



Structural Shocks and Migrant Worker Vulnerability in Singapore: An Interrupted Time Series Analysis from 2005 to 2025

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Abstract

The large numbers of low-waged migrant workers in Singapore leads to the concentration of employment opportunities in high-risk, low-protection jobs and ties up most workers to single-employer licenses; this relationship stifles injury reporting and limits access to care, and increases occupational vulnerability. This paper is based on a time-series analysis that uses the period of 2005-2025 to model the inflow of migrant workers into Singapore with a time variable, a Post-COVID level indicator and Time×Post-COVID interaction to determine the structural changes around the COVID-19 pandemic. The results indicate that the baseline time trend has a positive effect on the outcome over time (coefficient = 0.0384), that the occurrence of COVID is accompanied by a significant immediate decline of the outcome (coefficient = -0.3227), and that the post-COVID interaction suggests a positive change in the outcome growth thereafter (coefficient = 0.0383). Marginal-effects interpretation demonstrates a negative level effect at the onset of the COVID and faster growth afterward, which provisos that the shock decreased the levels, but was succeeded by an aggravated positive direction. These trends refer to both immediate negative effects of crises, as well as structural processes that require the policy to remedy, such as the enhancement of reporting protective measures, healthcare access, and structural labor reforms of migrant employees.

Keywords: *Migrant Workers; COVID-19; Global Recession; ITSA; Single Employer; Singapore*

Introduction

Most workers end up claiming injuries or illnesses but most of them take long to report the injuries or illnesses due to uncertainty over the severity of their conditions as well as lack of knowledge about the compensation procedures that the workers are entitled to. Through language barriers, access to care and effective communication is also hindered further adding to fears of job insecurity. One more factor that contributes to under-reporting is the situation of employer suppression, unfavorable attitudes towards the compensation system, which highlights the fact that the increase of linguistic and cultural competence is not enough. These barriers need to be overcome by a comprehensive systemic policy and procedure

changes (Premji et al., 2022). Work-permit reliance on one employer prevents migrant workers in Singapore to report their problems in the work place out of the fear of retaliation, language barriers, default, and sub-par living standards. The behavior of supervisors is an important factor that affects whether they choose to be silent or to speak up (Purnell, 2023).

This research records a high rate of workplace injuries and deaths amidst the migrant workers in Singapore and this is evidence of the precarity in their working conditions. This vulnerability is caused by hazardous working conditions, lack of adherence to the safety standards, and socio-cultural and political obstacles that inhibit health-seeking behavior. The study proposes the so-called concept of the produced injured, which refers to those people whose vulnerability in terms of being harmed is exacerbated by the political economy of migrant labour. The main ones are the organization of migration, deportability, the contract fraud, and fraudulent recruitment procedures (Yea, 2022). The research identifies the high legal, social, and economic limitations to migrant workers in Singapore as it notes that the transnational labour economy does not only render capital back to the home country in terms of monetary money remittances but also the physical and emotional costs on workers, as it is also referred to as broken bodies. The research provides empirical evidence on the manner in which labour-market volatility makes unskilled migrant workers expendable and shows the multidimensional relationship between workers, employers, NGOs, and bureaucrats, locating these experience within larger political and cultural processes of globalization (Koh, 2016). The dependency of work-permits encourages the fear of being displaced, which prevents the Bangladeshi workers to report. Languages, debts, poor sleeping conditions, and behaviour of supervisors also play an important role in whether they will be silent or raise their voices about issues at the workplace (Dutta, 2017).

