Trade Liberalization and Internal Migration in Indonesia

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Abstract: The economic impact of trade liberalization is unevenly distributed among regions because of imperfect labor mobility. This study uses individual-level panel data from Indonesia to investigate how tariff reductions on intermediate inputs influence migration decisions, considering the costs and benefits of migration. The results indicate that regions experiencing substantial reductions in input tariffs have become more attractive to potential migrants, especially skilled workers, due to the complementarity between skills and imported inputs. However, for the majority, migration costs surpass incentives, emphasizing the effectiveness of reducing migration costs to redistribute the gains of nationwide trade liberalization.

Keywords: internal migration, skills, trade liberalization
JEL classification code: F16, J24, R23

Acknowledgment: This study is supported by JSPS KAKENHI (Grant number: 21K01478).

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1. Introduction

Developing countries have implemented trade reforms extensively since the 1980s as part of their development strategies. While the impact of trade liberalization on economic growth has garnered significant attention, its distributional impacts within countries have received recent focus (Goldberg and Pavcnik, 2007). Studies have revealed the varied effects of trade liberalization on regional economies, with export liberalization benefiting regions with increased export opportunities (Egger et al., 2020; Fukase, 2013; McCaig, 2011; McCaig and Pavcnik, 2018). Conversely, import tariff reductions negatively impact regions exposed to import competition (Castilho et al. 2012; Dix-Carneiro and Kovak, 2019; Erten et al. 2019; Kovak, 2013; Topalova, 2010).

Recent trade liberalization in developing countries has resulted in tariff reductions on intermediate inputs. Advancements in information and communication technologies have enabled firms in developed nations to establish international production networks, in which segments of their production processes are offshored to developing countries (Baldwin, 2016). In this context, reductions in input tariffs provide increased access to high-quality inputs for firms in developing countries, thereby enhancing their performance (Amiti and Konings, 2007). Unlike tariff reductions on final goods, reductions in input tariffs have welfare-improving effects on residents (Kis-Katos and Sparrow, 2015).

Imperfect labor mobility is an implicit yet critical assumption in the aforementioned studies; otherwise, migration shrinks the wage or welfare gaps across regions in the long run. While some studies have affirmed that trade liberalization does not spur internal migration (Dix-Carneiro and Kovak, 2017; Erten et al., 2019; McCaig, 2011), its causes have not been explored. Migration decisions hinge on the costs and benefits of migration (Sjaastad, 1962). It is imperative to discern how tariff reductions influence the benefits of migration and quantify migration costs and benefits individually to redistribute the benefits of trade liberalization nationwide or prevent its adverse economic impacts from being concentrated in specific areas. For example, Morten and Oliveira (2024) argue that high migration costs hinder the integration of local labor markets in Brazil, suggesting that infrastructure development could mitigate diverse responses to trade liberalization across regions. Furthermore, reducing migration costs can generate overall welfare gains by spatially reallocating workers (Bryan and Morten, 2019; Tombe and Zhu, 2019).

In this study, using individual-level panel data from Indonesia, we investigate whether reductions in input tariffs incentivize migration and assess their extent relative to migration costs. The data tracked the same individuals over time, enabling us to differentiate between migrants and non-migrants. Assuming that individuals base their migration decisions on a comparison of migration costs and benefits, we developed a discrete choice model. This model relates the degree of regional exposure to input tariff reductions, which is constructed based on the initial regional industrial structure, to individuals' migration decisions and destination choices in subsequent periods.

Indonesia is an interesting case for examining the effects of trade liberalization on internal migration. It plays a significant role in international production networks, with trade in intermediate goods becoming increasing vital for local economies. Moreover, the Indonesian trade reforms implemented in the 1990s were considered exogenous to individual migration decisions. The political economy literature argues that industries with political clout may lobby for protection. However, external pressures such as the formation of the Association of Southeast Asian Nations (ASEAN) Free Trade Area Agreement in 1992, the completion of the General Agreement on Tariffs and Trade (GATT) Uruguay Round negotiations in 1994, and the establishment of the World Trade Organization (WTO) in 1995 drove Indonesia's trade reforms during this period. These reforms aimed to reduce the bound tariffs, with highly protected industries experiencing the most significant reductions. Hence, as shown by Mobarak and Purbasari (2006), it is unlikely that Indonesia's political landscape influences industry-level tariffs or non-tariff barriers.

The structure of this study is as follows. Section 2 provides a review of the literature and outlines the contributions of this study. Section 3 discusses the empirical methodology and Section 4 details the data and variable construction. Section 5 presents the estimation results. Finally, Section 6 concludes the findings and their policy implications.

2. Literature review

This study relates to two strands of the literature. The first is related to studies that examine the distributional effects of trade liberalization geographically. Previous studies focused on the impact of either export liberalization or import tariff reductions. For instance, U.S. tariff cuts on Vietnamese imports increased wages and decreased poverty in provinces where exported goods were mainly produced (Fukase, 2013; McCaig, 2011). Conversely, import tariff reductions in Brazil and India decreased wages and increased poverty in regions where most of the workers were engaged in sectors exposed to import competition (Kovak, 2013; Topalova, 2010).

The nonuniform impacts of trade liberalization across regions support the assumption that labor is not perfectly mobile within countries (Goldberg and Pavcnik, 2007). Several studies have examined the impact of international trade on internal migration in developing countries; however, they show mixed results. Hering and Paillacar (2016) demonstrated that Brazilian regions with greater access to foreign markets attract more in-migrants by offering higher wages and more job opportunities as compared to regions with limited access. Facchini et al. (2019) observed an increased in-migration to Chinese prefectures facing enhanced export opportunities to the U.S. market after China's entry into the WTO. Conversely, Dix-Carneiro and Kovak (2017) concluded that trade liberalization did not induce out-migration from regions exposed to import competition, causing long-lasting negative impacts on regional economies in Brazil (Erten et al., 2019; McCaig, 2011).

