

The Covid-19, Economic Crisis and Policy Retaliation: A Dynamic General Equilibrium Analysis.

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Abstract

This paper attempts to analyze the ceteris paribus effects of 'supply chain disruptions', 'strict government regulations', and 'change in saving rate' on urban unemployment thereby identifying a pattern of labour migration, in the unprecedented 'COVID' scenario. In doing this we use the Heckscher-Ohlin structure in a Harris-Todaro type economy, which has three sectors- a manufacturing sector, an agricultural sector and a skilled sector. We extend our representation to the long run by portraying a Solowian economy in which the accumulation of domestic capital stock plays a decisive role as a meter for unemployment and wage-disparity. Finally, we say that both in the short run as well as long run we see an unambiguous effect on inter-sectoral migration amongst the agricultural and the manufacturing sectors, thus also an unambiguous effect on unemployment which is counterproductive outcome of government's policy response.

JEL CLASSIFICATION: D50, E24, F2, F61, J6, O10.

Keywords: Covid-19, General Equilibrium, Migration, Unemployment.

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1. Introduction:

Intramural migration is an indispensable and inevitable integrant of the economic and social life of a country. Migrants account for a floating and invisible citizen alternating between the origin and the destination areas and remaining on the fringe of the society. In today's world, extensive migration is a usual practice as the global acumen of individuals expands. The manoeuvre has been beneficial to both immigrants' importation and exportation nations. Internal migration customarily comes about from a rural area in the country to the urbanized area such as the country's capital. These migrants are often wondering for a better standard of living or employment opportunities. Empirical analysis reveals that the asymmetrical shift of people from one place to another results in an adverse outcome.

Migration within a nation positively contributes to the destination's overall economy and development. Internal migration mainly causes due to economic purposes. Numerous individuals from the countryside proceed to their country's cities anticipating to earn more and bring their family up to a soaring standard of living. In large parts of our nation, there has been a humongous reverse migration due to COVID-19 pandemic. Thousands and thousands of labourers marched back to their villages for the sake of finding some warmth and empathy.

Census 2001 revealed that in India internal migrants account for as large as 309 million which was about 28% of the population. The data published by NSSO (2007-08) manifested a rise in internal migrants by 17 million in six years. The benefaction of migrants to the GDP of the Indian economy often goes unnoticed. The estimated data shows that migrants contribute around 10% of the country's GDP where almost 70% of the migrants being women. Census 2011 showed that the total number of internal migrants is 450 million which is approximately 35% higher than 2001 excluding child labor. West Bengal, Uttar Pradesh and Bihar have the highest number of migrants followed by Punjab, Rajasthan and Madhya Pradesh.

The sharp increase in migration over the years is due to the fact of the rapid urbanization of our cities and towns. 93% of India's total migrants get involved in the informal sector which includes seasonal or periodic migrant laborers in the Green Revolution.

Large scale migration persuaded by greater and greener pastures of economic progressiveness is a folk tale as most of the migration is for the subsistence and living and falls under the citatory of distress migration. Low threshold incomes perpetually force laborers for migration.

In the general context of the ongoing urbanization and rural industrialization, exploitation and utilization of labors take new conformation that is a combination and an ingenious adaption of the older forms of control and bondage contextualized to new conditions of capitalism. The foisting of the lockdown as a measure to contain the exponential growth thumped the unskilled and the semi-skilled migrant laborers the most. A rough estimate indicates that around 30 million migrants walked or were stranded in camps in their way back.

ILO estimates that around 400 million workers in the informal economy both unskilled and the semi-skilled will be falling in deeper into poverty during this crisis. The procedure for recuperation is going to be long-drawn out and throbbing for those migrants who would be looking for urban spaces.

