DISCUSSION PAPER SERIES

Local Labor Markets Dynamics and Export Shocks: Theory and Evidence from Indonesia

Carlos Góes
Juan Segnana
Raymond Robertson
Gladys Lopez-Acevedo

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Carlos Góes
UCSD

Raymond Robertson
Texas A&M and IZA

Juan Segnana
Tilburg University

Gladys Lopez-Acevedo
World Bank and IZA

ABSTRACT

Local Labor Markets Dynamics and Export Shocks: Theory and Evidence from Indonesia*

We study the dynamic effects of export exposure over local labor markets in Indonesia. We develop an empirical strategy to instrument exposure to exports using exposure to foreign demand shocks and validate it showing that the labor market responses are consistent with those expected from demand shocks in a spatial model. Export shocks unambiguously increase employment in Indonesia. While effects on average income per employee are ambiguous due to industry- and sectoral-compositional effects, our estimates of district-level welfare suggest that export shocks induce an increase in welfare.

Corresponding author:
Gladys Lopez-Acevedo
Poverty and Equity Global Practice Group (PEGP)
World Bank
2232 40th Pl NW
Washington DC, 20007
USA

E-mail: gacevedo@worldbank.org

1. Introduction

In the mid-1980s, Indonesia shifted its development strategy from a focus on import substitution to an emphasis on export orientation. This transition was accompanied by deregulation measures that linked the Indonesian economy with the global economy (Saryahadi, 2001). Given that the impacts of trade tend to differ across various sectors and individuals, regions that experience distinct sector-specific shocks might face uneven effects during the adjustment process. Consequently, concerns regarding distribution arise, highlighting the importance of comprehending how the labor market reacts to trade in general and exports in particular.

The adaptation of labor markets to trade shocks is closely intertwined with economic development. This paper assesses dynamic responses of labor market outcomes to increases in export exposure across local labor markets in Indonesia. Up to seven years after an initial shock, we calculate Impulse Response Functions (IRF) that capture the evolving short and long-run impacts of exports exposure on labor outcomes.

The primary analysis is based on a dataset that combines the Indonesian labor force survey (Sakernas) and industry exports (UN Comtrade) spanning from 1993 to 2014. To address the potential endogeneity of exports, we instrument exports using foreign demand shocks of Indonesian trade partners. The preliminary of the first stage indicate an extremely relevant instrument.

The estimations concerning the causal effects of trade shocks on local labor outcomes encompass various aspects, including wages, employment, underemployment, informality, and labor force participation.

Districts which face an increased exposure to exports see an increase in employment and a reduction of unemployment. A 1 billion USD increased exposure to exports induces a peak cumulative increase in employment of approximately 1,250 jobs 4 years after the shock. The response is still positive and significant even six years after the shock. Similarly, the shock induces a decrease in the unemployment rate of 0.16 percentage points 3 years after the shock and the effect is negative and significant even 7 years thereafter.

The influence on job quality indicators presents a mixed picture. For instance, initially, there is an indication that heightened exposure to exports leads to increased formalization rates. However, this effect diminishes over time, and the cumulative impact of a district being exogenously exposed to 1 billion USD in exports shows a decline of nearly 0.2 percentage points after 4 to 7 years. On the contrary, the underemployment rate consistently decreases, indicating a reduction in underemployment levels. The peak cumulative effect materializes five years post-shock, resulting in an almost 0.4 decrease in the underemployment rate. This effect stands out as one of the most significant magnitudes observed in the study.

This study contributes to the literature on the distributional effects of trade. The pervasiveness of informality makes the study of the relationship between trade liberalization and informality of main interest in Indonesia, as unskilled laborers are typically engaged in the informal economy. Increasing economic openness is associated with employment of skilled workers growing faster than that of unskilled workers. Following trade liberalization between 1993-2002, Indonesia registered a formalization of the unskilled labor force and experienced a structural reallocation of labor (Amiti and Cameron, 2012). The results in this study are consistent with the findings in Amiti and Cameron, 2012 but only for the short run, and provide additional and novel evidence on the dynamic effects liberalization on informality.

The remaining of this study is structured as follows. Section 2 presents stylized facts. Section 3 elaborates on the methodology. Section 4 presents the results. Section 5 introduces a quantitative spatial model and discusses and discusses the empirical results through the lens of an structural spatial model. Section 6 concludes.

2. Stylized facts

At the end of the 20th century and the beginning of the new millennium, labor market trends show that Indonesia continued through a processed of structural transformation. The share of agriculture, hunting, forestry, and fishing in the labor force (among those workers exposed to international trade) decreased from 2/3 in 1993 to about ½ in 2014. Services expanded from 18% to 24%. Manufacturing expanded from 14% to 20%.

Figure 2. Indonesia: Employment, by Aggregate Sector (1993-2014)
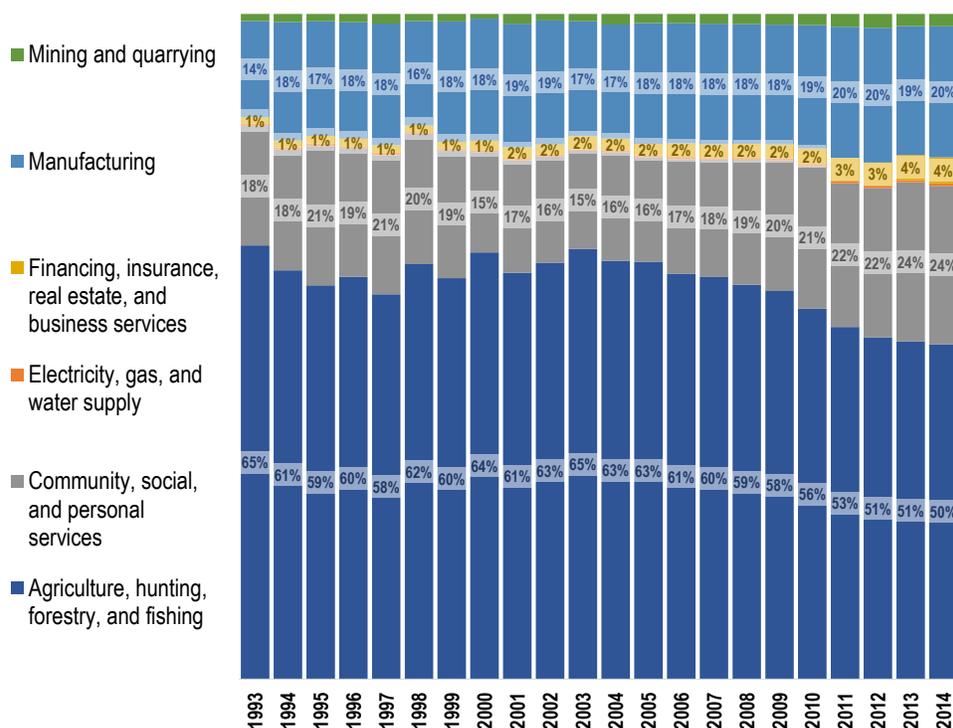
Source: Authors' calculations with data from Sakernas.

Merchandise trade was, and continued to be, dominated by manufacturing, with mining and quarrying accounting for about 20% of total trade value share and the primary sector counting for less than 10% than total value of exports. Some of the most important export products are coal briquettes (10.9% of total value), palm oil (8.21%), petroleum gas (4.48%), gold (2.16%), and rubber (2.07%).

Indonesia's six largest trade partners have persistently accounted for at least 60% of the value of total exports. However, the relative relevance of each partner has changed substantially over time. Japan

accounted for nearly 1/3 of the value of exports in the beginning of the period and less than 10% of the end of the period. Conversely, China took the opposite path grew in relative relevant from less than 5% to more than 15% of export values.