These results, particularly the latter, enhance the understanding of why the effects of trade liberalization are not uniformly distributed across regions. However, since previous studies did not consider migration costs, it is unclear whether trade liberalization created incentives for migration or whether the incentives generated by trade liberalization were insufficient to cover migration costs. In the latter case, regional policies such as infrastructure development should be effective in dispersing the effects of trade liberalization across areas.

The first contribution of this study is that it explicitly incorporates the costs and benefits of migration into an individual migration decision model. Unlike studies on export liberalization or import tariff reductions, studies on the association between input tariff reductions and internal migration in developing countries are limited. However, given the growing importance of trade in intermediate goods in these countries, identifying the factors that impede the uniform distribution of the benefits of trade liberalization is crucial for regional development. This study's results indicate that input tariff reductions are likely to widen the welfare gap across regions. While regions experiencing significant input tariff reductions have become more appealing to potential migrants, migration costs outweigh the incentives to migrate for most individuals, highlighting the necessity of policies aimed at reducing migration costs.

Trade liberalization also has distributional implications for workers with varying skill levels. Typically, developing countries have a comparative advantage in unskilled labor; therefore, export liberalization tends to benefit unskilled workers more than skilled workers (Fukase, 2013; McCaig, 2011). By contrast, trade in intermediate goods is considered to have skill-biased effects on labor demand (Hummels et al., 2018). For example, Feenstra and Hanson (1997) demonstrated that, from a developing country's perspective, U.S. firms outsource skill-intensive production processes to Mexico. Mexican firms engaging in outsourced activities import intermediate inputs from the U.S. and assemble them into final products using skilled workers. Kasahara et al. (2016) argued that imports of intermediate goods induced skill-biased technological changes in Indonesian firms, benefiting skilled workers more than unskilled workers. In summary, recent studies on the impact of international production networks on labor markets in developing nations underscores the increasing demand for skilled labor (Rodrik, 2018). An insufficient supply of skilled workers could potentially worsen the performance of local economies engaged in global competition (Matsuura and Saito, 2023).

The second contribution of this study is to investigate how the supply of skilled workers responds to their increased demand in the local labor markets of developing countries. Specifically, we explored whether input tariff reductions have different effects on individuals' migration decisions depending on their skill levels. Tariff reductions on intermediate inputs raise the returns on skills by increasing the demand for skilled workers. However, the literature has not thoroughly addressed whether, and to what extent, skilled individuals respond to these increased returns in their migration decisions. The individual-level panel data used in this study enabled us to estimate workers' skill levels during the initial period. By incorporating the initial skill level into the migration decision model, we found that skilled workers are more responsive to input tariff reductions than unskilled workers when selecting a migration destination. In other words, reducing migration costs is expected to incentivize skilled workers to relocate to regions that have experienced substantial input tariff reductions.

3. Empirical framework

Consider an economic space consisting of R regions within a country. Let V_{it}^{r} denote indirect utility that individual i can obtain in region $r \in \{1, \ldots, R\}$ at period t. Migration between periods t and $t+1$ can be viewed as a process of utility maximization for individuals: each individual residing in region r at period t decides whether and where to migrate by comparing the indirect utility from period $t+1$ onward in each region, net the migration costs (Sjaastad, 1962). Therefore, the maximization problem can be expressed as:

(1) $$\max_{d \in \{1,\ldots,R\}} V_{it+1}^{d} - C_{i}^{rd},$$

where, C_{i}^{rd} represents the migration costs from region r to d, with $C_{i}^{rr} = 0$[1].

The benefits (indirect utility) and costs of migration encompass monetary aspects, such as earnings and expenses for movement, and non-monetary factors, such as locational preferences and the psychological costs of adopting a new living environment. Greenwood (1975) concluded that actual moving costs and psychological costs increase to a certain extent with the distance between regions. Davis et al. (2001) further argued that there is a notable distinction between the decision to relocate and the destination choice. They considered the cost associated with departing from the current location, which is independent of distance and demonstrated that this cost significantly influences migration decisions.

Based on these arguments, we considered the following specifications for the benefits and costs of migration:

[1] The migration cost does not carry a time subscript in (1) because we presume it does not vary throughout the estimation period.

(2) $V_{it+1}^{d} = \beta_1 RTR_{t+1}^{d} + \beta_2 \ln POP_t^d + \beta_3 \ln GDPPC_t^d + \varepsilon_{it+1}^{d}$, and

(3) $C_i^{rd} = -\beta_4 DST^{rd} - \beta_5 DM_i$.

In Equation (2), RTR_{t+1}^{d}, POP_t^d, $GDPPC_t^d$, and ε_{it+1}^{d} represent the regional input tariff reduction from period t to $t+1$, regional population and GDP per capita at the initial period t, and individual i's preference for location d, respectively. We included $\beta_2 \ln POP_t^d + \beta_3 \ln GDPPC_t^d$ to represent the monetary benefits in region d at period t, and $\beta_1 RTR_{t+1}^{d}$ to measure the variation in benefits from period t to $t+1$ due to input tariff reductions. In other words, the sum of these three variables exogenously determines the monetary benefits in region d from period $t+1$ onward, which are realized through input tariff reductions. Further, DST^{rd} and DM_i in Equation (3) respectively denote the distance between regions r and d, and a migration dummy that takes the value of one if individual i decides to leave the current residence. The former quantifies the costs that individual i considers when determining the destination, whereas the latter measures the costs individual i considers when deciding to relocate.

Suppose that ε_{it+1}^{d} follows a type I extreme-value distribution; then, the probability that individual i chooses region d at period $t+1$ can be obtained from the utility maximization problem defined by (1) (McFadden, 1974):

(4) $P(Y_{it+1} = d) \equiv P_{id} = \frac{\exp(\beta_1 RTR_{t+1}^{d} + \beta_2 \ln POP_t^d + \beta_3 \ln GDPPC_t^d + \beta_4 DST^{rd} + \beta_5 DM_i)}{\sum_{d=1}^{R} \exp(\beta_1 RTR_{t+1}^{d} + \beta_2 \ln POP_t^d + \beta_3 \ln GDPPC_t^d + \beta_4 DST^{rd} + \beta_5 DM_i)}$.

