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THE IMPACT OF COVID-19 PANDEMIC ON REGIONAL ECONOMY: SUPPLY-DRIVEN INTERREGIONAL INPUT-OUTPUT (IRIO) APPROACH FOR EAST JAVA PROVINCE

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ABSTRACT

The COVID-19 pandemic mitigation measures have led to supply and demand-side labor market shock. By employing the Supply-Driven Interregional Input-Output (IRIO) approach, we estimate the impact of that labor shock on the regional economy. The model is based on the 2020 Indonesian IRIO Table, the updated version of the 2016 IRIO Table with RAS procedures. The IRIO table consists of 34 provinces and 17 sectors. Referring to our estimation, the labor shock in East Java Province has reduced the output, value-added, and employment in East Java Province by 97 trillion rupiahs, 49.41 trillion rupiahs, and 532,066 labor, respectively. Manufacturing, Wholesale and Retail Trade, as well as Accommodation and Food Service Activities, are the most adversely impacted sectors. Due to sectoral and regional interrelationships, the shock in East Java has influenced the other provinces, ultimately provinces on Java Island and in aggregate, it has reduced national output by 130.02 trillion rupiahs, shrunk the national value-added by 66.37 trillion rupiahs, and forced the 646,999 workers out of jobs with the sectoral impact has a similar pattern to the impact of East Java.

Keywords: *Labor Market Shock, COVID-19 Pandemic, Supply-Driven IRIO*

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ABSTRAK

Langkah-langkah mitigasi pandemi COVID-19 telah menyebabkan guncangan pasar tenaga kerja dari sisi penawaran dan permintaan. Dengan menggunakan pendekatan Supply-Driven Interregional Input-Output (IRIO), kami memperkirakan dampak guncangan tenaga kerja tersebut terhadap ekonomi regional. Model tersebut didasarkan pada Tabel IRIO Indonesia 2020, versi terbaru dari Tabel IRIO 2016 yang diperbarui dengan prosedur RAS. Tabel IRIO terdiri dari 34 provinsi dan 17 sektor. Merujuk hasil estimasi kami, goncangan tenaga kerja di Provinsi Jawa Timur telah menurunkan output, nilai tambah, dan penyerapan tenaga kerja di Provinsi Jawa Timur masing-masing sebesar 97 triliun rupiah, 49,41 triliun rupiah, dan 532.066 tenaga kerja. Sektor Manufaktur, Perdagangan Besar dan Retail, Akomodasi dan Jasa Makanan merupakan sektor yang paling terkena dampak negatif paling besar. Karena keterkaitan antar sektoral dan regional, guncangan pasar tenaga kerja di Jawa Timur telah mempengaruhi provinsi lain, terutama provinsi-provinsi di Pulau Jawa serta secara agregat

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guncangan ini telah menurunkan output nasional sebesar 130,02 triliun rupiah, mengurangi nilai tambah nasional sebesar 66,37 triliun rupiah, dan menyebabkan 646.999 pekerja kehilangan pekerjaan, dengan dampak sektoral dengan pola yang mirip dengan yang terjadi di Jawa Timur.

Kata Kunci: *Guncangan Pasar, Tenaga Kerja, Pandemi COVID-19, Supply-Driven IRIO*

JEL: J21, I15, R15

Introduction

The government's responses to contain the spread of the COVID-19 virus such as lockdown, non-essential business, schools, and public areas closures, and travel restrictions have disrupted all economic sectors around the globe. Based on the World Bank data, the world Gross Domestic Products (GDP) is estimated to fall by 3.59 percent in 2020. Domestically, according to BPS-Statistics Indonesia, Indonesia experienced a 2.07 percent output contraction during the same period, the worst since the massive monetary crisis in 1997/1998.

One of the propagations of the COVID-19 pandemic impacts on the economy was due to labor shock channels resulting from the combination of supply and demand-side labor shock (Rio-Chanona et al., 2020). At the initial stage, the government policy measures to mitigate the health crisis constrain production. Restriction on people's mobility, curfew, shortened operational business hours, closure for some industries, temporary suspension of transportation, and also amplified by the disruption of the supply chain led to the economy running under its full capacity (supply-side labor shock) (Dingel & Neiman, 2020; Hicks et al., 2020; Koren & Petö, 2020). Further, as the sectoral level impact may differ, industries exposed to negative COVID-19 pandemic pressure will have a tighter financial capacity and be forced to adjust their staffing temporarily or permanently. Conversely, some sectors like the health and information sectors may have incremental demand (Guerrieri et al., 2020), all of which have created a demand-side labor shock.

Confirmed by the data, the International Labor Organization (ILO) in 2021 reported 8.8 percent of total working hours reduced in 2020, or the equivalent of 250 million full-time workers in one year globally, with 33 million people becoming unemployed and 81 million people out of the labor market. In Indonesia, the COVID-19 pandemic has impacted 29.12 million workers or around 14.28 percent of the working-age population.

The effect of labor shock on the aggregate economy relies on the heterogeneous sectoral impact on labor (Borjas & Cassidy, 2020) and the linkage and interdependency between sectors in the economy (Acemoglu et al., 2012). COVID-19 pandemic impact in the form of labor shock differs in each economic sector due to the nature of the economic sector itself. The asymmetric labor shock depends on how the job can be conveniently shifted to be done remotely, whether or not the workers are intensively in contact with other people, or the essentiality classification (Borjas & Cassidy, 2020; Hensvik et al., 2020; Osotimehin & Popov, 2020).

Industries in which the job can be done remotely, such as banking and finance, information and technology, education, scientific, and technical services, have relatively experienced smaller negative labor shocks than other sectors, such as retail trade and manufacturing. Meanwhile, the sector classified as an essential sector can have leniency treatments to operate more normally than other sectors, such as health, banking, financial services. The linkage and interdependence between sectors or industries will spread the shock in a particular industry through network structure, leading to aggregate and sectoral economic fluctuation (Acemoglu et al., 2012).

This paper aims to observe the impact of labor shock, as a consequence of measures to curb COVID-19 spread, on the regional economy in Indonesia. The impact of labor shock on the sectoral or aggregate output will be estimated using the extended version of Ghosh (1958) supply-driven Interregional Input-Output (IRIO) as labor shock affects the supply side of the economy through output components. A supply-driven IRIO approach is more appropriate than the standard demand-driven IRIO analysis to estimate the shock's impact on the downstream of the sector to which it impacts the intermediate input of sectors (Leung & Pooley, 2001; Seung & Waters, 2009; Kim, 2015; Kim, 2021). The labor is employed as an input to produce outputs. The labor supply and demand shocks as the consequences of COVID-19 pandemic mitigation affect labor input and consecutively affect the output in a specific sector and influence the supply of raw and intermediate inputs for other sectors.

Our analysis contributes to the literature in three aspects. First, to our knowledge, there is still a lack of empirical research on the impact of COVID-19 on regional economic performance observed from the labor market shock channel. Second, we add the empirical works on the supply-driven IRIO analysis for the case of Indonesia. Third, this study is the first to use the updated version of the recently published 2016 IRIO Table to provide a more precise baseline for our simulation to enhance the model's accuracy.

In our simulation, we assume that the COVID-19 containment measures created supply shock in East Java Province, one of the provinces which experienced the highest number of COVID-19 cases. As the second-largest regional economy, East Java closely represents the national economic structure compared to the largest regional economy, DKI Jakarta Province. The magnitude of the shock is estimated by the reduction of the output in the economic sectors affected by the labor shock. To assess the transmission of the shock in East Java Province to other regions in Indonesia, we calculate the backward linkage effect and the forward linkage effect under the supply-driven IRIO framework. We employ the 2020 IRIO table, an updated version of the recently released 2016 IRIO table using RAS procedures. The total backward linkage effect and forward linkage multiplier will determine the aggregate impact of the shock on sectoral and regional output. The analysis will be further extended into the impact of the shock on value-added and employment.

