue for the non-contact-intensive (non-CI) industry is around 0.10, while the figure for the contact-intensive industry is 0.09, which is very similar. The difference test using the linear combination suggests that the impact of revenue on employment between CI and non-CI firms is not statistically different. Thus, we have no evidence to conclude that the employment elasticities on revenue are heterogeneous across sectors.

5.3.2. The GMM estimations

Although we can provide evidence that the strict exogeneity assumption is satisfied using the Wooldridge exogeneity test (2010, Chapter 10), the assumption is unsatisfied if we include leads and lags of the explanatory variable on the right-hand side of the estimations as suggested by Su et al. (2016).22 To check the robustness of the FE estimation, especially from the reverse causality bias, we regress the number of full-time employees on revenue using the GMM approach. In applying the GMM, we treat the revenue and employment as endogenous and follow Kiviet (2020) to choose the valid model based on the serial correlation presence, instrument exogeneity, and endogenous assumption validity. We utilise the under-identification test proposed by Windmeijer (2021) to investigate the instruments’ validity, primarily based on their predictability power on the endogenous variable.

As shown in Table 15, column 1, the impact of revenue on employment is 0.10 and significant at a 5% level. The coefficient is the same as the one from the FE approach, which gives us more confidence. Using the estimate, we can expect that if the average firms in Indonesia suffer around a 100% drop in revenue, as occurred in Q2-2020, the number of employees will decline by around 10%. Assuming that the elasticity is also applicable to other countries in the ASEAN-5 and workers cannot switch their jobs due to the strict lockdown, it is understandable that the unemployment rate in the Philippines surged from around 6% to 17% in Q2-2020 when a very restricted lockdown was implemented.

22 We regressemployment on L1, L2, F1, and F2 of revenue. The lags and leads of the revenue are jointly significant to employment.
Table 15
The impact of revenue on employment using GMM.

| Model                | Variable                  | Samples | 1         | 2         | 3         | 4         | 5         | 6         | 7         |
|----------------------|---------------------------|---------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                      | Dependent variable        |         |           |           |           |           |           |           |           |
|                      | Number of full time       | All     | 0.83***   | 0.83***   | 0.87***   | 0.77***   | 0.84***   | 0.82***   | 0.90***   |
|                      | employees (ln)            | All     | (17.30)   | (17.37)   | (12.41)   | (9.45)    | (17.08)   | (14.37)   | (30.77)   |
|                      | Revenue (ln, real value)  | IDN     | 0.10**    | 0.10      | 0.12*     | 0.03**    | 0.03      | 0.11*     | 0.07***   |
|                      |                           | VNM     | (2.50)    | (0.87)    | (1.71)    | (2.04)    | (0.93)    | (1.91)    | (3.58)    |
|                      |                           | All     | 0.00      |           |           |           |           |           |           |
|                      |                           | Non-CI  |           |           |           |           |           |           |           |
|                      |                           | CI      |           |           |           |           |           |           |           |
|                      | Revenue x D. IDN=1        | All     | 0.10**    |           |           |           |           |           |           |
|                      |                           | (1.43)   |           |           |           |           |           |           |           |
|                      |                           | Non-CI  |           |           |           |           |           |           |           |
|                      |                           | CI      |           |           |           |           |           |           |           |
|                      | Margins at IDN=1          | All     | 0.10**    |           |           |           |           |           |           |
|                      |                           | (1.43)   |           |           |           |           |           |           |           |
|                      |                           | Non-CI  |           |           |           |           |           |           |           |
|                      |                           | CI      |           |           |           |           |           |           |           |
|                      | Margins at Non-CI=1       | All     | 0.11**    |           |           |           |           |           |           |
|                      |                           | (1.02)   |           |           |           |           |           |           |           |
|                      |                           | Non-CI  |           |           |           |           |           |           |           |
|                      |                           | CI      |           |           |           |           |           |           |           |
|                      | Joint-test p-value        | All     | 0.03      |           |           |           |           |           |           |
|                      |                           | (0.07)   |           |           |           |           |           |           |           |
|                      |                           | Non-CI  |           |           |           |           |           |           |           |
|                      |                           | CI      |           |           |           |           |           |           |           |