Given Equation (4), maximizing the following log-likelihood function yields the parameter estimates for Equations (2) and (3):

(5) $\ln L = \sum_i \sum_d D_{id} \ln P_{id}$,

where D_{id} is a dummy variable that takes the value one if region d is chosen by individual i.

In the previous section, we argued that input tariff reductions have skill-biased effects on the regional labor market, influencing the returns to skills in that region. To examine whether regional input tariff reductions attract skilled workers by offering higher returns, we modified Equation (2) as follows:

$$(6) \qquad V_{it+1}^{d} = \beta_{1i} RTR_{t+1}^{d} + \beta_2 \ln POP_t^d + \beta_3 \ln GDPPC_t^d + \varepsilon_{it+1}^{d},$$

where, the subscript i of β_{1i} indicates that the regional input tariff reduction has different impacts on the benefits of migration across individuals. Specifically, we assumed the following:

$$(7) \qquad \beta_{1i} = \beta_{10} + \beta_{11} SKL_i.$$

SKL_i in Equation (7) represents the skill level of individual i. If $\beta_{11} > 0$, the higher the skill level of an individual, the greater the returns from input tariff reductions, increasing the probability of choosing a location experiencing significant input tariff reductions.

These two comments are in order: As discussed in Section 4, we considered approximately 200 regions in Indonesia as potential destinations. Ideally, we should have included only regions that individuals considered as their destination candidates in the estimation. However, it is not possible to ascertain all the potential destinations for each individual. Instead, following studies in the discrete choice literature (Guimarães et al., 2000; Su et al., 2021), we considered that the choice set for non-migrant i consists of its current residence and 19 randomly selected regions. The choice set for migrant i consists of their destination, current residence, and 18 randomly selected regions. Consequently, every individual chooses their residence in period $t+1$ among the 20 candidates[2].

Second, the conditional logit model employed here relies on the independence of irrelevant alternatives (IIA) assumption. To verify the robustness of our results to this assumption, we present the results obtained using a random parameter logit model, which does not rely on the IIA assumption (Train, 2003). Specifically, Equation (7) is modified as

(8) $$\beta_{1i} = \beta_{10} + \beta_{11} SKL_i + \beta_{1v}\xi_{1i},$$

where, ξ_{1i} is a random variable following a normal distribution with mean zero and standard deviation β_{1v}. ξ_{1i} measures the heterogeneity of individuals' preferences toward regional exposure to input tariff reductions; a positive value indicates that individual i prefers locations experiencing significant input tariff reductions. We repeated the same modification for parameters β_2 to β_5 by adding the corresponding preference heterogeneity ξ_{ji}, $j = 2, \ldots, 5$:

(9) $$\beta_{2i} = \beta_{20} + \beta_{2v}\xi_{2i},$$

(10) $$\beta_{3i} = \beta_{30} + \beta_{3v}\xi_{3i},$$

(11) $$\beta_{4i} = \beta_{40} + \beta_{4v}\xi_{4i},$$ and

(12) $$\beta_{5i} = \beta_{50} + \beta_{5v}\xi_{5i}.$$

4. Data and variable construction

This study investigates the impact of input tariff reductions implemented in Indonesia during

[2] We repeated the same exercise using the subsets of 30 regions for robustness checks and obtained similar results.

the 1990s on internal migration. Historically, Indonesia's economy has relied heavily on agriculture and mining. However, a sharp decline in oil prices in the early 1980s prompted the government to diversify its economic structure. This led to the adoption of export-oriented industrialization policies and the implementation of unilateral trade reforms, including tariff reductions and the removal of non-tariff barriers in the mid to late 1980s. Although trade reforms slowed in the early 1990s, particularly in politically sensitive sectors such as agriculture and certain manufacturing products, the ASEAN Free Trade Area Agreement in 1992, completion of the GATT Uruguay Round negotiations in 1994, and establishment of the WTO in 1995 reignited Indonesia's trade reforms (Feridhanusetyawan and Pangestu, 2003).

One of the objectives of trade reforms during this period was to reduce all bound tariffs to specific levels. Figure 1 illustrates the tariff reductions from 1993 to 2000 based on the 1993 tariff levels. Tariff data at the six-digit Harmonized System (HS) level were sourced from the United Nations Conference on Trade and Development's (UNCTAD) Trade Analysis and Information System using the World Bank's World Integrated Trade Solutions. Subsequently, the unweighted average of the effectively applied rates was calculated for each four-digit International Standard of Industry Classification (ISIC), revision 2[3]. Figure 1 suggests that apart from alcoholic beverages (not depicted), industries that were highly protected in 1993 underwent the most substantial tariff reductions. This indicates that political factors are less likely to influence tariffs at the industry level in Indonesian

[3] We used the concordance table between HS and ISIC codes provided by the World Bank.

industries.

The key variable, regional input tariff reduction, was derived as the weighted average of tariff changes from 1993 to 2000 (Kis-Katos and Sparrow, 2015):

(13) $RTR_{t+1}^{d} = -\sum_{j} s_{j}^{d} \sum_{k} v_{kj} \Delta TR_{k}$,

where, ΔTR_k represents tariff changes from 1993 to 2000 in manufacturing industry k, as defined at the four-digit ISIC level; v_{kj} is the proportion of inputs purchased from industry k by manufacturing industry j; and s_j^d is the output share of industry j in region d[4]. The value of v_{kj} is sourced from the 1990 *Indonesian Input-Output (IO) Table*[5], whereas s_j^d is obtained from the 1993 *Annual Survey of Medium and Large Manufacturing Establishment* in Indonesia[6]. Both datasets are published by Statistics Indonesia (*Badan Pusat Statistik*, BPS). Equation (13) illustrates that the regions experiencing greater tariff reductions on intermediate inputs are those in which industries that use inputs subject to significant tariff reductions have a substantial output share within the region.