Figure 1. Indonesia: Merchandise Exports Value Shares
(by sector)   (by trade partner)
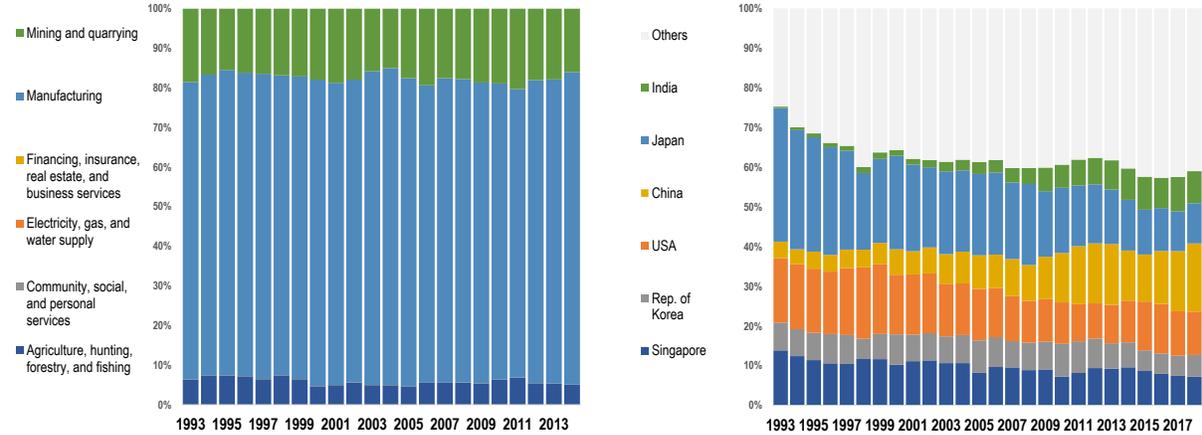
There is a large regional variation in labor market exposure to merchandise exports in Indonesia. Some districts have large exposure of more than 30 billion USD per year while others do not reach 3 billion USD. The provinces located in West Papua (Easternmost large island), which concentrate a large part of the mining industry, have an outsized exposure to exports. There is also a large exposure in Sumatra (Westernmost large island), where Palm Oil production is particularly strong.

Figure 3. Indonesian Districts: Labor Market Exposure to Merchandise Exports
(Average 1993-2014, in billion real USD)

[2.6, 34.1]
(34.1, 35.4]
(35.4, 36.7]
(36.7, 37.8]
(37.8, 53.8]

Source: Authors' calculations with data from Sakernas and UNCOMTRADE. This Figure denotes a region-specific exposure to exports, defined as $\frac{1}{T}\sum_t \check{X}_{r,t} = \frac{1}{T}\sum_t \sum_i \frac{L_{r,i,t}}{L_{r,t}} \check{X}_{i,t}$ where $\check{X}_{i,t}$ denotes total exports of industry i at period t; $L_{r,i,t}$ denotes total employment in region r and industry i; and $L_{r,t} \sum_i L_{r,i,t}$ is the total aggregate employment in region r.

3. Empirical Strategy

A common strategy to evaluate the distributional impacts of trade from a spatial perspective is to exploit the differential exposure of local labor markets of a given country to international trade shocks. Conceptually, these shocks typically happen at some aggregate level -- say, at the industry level -- and local labor markets are differentially exposed to aggregate shocks by some pre-existing characteristic -- say, by the industry composition of the labor force. A local labor market exposure to an aggregate shock will be a weighted average of its exposure to each aggregate shock.

Suppose, for instance, that there are two regions (North and South) and two industries (Manufacturing and Agriculture) in a country. Suppose further that the South has most of its labor force employed in Agriculture and the North has most of its labor force employed in manufacturing. If foreign demand for Agriculture goes up exogenously, then the South will be more exposed to this international trade shock. We capture distributional effects of trade by measuring the relative effect of the most exposed region relative to the least exposure region, which can be thought of as a simple differences-in-differences estimator.

Methodologically, when there are many regions and sectors, we estimate the distributional effects of trade through shift-share (Bartik) regressions (for details on the methodology, see Borusyak et al., 2020). The intuition above still follows through, and the estimator can still be interpreted as differences-in-differences one (cf. Chodorow-Reich, 2020). This method became standard in the literature and is used both for import

shocks (Autor et al., 2013 and Dix-Carneiro and Kovak, 2015) and export shocks (Robertson et al., 2021 and Góes et al., 2023).

Formally, to measure the impact of exports over local labor markets, we interact export growth in different industries $i \in \mathcal{I}$ with differential exposure to industry-specific shocks across different local labor markets. Formally, we define local labor market exposure to exports growth as:

$$\Delta \tilde{X}_{r,t} \equiv \sum_{i \in \mathcal{I}} \frac{L_{r,i,t-1}}{L_{r,t-1}} \cdot \Delta \tilde{X}_{i,t} = \sum_{i \in \mathcal{I}} \frac{L_{r,i,t-1}}{L_{r,t-1}} \cdot \left(\tilde{X}_{i,t} - \tilde{X}_{i,t-1} \right)$$

where $\tilde{X}_{i,t}$ denotes total exports of industry i at period t; $L_{r,i,t}$ denotes total employment in region r and industry i; and $L_{r,t} = \sum_{i \in \mathcal{I}} L_{r,i,t}$ is total aggregate employment in region r.

Given the shares $\frac{L_{r,i,t}}{L_{r,t}}$, our objective is to estimate the dynamic treatment effect of a regressor on the regressand above, which can be done provided that the shifters $\Delta \tilde{X}_{r,t}$ are as good as random. If this this were true, we would be able to recover the dynamic treatment effect by estimating a sequence of local projection regressions as in Jordà (2005).

Given some some outcome of interest $O_{r,t-1}$ and a vector of control variables $\mathbf{Z}'_{r,t-1}$ one could estimate a sequence of OLS regressions:

$$O_{r,t+h} - O_{r,t-1} = \alpha_h + \beta_h \Delta \tilde{X}_{r,t} + \mathbf{Z}'_{r,t-1} \boldsymbol{\phi}_h + \varepsilon_{r,h}, \text{ for } h \in \{ 0,1,2,3 \dots \}$$

Note that, in this sequence of regressions, for each t, the right-hand variables are the same while the dependent variable changes and denotes the cumulative change of the outcome variable since the reference period. The path of β_h shows a cumulative impulse response function that can be interpreted as the dynamic average treatment effect of the outcome variable.

Provided that estimation is consistent, as shown by Plagborg-Møller and Wolf (2021), local projections like the one above retrieves impulse response functions that are asymptotically identical to the ones from vector autoregressions (VARs) but with the advantage of being fully flexible models for instrumental variable estimation and not requiring identifying the full matrix of autoregressive coefficients.

Furthermore, more recently, Dube et al. (2023) have shown that a local projections design as the one above can be generalized as a dynamic differences-in-differences estimator. While their paper focuses primarily on the case of with a binary treatment, the authors argue that it extends to the continuous treatment case, which would be the one we would consider here with $\Delta \tilde{X}_{r,t}$.

These results hinge on the consistency of the estimator. However, there are many reasons to believe exposure to exports can be endogenous, including the fact that they depend on local human capital, technology, and other factors of production, which can be naturally correlated with unobserved local labor market characteristics. Therefore, one needs to use some plausibly exogenous shifters that are not correlated with domestic demand to consistently estimate β_h.

We propose an instrument that tries to isolate an exogenous part of exports by leveraging the correlation between changes in exports and changes in past foreign demand. Hence, this instrumentation strategy is

similar to the one implemented in Aghion et al. (2018), in which one takes demand in all destinations as a proxy for exogenous variation in a particular industry.

Let $\mathcal{S}$ be set of countries in the world and let $s \in \mathcal{S}$ denote our source country – Indonesia. Indonesian exports are its sales to the set of all countries other than itself $d \in \mathcal{S} \setminus s$: $\tilde{X}_{i,t} = \sum_{d \in \mathcal{S} \setminus s} \widetilde{X_{d,i,t}}$. Formally, we define our instrument as:

$$\Delta \bar{X}_{r,t} \equiv \sum_{i \in \mathcal{J}} \frac{L_{r,i,t-1}}{L_{r,t-1}} \cdot \sum_{d \in \mathcal{S} \setminus s} \frac{\widetilde{X_{d,i,t-1}}}{\tilde{X}_{i,t-1}} \cdot \Delta Y_{d,t}$$

where $\frac{\widetilde{X_{d,i,t-1}}}{\tilde{X}_{i,t-1}}$ denotes country d's share of industry i's exports; and $\Delta Y_{d,t}$ is the change in U.S. dollar GDP in country d. Note that this instrument incorporates **every country that Indonesia exports to** in **every industry**, with a higher weight to the higher export partners, which are likely to be the six partners emphasized in Figure X, but can differ for industry-specific exports.