We found empirical evidence that the propagation of the labor shock in East Java Province has reduced its output, value-added, and employment. The backward and forward linkage interdependence between regions has intensified the impact on thenational-level economy. Provinces in Java Island are estimated as being the most affected regions. At the same time, from a sectoral point of view, Manufacturing, Wholesale and Retail Trade, and Accommodation and Food Service Activities sectors suffered the most significant decline in output due to the shock. On the contrary, the Information and Communication, Education, and Human Health and Social Work Activities sector gained an increase in output due to the shock.

The rest of the paper is organized as follows. Section II presents the data and methods of analysis. Discussion of the empirical results of the estimation provided in Section III, and Section IV provides conclusion and policy recommendation. The Appendix contains some further data, estimation results, and figures.

Literature Review

A large set of studies has been carried out on the impact of COVID-19 pandemic on the economy. The catastrophic impact of COVID-19 on the economy was transmitted through supply and demand channels (Brinca et al., 2020; Pichler & Farmer, 2021). Some studies put the focus on the supply side shock as the consequences of the government prevention measures

of COVID-19 spread. Guerrieri et al. (2020) argued that the impact of Covid-19 pandemic has a feature of Keynesian supply shock, which the supply shock emerged to lead to larger demand shock. Some studies are built with the framework that covid-19 has enormously impeded the supply side of the economy related to the impact on the workers in different types of economic sectors (Papanikolaou & Schmidt, 2020; Rio-Chanona et al., 2021).

Lockdown has caused a decline in the number of labors, hours of work, and labor productivity (Olivia et al., 2020; Brinca et al., 2021; Paños & Patón, 2021). Moreover, some sectors may have to shut down their business due to the restrictions issued by the government. This will reduce the production capacity in the economy. In the following stage, drop in household revenue due to the job loss and uncertain economic condition will also reduce consumption and lead to demand shocks (Olivia et al., 2020). The propagation of the shock triggered by the pandemic to the output is described in Figure 1.

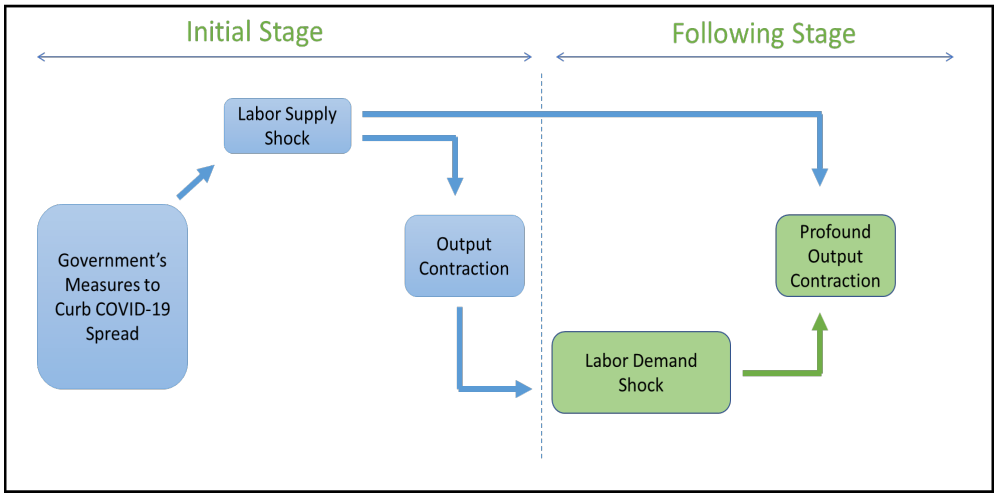

Figure 1: Illustration of the LABOR Shock Propagation Caused by COVID-19 Pandemic Policy Measures to the Economy

Labor supply shocks influenced the economy through the sectoral forward and backward linkages; hence, previous research utilized the Input-Output (IO) framework to analyze the effect of COVID-19 pandemic on the economy (Paños & Patón, 2021; Pichler & Farmer, 2021). As the initial nature of shock caused by COVID-19 is the supply shock, Kim (2021) reiterated that standard demand-driven IO framework cannot capture the impact properly. The demand-driven IO assumed that supply is perfectly elastic. If final demand changes, the supply side will adjust the production level to match the number of demands. However, in a supply-driven IO framework, we suppose that supply shock can reduce output of a sector. Later, this output may be used as an input for other sectors; therefore, there will be a supply chain reduction in other sectors (Kim, 2021).

Previous studies have been conducted using the Supply-Driven Input-Output Approach to simulate the impact of a shock on the economy. Arto et al. (2015) used Input-Output method to measure the impact of supply side shock caused by the Japanese Earthquake in 2011 on the global economic condition. They estimated that global value-added has fallen by approximately USD 139 billion because of the disaster, and the most affected sector was transport equipment. The Supply-Driven IO method was also used to investigate the effect of Foot and Mouth Disease (FMD) outbreak in South Korea, and the projected total impact on the economy resulting from this simulation was larger than the demand-driven IO approach (Kim, 2015). In addition, Kim (2021) analyzes the effect of trade disputes between Korea and Japan, in this

case Japan's export control of materials for producing semiconductors and display panels, on the Korean economic performance. The study concluded that the policy will decrease the GDP of Korea by 0.72% and reduce employment by 0.22%.

Research Methods and Data

This section consists of four subsections. The first three parts explain the methodology, namely Interregional Input-Output Matrix, Supply-Driven Interregional Input-Output (IRIO) Analysis, and Shock Identification. The last part of this section provides information on the data used for the analysis.

Interregional Input-Output Matrix

To illustrate the interrelationship between economic sectors, we employ the Interregional Input-Output (IRIO) matrix. The matrix represents the economy's total output produced by all economic sectors distributed to the final consumer and used by other sectors as inputs. Suppose there are two regions (r and s) and two sectors (i and j) in the economy. The market-clearing condition of total output from all economic sectors and regions takes the following equation:

$$\begin{bmatrix} x^r \\ x^s \end{bmatrix} = \begin{bmatrix} Z^{rr} & Z^{rs} \\ Z^{sr} & Z^{ss} \end{bmatrix} \begin{bmatrix} u \\ u \end{bmatrix} + \begin{bmatrix} y^{rr} + y^{rs} \\ y^{sr} + y^{ss} \end{bmatrix} \quad (1)$$

Where is the total output produced by all sectors in the region r, represents the intermediate inputs used by all sectors in region r which is also comes from that region, is vector of ones, and denotes the final demand of goods produced by region r. The input coefficient represents the input share of sector *j* in region r required from sector *i* in region *r* to produce one unit of product (Arto et al., 2015). Let the Matrix be *n* x *n* matrix of the coefficient , where *n* is the number of all economic sectors:

$$A^{rr} = \begin{bmatrix} a_{ii}^{rr} & a_{ij}^{rr} \\ a_{ji}^{rr} & a_{jj}^{rr} \end{bmatrix} where\ n = (i,j) \quad (2)$$

Thus, as the coefficient written in the matrix form, the total output can be expressed as $x = Ax + y$, or

$$\begin{bmatrix} x^r \\ x^s \end{bmatrix} = \begin{bmatrix} A^{rr} & A^{rs} \\ A^{sr} & A^{ss} \end{bmatrix} \begin{bmatrix} x^r \\ x^s \end{bmatrix} + \begin{bmatrix} y^{rr} + y^{rs} \\ y^{sr} + y^{ss} \end{bmatrix} \quad (3)$$

The solution for the total output vector is $x = (I-A)^{-1}y$, where the *n x n* matrix $(I-A)^{-1}$ is called the Leontief inverse matrix, measuring the effect of final demand on the output. Correspondingly, to measure the output change as the impact of the change in the final demand, we can express with $x = (I-A)^{-1}y$. This mechanism is called the demand-driven IRIO approach. However, in case of supply shock, demand-driven IRIO is not sufficient to describe the overall impact in the economy (Kim, 2021).