Regarding migration data, we used microdata from the *Indonesian Family Life Survey* (IFLS)[7]. The initial survey, conducted in 1993, covered approximately 7200 households in 13 out of Indonesia's 27 provinces[8]. Subsequent surveys were conducted in

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[4] Using the employment share instead of the output share produces similar results.
[5] We used the concordance table provided by BPS to link the industry codes used in the IO table to the four-digit ISIC codes.
[6] The survey was conducted exclusively for firms with 20 or more employees, yet it encompasses over 60% of the total value added in Indonesian manufacturing (Ramstetter, 2009).
[7] This dataset has been extensively used in economic research. For studies related to migration, refer to Bryan and Morten (2019), Pardede et al. (2020), and Sugiyarto et al. (2019).
[8] The 13 provinces comprise four provinces (North Sumatra, West Sumatra, South Sumatra, and Lampung) on the island of Sumatra, five provinces (DKI Jakarta, West Java, Central Java, DI Yogyakarta, and East Java) on the island of Java, and four provinces (Bali, West Nusa Tenggara, South Kalimantan, and South Sulawesi) covering the other major island groups.

1997, 2000, 2007, and 2014, focusing on the same households interviewed in 1993 and their split-offs provided they remained in any of the 13 provinces. We focused on the migration between 1993 and 2000 for the following reasons: First, the Indonesian economy was severely affected by the Asian financial crisis of 1997–1998, significantly influencing individuals' migration decisions. For instance, out-migration from urban areas surged temporarily during the crisis (Gilligan et al., 2000). Therefore, the residential status in 1997 may not accurately reflect the migration decisions influenced by input tariff reductions up to that year. Second, tariff reductions during the 2000s were much smaller than those in the 1990s, suggesting that migration during the 2000s was likely driven by factors other than trade liberalization.

The survey provides comprehensive data on individual attributes, such as age, education, earnings, employment status, and industry code at the one-digit ISIC level, for each household member, along with household locations. Given our emphasis on labor migration, we narrowed the sample to household heads aged 22–65 in 2000 (individuals aged 15–58 in 1993) whose employment status in 1993 and 2000 fell under private or government employee or self-employed categories. Additionally, individuals who attended school during this period and those who migrated multiple times were excluded. Furthermore, among those who migrated during this timeframe, we excluded individuals employed in agriculture or mining sectors and government employees at the destination[9]. However, we refrained from

[9] The first two are natural resource-oriented industries, and the location of government agencies is determined by political reasons. Thus, the regional characteristics employed in this study cannot capture the returns from engaging in those activities in the destination.

restricting the sample to individuals who migrated and secured employment in the manufacturing industry at the destination, as this would substantially diminish the number of observations. The underlying assumption posits that a surge in labor demand within the manufacturing sector, prompted by input tariff reductions, intensifies labor market competition across other sectors within the same region.

We determined the skill level of individuals in the initial period using the residual from a Mincerian earnings regression as follows:

(14) $$\ln w_{it} = \alpha_1 AGE_{it} + \alpha_2 AGE_{it}^2 + \alpha_3 DG_i + \alpha_4 DE_{it} + f_R + f_j + \eta_{it},$$

where w_{it} represents the monthly earnings of individual i in 1993; AGE_{it} denotes the age of individual i in 1993; and DG_i is a gender dummy that takes the value one if individual i is male. The IFLS collects earnings data from employed and self-employed individuals. We distinguished the employment status of individual i as either employed or self-employed, based on their primary job. To account for the earnings disparity between formal and informal (self-employed) jobs, we included a dummy variable, DE_{it}, which takes the value of one if individual i was employed in 1993. Finally, f_R and f_j are island- and industry-fixed effects, respectively, controlling for earnings differences across islands and industries[10]. Since educational attainment is not included in Equation (14), the skills obtained as residuals from Equation (14) encompass those obtained through education.

A major concern regarding this dataset is its representativeness. In this study, we used each district (*kabupaten* or *kota*) as a geographical unit because regional labor markets

[10] There are three island dummies: Sumatra, Java, and the other islands.

are well defined at this level in Indonesia (Kis-Katos and Sparrow, 2015). Subsequently, individuals were classified as migrants if they resided in a different district in 2000 than they did in 1993. However, as the survey was conducted in only 13 provinces, individuals migrating to or from the other 14 provinces were not included. Nonetheless, it is less likely that we missed significant migration flows within the country because the surveyed provinces encompassed approximately 83% of the Indonesian population (Smith et al., 2002). According to the 2000 *Census of Population*, 5.9% of Indonesia's population migrated across districts from 1995 to 2000 (Sukamdi and Mujahid, 2015), which was close to the migration rate of 7.5% observed in the sample from 1993 to 2000.

Finally, data on population and GDP in 1990 at the district level were obtained from the 1990 *Population Census* and the 1983–1993 *Gross Regional Domestic Product of Regencies/Municipalities in Indonesia*, respectively. The distance between district capitals was measured using the great circle distance. Table 1 provides the summary statistics of the variables.

5. Estimation results

Table 2 presents the baseline results of this study[11]. Column (1) shows the positive and statistically significant effects of regional input tariff reductions on individual welfare. Tariff reductions in intermediate inputs enhance the performance of firms that employ these inputs intensively, thereby increasing labor demand in the regions where they agglomerate.

[11] All estimates in Tables 2 to 4 were obtained using NLOGIT Version 6.