Estimation now takes the form of two-stage least squares, with the first stage being:

$$\Delta \tilde{X}_{r,t} = \alpha + \beta \Delta \bar{X}_{r,t} + \mathbf{Z}'_{r,t-1} \boldsymbol{\phi} + \bar{\varepsilon}_{r,t}$$

and the second stage is:

$$O_{r,t+h} - O_{r,t-1} = \alpha_h + \beta_h \Delta \hat{X}_{r,t} + \mathbf{Z}'_{r,t-1} \boldsymbol{\phi}_h + \varepsilon_{r,h}, \text{ for } h \in \{ 0,1,2,3 \dots \}$$

where $\Delta \hat{X}_{r,t}$ are the predicted values of the first stage regression. Estimation of β_h is consistent if $E[\Delta Y_{d,t} \cdot \varepsilon_{r,h} | \mathbf{Z}'_{r,t-1}, L_{r,i,t-1}, \widetilde{X_{d,i,t-1}}] = 0$ for every d and r pair at every horizon h -- i.e. if past changes in foreign demand are uncorrelated with the distribution of unobserved factors that drive changes local labor markets in Indonesia.

The intuition is that global foreign demand shocks can impact an open economy like Indonesia. Furthermore, each Indonesian district is itself a small open economy. Therefore, it is unlikely that changes in foreign demand are correlated with the *distribution of unobserved factors* that *differentially* drive changes local labor markets.

As shown in the binscatter below, which is a visual representation of the first-stage regression, changes in exposure to exports are strongly correlated with changes in exposure to foreign demand shocks. The f-statistic is greater than 1,800, so the instrument is extremely relevant. If one agrees that this instrument also satisfies the exclusion restriction, then we can appropriately interpret the results in this section as the causal dynamic effect of exports on local labor markets in Indonesia.

Figure 4. Indonesian Districts: Labor Market Exposure to Merchandise Exports
(binscatter that partitions the support of the x-axis into 100 bins; x-axis: regional exposure to foreign demand growth, US$2015 billion; y-axis: regional exposure to export growth, US$2015 billion)
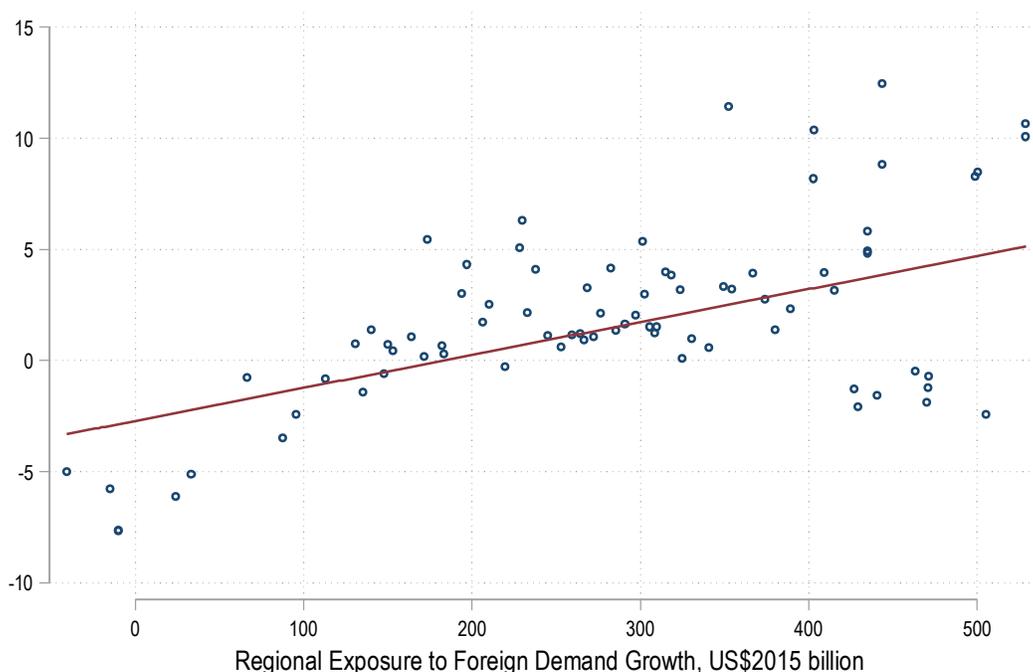
The underlying regression has n = 8,558, with unconditional ß = 0.0148 and t-stat = 42.52

Source: Authors' calculations with data from Sakernas and UNCOMTRADE.

4.   Main Results

As mentioned in the previous section, the results in this section should be interpreted in **relative terms,** as in a difference in differences estimator**.** Below we plot the results of a given region being relatively more exposed to exports (as instrumented by foreign demand shocks) over time, which we interpret as the causal dynamic treatment effect of exports on those outcome variables.

Below, in each Figure, the red line shows the coefficients β_h estimated using two-stage least squares as explained in the methodology session. The confidence interval shows 95% confidence bands with standard errors clustered at the district-level. Controls include share of females, share of population with high-school or higher education, share of urban population, average age in district, as well as district fixed-effects. Time-fixed effects are not included because the data are already first-differenced. Since we are focusing on labor market effects, for consistency, we restrict the sample to individuals between 15 to 64 years old.

Job creation: employment, unemployment rate, and labor force participation

Districts that face an increased exposure to exports see an increase in employment. A 1 billion USD increased exposure to exports induces a peak cumulative increase in employment of approximately 1,250 jobs 4 years after the shock. The response is still positive and significant even six years after the shock.

When normalizing the impulse response function (IRF) to one with a one standard deviation shock, which is approximately 5.25 billion USD increased exposure to exports, the peak cumulative response in employment is of about 0.12 standard deviations the annual change in district employment in Indonesia. The standardized IRFs are shown in Appendix A.

Figure 5. Effect of Exports on Employment
(Effect of a 1 billion USD increased exposure to exports on employment, in number of jobs)
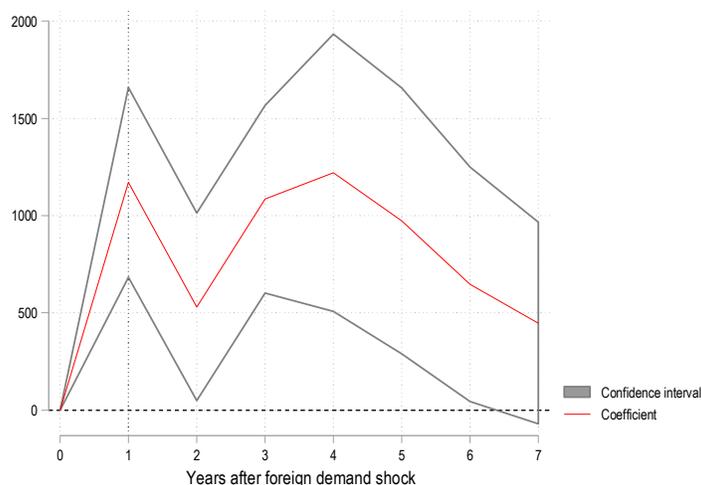
Consistent with the effect above, districts more exposed to exports see a decline in their unemployment rate. The decline is economically small, but statistically significant. As with the employment creation, this is an effect that is consistent with foreign demand shocks through increased exposure to exports boosting local income relative to other local labor markets.

A 1 billion USD increased exposure to exports induces a decrease in the unemployment rate of 0.16 percentage points 3 years after the shock. The effect is negative and significant even 7 years after the shock. After normalization, the peak response in the unemployment rate to a 1 standard deviation increase in exposure to exports is 0.18 standard deviations of the annual change in the unemployment rate across Indonesian districts.

Figure 6. Effect of Exports on the Unemployment Rate
(Effect of a 1 billion USD increased exposure to exports on the
unemployment rate, in percentage points)
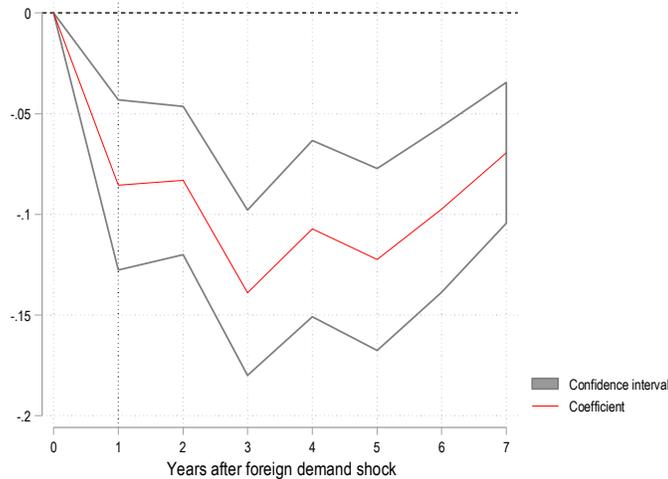
Finally, we estimate the effect on labor force participation. The effects are now inconsistent, moving between positive and negative and been economically small. This suggests that the effects on the unemployment rate are being driven almost entirely by the employment result rather than changes on labor force participation. When normalized by the standard deviation, the responses of the LFPR stays between -0.07 and +0.08 standard deviations of the change in LFPR across Indonesian districts.