Variables assumptions

|                      | Full time employee | Pre     | Pre     | Pre     | Pre     | Pre     | Pre     | Pre     |
|                      | Revenue            | Endo    | Endo    | Endo    | Endo    | Endo    | Endo    | Endo    |
|                      | GM M               | Sys     | Sys     | Sys     | Sys     | Sys     | Sys     | Sys     |
| Observations         | 5,454              | 5,454   | 4,262   | 1,192   | 5,454   | 4,752   | 702     |
| Number of id         | 458                | 458     | 343     | 115     | 458     | 400     | 58      |
| No. Instruments      | 28                 | 31      | 30      | 31      | 31      | 28      | 25      |
| Hansen p-value       | 0.60               | 0.49    | 0.27    | 0.94    | 0.38    | 0.61    | 0.54    |
| AR1 p-value          | 0.00               | 0.00    | 0.00    | 0.00    | 0.00    | 0.00    | 0.00    |
| AR2 p-value          | 0.76               | 0.77    | 0.95    | 0.33    | 0.76    | 0.84    | 0.32    |
| Underidentified p-value | 0.00           | 0.00    | 0.00    | 0.01    | 0.00    | 0.00    | 0.07    |
| AIC                  | −5.23              | −5.57   | −4.44   | −11.68  | −4.68   | −5.32   | −9.03   |
| Incremental Hansen p-value | > 0.2            | Y       | Y       | Y       | Y       | Y       | Y       |

Notes: Pre=Predetermined, Endo=Endogenous, Sys=System GMM; All estimations include constant, sector, and time fixed effect; Column 2alt and 5alt assume that revenue is predetermined instead of endogenous; t-statistics in parentheses.

***p < 0.01.
**p < 0.05.
*p < 0.1.

For heterogeneity analyses, we check if the impact of revenue on employment is different based on country and sector’s contact intensity. In Table 15, column 2, we include the interaction of revenue and country dummy, 1 for Indonesia and 0 for Vietnam. The coefficient of revenue is not statistically significant; the margin for the Indonesian samples is 0.10, significant at the 5% level, suggesting that the impact of revenue on employment in Indonesia is 0.10, in line with the FE estimation. When we estimate the impact using separated samples by country, we find that the coefficient for the Indonesian firms is 0.12 at 10% alpha (column 3), while the one for the Vietnamese samples (column 4) is 0.03. However, the sample disaggregation by countries potentially creates a small sample bias in the GMM estimations, especially for the Vietnam case, where the number of samples is only 115. See Baum et al. (2003), who refer to Hayashi (2000) for small sample bias in GMM estimation.

The heterogeneity between CI and non-CI firms is also not convincing. In Table 15, column 5, the margins for the non-contact intensive industry is 0.11, significant at the 5% level showing the similarity with the baseline estimation in column (1). The result is unsatisfactory when we run the estimation using the split samples. In column 6 (non-CI firms only), the coefficient of revenue is 0.11 but marginally significant. While in column 7 (CI-firms only), the figure is 0.07, significant at a 1% level, but the estimation hardly passes the under-identification test. Although these estimates are very similar to the ones from FE estimations, the result is not highly satisfactory because of the limited samples from the CI industry that affect the GMM robustness.

Except for the one in column (7), the estimations in Table 15 are satisfactory based on the valid GMM criteria. First, the instruments are exogenous and robust. The Hansen p-values in all estimations are above 0.5, suggesting that the instruments are jointly exogenous, while the difference-in-Hansen p-value of each instrument is above 0.2, suggesting the exogeneity of each instrument.23 Second, the instruments have strong predictability power on the non-exogenous

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23 It follows the criteria suggested by Kiviet (2020).
variable. This conclusion is based on the under-identification test suggested by Windmeijer (2021).\(^{24}\) Third, there is no remaining second-order serial correlation with the AR-2 \(p\)-values above 0.70. Fourth, no instrument proliferation issue that potentially affects the instrument exogeneity. Although there is no maximum standard, Roodman (2009) suggests that the number of instruments should be far below the unit of observation. In all estimations, the number of instruments is around 28 to 36, far below the number of firms, which is 458.