Populous regions also attract migrants, but GDP per capita does not significantly influence migration decisions. Regarding migration costs, the distance and migration dummies have negative and significant effects on the probability of migration. Potential migrants tend to choose destinations close to their current residences to minimize migration costs. Additionally, individuals incur the cost of leaving their current residence, regardless of their destination. Finally, we included two dummy variables indicating migration from/to the Special Capital Region of Jakarta (*DKI Jakarta*) to capture the unobserved economic and noneconomic effects of the primate city in Indonesia. We observed an increased probability of out-migration from Jakarta during this period, consistent with the finding of Gilligan et al. (2000) that out-migration from urban areas temporarily increased during the Asian financial crisis of 1997–1998.

Personal characteristics such as age and gender significantly influence migration decisions (Sjaastad, 1962). Our initial inspection of the data corroborates this, showing that the probability of migration is 9.8% for individuals aged 15–24 years, but sharply declines to 5.4% for those aged 25–34 years, and further drops to 1.3% for those over 35 years. In Column (2), we allowed the costs individual i considers when making the decision to leave the current residence to vary across individuals by including age and gender dummies in the specification of the parameter β_5 on the migration dummy:

(15) $$\beta_{5i} = \beta_{50} + \beta_{51}DA_{1i} + \beta_{52}DA_{2i} + \beta_{53}DG_i,$$

where DA_{1i} and DA_{2i} are dummy variables that take the value of one if individual i was aged between 25 and 34 years and over 35 years in 1993, respectively. The estimation results demonstrate that the older an individual, the lower the probability of migration. However, the inclusion of dummy variables for age and gender did not affect the size or significance of other parameters.

Finally, Columns (3) and (4) present the estimation results using the random-parameter logit model. The statistically significant parameters on several random variables (ξ_{ji}, $j = 1, \ldots, 5$) support the use of the random parameter logit model in identifying the heterogeneity of individuals' preferences. However, the estimation results did not change qualitatively or quantitatively, confirming the robustness of our results to IIA.

Further, we investigated whether the impact of input tariff reductions on migration decisions varies according to individual skill levels. Panel (a) of Table A1 in the Appendix presents the estimation results of the Mincerian earnings regression[12]. All findings are intuitive: earnings increase with age, albeit at a decreasing rate; on average, male workers earn more than female workers; and on average, employees earn more than self-employed workers. Panel (b) of Table A1 examines the relationship between skills as measured in Panel (a) and educational attainment. The results validate our skill measurement: individuals with higher degrees tend to exhibit higher skill levels. However, the R-squared value was very low, suggesting that educational attainment alone does not fully account for skill formation.

Table 3 presents the estimation results, considering the heterogeneous response of skill to input tariff reductions. Column (1) shows that trade liberalization enhances the attractiveness of regions exposed to input tariff reductions as migration destinations,

[12] We excluded individuals whose earnings were in the top or bottom 1% of the distribution as outliers.

particularly for skilled individuals. Tariff reductions in intermediate inputs have skill-biased effects on labor demand, favoring highly skilled workers. Column (1) considers the case in which the effects of a regional input tariff reduction strictly increase monotonically with individual skills. However, individual skills may not be measured precisely, because income from self-employment is likely to be subject to measurement errors, particularly in developing countries such as Indonesia (Smith et al., 2002). To address this issue, we first classified individuals into four groups based on their skill levels and skill distribution quartiles. We then constructed four dummy variables indicating the group to which each individual belonged. Column (2) uses these four mutually exclusive dummy variables as approximate measures of skill level. The results continued to support our findings in Column (1): Only individuals with above-median skill levels respond to input tariff reductions. Finally, the estimation results obtained using the random parameter logit model in columns (3) and (4) provide qualitatively and quantitatively similar outcomes.

Table 4 presents the results of the robustness checks. First, previous studies have demonstrated that skilled workers are more likely to migrate than unskilled workers, suggesting a lower migration cost for the former compared to the latter (Greenwood, 1975). Alternatively, skilled workers are more likely to be attracted to regions with large markets or abundant human capital (Borjas et al., 1992; Combes et al., 2008; Su et al., 2021). The positive effects of skill on the probability of migration in Table 3 may partly reflect these relationships. Columns (1) and (3) of Table 4 allow parameters other than that on RTR_{t+1}^{d} (β_{2i} to β_{5i}) to vary with the skill level of individuals. This modification did not affect our finding that skilled workers were more likely to be attracted to regions exposed to input tariff reductions.

Second, to address the robustness of our findings regarding the measurement issue concerning income from self-employment, Columns (2) and (4) of Table 4 narrow the sample to individuals primarily employed as wage earners in 1993 because wages are expected to be recorded more accurately than income from self-employment[13]. However, given that the informal sector comprises a substantial portion of employment in Indonesia (Hohberg and Lay, 2015), restricting the sample to wage earners significantly reduces the number of observations, potentially compromising its representativeness. Nonetheless, our results remained robust even after excluding self-employed workers.

Thus far, the results confirm that tariff reductions on intermediate inputs create incentives for migration, especially among skilled workers, to regions where firms using these inputs agglomerate. However, individuals must bear the migration costs while relocating. To examine whether the incentives created by input tariff reductions are sufficiently significant to offset migration costs, we evaluated the relative magnitudes of the costs and benefits of migration based on the results in column (3) of Table 3. Specifically, we considered a scenario in which two regions, A and B, share the same regional characteristics and locational preferences for individual i. However, input tariff reductions from period t to $t+1$ result in a five-percentage-point increase in RTR in region B, corresponding to two standard deviation changes. We then considered the migration decision

[13] Refer to Column (2) of Table A1 for the corresponding results of the Mincerian earnings regression.

of individual i residing in region A in period t. Individual i migrates to region B if the benefits of migration from period $t+1$ onward, net of the migration costs, exceed the indirect utility of residing in region A.