2. Literature Survey:

A few theoretical models of rural-urban migration and the informal sector are available in the literature. Harris-Todaro (1970) exhibits rural-urban migration in a dual economy framework. The informal and formal sectors are the sub-divisions of the urban sector where migrants not getting employed in the formal sector spontaneously gets a job in the informal sector. In his model, there subsists open urban unemployment despite the existence of the informal sector. There are four distinct different income groups within the working class which result in a positive degree of inequality in the dispersal of income of the laborers, which has been firmly discerned by Harris Todaro (1970). Sen (1974) proposed several politics taking into context the welfare of society. Contemplating the urban sector in small segments and their basic models have been extended in several directions by Stiglitz (1982) and Grinols (1991). Shadow wage rate in the urban formal sector was shown by Stiglitz (1982)

whereas Grinols (1991) was engrossed in modeling the General Equilibrium effects of foreign capital inflow in less developed economies.

Datta Chaudhari (1989), Sarkar and Ghosh (1989) came to a conclusion where the policy which reduces the rate of interest paid by the informal sector also tends to reduce the aggregate output and employment in the industrial sector. Studies shown by Joshi & Joshi (1976) on India has note that average informal sector earnings are roughly equal to if not higher than rural earnings. By taking into account the Heckscher-Ohlin framework and considering the manufacturing sector as a capital-intensive sector and the agricultural sector as the labor intensive, we have viewed the manufacturing sector as an import-competing sector and the agricultural sector and skilled sector as export-competing sectors.

We have upshot the effects of government's regulation, supply chain disruptions and an increase in the precautionary savings on the manufacturing and the agricultural sector. By taking help from Solow (1956) from the technique adapted from Gupta (1993) we have discussed the effects of an increase in saving rate in the long run. We have considered the wage in the agricultural sector as flexible as opposed to the fixed-wage rate in the manufacturing sector. Harris-Todaro framework has been used to explain the migration and the reverse migration between the manufacturing and the agriculture sector. Dasgupta and Rajeev (2020) have made a theoretical analysis of the pandemic in a Keynesian macroeconomic framework in the short run which differs from our paper which reveals the effects of Covid-19 in the informal sector primarily the agricultural sector using a trade-theoretic microeconomic model.

3. Empirical Evidences And Motivation:

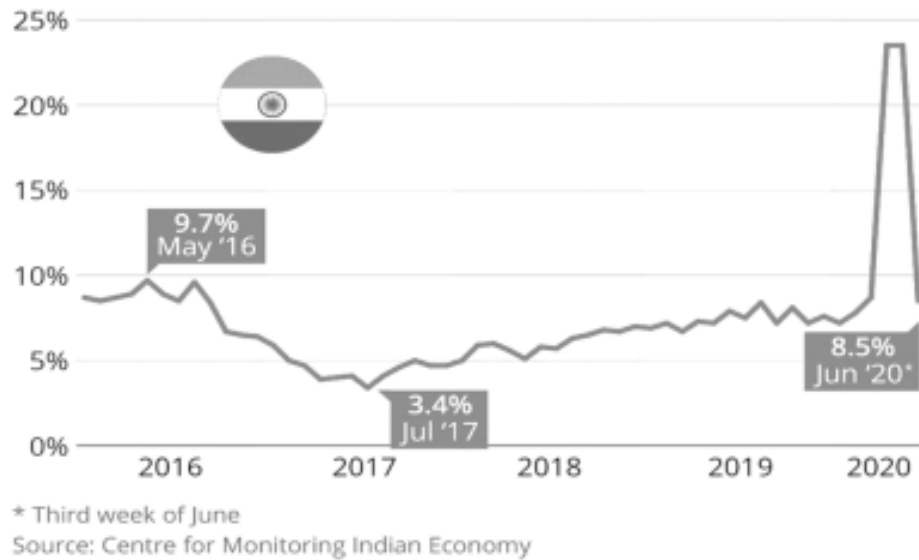
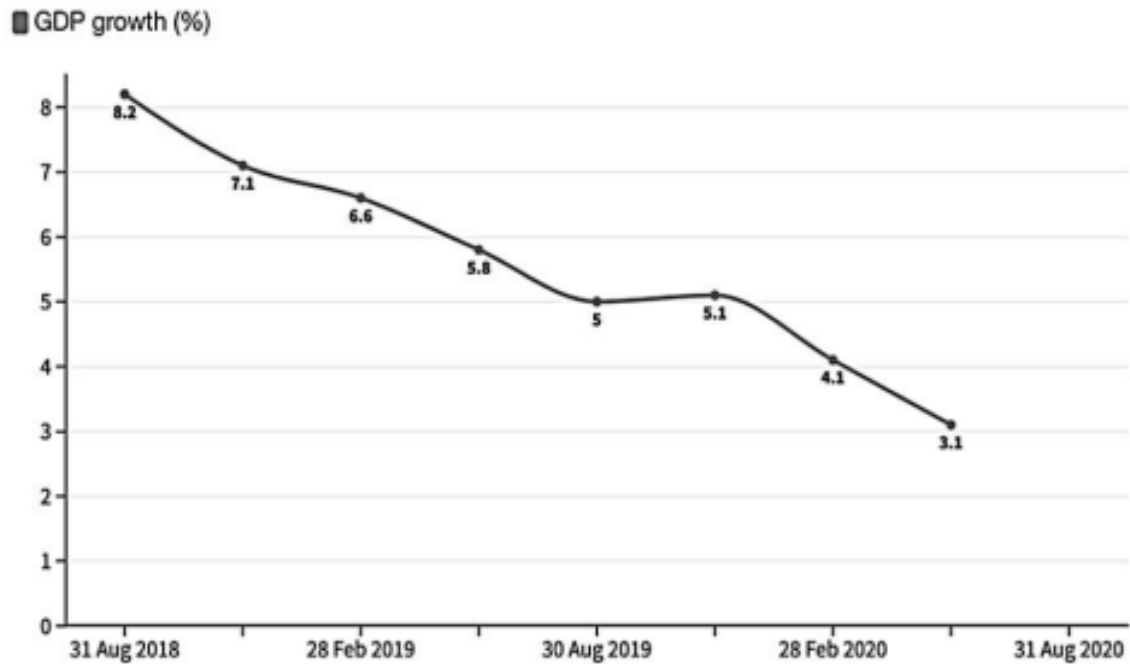