The limitation is that the samples from Vietnam firms (column 4) and CI industries (column 7) are small, potentially affecting the robustness of the GMM estimations. However, when all samples are pooled together, such as in columns (1) and (2), the results from the GMM and FE estimations are similar, providing confidence in their validity.

5.3.3. The multi-period DiD estimations

To check the robustness of the FE and GMM estimations and to identify the impact path over time, we conducted event analyses using multi-period DiD with the detailed identification and the empirical strategy in Section 3.2.4. Table 16 shows that the impact of revenue on employment is around -0.09 based on acceptable DiD estimations in columns (2), (3), and (7). The treated group used in columns (1) to (3) are firms whose real revenue during the pandemic is below 90% of their pre-pandemic level, while the ones in columns (4) to (7) are those whose post-pandemic figure is less than 80%. The 80% threshold provides a clear separation between the treated and control groups. Both strategies produce similar estimates when the pre-trend holds, -0.09 significant at 1%.

Models (2), (3), and (7) are preferred because their pre-trend \(p\)-value is above 0.10, suggesting that the parallel trend holds. Different from Model (2), Model (3) and (7) include a country dummy and make them conditional models in which the parallel trend holds conditional on the country dummy.\(^{25}\)

To see if the impact is heterogeneous across countries, we run the estimations using split samples by country. Table 16, columns (8) to (11) show that the average impacts in the two countries are very close to the FE and GMM estimates: the average treated for the treated (ATT) in Indonesia is around -0.10, while that in Vietnam is -0.07. However, as we run the estimations separately, we cannot provide evidence if the coefficients are statistically different.

The benefit of using event analyses is that we can see the impact path over time, as presented in Fig. 16 and Table 16. In Indonesia and Vietnam, the impact of revenue on employment is statistically significant at 5% in T+1 with similar magnitudes, -0.08 and -0.09, respectively (Table 16, columns 9 & 10). It means the employment of firms whose revenue falls below 80% of their pre-pandemic level is 8%–9% lower in Indonesia and Vietnam one quarter after the restrictions were imposed. In the next quarter, employment in Indonesia fell to 12% lower while the one in Vietnam is steady at 9% lower. In T+3, the Indonesian firms still reduced their employment to balance the declining revenue, while no such evidence was found in Vietnam at T+3 (see also Fig. 16).

By comparing these figures with the firms’ revenue in each country (Fig. 7), we can see that firms started to adjust their employment right after the restriction was imposed in Q2-2020. As the revenue decline is deeper in Indonesia, the employment reductions are more substantial but gradual, from 8% in T+1 to 18% in T+3. In contrast, the adjustment in Vietnam is faster, completed in one quarter, although the magnitude is smaller in line with their more minor revenue loss. This behaviour fits with the literature suggesting that stricter labour regulation will slow labour adjustment because it is costly and leads to labour hoarding. As discussed by Ardijono and Patunru (2022a), the labour regulation in Indonesia was more rigid than the one in Vietnam. In comparison, the redundancy cost in Indonesia was worth 57.8 weeks of salary, while the similar cost in Vietnam was around 24.6 weeks (Schwab, 2019).\(^{26}\)

The slower adjustment in Indonesia is confirmed when we disaggregate the analyses into CI and non-CI firms. Fig. 17 (panels a and b) and Table 16 (columns (12) to (15)) show that the labour adjustments of CI firms in Indonesia became statistically significant at T+2 with a magnitude of 14% and escalated to 27% in T+3. In comparison, the one in Vietnam started in T+1 with a magnitude of 28% and kept relatively constant until T+3. In other words, while the adjustment in CI firms in both countries reached more than 25%, the Indonesian firms completed the adjustment in T+3 while the one in Vietnam did it in T+1. A similar story is shown by the non-CI firm in both countries (Fig. 17 Panel c and d, Table 16 columns 14 and 15). The employment reduction of non-CI firms in Indonesia escalated from T+1 to T+3. At the same time, the one in Vietnam is significant in T+1 but turns insignificant in T+2 and T+3, suggesting the labour adjustment in Vietnam is instantaneously completed. Again, this pattern exhibits the slower labour adjustments in Indonesia relative to Vietnam during the pandemic.