From Equations (2) and (3), this condition collapses to:

$$(16) \qquad V_{it+1}^{B} - C_{i}^{AB} - V_{it+1}^{A} = -\left(\hat{\beta}_{4i} DST^{AB} + \hat{\beta}_{5i}\right)\left(\frac{5\hat{\beta}_{1i}}{-\left(\hat{\beta}_{4i} DST^{AB} + \hat{\beta}_{5i}\right)} - 1\right) > 0,$$

where the hat on parameters denotes the expected value of individual-specific parameters, which is obtained following Train (2003). Since $\hat{\beta}_{4i} DST^{AB} + \hat{\beta}_{5i} < 0$, Equation (16) takes a positive value if the benefit-to-cost ratio (the first variable in the second parenthesis) is greater than one. Figure 2 shows the kernel density estimates of the benefit-to-cost ratio for different distance (DST^{AB}) values. We find that the benefit-to-cost ratio does not exceed the value of one in either case, suggesting that input tariff reductions alone do not create a sufficient incentive to migrate, particularly when the two regions are distant from each other. Thus, it is necessary to reduce migration costs to increase the probability of migration. However, its impact on migration decisions is not uniform across individuals. Figure 2 illustrates that this ratio varies substantially across individuals. A reduction in migration costs is more likely to induce the migration of skilled workers.

6. Conclusion

Trade liberalization has been extensively adopted in developing nations to bolster economic growth. Beyond their macroeconomic effects, trade reforms have significantly influenced regional economies. Various regional factors, including industrial structure and geographical characteristics, determine the extent to which regions are exposed to trade liberalization. In theory, migration alleviates the welfare disparities between regions. However, the nonuniform impacts of trade liberalization across regions suggest that labor mobility within countries is imperfect. To explore the causes, we investigated whether tariff reductions on intermediate inputs augment the incentives for potential migrants to move and assessed their magnitude relative to migration costs using individual-level panel data from Indonesia.

Our findings are as follows: First, we observed that reductions in input tariffs enhance the attractiveness of regions in which firms using these inputs agglomerate because these firms can procure high-quality imported inputs at reduced costs. However, the incentives generated by these tariff reductions are insufficient to offset migration costs entirely. Consequently, trade liberalization exacerbates the welfare gap between regions by favoring individuals originally situated in regions exposed to input tariff reductions. In other words, reducing migration costs should effectively redistribute the benefits of nationwide trade liberalization. Second, reductions in input tariffs yield varying returns on migration depending on skill level. Given the crucial role skilled workers play in handling imported inputs, returns increase more for skilled workers than for their unskilled counterparts. Therefore, lowering migration costs is expected to encourage skilled workers to move to regions undergoing significant input tariff reductions, thereby augmenting the supply of skilled labor in those regions.

However, the literature on human capital spillovers suggests that regions that attract skilled workers can achieve higher utility (Moretti, 2004). Therefore, our findings imply that input tariff reductions may exacerbate regional welfare disparities even if migration costs are significantly lowered owing to the uneven distribution of skills across different regions. Identifying the overall impact of input tariff reductions on regional economies is crucial for future research.

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Table 1. Summary Statistics

Variable	Mean	Std. dev
Regional input tariff reduction from 1993 to 2000 (RTR)	3.885	2.444
Population in 1990 ($POP/1000000$)	0.778	0.621
GDP per capita in 1990 ($GDPPC$, million Rupiah)	0.916	0.725
Distance between district capitals (DST, kilometers)	867.633	626.029
Individual skill in 1993 (SKL)	0.000	0.966
Monthly earnings in 1993 (w, thousand Rupiah)	149.900	178.974
Dummy for primary job in 1993 (DE, 1 for wage earners)	0.488	0.500
Age in 1993 (AGE)	37.966	9.632
Dummy for individuals between the age of 25 and 34 in 1993 (DA_1)	0.320	0.466
Dummy for individuals over the age of 35 in 1993 (DA_2)	0.610	0.489
Gender dummy (DG, 1 for male)	0.916	0.277

Source: BPS, Population Census, 1990.
BPS, Gross Regional Domestic Product of Regencies/Municipalities in Indonesia, 1983–1993.
UNCTAD, Trade Analysis and Information System.
Indonesian Family Life Survey, 1993 and 2000.

Table 2. Determinants of Migration: Base Model

	Conditional logit				Random parameter logit			
	(1)		(2)		(3)		(4)	
Variable	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
RTR (regional input tariff reduction)								
Constant (β_{10})	0.096***	0.031	0.106***	0.032	0.072**	0.036	0.087**	0.038
ξ_{1i} (β_{1v})					0.026	0.060	0.041	0.064
$\ln POP$ (population)								
Constant (β_{20})	0.764***	0.102	0.830***	0.112	0.854***	0.147	0.950***	0.152
ξ_{2i} (β_{2v})					0.201	0.212	0.166	0.244
$\ln GDPPC$ (GDP per capita)								
Constant (β_{30})	-0.232	0.166	-0.238	0.165	-0.090	0.154	-0.138	0.162
ξ_{3i} (β_{3v})					0.470*	0.270	0.497*	0.259
DST (distance)								
Constant (β_{40})	-0.011***	0.003	-0.010***	0.003	-0.043***	0.005	-0.041***	0.005
ξ_{4i} (β_{4v})					0.016***	0.002	0.015***	0.002
DM (dummy for migration)								
Constant (β_{50})	-4.128***	0.357	-2.714***	0.634	-3.111***	0.677	-1.639**	0.703
DA_1 (β_{51}, age 25–34)			-0.739***	0.275			-0.862**	0.358
DA_2 (β_{52}, age over 35)			-2.223***	0.318			-2.718***	0.461
DG (β_{53}, 1 for male)			-0.121	0.451			-0.096	0.485
ξ_{5i} (β_{5v})					1.225*	0.731	1.369**	0.598
Dummy for out-migration from Jakarta	2.555***	0.327	2.589***	0.337	3.010***	0.514	3.069***	0.484
Dummy for in-migration from Jakarta	0.234	0.453	0.162	0.459	-0.027	0.589	-0.001	0.606
# of individuals	4106		4106		4106		4106	
Log-likelihood	-812.06		-765.79		-744.41		-702.37	

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. The coefficients and standard errors were adjusted for the sampling weights. For the random parameter logit estimation, we used Halton draws with 200 replications.