Supply-Driven Interregional Input-Output (IRIO) Analysis

We follow the calculation of supply-driven IRIO developed by Kim, 2021. The first part of the supply-driven IRIO approach is derived from the backward linkage effect procedure. The market-clearing condition of total domestic output from all economic sectors, $x = (I-A)^{-1}y$, can be decomposed into impacted and unimpacted sectors, as follows:

$$\begin{bmatrix} x^r \\ x^s \end{bmatrix} = \begin{bmatrix} A^{rr} & A^{rs} \\ A^{sr} & A^{ss} \end{bmatrix} \begin{bmatrix} x^r \\ x^s \end{bmatrix} + \begin{bmatrix} y^{rr} + y^{rs} \\ y^{sr} + y^{ss} \end{bmatrix} \quad (4)$$

Assume that the shock only affects all sector in region r (n_1); thus, n_2 is the number of sectors and region which are unaffected by a shock (n_2= n-n_1). The outputs in region r are exogenous or not influenced by the final demands. Hence, the first row in equation (4) does not hold. From the second row of the equation (4), $x^s = A^{sr}x^r + A^{ss}x^s + y^{sr} + y^{ss}$, the unimpacted

sectors, n_2 in which the endogenous output, x^s, will be subject to the exogenous variable x^r and $y^{sr}+y^{ss}$. Solving the equation for x^s

$$x^s = (I-A^{ss})^{-1}(A^{sr}x^r + y^{sr} + y^{ss}) \quad (5)$$

The total influence of output shock in region r to output in region is computed as follows:

$$\Delta x^s = (I-A^{ss}) - 1A^{sr}\Delta x^r \quad (6)$$

with assumption $y^{sr}+y^{ss}$. The backward linkage effect of Δx^r on x^s can be measured with the $n_2 \times n_1$ matrix $(I-A^{ss})^{-1}A^{sr}$.

For the second part of the supply-driven IRIO analysis, we look at the context of forward linkage formulation using the modified version of the Ghosh (1958) model (Leung & Pooley, 2001; Seung & Water, 2009; Kim, 2015; Kim, 2021). Suppose the output coefficient matrix, B, for example, $[b_{ij}^{rr}] = \left[\frac{x_{ij}^{rr}}{x_i^r}\right]$, where $[b_{ij}^{rr}]$ is the allocation of output from sector *i* in region *r* which is used as an intermediate input for industry *j* in region *r.* The output coefficient is also known as the allocation or supply coefficient (Miller & Blair, 2009; Kim, 2021).

Furthermore, the total input, x', can be decomposed into $x' = w + w^m + v$, where w is domestic intermediate input, w^m is imported intermediate input, and is value-added. Since $w = x'B$, we can reconstruct the equation into:

$$x' = x'B + w^m + v \quad (7)$$

solving x' we get $x' = (w^m + v)(I-B)^{-1}$ or $\Delta x' = \Delta v(I-B)^{-1}$ with assumption $\Delta w^m = 0$. The *n* x *n* matrix $(I-B)^{-1}$ is known as the Ghosh inverse matrix and has a similar function as the Leontief inverse matrix, $(I-A)^{-1}$, in the demand-driven IRIO approach.

From equation (7), we can decompose the total input x' into impacted and unimpacted sectors, as follows:

$$[x'^r x'^s] = [x'^r x'^s]\begin{bmatrix} B^{rr} & B^{rs} \\ B^{sr} & B^{ss} \end{bmatrix} + [w^{m\prime r} w^{m\prime s}] + [v'^r v'^s] \quad (8)$$

Since n_1 represents the number of affected sectors in region r, only the second part of equation (8) holds, that is

$$x'^s = x'^r B^{rs} + x'^s B^{ss} + w^{m\prime s} + v'^s \quad (9)$$

The endogenous variable x'^s will depend on the endogenous variable x'^r and x'^s. Solving the equation for x'^s, we get $x'^s = (x'^r B^{rs} + w^{m\prime s} + v'^s)(I-B^{ss})^{-1}$, or by assuming that $\Delta w^{m\prime s} = \Delta v'^s = 0$, it is equivalent to

$$\Delta x^s = [B^{rs}(I-B^{ss})^{-1}]'\Delta x^r \quad (10)$$

The forward linkage effect of Δx^r on x^s can be measured with the $n_2 \times n_1$ matrix $[B^{rs}(I-B^{ss})^{-1}]'$.

Hence, from the supply-drive IRIO analysis, we got two sets of matrix multipliers which determine the effect of the supply side output shock in region r (Δx^r) on the output of region s (:

1. Backward linkage effect determined by $[(I-A^{ss}) - 1A^{sr}]$

2. Forward linkage effect calculated by $[[B^{rs}(I-B^{ss})^{-1}]'$

Both matrices have a dimension of $n_2 \times n_1$. However, we need to acknowledge another effect, the direct effect of exogenous shock in region *r* to x^r which is equivalent to Δx^r. The direct

impact only needs to be computed once. Following the work by Kim, 2021, the direct impact is considered as the element of the backward linkage effect and represented by adding the $n_1 \times n_1$ identity matrix on top of the backward linkage matrix. For notational purposes, we also add an $n_1 \times n_1$ zero matrix on top of forward linkage matrix. Finally, we have two matrices with the dimension of $n \times n_1$

$$Backward\ linkage\ coefficients = \left[\frac{I_{n_1 \times n_1}}{[(I - A^{ss})^{-1} A^{se}]_{n_2 \times n_1}} \right]_{n \times n_1} \tag{11}$$

$$Forward\ linkage\ coefficients = \left[\frac{O_{n_1 \times n_1}}{[BR^{rs} (I - B^{ss})^{-1} A^{se}]_{n_2 \times n_1}} \right]_{n \times n_1} \tag{12}$$

After obtaining the impact of the shock on output, we can also gauge the impact on value-added and employment both at the sectoral and regional levels. Those effects are measured by multiplying the diagonalized matrix of the value-added coefficient or employment coefficient with the output vector.

Shock Identification

Based on the Cobb-Douglas production function, the total output (Y_i) depends on the productivity (A_i) and labor input (L_i). The function is as follows:

$$Y_i = A_i L_i^a \prod_j x_{ij}^{\gamma(w_{ij})} \tag{13}$$

where, and are the labor and other input elasticity, respectively. In this setup, the labor shock induced by supply and demand sides shocks due to the government measures to contain the spread of the COVID-19 virus infection. If there is labor input reduction in sector *i,* input the output in sector *i* will eventually contract weighted by the labor elasticity.

Following Barlow and Vodenska (2021), due to the reduction of the labor employed, the economic sectors will produce a fragment of its initial production, the labor supply shock has the following effect:

$$Y_i^1 = (S_i)^{\alpha} Y_i^0 \tag{14}$$

$$\Delta Y_i = Y_i^1 - Y_i^0 \tag{15}$$

where $S = \left[\frac{L_i^1}{L_i^0} \right]$ is the labor input ratio in sector *i*, between a period and the period prior. The superscript denotes the period t. The output of sector *i* at the initial period, Y_i^0, will be corrected to a portion $(S_i)^{\alpha}$ of itself at t=1 . The supply-side shock identified in this paper is measured by the difference of outputs between two consecutive periods due to labor shock (equation (15)).