Poor living- and working-conditions put migrant workers under continuous stress, whereas the future expectations of stigma and unwillingness to seek medical help only add to the mental-health burden (Farwin et al., 2023). The literature on low-paid construction workers of the Tamils in Singapore emphasizes the concept of social marginalization and precarious working condition of the workers, where they lacked a place in the narrative of state as they contributed significantly to the labour market. In spite of being viewed as faceless and voiceless, these labourers have been shown to be agents and possess a sense of identity and viewing their work as a collective contribution to the development of Singapore. The paper determines a two-fold precarity, namely labour precarity, which is defined by discrimination and adverse working environment, and place precarity, which is characterised by social exclusion and restricted resources (Hamid and Tutt, 2019). The studies on construction industry point out that subcontracting is linked with increased number of accidents in the workplace with significant proportion of migrant workers being the victims. The lack of safety awareness and communication barriers in foreign workers increase their vulnerability, and the use of subcontracted labour makes supervising and coordinating activities more complicated, which affects the deterioration in safety standards. Research also indicates that there is a positive correlation between commitment of workers to a company and safety performance, meaning that companies that have a high rate of subcontracting can perform poorly in safety aspects. Despite the fact that a lot of studies have been done to establish the impact of subcontracting on the wages and working conditions, health and safety has not been explored extensively (Debrah and Ofori, 2001).

The level of language proficiency also plays a vital role in determining whether migrant workers will report a workplace problem in Singapore because English incompetence results in a practical issue of communication, which causes embarrassment and fear of not understanding the instructions, which discourages the former to discuss their working conditions (Rubdy and McKay, 2013). It has been shown that the legal position of migrant domestic workers in Singapore imposes some type of allegiance to its employer-sponsor since their residency depends on the existence of active and sole live-in employment. This dependency on work-permits adds to precarity and may subject workers to a number of different forms of soft violence, restricting their rights of assertion and reporting of workplace issues. Such a legal

approach to unfree labour management is an essential amount of influence over the welfare of migrant domestic workers by continuing to disempower and exploit them and directly impacting their readiness to report about injuries, unpaid wages, or unsafe working conditions (Parrenas et al., 2020).

Literature Review

Migrant workers rely on an individual employer to issue work permits is likely to discourage the reporting of grievances at work place since the fear of being dismissed is a very strong force. The significance of language barriers, indebtedness, low-quality living conditions, and the behavior of supervisors become the critical factors that define whether the workers want to stay quiet or speak up (Parreñas et al., 2020). Two major conceptual issues inherent in understanding precarious employment: the identification of social vulnerabilities and the distribution of moral responsibility within networks that create social vulnerabilities. Low pay, short term contracts and poor legal safeguards all breed economic insecurity and social marginalisation of migrant labour in Singapore, and relational practices between employers and the state amplify dependence, disempowerment and discrimination. Moral complicity is classified as enabling, collaborating, and condoning the creation of precarity, which further intensifies shared responsibility in actors; simultaneously, the general management plans often decentralised the responsibility and weakened the long-term well-being of employees (Chin, 2019).

A significant proportion of the male migrant workers (71 %) were either not covered by health insurance or were not aware of this. Among the respondents who indicated that they have been ill during their stay in Singapore, 87 percent sought medical treatment, which shows that the rate of utilisation of healthcare services is relatively high. The probability of seeing a physician was positively related to the number of planned rest days and higher monthly salaries, indicating that the financial and temporal limitations mediate the health-seeking behaviour. Notably, 15 percent of respondents reported that they plan to continue to work regardless of severe pain that can be related to a work-related injury, which is concerning with regard to health and work. Workers with lower income were more willing to show their concerns about the cost of healthcare and the uncertainty about coverage, thus demonstrating the lack of awareness about their rights and the support systems that exist (Lee et al., 2014). The risk of workplace accidents, injuries, and even deaths faced by migrant workers is high, and the risk profile is determined by the language barrier, insufficient education, the divergence between cultures, exploitation, racism, discrimination, and the number of years stayed in the country (Thamrin, 2019).

The current body of literature is keen on conditionality as the key element in explaining precarity that faces migrant domestic workers in Singapore, demonstrating that conditions imposed play a significant role in shaping their vulnerability and instability. The role of migration industry and how migration policy and labour market demand contribute to the continued existence of these precarious conditions is highlighted by researchers who view that systemic changes are urgent to improve the working and living conditions of these workers (Wee et al., 2019). The migration of low paid labour in Singapore is mainly caused by factors of economic utility, which usually puts aside the issue of ethics, and isolated interventions on discrete issues have low effectiveness. A labour justice system, with the so-called precarity package and the democratization of institutions and collective political responsibility, proper empowerment of migrant workers (Chok, 2013). Occupational accidents are also more fatal among migrant workers compared to the natives, which is mainly because of their concentration in the high-risk occupations. This lack of global and national indicators on migrant health leads to partial and piecemeal data regardless of their growing impact in reducing labour deficits in less favourable sectors. There is an increasing trend of reported work-related injuries and work-related diseases among the migrant workers as compared to the trends realized among the native workers. The article stresses the need to improve data-collection systems and specific risk-management measures to reduce the impact of occupational health and safety among migrant employees (Porru & Baldo, 2022).