Figure 7. Effect of Exports on the Labor Force Participation Rate
(Effect of a 1 billion USD increased exposure to exports on the Labor
Force Participation Rate, in percentage points)
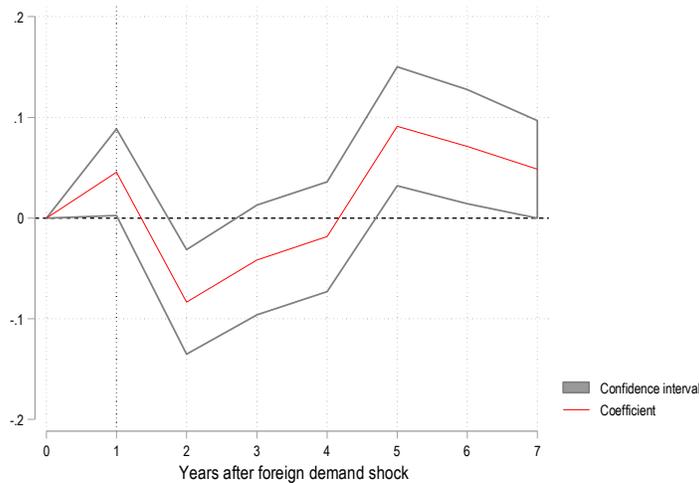
Job quality: informality and underemployment

When decomposing the effects between formal and informal employment, we observe that formal employment responds positively at the time of the shock. This is intuitive, since in general exporters tend to be larger firms who are more likely to be in the formal sector.

The peak cumulative response happens two years after the shock: a 1-billion-dollar increased exposure to exports induces 645 extra formal jobs relative to other Indonesian districts. Normalizing the responses in terms of standard deviations, a 1-standard-deviation shock to export exposure induces a 0.13 standard deviation peak response in formal employment two years after the shock.

After the fourth year, the effect becomes muted. The point estimates become negative and statistically insignificant throughout the estimate horizon. This could be due to the persistency of trade shocks themselves, which become less important over time. It could also be, as we will see below, due to substitution of formal for informal employment due to low employment attachment.

Figure 8. Effect of Exports on Formal Employment
(Effect of a 1 billion USD increased exposure to exports on formal employment, in number of jobs)
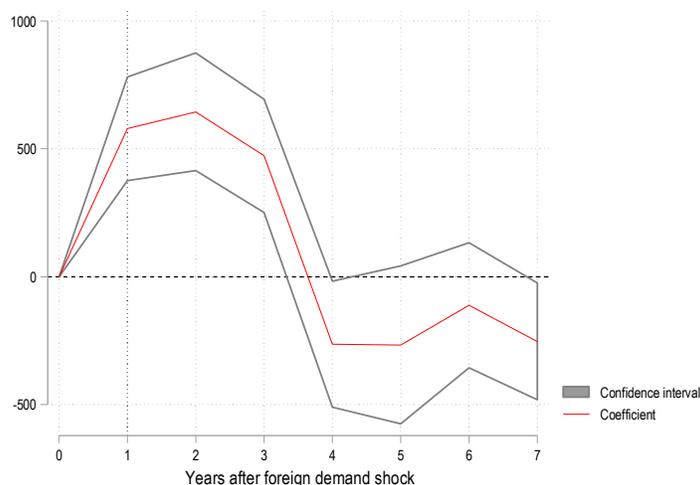
Informal employment has essential the reverse dynamics. It does not respond immediately after the shock. Again, this is intuitive since the informal sector is less exposed to exports. If anything, we observe a *decrease* in informal employment in the initial horizons after the shock, which could potentially be explained due to employment being displaced from informal to the formal exporting sectors. Starting in year 3, we observe an increase in the informal employment response, which peaks in year 4. Over the long run, the response converges to close to zero.

The peak cumulative response is that on year 4 a 1-billion-dollar increased exposure to exports induces 790 extra informal jobs relative to other Indonesian districts. The normalized responses suggest that the response to a 1-standard-deviation shock is of 0.14 standard deviations. Hence, the peak normalized responses of formal and informal are comparable and the higher peak numbers of informal employment are just an artifact of a base effect – average changes in informal employment are higher, presumably because the share of this sector is larger in the Indonesian economy.

Figure 9. Effect of Exports on the Informal Employment
(Effect of a 1 billion USD increased exposure to exports on informal employment, in number of jobs)
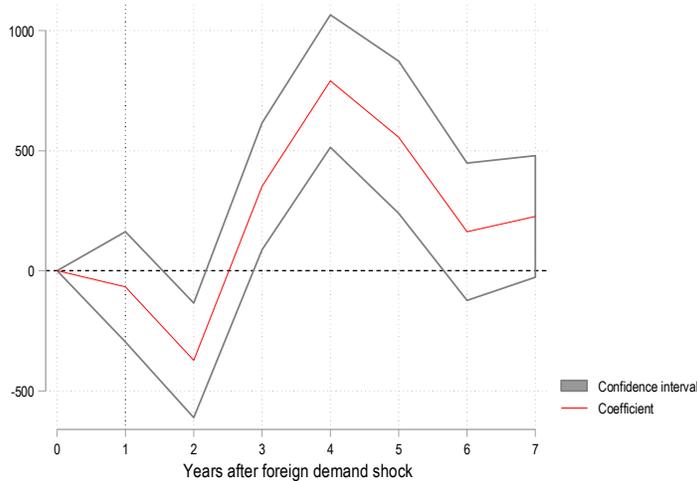
The effects on the underemployment rate are consistently one of decreasing it – i.e., leading people out of underemployment. The peak cumulative effect happens 5 years after the shock, approaching nearly a 0.4 decrease in underemployment rate. This is one of the largest effects in economic magnitude that we observe in the study.

The peak normalized response of the underemployment rate is quite dramatic. After 5 years, a 1 standard deviation increased exposure to exports leads to a 0.18 standard deviation *decrease* in the underemployment rate, where the standard deviation in relative to the annual change in the underemployment rate across Indonesian districts.

Figure 10. Effect of Exports on the underemployed rate
(Effect of a 1 billion USD increased exposure to exports on the underemployed rate, in percentage points)
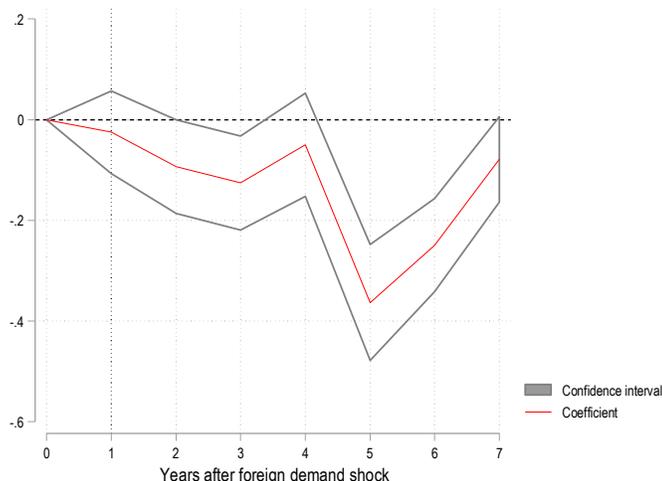
Wages and welfare

The year one effect is that districts which face an increased exposure to exports see a decrease in real monthly wages. However, this effect is short-lived. In year two, the cumulative effect becomes zero and it hovers between negative and zero.

The effect is economically small. At its peak, the negative cumulative effect never reaches 5,000 2007 real Indonesia rupiah (< 1 USD at the present day). The standardized response peaks at -0.08 standard deviations at year five but can range as high as +0.02 standard deviations.