Data

The main data source for this analysis is the interregional input-output (IRIO) table which provides sectoral and regional disaggregation of economic interrelationship as well as equations for gross regional and gross national products. The latest available IRIO table in Indonesia is the 2016 IRIO table, recently published by BPS-Statistics Indonesia. Indonesia's IRIO table is available at regional and sectoral classifications. The regional classifications are based on the existing 34 provinces in Indonesia and sectoral classifications are provided with 17 economic sectors.

To adjust the dataset with current economic conditions, we update the 2016 IRIO table to the 2020 IRIO table by employing the RAS method developed by Richard Stone (Miller & Blair, 2009). In updating the IRIO table, we also make use of the current price GRDP data by

sector from all provinces in 2020. We performed 51 iterations to get the 2020 version of the IRIO table. Then, we rearrange the table for simulation purposes, locating East Java Province and its 17 economic sectors at the upper left of the table (Figure 2). The information on the baseline value of output, value-added, and employment level in each province is presented in Table 1.

Provinces / Sector / Sector A-RSTU		East Java	…	Papua	Total Final Demand	Total Output
		…	Sector A-RSTU			
East Java	Sector A-RSTU	Z^{11}	…	Z^{134}	F^{1}	X^{1}
….	…	…	…	…	…	…
Papua	Sector A-RSTU	Z^{341}	…	Z^{3434}	F^{34}	X^{34}
Value-Added		V^{1}	…	V^{34}		
Total Input		X'^{1}	…	X'^{34}		

Figure 2: Illustration of the Indonesia IRIO Table with East Java as the Constrained Region

To estimate the output shock due to the negative labor shock, we use labor data from the National Labor Force Survey (Sakernas) in February 2021 and February 2020. For calculating the labor elasticity, we also used the constant gross regional domestic product (GRDP) data for each province retrieved from BPS-Statistics Indonesia in 2019 and 2020.

Result and Discussion

This section consists of three subsections. We discuss the calculation of the shock variable first, then accuracy check of RAS approach and the results of the IRIO simulation are provided in the following subsections.

Estimation of Shock Magnitude

According to our calculation displayed in Table 2 (on Appendix 1), negative output shock occurs in ten sectors while the other seven sectors experience positive output shock. In terms of value, the most substantial decrease in output happened in the Manufacturing sector (-33.93 trillion rupiahs), followed by Wholesales & Retail Trade (-30.48 trillion rupiahs), Accommodation & Food Beverages Activity (-20.69 trillion rupiahs), and Construction (-14.82 trillion rupiahs). In terms of percentage, the Other Services sector suffered the highest decrease in output by -12.34%, followed by Transportation & Storage (-10.16%), and Accommodation & Food Beverages Activity (-8.22%). On the contrary, the output of the Information and Communication sector rose significantly by 20.29 trillion rupiahs or increased by 10.61% followed by Education Services (+4.11 trillion rupiahs or increased 4.29%), Agriculture (3.27 trillion rupiahs or increased 0.95%), and Human Health & Social Work Activity (+2.62 trillion rupiahs or increased +8.29%). In aggregate, East Java Province suffered from a negative output shock of approximately 97 trillion rupiahs.

Accuracy Check of RAS Approach

To check the accuracy of our RAS calculation, we compute Mean Absolute Deviation (MAD) following the formula by Miller and Blair (2009).

$$MAD = (1/n^2)\sum_{i=1}^{n}\sum_{j=1}^{n}|e(a)_{ij}|$$

where $e(a)_{ij}$ is the element of an error matrix $\mathrm{E(A)}$ which is defined as the difference between the estimated input coefficient obtained from RAS $(\widetilde{a_{ij}})$ and the 2016 IRIO baseline

input coefficient (a_{ij}) The result of our MAD is 0.00019, representing that the average difference of the two coefficients is quite small. Hence, we can argue that our RAS calculation is accurate and reliable.

Table 1: Baseline Output, Value-Added, and Employment

Province	Output[a] (in million Rp)	Value Added[b] (in million Rp)	Employment[c]
East Java	4,128,386,989	2,299,465,000	21,030,711
Nanggroe Aceh Darussalam	277,310,990	166,374,000	2,388,367
North Sumatera	1,586,059,159	811,281,000	7,029,733
West Sumatera	413,503,890	242,118,000	2,584,119
Riau	1,236,620,219	729,167,000	3,124,739
Jambi	343,012,177	206,846,000	1,745,146
South Sumatera	883,501,315	458,432,000	4,215,064
Bengkulu	124,374,589	73,338,000	1,043,415
Lampung	641,120,008	354,633,000	4,409,752
Bangka Belitung Islands	123,828,847	75,534,000	718,693
Riau Islands	503,629,870	254,252,000	1,037,133
DKI Jakarta	5,210,590,304	2,772,381,000	4,909,174
West Java	4,042,165,196	2,088,039,000	22,311,685
Central Java	2,672,430,020	1,348,628,000	17,701,854
DI Yogyakarta	265,314,109	138,386,000	2,201,508
Banten	1,191,207,274	626,437,000	5,686,915
Bali	404,515,113	224,213,000	2,427,290
West Nusa Tenggara	217,831,928	133,520,000	2,638,359
East Nusa Tenggara	172,214,829	106,507,000	2,783,505
West Kalimantan	425,249,997	214,002,000	2,534,397
Central Kalimantan	299,051,825	152,192,000	1,353,626
South Kalimantan	327,029,351	179,151,000	2,100,817
East Kalimantan	1,127,458,194	607,319,000	1,757,897
North Kalimantan	160,889,158	100,545,000	333,508
North Sulawesi	223,153,374	132,301,000	1,139,572
Central Sulawesi	368,528,605	197,442,000	1,516,663
South Sulawesi	854,126,941	504,479,000	4,176,800
Southeast Sulawesi	200,311,752	130,183,000	1,323,236
Gorontalo	65,322,994	41,725,000	585,225
West Sulawesi	82,584,077	45,910,000	693,833
Maluku	76,894,886	46,263,000	779,870
North Maluku	84,623,993	52,066,000	507,370
West Papua	155,222,277	83,567,000	459,890
Papua	328,541,931	198,928,000	1,763,180
Total	**29,216,606,181**	**15,795,624,000**	**131,013,046**

Source: [a)] The output is obtained from the 2020 IRIO Table. [b)] Value-added is obtained from the 2020 current price GRDP data published by BPS-Statistics Indonesia. [c)]Employment data is based on National Labor Force Survey (Sakernas) data published by BPS-Statistics Indonesia.

IRIO Simulation Results

After defining the magnitude of shock for each sector, we utilize the IRIO framework to measure the impact of the shock on the regional economy. We separate the analysis into the provincial and sectoral perspectives.

Backward and Forward Linkage Coefficient

The backward linkage and forward linkage coefficients are calculated using equations (11) and (12) in the supply-driven IRIO framework. The result for each coefficient is in a 578 x 17 matrix size, including a 17 x 17 identity matrix in the backward linkage coefficient matrix and a 17 x 17 zero matrix in the forward linkage coefficient matrix.