Figure 1: Figure showing trends in average rate of unemployment in India

Figure1- shows a steep rise in the average unemployment rate in India during the pre-Covid-19 and during COVID-19 crisis. The data provided by CMIE states that unemployment levels have risen to 27% from 9%. It stood at 29.22% in the urban areas, as against 26.69% in the rural areas. However, the average rate of unemployment had fallen when Government announced the NREGP expansion programme in the rural sector and reverse migration was at peak level.



Source: Ministry of Statistics and Programme Implementation (MOSPI), Government of India

Figure 2 GDP growth rate in India

Figure2- shows the contraction in India's GDP growth rate as a result of Covid-19 virus. World Bank reports 5.2 percent contraction in global GDP in 2020 and a Historic contraction of per capita income. India's real GDP for the April-June 2021 quarter fell by 23.9% in comparison to the same quarter a year ago.

[Table 1 here]



Source: Centre for Monitoring Indian Economy (CMIE, 2020)

Figure 3 Labour force participation and unemployment rate in India during the COVID-19 crisis

The table above (table 1) had been depicted in figure 1 above which shows the line charts of the rate of unemployment from May, 2017 to April, 2019, i.e., almost for two years from 2017-19. Throughout we see an upward trend in the data, with a slight fall in both Urban and Rural unemployment. Rural unemployment falling from 4% to 3% (approx.) in July, 2017. The urban unemployment falling from 4% to a little over 3% (approx.). We see a notable fall in rural unemployment in the month of May, 2018 from 6% in March, 2018 to a little over 4% (approx.). We also see a fall in total unemployment in this month of 2018. There is however a notable rise in the urban unemployment in between Jan, and Feb of 2019 and eventually it falls in April, 2019. Another notable fact is that there is a fall in rural unemployment in the months of November, January and March, 2019. However, total unemployment rises from close to 6% to close to 8% (approx.).

[Table 2 here]

The movement observed in the unemployment rate corresponds to the level of reverse migration among unskilled workers in the economy. Table 2 summarizes the rate and level of reverse migration during the COVID-19 crisis.