For context, real average wages in Indonesia in our sample are 1,054,832 in 2007 Indonesia Rupiah, which are 2,165,206 in 2023 Indonesia Rupiah or approximately 140 USD. Since our model is run in changes, the appropriate unit of reference is the *change* in wages. The average change in real wages is 17,317 2007 Indonesia Rupiah (2.33 USD at the present day) while the standard deviation is 638,369 2007 Indonesia Rupiah (41.87 USD at the present day). Results on wages must be interpreted with these numbers as reference.

Figure 11. Effect of Exports on Real Monthly Wages
(Effect of a 1 billion USD increased exposure to exports on real monthly wages, in 2007 real Indonesian Rupiah)
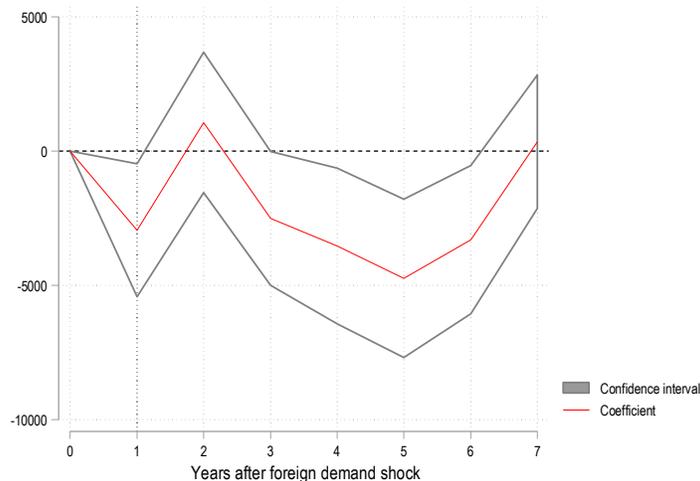
While the effect on real wages *per worker* over the short-run is negative, this does not necessarily speak of *welfare*, since the number of jobs increased. To proxy a measure of welfare, we calculate the cumulative effect on the total real wage bill for a given district. A 1 billion dollar increase in exposure to exports in a given Indonesian district induces a peak cumulative response in the total real wage bill in that district of 1.3 trillion 2007 real Indonesian rupiah (~ 178 million USD at the present day exchange rate) one year after the shock.

This effect is positive and significant up until 4 years but dies out on the mid-horizon, mirroring the trajectory of employment. The standardized response shows that the short-horizon effect is relatively large, as high as 0.17 standard deviations in response to a 1 standard deviation shock at year one. This suggests that the effects on welfare are positive.

Figure 12. Effect of Exports on Real Total Wage Bill
(Effect of a 1 billion USD increased exposure to exports on the unemployment rate, in trillion Indonesian Rupiah)
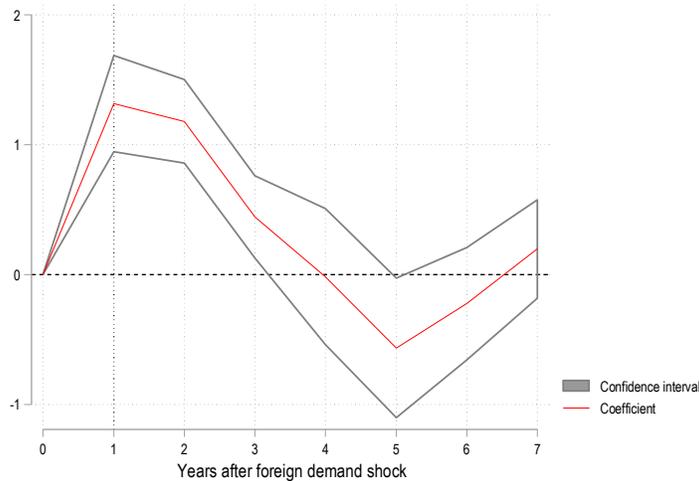
5. Heterogeneous effects between high skilled and low skilled workers

As a second step, we decompose some of the effects between high skilled workers and low skilled workers. Skilled workers are those who have completed at least a high school education. The impulse response functions are estimated independently for each group and overlayed for each horizon in order to compare the dynamics for each group.

Employment responds positively for both groups but much more so unskilled workers. While this is partly due to a base effect – the standard deviation in the changes in unskilled employment (42,093) is higher than in the change to skilled employment (23,945). However, since the effects on unskilled employment are more than twice as large than the effects on skilled employment for most of the horizon, overall employment shifts towards unskilled employment after a foreign demand shock.

Figure 13. Effect of Exports on Employment
(Effect of a 1 billion USD increased exposure to exports on employment, in number of jobs)
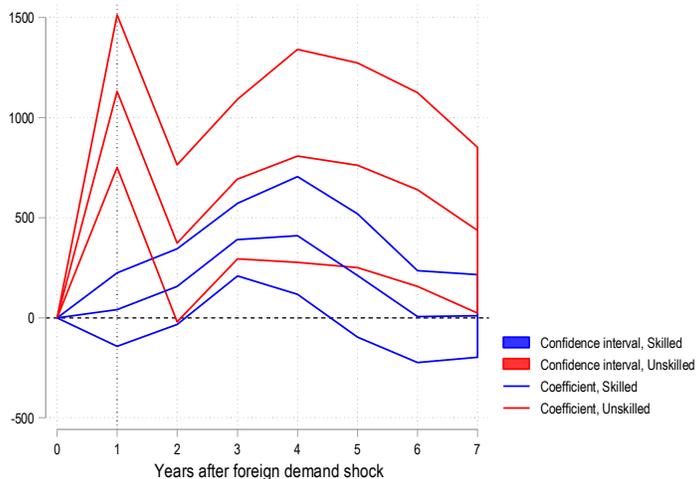
Initially, real wages respond positively for both skilled and unskilled workers, which is consistent with positive foreign demand shocks. However, the effect over the short run is heterogenous: for unskilled workers real wages, it becomes negative while for skilled workers it persists being positive. At the mid-horizon, both effects converge to zero.

One potential explanation for the negative medium-term response of unskilled wages is the fact the (presumably) much larger shock to unskilled workers, inferred from the short-term response of unskilled unemployment, could induce a dynamic response from supply of unskilled workers in the medium term.

Figure 14. Effect of Exports on Real Monthly Wages
(Effect of a 1 billion USD increased exposure to exports on real monthly wages, in 2007 real Indonesian Rupiah)
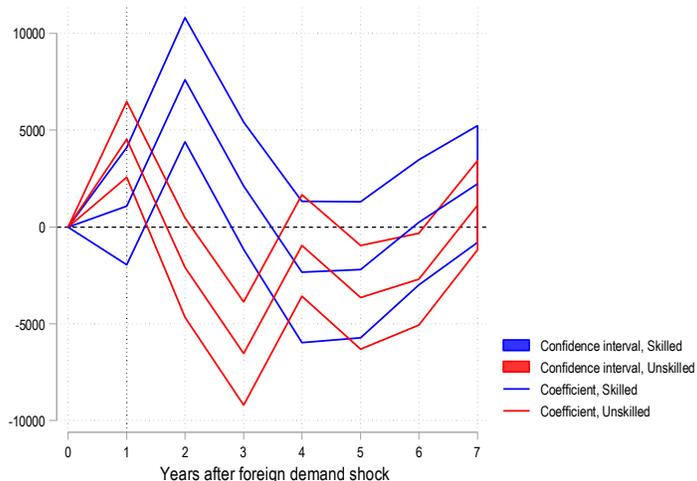
Conversely, there seems to be no differential impact on formalization rates across skill levels. As shown in the figure below, the within-group formality rate responds moves in-tandem, suggesting that the dynamics for the formal and informal employment plotted in Figures 8 and 9 are similar for both groups.

Figure 15. Effect of Exports on the Formality Rate
(Effect of a 1 billion USD increased exposure to exports on the formality rate, in percentage points)
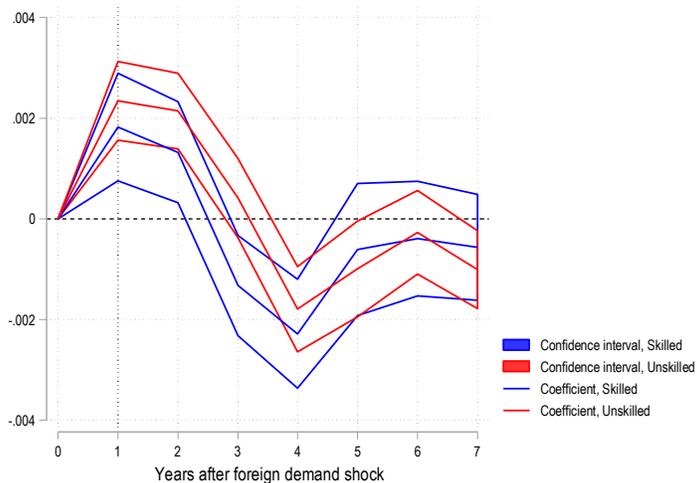
6. Discussion of the results through the lens of a simplified spatial economy

Description of the model

In this section, we introduce a simple quantitative spatial framework, modelled after Allen and Arkolakis (2014), which allows for trade and migration, and use it to add the theoretical structure interpret our

empirical results. We will model exports as a foreign demand shock that lies outside of the model and concentrate on the general equilibrium effects of local labor markets.