With the COVID-19 pandemic, the mainstream media portrayed low-paid migrant labourers in Singapore as dangerous to health, focusing on their living standards yet virtually ignoring structural vulnerabilities. Insurance has changed on a cultural description of behaviour to an acknowledgement of a victim of systemic injustice, but rights-based models have been missing. In the study, precarious living conditions were also identified as not allowing workers to seek medical attention; hence the need to have a systemic review of labour management practices to enhance their working and living conditions (Kaur, Gill, 2020). The report brings out the structural violence faced by low-waged migrant workers in Singapore, which was compounded by substandard housing, sanitation, and food insecurity during the COVID-19 pandemic. Crowded dorms hindered compliance to health standards by workers, and their voices were undermined and access to information and resources were limited by authoritarian state management. Anxiety and depression were reported to be related to cramped and prison-like living conditions and demonstrated that the needs of the participants are not met by official responses and that the available support systems fail to work properly (Dutta, 2020). The COVID-19 pandemic increased the vulnerability of migrant workers, who the host states acted to protect by taking policy actions (Medina, 2023). The migrant worker population in Singapore has been disproportionately affected by the COVID-19 pandemic and resulted in the largest number of cases per million in Southeast Asia. The discrimination against workers with lower wages has been also exacerbated and their vulnerability to exploitation also increased. Though the responses of the government were quick and effective, they were more of treating migrant workers as the source of danger than the community that needs protection. Systemic deficiencies in the management of migrant workers have been revealed by the crisis, which highlights the necessity to introduce wholesale reforms to prevent future crises (Farwin et al., 2023). The movement of occupational risks with migrant workers in industrial premises has risen after COVID-19 due to labour shortages and the rise in societal awareness of occupation health and safety concerns. The lack of previous studies highlights the importance of enhancing the society perception of migrant workers to counter the low awareness and negative perceptions to successfully cope with these risks (Lee, 2023).

Empirical studies have identified a set of factors that inform the patterns of employment of migrant workers during financial crises and hence highlight the distinctive susceptibilities faced by members of this group of workers during economic downturns. According to such studies, such adversities repeatedly occur in the form of job displacement, wage reduction, and augmented job security. Available literature suggests tailored solutions and policy tools to reduce these harmful effects, which explains the necessity of actions capable of specifically addressing the unique risks facing migrant workers in the times of fiscal unpredictability (XUE, n.d.).

The global recession of 2008 affected migrant workers in Singapore, with job displacement, wage non-payment, and failure to be paid by the employers. Many people sought the help of non-governmental organizations, which further added to their vulnerability, as employers began implementing phantom-worker arrangements which sought to avoid statutory provisions of employment (Ong, 2014).

Analytical literature on the 2008 financial crisis emphasizes its far-reaching impact on the working opportunities of migrant employees, which is a demonstration of the increased vulnerability to joblessness during economic downturns. Scholars emphasise the need to have long-term, consistent employment policies that ensure holistic employment noting that current ones may not be adequate. The proposed measures regarding the promotion of employment stability include statistical monitoring, labor-security warnings, emergency response systems, and social-security solutions specific to the population of migrant workers (Long, n.d.).

Methodology

Research design

The current research chose a quantitative design of secondary data time-series regression to examine how structural shocks are related to policy-relevant timeframes and susceptibility of migrant workers in Singapore. In particular, it studies discontinuities, including the COVID-19 pandemic (since 2020) and the 2008 Global Financial Crisis that have both influenced the time-dependent trend of the outcome variable.