Table 3: Provincial Backward Linkage, Forward Linkage, and Total Effect Coefficients

Province	Code	Backward Linkage Coefficient	Forward Linkage Coefficient	Total Effect Coefficient
East Java	35	17	0	17
Nanggroe Aceh Darussalam	11	0.0042	0.0148	0.0189
North Sumatera	12	0.0753	0.1418	0.2171
West Sumatera	13	0.0103	0.0258	0.0360
Riau	14	0.1885	0.0340	0.2225
Jambi	15	0.0238	0.0141	0.0380
South Sumatera	16	0.2505	0.1222	0.3727
Bengkulu	17	0.0024	0.0088	0.0112
Lampung	18	0.0287	0.0306	0.0593
Bangka Belitung Islands	19	0.0071	0.0062	0.0133
Riau Islands	21	0.0147	0.0203	0.0349
DKI Jakarta	31	0.3500	0.2688	0.6188
West Java	32	0.2314	0.4587	0.6901
Central Java	33	0.2548	0.4156	0.6704
DI Yogyakarta	34	0.0104	0.0459	0.0564
Banten	36	0.1414	0.1475	0.2889
Bali	51	0.0124	0.0389	0.0513
West Nusa Tenggara	52	0.0160	0.0189	0.0349
East Nusa Tenggara	53	0.0069	0.0208	0.0277
West Kalimantan	61	0.0077	0.0434	0.0511
Central Kalimantan	62	0.0997	0.0574	0.1571
South Kalimantan	63	0.0186	0.0244	0.0430
East Kalimantan	64	0.3710	0.1434	0.5144
North Kalimantan	65	0.0339	0.0130	0.0469
North Sulawesi	71	0.0110	0.0153	0.0263
Central Sulawesi	72	0.0151	0.0845	0.0997
South Sulawesi	73	0.0198	0.0529	0.0727
Southeast Sulawesi	74	0.0167	0.0141	0.0309
Gorontalo	75	0.0013	0.0038	0.0051
West Sulawesi	76	0.0006	0.0061	0.0067
Maluku	81	0.0048	0.0112	0.0159
North Maluku	82	0.0034	0.0062	0.0096

Province	Code	Backward Linkage Coefficient	Forward Linkage Coefficient	Total Effect Coefficient
West Papua	91	0.0043	0.0219	0.0262
Papua	94	0.0142	0.0296	0.0439
Total		**19.2510**	**2.3611**	**21.6121**

Source: Authors' Calculation

The recapitulation of backward linkage and forward linkage coefficients in the provincial perspective is presented in Table 3. East Java experiences the direct impact of the shock which is represented by the highest backward linkage and total effect coefficients. Other provinces were exposed to the indirect impact of shock in East Java. The top three provinces with the biggest total indirect impact coefficient are West Java, Central Java, and DKI Jakarta. These facts imply a close relationship between East Java and those aforesaid provinces in the upstream and downstream sectors of production. This means if a shock occurred in East Java, those three provinces will experience the most significant effect compared to other provinces.

Table 4 provides information on the backward linkage and forward linkage coefficients from the sectoral standpoint. The backward linkage coefficient represents the influence of a unit of exogenous shock in one sector to its supplying (upstream) sector; whereas, the forward linkage coefficient suggested that an exogenous shock in a sector will generate forward impact on the sector which used its output as materials (downstream sector) (Kim, 2021). The sectors which have the highest backward linkage and forward linkage coefficients are Manufacturing, Mining and Quarrying, and the Construction sector. When the shock happens, these sectors will transmit a higher magnitude of impact on their upstream and downstream sectors.

Table 4: Sectoral Backward Linkage, Forward Linkage, and Total Effect Coefficients

Sector	Code	Backward Linkage Coefficient	Forward Linkage Coefficient	Total Effect Coefficient
Agriculture, forestry, and fishery	A	1.1899	0.0775	1.2674
Mining and Quarrying	B	1.5263	0.1268	1.6531
Manufacturing	C	1.7566	0.9296	2.6862
Electricity and Gas	D	1.1157	0.1187	1.2344
Water supply, Sewerage, Waste Management and Remediation Activities	E	1.0008	0.0027	1.0035
Construction	F	1.0323	0.3459	1.3782
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	G	1.1991	0.1689	1.3680
Transportation and Storage	H	1.1000	0.1187	1.2187
Accommodation and Food Service Activities	I	1.0124	0.0917	1.1041
Information and Communication	J	1.0447	0.0669	1.1116
Financial and Insurance Activities	K	1.1545	0.0347	1.1892
Real Estate Activities	L	1.0308	0.0222	1.0530
Business Activities	MN	1.0562	0.0227	1.0789
Public Administration and Defense; Compulsory Social Security	O	1.0073	0.1153	1.1226
Education	P	1.0031	0.0514	1.0546

Sector	Code	Backward Linkage Coefficient	Forward Linkage Coefficient	Total Effect Coefficient
Human Health and Social Work Activities	Q	1.0079	0.0388	1.0466
Other Services Activities	RSTU	1.0133	0.0286	1.0418
Total		**19.2510**	**2.3611**	**21.6121**

Source: Authors' Calculation

Impact on Output, Value-Added and Employment

The impact of sectoral shock in East Java on Indonesia's provincial output is calculated by multiplying the coefficient matrix with sectoral output shock. The direct impact of this shock shows that East Java's output decreased by about 97 trillion rupiahs, and the employment level dropped by 532,066 workers (see Table 5 on Appendix 2). In addition, East Java's value-added fell by 49.41 trillion rupiahs or slightly higher than actual data released by BPS-Statistic Indonesia, which reported the gross regional domestic product (GRDP) in current price in 2020 is 46.32 trillion rupiahs less than the previous year. All of the direct impacts come from the backward linkage multiplier effect.

Overall, the negative output shock in East Java has created a decline in national output by around 130.02 trillion rupiahs which decomposed into backward linkage effect by -114.71 (88.23%) trillion rupiahs and forward linkage effect by -15.31 (11.77%) trillion rupiahs. The shock also induced a reduction in value-added by around 66.37 trillion rupiahs from the backward linkage effect (-59.19 trillion rupiahs or 89.19%) and forward linkage effect (-7.18 trillion rupiahs or 10.81%) and forced 649,999 workers out of jobs (see Table 6 on Appendix 3).

Table 6 (Appendix 3) presents the empirical findings of the propagation of the impact of the shock in East Java Province to other provinces. The magnitude of the effect on other provinces represents the degree of economic interrelationship, both backward and forward linkage between East Java Province with other provinces. From Table 6 (on Appendix 3), Provinces in Java Island are the most affected by the shock in East Java. The shock in East Java reduced output by 5.81 trillion rupiahs in Central Java, 4.52 trillion rupiahs in West Java, and 3.87 trillion rupiahs in DKI Jakarta. East Kalimantan, Riau, and North Sumatera are the most affected provinces from outside Java Island, with the reduced output of 2.6 trillion rupiahs, 2.04 trillion rupiahs, and 1.7 trillion rupiahs, respectively. Meanwhile, Gorontalo, West Sulawesi, and Bengkulu are among the least impacted provinces.

These findings suggest the prevailing geographical or spatial influence on the economic interrelation between provinces in Indonesia. Moreover, most economic activities are concentrated in Java Island, such as manufacturing industries that are spatially disproportionately distributed (as shown by a large extent of previous studies), leading to higher interdependence among provinces in Java Island.

The estimated impact on value-added, as shown by Table 6 (on Appendix 3), has the same pattern as the impact on output. Central Java, West Java, DKI Jakarta, East Kalimantan, and Riau have the biggest reduced value-added by around 2.7 trillion rupiahs, 2.14 trillion rupiahs, 1.97 trillion rupiahs, 1.34 trillion rupiahs, and 1.11 trillion rupiahs, respectively. Further analysis on the employment impact found that the shock in East Java has impacted Central Java, West Java, West Sumatera, and South Sumatera the most. The asynchronous patterns of the impact between the shock on output (gross output and value-added) and employment can be explained by the distinct sectoral interrelationship between East Java Province and every other Province. Also, each sector has a different elasticity of labor absorption.