6. Conclusion & policy implications

Numerous studies have investigated the impact of the Covid-19 pandemic on firm performance and employment, but few have discussed the evolution of adjustments and the link between revenue and employment during the pandemic. To fill this gap, we use the listed firm data from the ASEAN-5 from Q1-2018 to Q3-2021 to see the impact of the pandemic on

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\(^{24}\) The hypothesis of the test is the instruments have no predictability power on the non-exogenous variable.

\(^{25}\) We use improved doubly robust DiD estimator, which is a default in csdid command, for all estimations

\(^{26}\) In Q1-2021, the Indonesian government issued Regulation No. 35/2021 as part of the Omnibus Law, reducing the redundancy cost to around 22 weeks. As we assign Q1-2020 as T+0, our estimations only cover the observations until T+3 (Q4-2020) or before the policy changes implementation.
Table 16
The impact of revenue on employment using event study.

| Period     | [1]       | [2]       | [3]       | [4]       | [5]       | [6]       | [7]       | [8]       | [9]       | [10]      | [11]      | [12]      | [13]      | [14]      | [15]      |
|------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| ATT        | −0.09***  | −0.09***  | −0.08***  | −0.10**   | −0.09***  | −0.09***  | −0.10**   | −0.10***  | −0.10***  | −0.07**   | −0.07**   | −0.14***  | −0.26***  | −0.10***  | −0.04***  |
| t-stat     | (−6.31)   | (−6.31)   | (−5.53)   | (−5.53)   | (−5.53)   | (−5.53)   | (−5.53)   | (−5.41)   | (−5.41)   | (−2.32)   | (−2.32)   | (−2.35)   | (−2.35)   | (−2.35)   | (−2.35)   |
| Pre average| 0.03***   | 0.03***   | 0.03***   | 0.03***   | 0.03***   | 0.03***   | 0.03***   | 0.03***   | 0.03***   | 0.04***   | 0.04***   | 0.04***   | 0.04***   | 0.04***   | 0.04***   |
| T−4        | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      |
| T−3        | 0.06      | 0.06      | 0.06      | 0.06      | 0.06      | 0.06      | 0.06      | 0.06      | 0.06      | 0.06      | 0.06      | 0.06      | 0.06      | 0.06      | 0.06      |
| T−2        | 0.00      | 0.00      | 0.00      | 0.00      | 0.00      | 0.00      | 0.00      | 0.00      | 0.00      | 0.00      | 0.00      | 0.00      | 0.00      | 0.00      | 0.00      |
| T−1        | 0.02      | 0.02      | 0.02      | 0.02      | 0.02      | 0.02      | 0.02      | 0.02      | 0.02      | 0.02      | 0.02      | 0.02      | 0.02      | 0.02      | 0.02      |
| T+0        | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      | 0.03      |
| T+1        | 0.09***   | 0.09***   | 0.09***   | 0.09***   | 0.09***   | 0.09***   | 0.09***   | 0.09***   | 0.09***   | 0.09***   | 0.09***   | 0.09***   | 0.09***   | 0.09***   | 0.09***   |
| T+2        | −0.11**   | −0.11**   | −0.11**   | −0.11**   | −0.11**   | −0.11**   | −0.12**   | −0.12**   | −0.12**   | −0.12**   | −0.12**   | −0.12**   | −0.12**   | −0.12**   | −0.12**   |
| T+3        | −0.13***  | −0.13***  | −0.13***  | −0.13***  | −0.13***  | −0.13***  | −0.18***  | −0.18***  | −0.18***  | −0.18***  | −0.18***  | −0.18***  | −0.18***  | −0.18***  | −0.18***  |

Notes: The number shows the level of employment of the treated group (firms whose revenues fall below the threshold) compared to the control group due to their revenue declines. The threshold refers to the level of firms revenue during Covid compared to the pre-Covid level. IDN=Indonesia, VNM=Vietnam. ATT=Average Treatment Effect of the Treated. Robust t-statistics in parentheses.