This research was conducted in Singapore, a jurisdiction where the low-wage migrant labor force is laboring on a work-permit regime that creates a high dependency on one employer. This regulatory regime can affect the incentive of employees to disclose occupational accidents including injuries, wage infraction or unsafe environments.

Data source

The secondary data were obtained in the form of publicly available online statistics, institutional reports, and peer-reviewed literature on the topic of migrant worker workplace vulnerability in Singapore.

Model Specification

The dependent variable was log-transformed ($\ln(Y)$) to estimate temporal trends and structural changes after a significant event. This change enables proportional interpretation and stabilisation of variance across the time series.

Model 1:

Key variables:

Time- a continuous variable that represents A continuous time unit (years).

The post-COVID - a number that indicates the years since 2020 (dummy, 0 = pre-COVID, 1 = post-COVID).

TimePostCOVID The interaction term between Time and PostCOVID, the change in slope after the intervention.

The general regression equation:

$$\ln(Y) = \beta_0 + \beta_1 \cdot \text{Time} + \beta_2 \cdot \text{Post-COVID} + \beta_3 \cdot \text{TimePostCOVID} + \varepsilon$$

Model 2:

Key variables:

Time- a continuous variable, where the units of time are evenly spaced (years).

GlobalRecession2008 - A dummy variable representing the years before 2008 = 0 and 2008 and following (post-global-recession) = 1.

TimeGlobalRecession - the interaction term between Time and GlobalRecession2008, which is the slope change following the 2008 recession.

Revised model:

$$\ln(Y) = \beta_0 + \beta_1 \cdot \text{Time} + \beta_2 \cdot \text{GlobalRecession2008} + \beta_3 \cdot \text{TimeGlobalRecession} + \varepsilon$$

Interpretation:

β_1 is the previous yearly trend in 2008 and onwards;
The immediate level change of 2008 recession is captured by 2;
A 3 indicates the change of the annual trend since the recession.

Testing and Robustness

To ensure the validity of statistical inference, a test of serial correlation and model specification was conducted in the study. A BreuschGodfrey LM test was used to identify autocorrelation within the residual. Since time-series data are likely to violate the assumption of independence, Newey-West robust standard errors have been estimated to eliminate heteroskedasticity and autocorrelation. The residual behaviour was also analysed through a scatter plot between fitted values versus residuals, a visual analysis of systematic patterns and possible model misspecification.

Analysis

Interrupted time series analysis has been conducted on data using STATA MP 16.

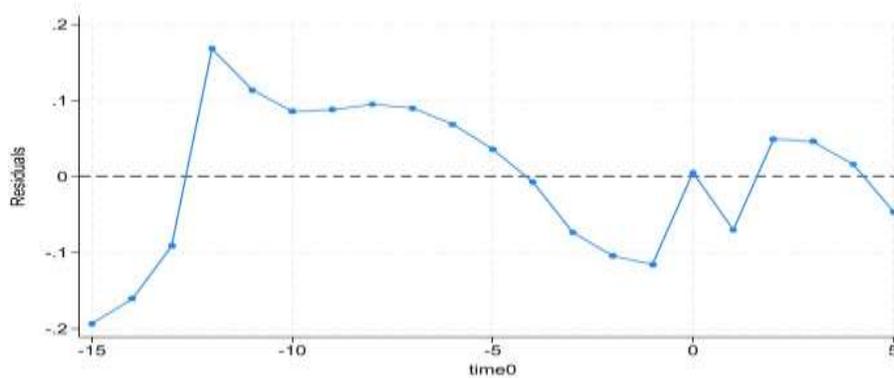
Table 1
Baseline Model

Source	SS	df	MS	Number of obs =	21
Model	.648983714	3	.216327905	F(3, 17) =	19.11
Residual	.192443819	17	.011320225	Prob > F =	0.0000
				R-squared =	0.7713
				Adj R-squared =	0.7309
Total	.841427533	20	.042071377	Root MSE =	.1064

	lnY	Coefficient	Std. err.	Std.	> t	P	[95% conf. interval]
post	time_	.03	.02	.46	1	0	- .0170105 .0936131
post	post_	- .32269	.09	3.35	0.004	0	-.5258446 .1195355
covid	time0	.0384	.00	.04	6	0	.02 4985 .0518151
	_cons	13.9687	.05	41.63	2	0	13.8 4675 14.09069