The estimated results of the simulation in the sectoral context are described in Table 7 (Appendix 4). The shock in East Java has caused different effects across sectors in Indonesia. In terms of output, the Information, and Communication, Education, Human Health and Social Work Activities, Real Estate Activities, as well as Water Supply sectors experienced increases in output due to the shock. Information and Communication received the highest output increase by about 20.32 trillion rupiahs, consisting of 20.06 trillion rupiahs from the backward linkage effect and 0.26 trillion rupiahs from the forward linkage effect. The new trend of remote working and distance learning due to mobility restrictions has created a higher dependency on information and communication technology (ICT) in Indonesia (Sparrow et al., 2020).

In contrast, most sectors encountered a decline in their output. There were three sectors with the most plummeting output, namely the Manufacturing, Wholesale and Retail Trade, and Accommodation and Food Service Activities. The manufacturing sector's output declined by around 48.03 trillion rupiahs, or 36.94% of the total effect on output. In addition, the output of Wholesale and Retail Trade changed by -33.22 trillion rupiahs. The lockdown and mobility restrictions have disrupted the supply chain, especially for manufacturing and distribution sectors. Furthermore, border closure and travel restrictions caused a significant drop in the Accommodation and Food Service Activities sector by -21.29 trillion rupiahs. As this sector is closely related to SMEs, the negative impact of pandemics on the tourism sector will have a spill-over impact on SMEs (Nugroho & Negara, 2020).

Regarding the impact on value-added, Table 7 on Appendix 4 displayed the same pattern as the effect on output for the five sectors positively influenced by the shock in East Java. The highest increase in value-added occurred in the Information and Communication sector (12.59 trillion rupiahs), followed by Education (2.54 trillion rupiahs) and Human Health and Social Work Activities (2.25 trillion rupiahs). On the other hand, the Wholesale and Retail Trade sector suffered the biggest decline in value-added by approximately 24.35 trillion rupiahs. This figure is higher than the reduction of value added by 20.59 trillion rupiahs in the Manufacturing sector.

The sectoral output shock in East Java led to the change in sectoral employment in Indonesia. This study found that the shock will create 38,592 employment opportunities in the Education sector. The rise in jobs also happened in the Human Health and Social Work Activities (25,583) and Agriculture Sector (15,907). The finding for the Agriculture Sector is quite interesting since the output and the value-added of this sector declined because of the shock in East Java. We assume that the COVID-19 pandemic has forced impacted workers in urban areas to migrate to rural areas to do agriculture. Traditionally, the agricultural sector can absorb the excess labor supply. Further, our estimation showed that the number of labors in the Wholesale and Retail Trade sector will decline by 237,649 labors. Moreover, a substantial number of job losses also prevail in the Other Services Activities (139,789 jobs lost) and Accommodation and Food Service Activities sector (131,721 jobs lost). Services-related jobs usually require face-to-face interaction; thus, social restrictions make it difficult for the services workers to do their jobs.

In general, our simulation results suggest that the Manufacturing Sector, Wholesale and Retail Trade, as well as Accommodation and Food Service are the most significantly impacted sectors by the COVID-19 related measures. These outcomes are similar to the study conducted by Richiardi et al. (2020) which examined the effect of lockdown in the UK with the I-O method. They found that almost 25% of employment in the UK is at risk, especially in the Accommodation and Food industry, Transport and Storage, and Manufacturing sector.

Conclusion and Recommendation

Based on our estimation, the output reduction due to labor shock in East Java province is 97 trillion rupiahs. The value-added contracted by 49.4 trillion rupiahs, this figure is quite similar with the actual data reported by the BPS- Statistics Indonesia. The shock also led to 532,066 workers losing their jobs.

Due to the backward and forward interrelationship, the shock in East Java Province has spread to other provinces. All provinces encounter the reduction of output, value-added, and employment, with the most affected provinces being the provinces in Java Island. In total, labor shock in East Java Province has cut down the national output by 130 trillion rupiahs and value-added by 66.36 trillion rupiahs and driven a drop in 646,999 employments.

Moreover, we estimate that labor shock due to COVID-19 containment measures in East Java Province has put pressure on the sectoral economy, with Manufacturing, Wholesale and Retail Trade, as well as Accommodation and Food Service Activities, having experienced the biggest pressures. The drop in output in these three sectors accounted for 78.86% of the total reduction in aggregate output. Conversely, the Information and Communication sector is enjoying an increase in output and value-added. Regarding employment, the Wholesale and Retail Trade sector faced the highest job reduction with 237,649 workers out of a job while the Education sector absorbed an additional 38,592 workers.

As a recommendation, we recommend some labor-related policies to reduce the severity of the impact of the COVID-19 pandemic and accelerate the economic recovery in the post-pandemic. These measures can be initiated by either the central or local government. First, the government could introduce innovative labor policies and social protection measures to mitigate the adverse impact of this pandemic-led crisis, such as an unemployment benefits program to temporarily substitute a portion of income while the workers are losing their job and looking for a new job. This program aims to protect the unemployed from falling into poverty and keep the workers from switching to a new job that gives less payment and provides an incentive to find a job that matches their skills and interest to avoid inefficiency in the labor market.

Since SMEs are more prone to pandemic-related shock, the government can reinforce current measures to support SMEs. First, they can provide financial support, including increasing the funding for giving loans, grants, and subsidies. The financial support also can be in the form of policies to suspend tax collection, refrain from increasing or introduce new duties imposed on them until the recovery has been secured and they are financially stable. Aside from liquidity support, the government can also allow SMEs to search for a new market via virtual business matching or provide training on adapting to digitalization. If the SMEs become more resilient to the negative impact of the shock, we can prevent further reduction in employment.

Moreover, ILO (2021) has also recommended strengthening labor skills and capabilities through training and vocational education to improve labor conditions. A quick evaluation of the new labor market trend is needed for formulating suitable training programs to meet those needs. It is also essential to broaden the target of the training program not only for young people but also for adults of working age. Lastly, with the growing trend of virtual training and ensuring that those skills are fully utilized, the government can create policy regarding recognizing the credentials obtained from such programs in the labor market.

Lastly, the government should maintain labor policies that promote job creation. Labor policies supporting firms to expand their capacity in post-pandemic recoveries, such as allow-

ing extensions of business or working hours, refraining from increasing the minimum wage, or giving policy support for firms to make staffing adjustment easier, would benefit firms expedite the economic recovery.

It is important to note, since the regional economy is interrelated in sectors and regions, considering the dynamic regional and sectoral fluctuation in other regions and sectors is crucial in constructing an economic model.

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Appendix 1

Table 2: Identification of Sectoral Output Shock Due to Labor Market Shock in East Java Province

Sector / Sector Code	Change of Constant Price GRDP (%)	Change of Labor or Employment (%)	The GRDP elasticity of labor ()	Ratio of Labor between 2021 and 2020 (*S*)	East Java's sectoral output (in million Rp	in million Rp	Sectoral Output Shock (in million Rp
Agriculture, forestry, and fishery /A	0.94	(0.40)	(2.3489)	0.9960	344,100,485	347,373,797	3,273,312
Mining and Quarrying/B	(4.18)	23.23	(0.1799)	1.2323	110,624,367	106,545,114	(4,079,253)
Manufacturing/C	(2.06)	(6.18)	0.3336	0.9382	1,611,992,453	1,578,063,586	(33,928,867)
Electricity and Gas/D	(2.39)	(10.24)	0.2335	0.8976	46,482,249	45,324,995	(1,157,254)
Water supply, Sewerage, Waste Management and Remediation Activities/E	5.04	12.43	0.4054	1.1243	3,132,393	3,284,815	152,423
Construction/F	(3.28)	(12.09)	0.2711	0.8791	431,650,398	416,829,740	(14,820,659)
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles/G	(5.74)	4.69	(1.2228)	1.0469	559,124,766	528,634,969	(30,489,797)
Transportation and Storage/H	(11.16)	8.50	(1.3140)	1.0850	154,263,865	138,590,051	(15,673,814)
Accommodation and Food Service Activities/I	(8.87)	6.88	(1.2887)	1.0688	251,734,787	231,043,539	(20,691,248)
Information and Communication/J	9.83	(4.95)	(1.9870)	0.9505	191,326,679	211,620,862	20,294,184
Financial and Insurance Activities/K	0.18	(43.37)	(0.0041)	0.5663	79,786,267	79,973,576	187,309
Real Estate Activities/L	3.95	24.46	0.1616	1.2446	49,644,001	51,430,445	1,786,445
Business Activities/ MN	(7.22)	(15.040	0.4802	0.8496	34,418,132	31,827,388	(2,590,744)