Consider a country with many regions $r \in \mathcal{R}$. Workers are mobile across regions and trade across regions. Total utility in each of those regions is:

$$V_d = \left(\sum_{d \in \mathcal{R}} q_{sd}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \times U_d$$

where q_{sd} is the demand for a differentiated goods ($q_i: i \in \mathcal{R}$) produced in source country s and consumed at destination country d and U_d are local amenities of location d. Demand for each variety is:

$$q_{sd} = \left(\frac{p_{sd}}{P_d} \right)^{-\sigma} \frac{w_d}{P_d}$$

where $P_d = \left(\sum_{s \in \mathcal{R}} p_{sd}^{1-\sigma} \right)^{\frac{1}{1-\sigma}}$ is the ideal price index at d.

Each aggregate consumption good q_s is a sectoral composite of $g \in \mathcal{G}$ countably many sectors, defined as a Cobb-Douglas defined as in Caliendo and Parro (2015), but for the sake for simplicity, without an input-output structure:

$$q_s \equiv \prod_{g \in \mathcal{G}} (q_{s,g})^{\beta_g}, \qquad s.t. \quad \sum_{g \in \mathcal{G}} \beta_g = 1$$

Given this technology, we can write the price index as:

$$p_s = \prod_{g \in \mathcal{G}} (p_{s,g}/\beta_g)^{\beta_g}$$

In each region and sector, firms have a linear technology in labor. For a firm in sector g, its output is:

$$y_{s,g} = A_s A_g \, l$$

where A_g denotes sector-wide productivity; A_s denotes regional average productivity; and l denotes demand for labor. We assume there is free entry and perfect competition. Given that, the equilibrium satisfies factory-gate prices equating marginal costs, or:

$$p_{s,g} = \frac{w_s}{A_s A_g}$$

where w_s are wages in region s. In this economy consumers face iceberg trade costs. We make the standard assumption that $\tau_{ss} = 1$ (self-trade is costless) and $\tau_{sd} \leq \tau_{sz}\tau_{zd}$ (trade costs satisfy the triangle inequality). Therefore, the prices satisfy:

$$p_s = \prod_{g \in \mathcal{G}} (w_s/A_s A_g \beta_g)^{\beta_g}$$

$$p_{sd} = \tau_{sd} p_s = \tau_{sd} \prod_{g \in \mathcal{G}} (w_s/A_s A_g \beta_g)^{\beta_g}$$

$$P_d = \left(\sum_{s \in \mathcal{R}} p_{sd}^{1-\sigma} \right)^{\frac{1}{1-\sigma}} = \left(\sum_{s \in \mathcal{R}} (\tau_{sd})^{1-\sigma} \prod_{g \in \mathcal{G}} (w_s/A_s \, A_g \beta_g)^{(1-\sigma)\beta_g} \right)^{\frac{1}{1-\sigma}}$$

We can now write expenditure of consumers in d on goods coming from country *s:*

$$X_{sd} = p_{sd} q_{sd} = \left(\frac{p_{sd}}{P_d} \right)^{1-\sigma} w_d$$

Note that we can also synthetically express expenditure in goods coming from *s* as a share of total expenditure, using the fact that total nominal expenditure equals total nominal income $X_d = w_d$:

$$\pi_{sd} \equiv \frac{X_{sd}}{X_d} = \frac{(\tau_{sd})^{1-\sigma} \prod_{g \in \mathcal{G}} (w_s/A_s \, A_g \beta_g)^{(1-\sigma)\beta_g}}{\sum_{k \in \mathcal{R}} (\tau_{kd})^{1-\sigma} \prod_{g \in \mathcal{G}} (w_k/A_k \, A_g \beta_g)^{(1-\sigma)\beta_g}}$$

$$= \frac{(\tau_{sd})^{1-\sigma} \prod_{g \in \mathcal{G}} (w_s/A_s)^{(1-\sigma)\beta_g}}{\sum_{k \in \mathcal{R}} (\tau_{kd})^{1-\sigma} \prod_{g \in \mathcal{G}} (w_k/A_k)^{(1-\sigma)\beta_g}}$$

$$= \frac{(\tau_{sd})^{1-\sigma} (w_s/A_s)^{(1-\sigma)}}{\sum_{k \in \mathcal{R}} (\tau_{kd})^{1-\sigma} (w_k/A_k)^{(1-\sigma)}}$$

where the second equality comes from the fact that the region and sector productivity are separable, and therefore the sequence of products $(A_g \beta_g)^{(1-\sigma)\beta_g}$ cancel out in the numerator and denominator; and the third equation comes from the fact the Cobb-Douglas assumption of production, and therefore in summing all of the coefficients $\sum_{g \in \mathcal{G}} \beta_g = 1$.

The trade market clearing condition is defined as:

$$w_s L_s = \sum_{d \in \mathcal{R}} \pi_{sd} \, w_d L_d$$

Finally, to define the labor market equilibrium, individuals will choose locations *d* that maximize their indirect utility, given by:

$$d^* = argmax_d \left\{ W_d = \frac{w_d}{P_d} U_d \right\}$$

Quantitative simulation and comparison with empirical results

We run a simple quantitative exercise in which we assume that there are 10 regions in the country which differ in their sectoral productivity. We then double the productivity of the region that is on average most productive, to simulate the effects of an exogenous positive labor demand shock, trace out the general equilibrium predictions of the model, and compare them to our empirical results.

Figure 16: Results from Quantitative Spatial Model After an Exogenous Change in Labor Demand (x-axis accounts for average productivity across sectors in region r, left-panel: change in labor force and employment; right-panel: change in real wages)
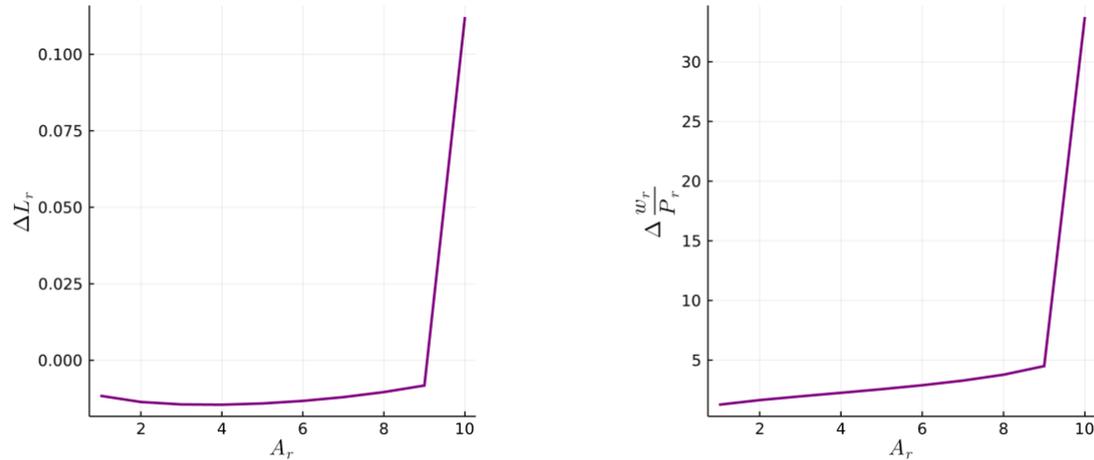
The model predicts that total employment (which is also equal to total population) will expand where there is a positive demand shock relative to other regions, which population contracts in every other region – this is seen in the left panel of Figure 16. Therefore, if mobility is possible, it predicts migration flows from regions not exposed to demand shocks to those exposed to demand shocks.