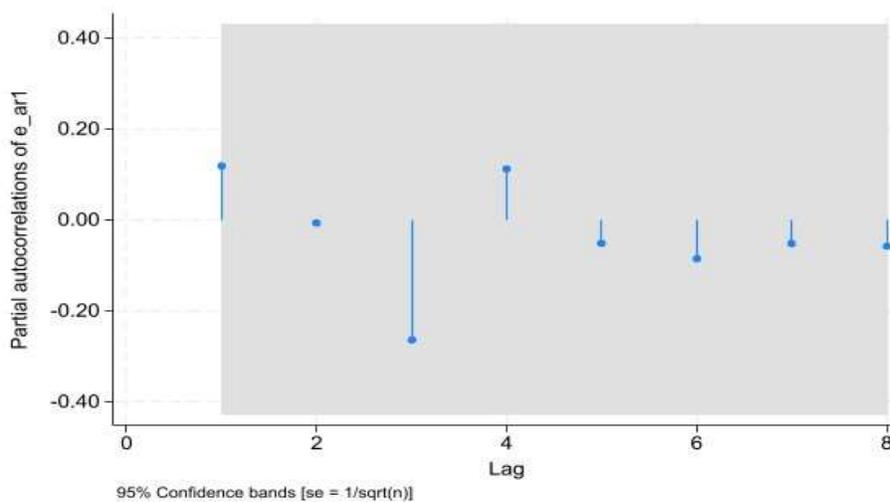
The regression findings suggest that the trend in the baseline time in lnY is strong and positive. The time0 coefficient is 0.0384 ($p < 0.001$), which means that the average increase in Y with time is about 3.9 per cent (95% CI: 0.025 to 0.0518). The post-COVID indicator is associated with a statistically significant and substantive immediate decline and the postcovid coefficient is -0.3227 ($p = 0.004$), which represents an approximate 27.6 95 percent interval decrease in Y at the beginning of the post-COVID period (95 percent CI of the effect -52.6 percent to -11.9 percent). In comparison, the post-COVID slope change (timepost) is positive (0.0383) but nonsignificant ($p = 0.162$; 95% CI: -0.0170 to 0.0936), which does not give any credible evidence that the time trend in ln Y altered due to the advent of COVID. The value of the intercept (13.9687) presents the predicted value of lnY, given that covariates are set to zero; the substantive meaning of the intercept depends on whether the zero-value of the predictors makes sense. These findings imply that there is a consistent upward trend before the COVID and a significant change in the level at the onset of COVID, but no definitive change in the slope of the post-COVID trend.

Figure 1
Residual Scatter Plot



The time-based plot of the residuals has an obvious, unrandom trend. Between time0 ⁶ - 15 and ⁷ - 9, the number of residuals increases steeply to ⁻ 0.20, then positively and more gradually to ⁻ 4. Between - 4 and 0 the residuals decline but touching zero at -0.12 and small wiggles on the positive side between the time0 of -4 and time0 of 0. This serially progressive, gradually changing pattern (not scattered white-noise around zero), signs of first-order autocorrelation and systemic model misfit at other times, in line with the BreuschGodfrey outcome in Table 3. Substantively, it is noted that the pre-period displays a strong upward outlier (there may also be an outlier around the transition, but not isolated large discontinuities) with a smooth decrease to the pre/post transition; no single large discontinuity at time0 occurs, but a shift in the pattern around the transition with short-term spikes just post 0. In practice, these characteristics imply that the model must consider serial correlation and potential time-varying structure, such as through the use of Newey-West or AR errors (or inclusion of lagged dependent terms, seasonal or nonlinear time trends), verify the effect of early outliers, and plot fitted values with confidence bands to determine whether the model is reflecting the observed dynamics.