***p < 0.01.
**p < 0.05.
p < 0.1.
firms’ performance, the employment elasticity of revenue, and the impact path of revenue on employment. We summarise the finding with some policy implications below.

The impact of the pandemic on firms’ performance is heterogeneous across sectors, countries, and time depending on the pace of virus spread and the degree of government restrictions. For most ASEAN-5 countries, the correlations between government restriction, mobility, and firms revenue were very high in 2020 but weakened in 2021 as most governments implemented restrictions more selectively and rolled out vaccination programs. Arguably, the restriction is necessary to maintain the public health order during the pandemic, but it increases unemployment which should be
adequately mitigated. To explain the transmission mechanism of restriction to unemployment, we investigate the firms’ performance during the pandemic and analyse how the revenue loss affects their hiring decisions.

During the pandemic, both firms in the contact-intensive and non-contact-intensive industries suffered revenue loss, although the magnitude for the former was more substantial as they were more bound to government restrictions. In countries where the number of cases was low or restrictions were selectively implemented, such as Thailand, Malaysia, and Vietnam, firms’ performance recovers faster. In the Philippines and Indonesia, where restrictions were stricter and extensively implemented, shocks from revenue drops were amplified by the surging cost of unsold inventory and idle labour. During the pandemic, the firms’ inventory-to-revenue ratios in Indonesia and the Philippines were persistently higher than their pre-pandemic level, while their counterparts in other ASEAN-5 were able to adjust it in one or two quarters after the initial lockdown. With such deteriorating revenue and surging costs, firms’ profitability declined, pushing them to reduce the number of workers, leading to rising unemployment.

Using samples from Indonesia and Vietnam, we find that the employment elasticity to revenue is around 0.10, suggesting that every 10% revenue decline will be translated into around a 1% headcount reduction. The estimates are consistent when we use the fixed effect (FE) and the generalised method of moments (GMM) that respectively address the strict exogeneity assumption and the reverse causality bias. In general, both approaches suggest that the average contemporaneous impact of revenue on employment during the pandemic is not statistically different between industries and countries. It implies that revenue is the key to the employment hiring decision. However, our event analyses reveal that the labour adjustments’ paths are heterogeneous across industries and countries during the pandemic.

By comparing the firms’ responses in Indonesia and Vietnam and disaggregating them into contact-intensive and non-contact-intensive, we find that the labour reductions are country-specific and not instantaneous. In both countries, the employment reduction was not statistically significant in T+0 (Q1-2020). In Indonesia, the labour adjustment in the contact-intensive industry became significant at T+2 or two quarters after the pandemic began, and the magnitude intensified until T+3. In contrast, the labour adjustment in the same industry in Vietnam happened in T+1 and stabilised until T+3. A similar pattern is also evident in the non-contact intensive industries, where the adjustment in Indonesia was gradual, while the one in Vietnam was completed in one quarter, suggesting labour market rigidities in Indonesia. The potential cause is the more stringent hiring and firing regulation in Indonesia, for example, on their much higher redundancy cost. Numerous studies have shown that hiring and firing regulation affects the cost and the speed of labour adjustment, but such causation is beyond the scope of this paper.

The findings emphasise the importance of effective pandemic responses at the macro and micro levels to maintain firms’ revenues and employment. At the macro level, a measurable public health response that allows firms to generate revenue is the key to retaining employment during the pandemic. In countries such as Thailand and Vietnam, where the number of cases can be suppressed in 2020, the government can impose conditional restrictions, such as a specific-location lockdown instead of a widespread one, allowing the contact-intensive business in low-risk areas to operate. However, the relaxation in this industry should be followed by a robust health protocol to contain the virus spread. Meanwhile, at the micro-level, firms should adopt business models that enable them to maintain revenue without compromising public health. As evident from numerous studies, digitisation and online platform that enable firms to sell their product without face-to-face interaction should be promoted to increase firms’ agility in coping with a pandemic shock.

Acknowledgments

I am grateful to Dr Arianto Patunru for all suggestions, comments, and discussions that significantly improved this manuscript. I also thank Dr Yixiao Zhou, Joel Bowman, and the reviewer for their constructive comments. The financial support from the central bank of Indonesia is gratefully acknowledged. The opinion and errors are my own.