Sector / Sector Code	Change of Constant Price GRDP (%)	Change of Labor or Employment (%)	The GRDP elasticity of labor ()	Ratio of Labor between 2021 and 2020 (*S*)	East Java's sectoral output (in million Rp	in million Rp	Sectoral Output Shock (in million Rp
Public Administration and Defense; Compulsory Social Security/O	(0.39)	(20.79)	0.0186	0.7921	87,096,018	86,720,050	(375,968)
Education/P	3.96	(11.47)	(0.3448)	0.8853	95,816,281	99,927,178	4,110,897
Human Health and Social Work Activities/Q	8.70	18.97	0.4584	1.1897	31,625,822	34,247,719	2,621,897
Other Services Activities/RSTU	(13.80)	9.73	(1.4183)	1.0973	45,568,027	39,946,922	(5,621,104)
Total					**4,128,386,989**	**4,031,384,747**	**(97,002,243)**

Source: Authors' Calculation

Appendix 2

Table 5: Direct Impacts of Shock on East Java's Economy

Sector	Code	Impact on Output (in million Rp)			Impact on Value-Added (in million Rp)			Impact on Employment (in people)		
		Backward linkage	Forward Linkage	Total Impact	Backward linkage	Forward Linkage	Total Impact	Backward linkage	Forward Linkage	Total Impact
Agriculture, forestry, and fishery	A	3,273,312	-	3,273,312	2,602,398	-	2,602,398	64,541	-	64,541
Mining and Quarrying	B	(4,079,253)	-	(4,079,253)	(2,968,238)	-	(2,968,238)	(5,411)	-	(5,411)
Manufacturing	C	(33,928,867)	-	(33,928,867)	(14,855,462)	-	(14,855,462)	(67,057)	-	(67,057)
Electricity and Gas	D	(1,157,254)	-	(1,157,254)	(168,028)	-	(168,028)	(1,289)	-	(1,289)
Water supply, Sewerage, Waste Management and Remediation Activities	E	152,423	-	152,423	103,403	-	103,403	3,436	-	3,436
Construction	F	(14,820,659)	-	(14,820,659)	(7,341,241)	-	(7,341,241)	(45,089)	-	(45,089)
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	G	(30,489,797)	-	(30,489,797)	(22,473,219)	-	(22,473,219)	(216,556)	-	(216,556)
Transportation and Storage	H	(15,673,814)	-	(15,673,814)	(6,958,446)	-	(6,958,446)	(65,121)	-	(65,121)
Accommodation and Food Service Activities	I	(20,691,248)	-	(20,691,248)	(10,548,448)	-	(10,548,448)	(128,855)	-	(128,855)
Information and Communication	J	20,294,184	-	20,294,184	12,567,487	-	12,567,487	14,804	-	14,804

Sector	Code	Impact on Output (in million Rp)			Impact on Value-Added (in million Rp)			Impact on Employment (in people)		
		Backward linkage	Forward Linkage	Total Impact	Backward linkage	Forward Linkage	Total Impact	Backward linkage	Forward Linkage	Total Impact
Financial and Insurance Activities	K	187,309	-	187,309	146,527	-	146,527	347	-	347
Real Estate Activities	L	1,786,445	-	1,786,445	1,479,096	-	1,479,096	1,053	-	1,053
Business Activities	MN	(2,590,744)	-	(2,590,744)	(1,423,105)	-	(1,423,105)	(15,617)	-	(15,617)
Public Administration and Defense; Compulsory Social Security	O	(375,968)	-	(375,968)	(247,887)	-	(247,887)	(1,709)	-	(1,709)
SEducation	P	4,110,897	-	4,110,897	2,789,357	-	2,789,357	40,604	-	40,604
Human Health and Social Work Activities	Q	2,621,897	-	2,621,897	1,364,429	-	1,364,429	26,694	-	26,694
Other Services Activities	RSTU	(5,621,104)	-	(5,621,104)	(3,475,441)	-	(3,475,441)	(136,841)	-	(136,841)
Total		**(97,002,243)**	**-**	**(97,002,243)**	**(49,406,817)**	**-**	**(49,406,817)**	**(532,066)**	**-**	**(532,066)**

Source: Authors' Calculation

Appendix 3

Table 6: The Impacts of Labor Market Shock in East Java Province on Other Provinces' Economy

Provinces	Code	Impact on Output (in million Rp)			Impact on Value-Added (in million Rp)			Impact on Employment (in people)		
		Backward linkage	Forward Linkage	Total Impact	Backward linkage	Forward Linkage	Total Impact	Backward linkage	Forward Linkage	Total Impact
East Java	35	(97,002,243)	-	(97,002,243)	(49,406,817)	-	(49,406,817)	(532,066)	-	(532,066)
Nanggroe Aceh Darussalam	11	(33,245)	(84,820)	(118,065)	(22,247)	(47,882)	(70,128)	(298)	(382)	(681)
North Sumatera	12	(1,061,040)	(646,676)	(1,707,716)	(581,799)	(288,808)	(870,607)	(5,684)	(1,289)	(6,973)
West Sumatera	13	(132,282)	(109,969)	(242,251)	(93,631)	(58,965)	(152,596)	(1,261)	(305)	(1,566)
Riau	14	(1,849,015)	(193,798)	(2,042,813)	(1,018,866)	(91,232)	(1,110,099)	(3,393)	(299)	(3,691)
Jambi	15	(234,763)	(72,826)	(307,589)	(173,213)	(41,862)	(215,075)	(1,976)	(223)	(2,199)
South Sumatera	16	(883,419)	(522,993)	(1,406,412)	(530,596)	(228,340)	(758,936)	(5,154)	(766)	(5,920)
Bengkulu	17	(18,127)	(43,526)	(61,653)	(11,636)	(21,988)	(33,624)	(195)	(169)	(364)
Lampung	18	(325,393)	(269,249)	(594,642)	(163,064)	(131,658)	(294,722)	(1,846)	(997)	(2,843)
Bangka Belitung Islands	19	(94,806)	(48,472)	(143,278)	(53,497)	(26,608)	(80,105)	(472)	(166)	(638)
Riau Islands	21	(32,266)	(181,328)	(213,594)	(17,414)	(85,935)	(103,349)	(82)	(241)	(323)
DKI Jakarta	31	(2,413,823)	(1,465,381)	(3,879,204)	(1,355,728)	(618,235)	(1,973,963)	(2,692)	(643)	(3,336)
West Java	32	(1,945,159)	(2,576,443)	(4,521,602)	(992,271)	(1,157,714)	(2,149,985)	(9,564)	(5,248)	(14,812)
Central Java	33	(2,957,488)	(2,861,291)	(5,818,780)	(1,482,111)	(1,287,387)	(2,769,498)	(19,118)	(8,425)	(27,543)