Figure 2
Partial autocorrelation



The plotted residuals show that there is a distinct temporal trend, as opposed to a random scattering around zero: the residuals increase sharply between about -0.20 at time0 0 -15 and about +0.15 at zero - 12, and have moderate oscillations around zero in the post-period. Such a time-evolving structure, which is systematic and slow, points to first-order serial dependence and model misspecification. Such

diagnostics promote the application of inference techniques that are strong against autocorrelation (NeweyWest standard errors, autoregressive error terms or lagged dependent variables) and additional model-checking (influence diagnostics, fitted-value plots with confidence bands, etc.).

Table 4
Regression with Newey–West standard errors

Regression with Newey–West standard errors		Number of obs	=	21
Maximum lag = 1		F(3, 17)	=	30.82
		Prob > F	=	0.0000

lnY	Coefficient	Newey-West std. err.	> t	P	[95% conf. interval]
post time_	.03	.01	2	0	.009
post post_	.83013	.38589	.76	.013	0
covid time0	.32269	.36094	3.86	.001	.4990905
_cons	.0384	.07256	.58	.002	5771
	13.	.07	1	0	13.8
	.96872	.83132	78.37	.000	0349
					4.13395

The plotted residuals show that there is a distinct temporal trend, as opposed to a random scattering around zero: the residuals increase sharply between about -0.20 at time0 0 -15 and about +0.15 at zero -12, and have moderate oscillations around zero in the post-period. Such a time-evolving structure, which is systematic and slow, points to first-order serial dependence and model misspecification. Such diagnostics promote the application of inference techniques that are strong against autocorrelation (NeweyWest standard errors, autoregressive error terms or lagged dependent variables) and additional model-checking (influence diagnostics, fitted-value plots with confidence bands, etc.).

Limitations

The research relies on aggregated secondary data thus reducing the ability to assess the predictors at an individual level (such as personal indebtedness, supervisory behavior, or linguistic ability) directly. Besides, the models can identify change in trends and associations but cannot definitively determine causality due to the presence of confounding factors and the limitation of data. However, the approach is adequate to evaluate structural changes over a period and to produce evidence that is relevant to the vulnerability of migrant workers and barriers to reporting.

Recommendations

1. Despite the limited civil society environment in Singapore, non-governmental organizations (HOME and TWC2) have realized small but significant legal change in the migrant worker complaint system. Production politics between employees and employers, the recognition of the NGO welfare functions by the state, create the avenues of advocacy and issues resolutions even in an authoritarian environment (Bal, 2015).
2. There is a need to improve data-collection systems that include migrant workers to assess their health and occupational risks. Specialized risk-management programs, in combination with synchronized international health surveillance systems, should counteract the specific issues that this population demographic is facing (Porru & Baldo, 2022).
3. It is predicted that the migration of risks in the case of migrant workers in industrial premises will intensify following the COVID-19 pandemic because of the lack of production labor, which explains the need to incorporate issues of health and safety into the ILO context.

4. It is essential to enhance society's perception, particularly, the awareness and attitudes to migrant workers; otherwise, the adequate management of these risks will continue to be a significant challenge (Lee, 2023). Singapore policymakers adopted unprecedented monetary and fiscal policies to overcome the economic shocks that included heavy fiscal support as well as loan guarantees into the 2009 budget (Basu Das, 2010).

Conclusion

The analysis of aggregated data on migrant worker vulnerability in Singapore with interrupted-time-series shows three main results: a positive overall pre-shock tendency (coefficient ≈ 0.0384 , approximately 3.9 per cent each time period), sharp reduction at the advent of COVID-19 (coefficient ≈ -0.3227 , approximately 27.6 per cent change of level), and a strong increase in the post-COVID slope (interaction coefficient ≈ 0.0383), which indicates that some recovery occurs or dynamic changes to carry. These findings, as a group of them, point out to acute damages at the shock onset and long-lasting structural dynamics, which maintain vulnerability over time. The policy interventions must focus on the gathering of granular data on migrant worker health, safety, and reporting systems to enable individual-level analyses and causal inferences; adopt specific measures to mitigate immediate shocks (e.g., better outbreak control, easy and affordable healthcare and insurance), and reforms in the medium term (e.g., work-permit-dependence, subcontracting, and linguistic or legal access), and ongoing assessment using powerful time-series methods (HAC standard errors, AR error specifications, and sensitivity analysis) to identify the impact and guide future interventions.

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