We have presented results related to expansion of employment in the previous part of the paper, but we have also replicated the empirical model having total population as our dependent variable. It turns out that population also responds to export shocks, which is consistent with the results of our structural model.

As expected, workers respond to positive foreign demand shocks by migrating to those regions more exposed to those shocks. A 1-billion-dollar increased exposure to exports shock induces a peak cumulative response of about 1250 inward migrants about 4 years after the initial shock. This also helps explain why the labor force participation rate does not drop substantially in the initial horizon. The employment growth (an increase in the numerator of the LFPR) is likely compensated by an increase in population and labor force (an increase in the denominator of the LFPR).

Figure 17. Effect of Exports on Population
(Effect of a 1 billion USD increased exposure to exports on population, in persons)

Years after foreign demand shock
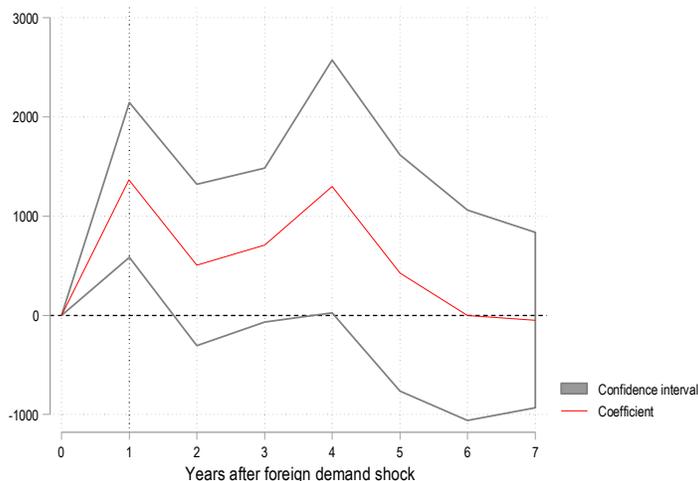
One caveat is that while in the model we have rule out international migration, in the data we cannot differentiate between international and domestic migration. The only estimate observable to the econometrician is the response of *population* to export exposure as instrumented by foreign demand shocks.

While it is reasonable to interpret this as migration, it is not possible to decompose these between domestic and international migration, since we do not have a longitudinal panel of individuals that follows their migration patterns over time, rather only a repeated cross-section (our dataset is a panel-data of *districts*). Estimating the effect of trade shocks over migration patterns in a developing country like Indonesia with longitudinal data would be a fruitful avenue of future research.

The right-hand side panel of Figure 16 shows that real wages are also expected to increase after a foreign demand shock. This is not an effect that we observe in aggregate wages. While this is a puzzling result, as shown this effect on average wages might be combining into an aggregate number covariances of multiple labor markets. As we showed in the previous section, once we estimate IRFs separately for average wages unskilled and skilled workers, we observe positive responses in the first period, which are consistent with positive foreign demand shocks.

Alternatively, what could be happening is a compositional effect. As some of the export industries in Indonesia are in extractive sector (such as palm oil and mining), if wages in those industries are during the sample period lower than average, higher exposure to exports could temporarily decrease wages in a given local labor market.

Finally, the combination of the two effects – employment and wages –, which summarize welfare, is positive in the model. It is also positive in the data. So, we document a channel that is, in many ways, consistent with a demand shock.

7. **Conclusion**

Uncovering the effects of exports on jobs in Indonesia represents a comprehensive effort to uncover the intricate threads that tie together international trade and labor market outcomes. This paper bridges the gap between empirical evidence and theoretical understanding, providing additional perspective on the

transformations that the Indonesian labor market has undergone due to its engagement with the global economy.

After tracing out the dynamic empirical effects of exports exposure on local labor markets, we show that the empirically observed dynamics are consistent with what is expected from demand shocks in a quantitative spatial model. Therefore, one can conclude that exports seem to have indeed boosted labor demand in local labor markets in Indonesia.

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Appendix A: Impulse Response Functions Normalized to a 1-standard deviation shock

Figure A1. Effect of Exports on Employment
(Effect of a 1 standard deviation increased exposure to exports on employment, in standard deviations)
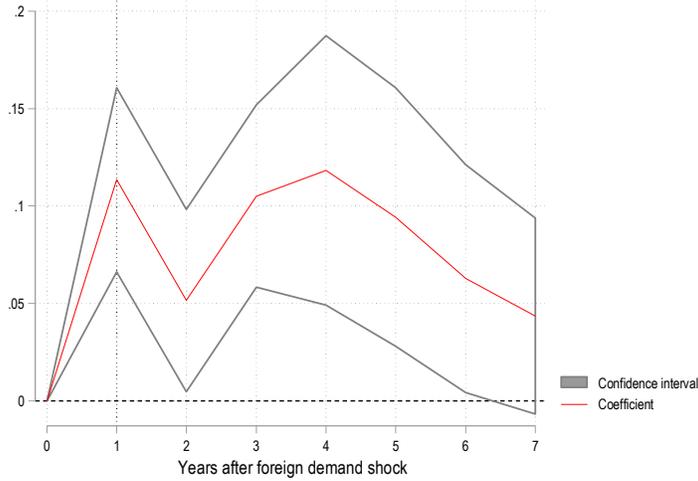
Figure A2. Effect of Exports on the Unemployment Rate
(Effect of a standard deviation increase exposure to exports on the unemployment rate, in standard deviations)
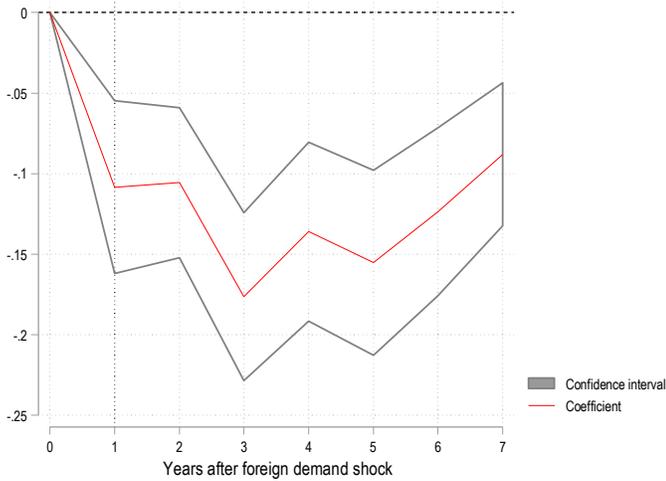
Figure A3. Effect of Exports on the Labor Force Participation Rate

(Effect of a standard deviation increase exposure to exports on the Labor Force Participation Rate, in standard deviations)
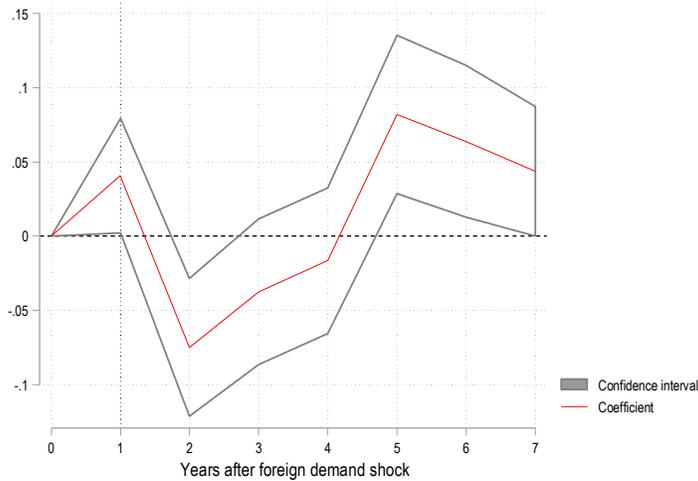
Figure A4. Effect of Exports on the Formal Employment