Given these empirical facts two questions which arise are the following. First, what were the channels through which the COVID-19 crisis penetrated into the Indian economy and particularly in the labour market. Second, what caused Government policy response to COVID-19 to produce counterproductive outcome and lead to policy failure. We attempt to

provide possible explanation to these questions by building an analytically tractable theoretical model in section 4. Few comparative statics and policy analysis have been carried out in section 5. The basic short-run model is extended to long-run dynamics in section 6. Finally, section 7 concludes the paper.

4. The Model:

Given the backdrop, the paper attempts to analyze the effect of COVID-19 on rural-urban migration of unskilled labor, urban unemployment and informalization of labor in terms of supply chain disruption, investment uncertainty, imposition of government regulation and precautionary savings.

4.1. Assumptions and Description of the Economy:

We consider a short run three-sector, three-factor Harris-Todaro type economy with fixed factor coefficient technology. The stylized economy consists of the following sectors. There is a rural agricultural sector (A) and an urban manufacturing sector (M) both of which uses unskilled labor

(L) and capital (K) as factors of production. There is a service sector (S) which uses capital (K) and a specific factor – skilled labor (S). The commodity produced by the agricultural sector is given by X_A , the commodity produced by the manufacturing sector is given by X_M and the commodity produced by the skilled sector is given by X_S . Labour market distortions exists in terms of rigid wage and unskilled labor in the urban manufacturing sector. There is involuntarily urban employment due to the rigid wage rate that leads to Harris-Todaro (1970) type rural-urban migration.

The unionized urban manufacturing wage (W_M) is exogenously given and is greater than the flexible rural wage (W_A). This rural-urban wage inequality leads to migration of unskilled labor from the rural sector to the urban sector. Migration equilibrium is attained when the expected urban wage equals the rural wage. In this migration equilibrium, unemployment continues to persist. Therefore, the Harris Todaro equilibrium is suboptimal.

We assume the rural agricultural sector is relatively labor intensive as compared to the urban manufacturing sector which is relatively capital intensive. In other words, this means that the capital-labor ratio (K/L) is lower for the commodity produced in the agricultural sector (X_A) than the commodity produced in the manufacturing sector (X_M), that is,

$$\frac{a_{LA}}{a_{KA}} > \frac{a_{LM}}{a_{KM}}, \text{ where } a_{Li} \text{ is the unskilled labor-output ratio in the } i\text{-th sector, } i = A, M$$

a_{Ki} is the capital-output ratio in the i -th sector, $i = A, M$

There is constant returns to scale in the production of both commodities which means that the amount of output increases in the same proportion as the increase in the amount of inputs. Perfect competition exists in both commodities and factor markets. There is perfect mobility of capital and unskilled labor within agricultural and manufacturing sectors but skilled labor is specific to the skilled sector.

Total capital endowment is assumed to be the sum of domestic capital denoted by K_D and foreign capital which is fixed and is denoted by $\bar{K}_F$. Tastes and preferences are same across the nations. The model assumes there is transportation cost (T) and government regulation (p) in the urban manufacturing sector. International trade is always balanced between nations. This is an extension of the Heckscher-Ohlin (H-O) model based on Jones (1965, 1971) framework and Chaudhuri and Mukhopadhyay (2010).

4.2. Equational Structure:

$$W_A a_{LA} + r a_{KA} = 1 \text{ (Numeraire)} \quad (1)$$

$$\bar{W}_M a_{LM} + r a_{KM} = P_M - T \quad (2)$$

$$W_S a_{SS} + r a_{KS} = P_S \quad (3)$$

$$\bar{W}_M \left(\frac{a_{LM} X_M}{a_{LM} X_M + U} \right) = W_A \quad (4)$$

$$a_{LA}X_A + a_{LM}X_M + U = \bar{L} \quad (5)$$

$$a_{KA}X_A + a_{KM}X_M + a_{KS}X_S = \bar{K} \quad (6)$$

$$a_{SS}X_S = \bar{S} \quad (7)$$

$$(X_A - D_A) + P_S(X_S - D_S) = P_M(D_M - X_M) \quad (8)$$

$$a_{LM} = a_{LM}(\rho); \quad a'_{LM} < 0$$

4.3. Working of the Model:

We have 7 equations and 7 unknowns – $W_A, r, W_S, X_A, X_M, X_S, U$

Eq. (8) shows the trade balance condition, that is, value of exports = value of imports

It determines the National Income Y .