Table 3. Determinants of Migration: Heterogeneous Effects by Skill Level

	Conditional logit				Random parameter logit			
	(1)		(2)		(3)		(4)	
Variable	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
RTR (regional input tariff reduction)								
Constant (β_{10})	0.089***	0.031			0.059	0.040		
SKL (β_{11})	0.096***	0.026			0.114***	0.040		
SKL_Q_1 ($SKL < Q_1$)			-0.064	0.042			-0.135	0.093
SKL_Q_2 ($Q_1 \leq SKL < Q_2$)			0.081	0.053			0.068	0.074
SKL_Q_3 ($Q_2 \leq SKL < Q_3$)			0.162***	0.049			0.143**	0.072
SKL_Q_4 ($Q_3 \leq SKL$)			0.171**	0.077			0.138*	0.071
ξ_{1i} (β_{1v})					0.042	0.071	0.011	0.114
ln POP (population)								
Constant (β_{20})	0.839***	0.114	0.842***	0.114	0.934***	0.155	0.924***	0.152
ξ_{2i} (β_{2v})					0.228	0.262	0.217	0.265
ln $GDPPC$ (GDP per capita)								
Constant (β_{30})	-0.285	0.175	-0.283	0.175	-0.177	0.170	-0.170	0.168
ξ_{3i} (β_{3v})					0.563*	0.295	0.559*	0.288
DST (distance)								
Constant (β_{40})	-0.010***	0.003	-0.010***	0.003	-0.049***	0.007	-0.049***	0.007
ξ_{4i} (β_{4v})					0.018***	0.002	0.018***	0.002
DM (dummy for migration)								
Constant (β_{50})	-2.757***	0.674	-2.751***	0.680	-0.708	0.631	-0.661	0.621
DA_1 (β_{51}, age 25–34)	-0.723**	0.295	-0.712**	0.295	-1.008***	0.379	-0.960***	0.371
DA_2 (β_{52}, age over 35)	-2.154***	0.336	-2.136***	0.335	-2.847***	0.502	-2.762***	0.491
DG (β_{53}, 1 for male)	-0.190	0.460	-0.204	0.464	-0.522	0.476	-0.542	0.470
ξ_{5i} (β_{5v})					1.168*	0.617	1.061	0.655
Dummy for out-migration from Jakarta	2.668***	0.351	2.662***	0.353	3.075***	0.504	3.011***	0.490
Dummy for in-migration from Jakarta	0.185	0.493	0.193	0.493	-0.089	0.665	-0.114	0.659
# of individuals	3871		3871		3871		3871	
Log-likelihood	-709.71		-710.34		-639.18		-640.09	

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. The coefficients and standard errors were adjusted for the sampling weights. For the random parameter logit estimation, we used Halton draws with 200 replications.

Table 4. Determinants of Migration: Robustness Checks

	Conditional logit				Random parameter logit			
	(1)		(2)		(3)		(4)	
Variable	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
RTR (regional input tariff reduction)								
Constant (β_{10})	0.081**	0.031	0.116***	0.036	0.055	0.041	0.045	0.046
SKL (β_{11})	0.090***	0.022	0.134***	0.042	0.123***	0.041	0.148***	0.053
ξ_{1i} (β_{1v})					0.043	0.074	0.083	0.083
ln POP (population)								
Constant (β_{20})	0.835***	0.112	0.858***	0.134	0.936***	0.154	0.939***	0.152
SKL (β_{21})	-0.009	0.095			-0.010	0.134		
ξ_{2i} (β_{2v})					0.165	0.269	0.230	0.323
ln $GDPPC$ (GDP per capita)								
Constant (β_{30})	-0.273	0.178	-0.346*	0.195	-0.178	0.167	-0.200	0.189
SKL (β_{31})	-0.114	0.134			-0.187	0.137		
ξ_{3i} (β_{3v})					0.586**	0.273	0.717**	0.282
DST (distance)								
Constant (β_{40})	-0.012***	0.003	-0.009***	0.003	-0.048***	0.007	-0.053***	0.009
SKL (β_{41})	0.003***	0.001			0.002**	0.001		
ξ_{4i} (β_{4v})					0.017***	0.003	0.020***	0.004
DM (dummy for migration)								
Constant (β_{50})	-2.596***	0.674	-2.362***	0.828	-0.758	0.640	-0.177	0.737
DA_1 (β_{51}, age 25–34)	-0.727**	0.300	-0.938***	0.321	-1.010***	0.373	-1.188***	0.393
DA_2 (β_{52}, age over 35)	-2.151***	0.339	-2.215***	0.364	-2.829***	0.483	-2.715***	0.461
DG (β_{53}, 1 for male)	-0.196	0.461	-0.425	0.652	-0.485	0.474	-0.317	0.646
SKL (β_{54})	-0.244*	0.141			-0.102	0.159		
ξ_{5i} (β_{5v})					1.148**	0.569	0.282	0.979
Dummy for out-migration from Jakarta	2.566***	0.384	2.558***	0.403	2.916***	0.490	2.729	0.449
Dummy for in-migration from Jakarta	0.182	0.499	0.336	0.542	-0.095	0.663	0.220	0.713
# of individuals	3871		1872		3871		1872	
Log-likelihood	-701.73		-503.16		-635.52		-440.69	

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. The coefficients and standard errors were adjusted for the sampling weights. For the random parameter logit estimation, we used Halton draws with 200 replications. In columns (2) and (4), we limit the sample to individuals primarily employed as wage earners in 1993.