Provinces	Code	Impact on Output (in million Rp)			Impact on Value-Added (in million Rp)			Impact on Employment (in people)		
		Backward linkage	Forward Linkage	Total Impact	Backward linkage	Forward Linkage	Total Impact	Backward linkage	Forward Linkage	Total Impact
DI Yogyakarta	34	(71,984)	(191,204)	(263,188)	(39,656)	(78,759)	(118,416)	(765)	(601)	(1,365)
Banten	36	(598,602)	(1,440,941)	(2,039,543)	(323,347)	(687,415)	(1,010,762)	(2,786)	(3,094)	(5,880)
Bali	51	(114,585)	(547,689)	(662,274)	(74,567)	(279,532)	(354,099)	(1,189)	(1,625)	(2,813)
West Nusa Tenggara	52	(217,328)	(208,472)	(425,800)	(139,107)	(116,254)	(255,360)	(4,202)	(1,313)	(5,515)
East Nusa Tenggara	53	(84,508)	(188,281)	(272,789)	(58,516)	(111,227)	(169,743)	(2,672)	(1,726)	(4,398)
West Kalimantan	61	(89,340)	(569,854)	(659,194)	(53,982)	(251,592)	(305,575)	(861)	(1,540)	(2,401)
Central Kalimantan	62	(1,080,057)	(210,089)	(1,290,145)	(518,249)	(89,596)	(607,845)	(4,564)	(353)	(4,918)
South Kalimantan	63	(62,648)	(80,612)	(143,260)	(37,173)	(38,646)	(75,819)	(296)	(310)	(607)
East Kalimantan	64	(1,790,201)	(817,778)	(2,607,979)	(945,502)	(397,473)	(1,342,975)	(1,950)	(629)	(2,579)
North Kalimantan	65	(160,155)	(121,274)	(281,429)	(101,586)	(72,075)	(173,660)	(299)	(128)	(428)
North Sulawesi	71	(152,989)	(167,004)	(319,993)	(99,184)	(86,929)	(186,113)	(957)	(436)	(1,394)
Central Sulawesi	72	(255,168)	(501,613)	(756,781)	(161,318)	(252,323)	(413,641)	(1,366)	(928)	(2,294)
South Sulawesi	73	(250,396)	(327,873)	(578,269)	(174,569)	(184,731)	(359,299)	(1,996)	(1,085)	(3,081)
Southeast Sulawesi	74	(237,456)	(87,922)	(325,378)	(165,614)	(50,831)	(216,445)	(1,655)	(323)	(1,978)
Gorontalo	75	(14,105)	(32,125)	(46,230)	(10,918)	(17,315)	(28,233)	(128)	(160)	(288)

Provinces	Code	Impact on Output (in million Rp)			Impact on Value-Added (in million Rp)			Impact on Employment (in people)		
		Backward linkage	Forward Linkage	Total Impact	Backward linkage	Forward Linkage	Total Impact	Backward linkage	Forward Linkage	Total Impact
West Sulawesi	76	(4,767)	(43,021)	(47,788)	(3,086)	(20,826)	(23,912)	(44)	(159)	(203)
Maluku	81	(65,168)	(39,418)	(104,586)	(45,765)	(20,938)	(66,703)	(999)	(182)	(1,181)
North Maluku	82	(54,817)	(77,479)	(132,296)	(40,689)	(41,757)	(82,446)	(597)	(322)	(919)
West Papua	91	(61,645)	(149,072)	(210,717)	(34,286)	(73,622)	(107,909)	(186)	(206)	(392)
Papua	94	(360,869)	(427,607)	(788,476)	(256,316)	(216,969)	(473,285)	(593)	(816)	(1,409)
Total		**(114,709,857)**	**(15,306,097)**	**(130,015,954)**	**(59,186,318)**	**(7,175,425)**	**(66,361,743)**	**(611,907)**	**(35,092)**	**(646,999)**
Share (%)		**88.23**	**11.77**	**100**	**89.19**	**10.81**	**100**	**94.58**	**5.42**	**100**

Source: Authors' Calculation

Appendix 4

Table 7: The Impacts of Labor Market Shock in East Java Province on National Level Economy

Sector	Code	Impact on Output (in million Rp)			Impact on Value-Added (in million Rp)			Impact on Employment (in people)		
		Backward linkage	Forward Linkage	Total Impact	Backward linkage	Forward Linkage	Total Impact	Backward linkage	Forward Linkage	Total Impact
Agriculture, forestry, and fishery	A	299,276	(660,694)	(361,417)	256,155	(508,545)	(252,389)	24,438	(8,530)	15,907
Mining and Quarrying	B	(5,972,162)	(712,496)	(6,684,658)	(4,227,066)	(464,924)	(4,691,990)	(6,668)	(550)	(7,218)
Manufacturing	C	(42,058,059)	(5,971,630)	(48,029,689)	(18,125,354)	(2,463,499)	(20,588,853)	(82,193)	(5,519)	(87,712)
Electricity and Gas	D	(1,287,245)	(390,182)	(1,677,427)	(187,694)	(55,650)	(243,345)	(1,398)	(39)	(1,436)
Water supply, Sewerage, Waste Management and Remediation Activities	E	147,794	(15,336)	132,458	100,790	(8,298)	92,492	3,318	(195)	3,123
Construction	F	(14,989,642)	(3,187,199)	(18,176,841)	(7,408,052)	(1,254,859)	(8,662,911)	(45,382)	(2,680)	(48,062)
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	G	(32,360,848)	(857,726)	(33,218,574)	(23,769,102)	(580,191)	(24,349,293)	(231,944)	(5,704)	(237,649)
Transportation and Storage	H	(16,508,961)	(969,540)	(17,478,501)	(7,347,417)	(439,659)	(7,787,076)	(68,065)	(1,848)	(69,913)
Accommodation and Food Service Activities	I	(20,751,813)	(535,832)	(21,287,646)	(10,577,569)	(264,405)	(10,841,974)	(129,488)	(2,233)	(131,721)
Information and Communication	J	20,056,064	260,192	20,316,256	12,417,881	168,228	12,586,108	14,579	265	14,844
Financial and Insurance Activities	K	(564,127)	(69,146)	(633,272)	(394,034)	(50,946)	(444,980)	(760)	(121)	(881)

Sector	Code	Impact on Output (in million Rp)			Impact on Value-Added (in million Rp)			Impact on Employment (in people)		
		Backward linkage	Forward Linkage	Total Impact	Backward linkage	Forward Linkage	Total Impact	Backward linkage	Forward Linkage	Total Impact
Real Estate Activities	L	1,578,208	(98,376)	1,479,832	1,325,931	(74,561)	1,251,370	922	(48)	874
Business Activities	MN	(2,843,453)	(90,487)	(2,933,940)	(1,571,728)	(52,678)	(1,624,407)	(16,431)	(517)	(16,948)
Public Administration and Defense; Compulsory Social Security	O	(422,477)	(1,131,941)	(1,554,418)	(272,948)	(610,215)	(883,163)	(1,867)	(2,726)	(4,593)
Education	P	4,095,704	(366,744)	3,728,960	2,779,709	(242,863)	2,536,846	40,517	(1,925)	38,592
Human Health and Social Work Activities	Q	2,588,601	(336,449)	2,252,152	1,348,935	(166,743)	1,182,192	26,544	(961)	25,583
Other Services Activities	RSTU	(5,716,717)	(172,510)	(5,889,227)	(3,534,754)	(105,616)	(3,640,370)	(138,028)	(1,761)	(139,789)
Total		**(114,709,857)**	**(15,306,097)**	**(130,015,954)**	**(59,186,318)**	**(7,175,425)**	**(66,361,743)**	**(611,907)**	**(35,092)**	**(646,999)**

Source: Authors' Calculation