Since $\bar{W}_M$ is fixed, r^* is obtained from eq. (2)

Putting the value r^* of in eq. (1), we obtain W_A^*

Putting the value r^* of in eq. (3), we obtain W_S^*

From eq. (6), we obtain X_S^*

From eq. (5) and eq. (7), we obtain X_A^* and X_M^* as a function of U

From eq. (4), we obtain U^*

It is a decomposable structure because the factor prices are determined by the commodity prices alone and do not depend on the factor endowments.

5. Comparative statics:

In the short run, we obtained the following three propositions:

5.1. Supply-Chain Disruption:

An increase in the transportation cost (T) leads to a fall in the rental rate of capital (r) and a subsequent increase in the unskilled rural wage (W_A) and skilled wage (W_S). This causes the rural wage to exceed the expected urban wage resulting in reverse migration of unskilled labor from the manufacturing sector to the rural sector and ultimately leading to fall in urban unemployment.

Proposition 1: A Supply-Chain Disruption in the manufacturing sector in terms of an increase in the transportation cost (T) leads to reverse migration of unskilled labor from the urban sector to the rural sector which augments informalization of labour and lowers the urban unemployment. Skilled labour gains at cost to capital owners in terms of factor prices.

5.2. Investment Uncertainty:

A fall in the total capital endowment ($\bar{K}$) leads to a fall in the total quantity produced by the manufacturing sector (X_M) and a rise in the total quantity produced by the agricultural sector (X_A) this follows directly from the Rybczynski Theorem. The level of output produced by the service sector (X_S) remains unchanged. Following from the fall in X_M , the probability of getting an urban job decreases. This causes the expected urban wage to fall short of the rural wage resulting in reverse migration of unskilled labor from the manufacturing sector to the rural sector and ultimately leading to fall in urban unemployment.

Proposition 2: An Investment Uncertainty in terms of fall in the total capital endowment ($\bar{K}$) would lead to reverse migration of unskilled labour from the urban sector to the rural sector which augments informalization of labour and lowers the urban unemployment.

5.3. Government Regulation:

As the government imposes strict regulations in factories increase in (p) , it would lead to a fall in the labor-output ratio (a_{LM}) in the manufacturing sector. The capital used also falls causing an increase in the rental rate of capital (r) and a subsequent fall in the skilled (W_S) and unskilled (W_A) wage rates. This causes the expected urban wage to exceed the rural wage resulting in migration of unskilled labor from the rural sector to the urban sector and ultimately leading to a rise in urban unemployment.

Proposition 3: Government Regulation in terms of increase in (p) would lead to migration of unskilled labor from the rural sector to the urban sector resulting in rise in the level of urban unemployment and fall in the informalization of labor.

6. An extension: A Dynamic Long Run Equilibrium Model

We develop a dynamic long run equilibrium model which is an extension of Solow (1956) in Jones type general equilibrium. The model assumes that skilled labour and capital owners save a constant fraction 's' of their income and that capital depreciates at a constant rate 'δ'. In our model, we assume that unemployment continues to persist even in the long run. This is proved in Gupta (1998).

Equation of motion for capital accumulation and its time path:

$$\begin{aligned}\frac{dK_D(t)}{dt} + (\delta - sr)K_D(t) &= sW_S\bar{S} \\ \Rightarrow \frac{dK_D(t)}{dt} + (\delta - sr)K_D(t) &= sW_S\bar{S} \\ \text{For Particular Integral, } \frac{dK_D(t)}{dt} &= 0 \\ \text{For Complementary Function, } \frac{dK_D(t)}{dt} + (\delta - sr)K_D(t) &= 0 \\ \Rightarrow K_D^*(t) &= \frac{sW_S\bar{S}}{\delta - sr}\end{aligned}$$