(Effect of a standard deviation increase exposure to exports on the formal employment, in standard deviations)
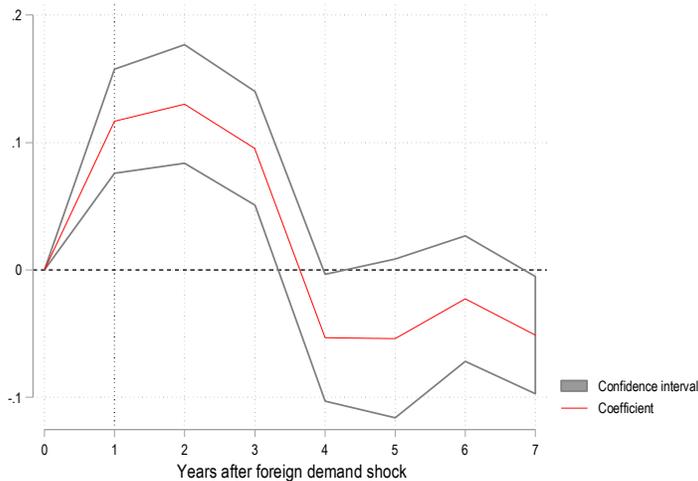
Figure A5. Effect of Exports on the Informal Employment
(Effect of a standard deviation increase exposure to exports on informal employment, in standard deviations)
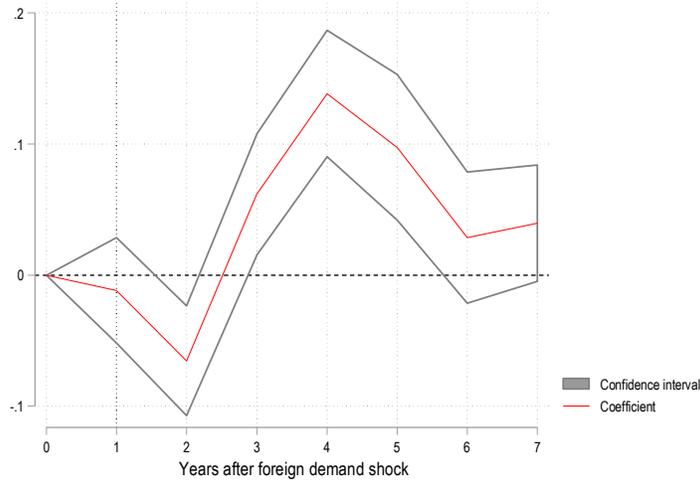
Figure A6. Effect of Exports on the underemployed rate
(Effect of a standard deviation increase exposure to exports on the underemployed rate, in standard deviations)
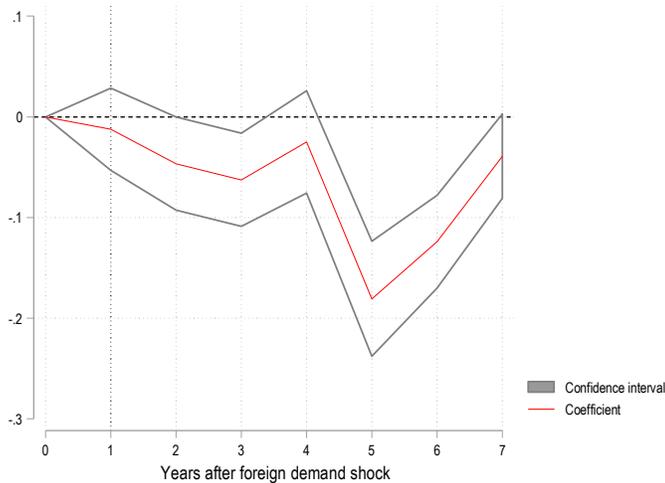
Figure A7. Effect of Exports on Real Monthly Wages
(Effect of a standard deviation increase exposure to exports on real monthly wages, in standard deviations)
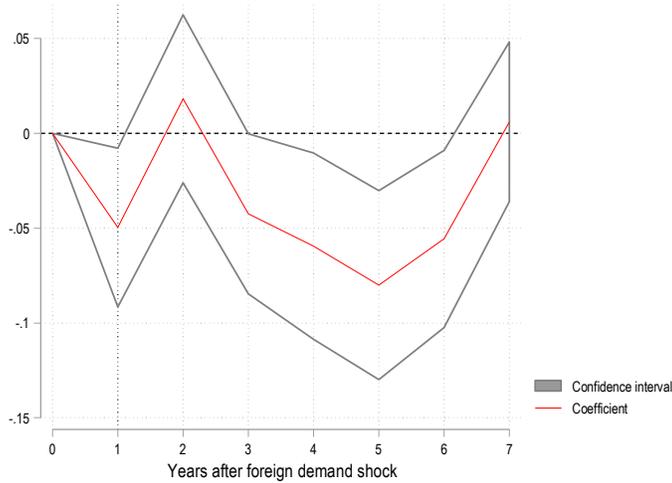
Figure A8. Effect of Exports on Real Total Wage Bill
(Effect of a standard deviation increase exposure to exports on real total wage bill, in standard deviations)
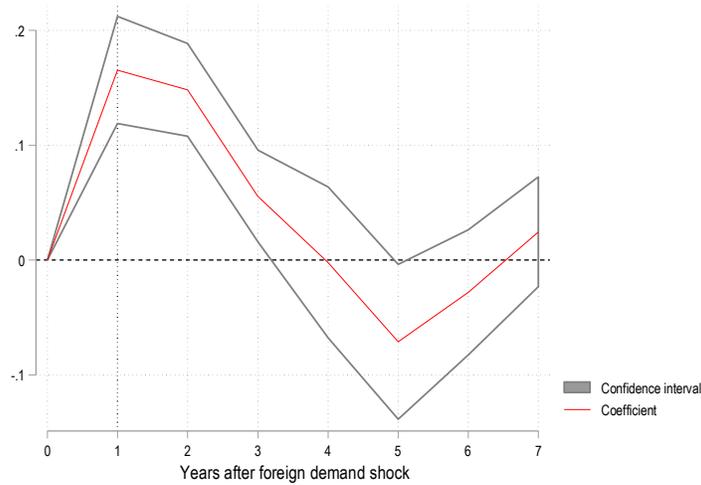
Appendix B - Data

Sakernas

The Sakernas data, also known as the National Labor Force Survey (Survei Angkatan Kerja Nasional), is a comprehensive dataset for Indonesia. It is a survey conducted by the Indonesian Central Bureau of Statistics (Badan Pusat Statistik or BPS) and provides detailed information on various aspects of the labor force in the country. The survey is typically conducted bi-annually and collects data from households across Indonesia.

The Sakernas data covers a wide range of topics related to employment, unemployment, and labor force participation. It includes information about individuals' demographic characteristics, educational attainment, occupation, industry, employment status, working hours, wages, and other relevant labor-related variables.

For this study, we built a repeated cross-sectional dataset between 1993 and 2014 using the August rounds of data. We harmonized industry codes to Klasifikasi Baku Lapangan Usaha Indonesia (KBLI) 1990 classification, the Indonesian industrial classification based on ISIC Revision 2.

UN COMTRADE

The UN Comtrade dataset, officially known as the United Nations Commodity Trade Statistics Database, is a comprehensive international trade database maintained by the United Nations Statistics Division (UNSD). This dataset provides detailed information on global merchandise trade, encompassing the import and export of goods and services between countries and regions. In this study, we limit the analysis to trade in merchandise only, since data on trade in services is very limited for the pre-2000s period.

UN Statistics Division (ISIC-HS Concordances)

The UN Statistics Division (ISIC – HS) concordances refer to a set of tables or mapping systems that establish a link between two international classification systems: the International Standard Industrial Classification of All Economic Activities (ISIC) and the Harmonized System (HS).

ISIC is a global standard for classifying economic activities. It provides a hierarchical structure that categorizes industries based on their primary economic activities. ISIC codes are used for various statistical and analytical purposes to group economic activities into meaningful categories. ISIC codes exist under four different classifications and levels of disaggregation. In this study, we use the nine-sector classification consistent with Revision 2.

The HS is an international nomenclature developed by the World Customs Organization (WCO) for classifying traded goods. It provides a standardized way of categorizing products for customs, trade, and tariff purposes.

The ISIC – HS concordances serve as a bridge between these two classification systems, allowing us to link economic activities (ISIC) from the Sakernas data to specific products or goods (HS) in the UN COMTRADE data.

World Development Indicators Data

The World Development Indicators (WDI) is a comprehensive dataset maintained by the World Bank that provides a wide range of economic, social, and environmental data for countries around the world. The dataset covers a variety of topics and indicators, offering insights into the development status and progress of countries over time. We use data on foreign GDPs from all commercial partners to Indonesia to build our Bartik instrument.

FRED-PCE Deflator

The Federal Reserve Economic Data (FRED) provides access to a wide range of economic data, including the Personal Consumption Expenditures (PCE) deflator, which is considered a more comprehensive measure of inflation by some economists due to its dynamic basket of goods and services. In this study, we use the PCE deflator to express the value of exports and wages in real terms.