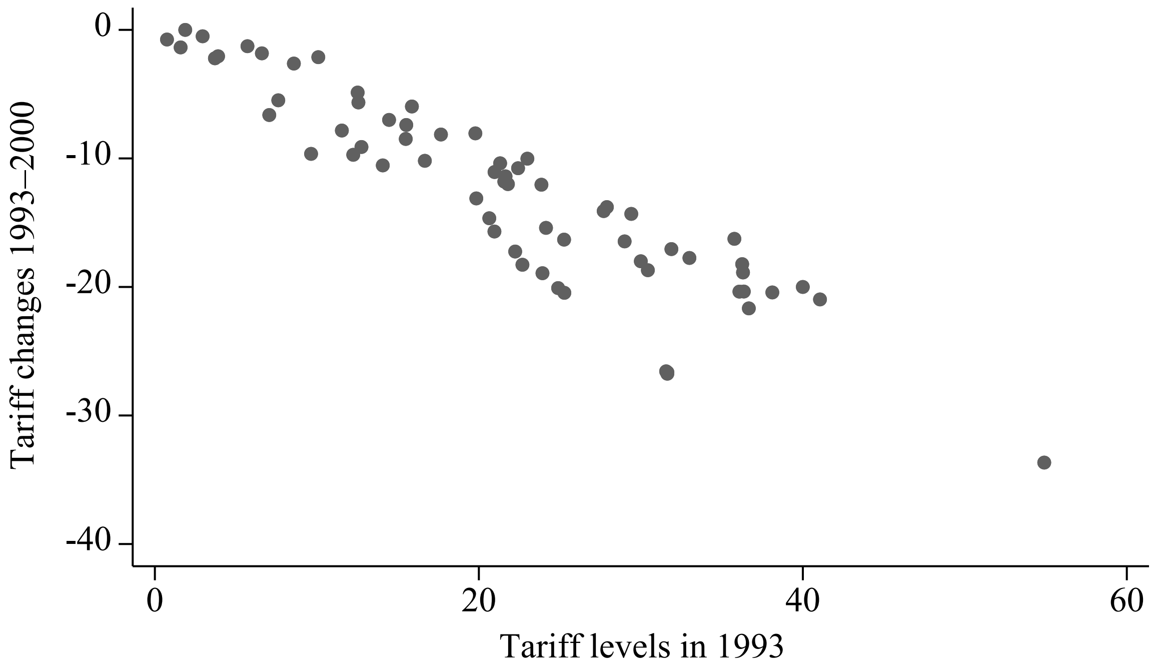

Figure 1. Tariff Reductions by Industry

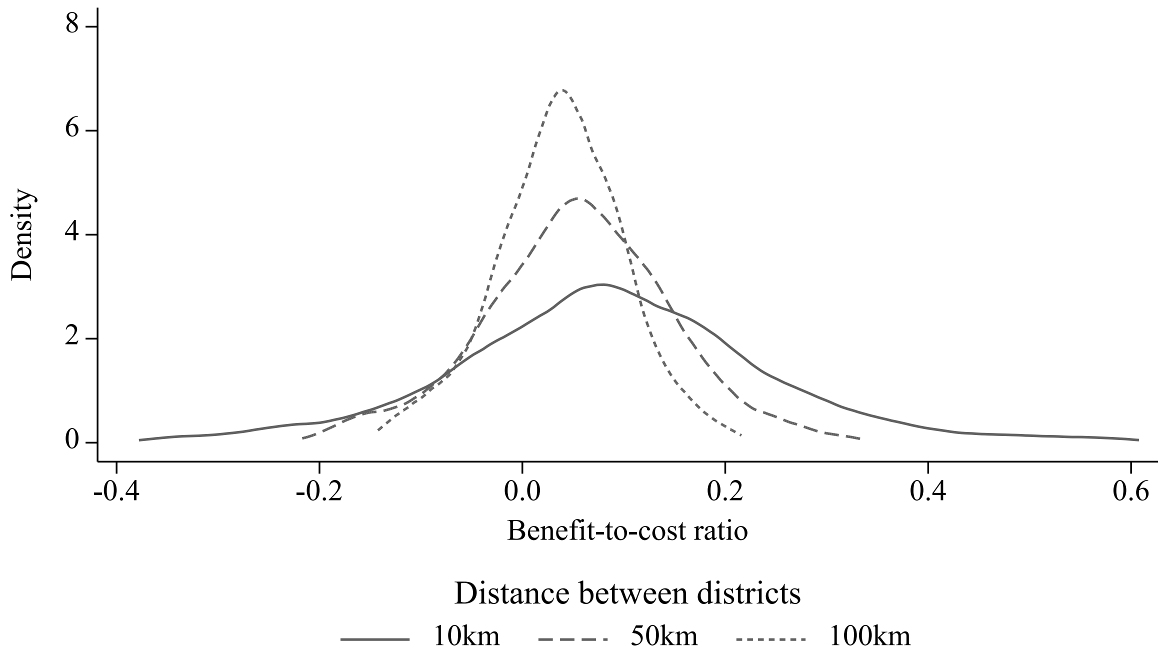

Figure 2. Benefit to Cost of Migration

Appendix

Table A1. Earnings Regression Estimates

Variable	(1)	(2)
(a) Dependent variable: log of earnings		
AGE (α_1)	0.094***	0.097***
	(0.012)	(0.015)
AGE^2 (α_2)	-0.001***	-0.001***
	(0.000)	(0.000)
DG (α_3, 1 for male)	0.587***	0.750***
	(0.058)	(0.085)
DE (α_4, 1 for wage earners)	0.226***	
	(0.036)	
Island fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
R-squared	0.21	0.22
(b) Dependent variable: individual skills obtained as residuals from (a)		
Secondary school	0.258***	0.316***
	(0.050)	(0.056)
High school	0.446***	0.519***
	(0.041)	(0.043)
University	0.866***	0.874***
	(0.092)	(0.083)
R-squared	0.05	0.11
Observations	3871	1872

Note: ***, **, and * represent statistical significance at the 1%, 5%, and 10% levels, respectively. In column (2), we limit the sample to individuals primarily employed as wage earners in 1993.