Let the trial solution be, $K_D(t) = Ae^{bt}$

$$\Rightarrow Abe^{bt} + (\delta - sr)Ae^{bt} = 0$$

$$\Rightarrow Ae^{bt}[b + (\delta - sr)] = 0$$

$$\Rightarrow b = -(\delta - sr)$$

For stability of equilibrium,

$$b < 0 \Rightarrow (\delta - sr) > 0$$

$$K_D(t) = \text{P.I.} + \text{C.F.}$$

$$\Rightarrow K_D(t) = \frac{sW_S \bar{S}}{\delta - sr} + Ae^{-(\delta - sr)t}$$

$$\text{In the Long Run, } t \rightarrow \infty \Rightarrow K_D(t) = \frac{sW_S \bar{S}}{\delta - sr}$$

Equational Structure:

$$W_A a_{LA} + r a_{KA} = 1 \quad (\text{Numeraire}) \quad (1)$$

$$\bar{W}_M a_{LM} + r a_{KM} = P_M - T \quad (2)$$

$$W_S a_{SS} + r a_{KS} = P_S \quad (3)$$

$$\bar{W}_M \left(\frac{a_{LM} X_M}{a_{LM} X_M + U} \right) = W_A \quad (4)$$

$$a_{LA} X_A + a_{LM} X_M + U = \bar{L} \quad (5)$$

$$a_{KA}X_A + a_{KM}X_M + a_{KS}X_S = K_D(s, W_s, r, \bar{S}, \bar{\delta}) + \bar{K}_F \quad (6)$$

$$a_{SS}X_S = \bar{S} \quad (7)$$

$$(X_A - D_A) + P_S(X_S - D_S) = P_M(D_M - X_M) \quad (8)$$

$$a_{LM} = a_{LM}(\rho); \quad a'_{LM} < 0$$

In the long run, we have the following three propositions:

6.1. Supply-Chain Disruption:

A rise in transportation costs (*ceteris paribus*), reduces the net revenue from the manufacturing (capital-intensive) sector. Thus we see a fall in rate of return (r), hence a rise in agricultural wage and also a rise in the skilled wage.

a) Now, if the rise in skilled wage is dominated by a fall in rate of return, capital stock (domestic) falls. Hence, we see a contraction of the manufacturing sector and an expansion in the agricultural sector. Thus, agricultural wage is more than the expected manufacturing wage, thus reverse migration occurs and we see a fall in unemployment.

Proposition 4: Capital decumulation, given that the fall in rental rate (r) dominates the rise in skilled wage rate (WS), owing to which the level of unemployment, migration and informalization of labor in the short run is reinforced in the long run.

b) Now suppose in the previous scenario, if the fall in rate of return is dominated by the rise in the skilled wage, capital stock (domestic) rises. Hence, the manufacturing sector expands and the agricultural sector contracts. This initiates migration and thus a rise in unemployment.

Proposition 5: Capital accumulation, given that the rise in skilled wage rate (WS) dominates the fall in rental rate (r), owing to which the level of unemployment, migration and informalization of labour remains ambiguous in the long run.

6.2. Government Regulation:

A rise in the regulations (*ceteris paribus*) leads to a fall in the labour per unit of output in the manufacturing sector. Now, we see a fall in skilled wage as well as a rise in agricultural wage but we see a fall in the rate of return.

a) If the rise in rate of return is dominated by the fall in the skilled wage, we see a fall in the domestic stock of capital. Thus, the manufacturing sector contracts and the agricultural sector expands. This leads to a higher agricultural wage, and thus reverse migration, hence fall in unemployment.

Proposition 6: Capital decumulation, given that the fall in skilled wage rate (WS) dominates the rise in rental rate (r), owing to which the level of unemployment, migration and informalization of labour in the short run is reinforced in the long run.

b) If the rise in the rate of return dominates a fall in the skilled wage, the domestic capital stock increases. This leads to an expansion in the manufacturing sector and the agricultural sector contracts. This leads to rise of the fixed, expected manufacturing wage over the flexible agricultural wage. Thus, migration and a rise in the unemployment.

Proposition 7: Capital accumulation, given that the rise in rental rate (r) dominates the fall in skilled wage rate (WS), owing to which the level of unemployment, migration and informalization of labour remains ambiguous in the long run.