Appendix. Production function

We refer to Bond and Van Reneen (2007) for the micro-foundation exposition. They consider a firm’s production function with constant elasticity of the substitution (CES) as follows:

\[
Y_t = F(K, L) = (a KL^\rho + a_0 L^\rho) ^{\frac{1}{\rho}}
\]

(A.1)

Where \( \rho = \frac{\sigma - 1}{\sigma} \) and \( \sigma \) is the elasticity of substitution between capital and labour.

It is assumed there is some degree of monopolistic competition, and the firm faces a downward sloping demand curve for its output \( Y_t \) of the iso-elastic form

\[
p_t = BY_t^{-\frac{1}{\gamma}}
\]

(A.2)

Where \( B \) is a demand shift parameter and \( \eta^0 > 1 \) is the price elasticity of product demand. So, the demands for capital and labour become:

\[
\pi_t(K_t, L_t) = p_t Y_t - w_t L_t - r_t K_t
\]

(A.3)

\[
\frac{\partial \pi_t}{\partial L_t} = \frac{dp_t}{dY_t} \frac{dY_t}{dL_t} Y_t + \frac{dY_t}{dL_t} p_t - w_t = 0
\]

(A.4)
From (2), we get:

\[ \ln p_t = \ln B - \frac{1}{\eta D} \ln Y_t \]

\[ \frac{\partial \ln p_t}{\partial \ln Y_t} = \frac{1}{\eta D} \]

\[ \frac{\partial p_t / p_t}{\partial Y_t / Y_t} = -\frac{1}{\eta D} \]

\[ \frac{\partial p_t}{\partial Y_t} = p_t \left( 1 - \frac{1}{\eta D} \right) \frac{\partial Y_t}{\partial L_t} \]

(A.5)

Substituting (5) into (4) and rearranging \( p_t \) yield

\[ p_t \left( 1 - \frac{1}{\eta D} \right) \frac{\partial Y_t}{\partial L_t} = w_t \]

(A.6)

From (1), we can get the solution for \( \frac{\partial Y_t}{\partial L_t} \)

\[ \frac{\partial Y_t}{\partial L_t} = \frac{\partial Y_t}{\partial (\cdot)} \frac{\partial (\cdot)}{\partial L_t} = 0 \]

\[ = \frac{1}{\rho} \left( a_k K_t^\rho + a_L L_t^\rho \right)^{\frac{1}{\rho} - 1} \cdot \left( a_k L_t \right)^{\rho - 1} \]

\[ = \frac{Y_t}{\left( a_k K_t^\rho + a_L L_t^\rho \right)} \cdot a_k L_t^{\rho - 1} = Y_t \left( Y_t \rho \right) a_k L_t^{\rho - 1} = \frac{a_k L_t^{\rho - 1}}{Y_t^{\rho - 1}} \]

(A.7)

Substituting (7) into (6) and rearranging \( L_t \) yield:

\[ p_t \left( 1 - \frac{1}{\eta D} \right) \frac{a_k L_t^{\rho - 1}}{Y_t^{\rho - 1}} = w_t \]

\[ L_t^{\rho - 1} = \frac{Y_t^{\rho - 1}}{a_k} \cdot \frac{w_t}{p_t \left( 1 - \frac{1}{\eta D} \right)} \]

\[ L_t = a_k^{\rho - 1} \cdot Y_t \left( \frac{w_t}{p_t \left( 1 - \frac{1}{\eta D} \right)} \right)^{\frac{1}{\rho - 1}} \]

(A.8)

Since \( \sigma = \frac{1}{1 - \rho} \), so

\[ L_t = a_k^{\sigma} \cdot Y_t \left( \frac{w_t}{p_t \left( 1 - \frac{1}{\eta D} \right)} \right)^{-\sigma} \]

(A.9)

The log-linear Equation

\[ \ln L_t = \sigma \ln a_k \left( 1 - \frac{1}{\eta D} \right) + \ln Y_t - \sigma \ln \left( \frac{w}{p} \right) \]

(A.10)

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