6.3. Saving Rate:

A rise in saving rate, that is, precautionary saving, (*ceteris paribus*) causes a rise in the domestic capital stock. Hence, an expansion in the manufacturing sector and a contraction in the agricultural sector occurs. And this results in a fixed manufacturing wage, which is higher than the flexible agricultural wage. Thus, leads to migration and a rise in unemployment.

Proposition 8: An increase in the precautionary saving rate (s) would lead to migration of unskilled labor from the rural sector to the urban sector resulting in rise in the level of urban unemployment.

7. Conclusion:

We show in our paper that in the short run, an increase in transportation cost leads to reverse migration from the urban manufacturing sector to the rural agricultural sector resulting in a fall in unemployment in this stylized, small developing country. An increase in the regulatory measures of the government leads to a fall in the rural wage rate and hence their migration from the rural to the urban sector. This aggravates the problem of unemployment in the urban manufacturing sector. An investment uncertainty in terms of a fall in total capital endowment in the manufacturing sector leads to contraction of the manufacturing sector resulting in a reduction of the probability to find a job in the urban sector and a subsequent fall in the expected urban wage. Thus, reverse migration takes place from the urban sector to the rural sector.

However, in the long run, we show that the capital stock is directly proportional with the skilled wage rate, the rate of precautionary savings, and the rental rate of capital and inversely proportional with the depreciation rate of capital. In the long run, an increase in transportation cost or the increase in the regulatory measures of the government, we observe that two situations arise. Firstly, a situation of capital decumulation results in a reverse migration of unskilled labour from the urban sector to the rural sector and a subsequent fall in urban unemployment. Secondly, a situation of capital accumulation results in the migration of labour from the rural sector to the urban sector and the subsequent rise in urban unemployment. Next, we consider an increase in the savings rate (precautionary), which would lead to capital accumulation which in turn encourages rural-urban migration and urban unemployment. In our model, we show that unemployment continues to persist both in the short run as well as in the long run.

However, in the short run, the informal sector acts as a shock-absorbing sector. The fact that the rural unskilled wage is flexible, it follows that whenever there is reverse migration of unskilled labour from the urban sector to the rural sector, the agricultural (informal)

sector readily absorbs this pool of incoming unskilled labour without resulting in any unemployment. This in turn effectively reduces the urban unemployment. Thus, the informal sector plays a crucial role in a small developing economy as it can reduce urban unemployment.

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Mathematical Appendix

$$W_A a_{LA} + r a_{KA} = 1 \quad (1)$$

$$\overline{W}_M a_{LM} + r a_{KM} = P_M - T \quad (2)$$

$$W_S a_{SS} + r a_{KS} = P_S \quad (3)$$

Eq. (2) can be rewritten as:

$$\overline{W}_M a_{LM} + r a_{KM} + T = P_M \quad (2.1)$$

Taking total differential we get,

$$a_{KM} dr + dT = 0 \quad (\text{Since } d\overline{W}_M = 0 \text{ and } dP_M = 0)$$

$$\Rightarrow \frac{a_{KM} r}{P_M} \frac{dr}{r} + \frac{T}{P_M} \frac{dT}{T} = 0$$

$$\Rightarrow \theta_{KM} \hat{r} + \theta_T \hat{T} = 0$$

$$\Rightarrow \hat{r} = \frac{-\theta_T \hat{T}}{\theta_{KM}}$$

Similarly, totally differentiating eq.(1) and eq.(3) we get,

$$\Rightarrow \theta_{LA} \hat{W}_A + \theta_{KA} \hat{r} = 0 \quad (1.1)$$

$$\Rightarrow \theta_{KS} \hat{W}_S + \theta_{KS} \hat{r} = 0 \quad (3.1)$$

Plugging the value of $\hat{r}$ in eq. (1.1) and eq. (3.1) we get,

$$\hat{W}_A = \frac{\theta_{KA} \theta_T \hat{T}}{\theta_{LA} \theta_{KM}} \quad \hat{W}_S = \frac{\theta_{KS} \theta_T \hat{T}}{\theta_{SS} \theta_{KM}} \quad (5)$$

$$a_{LA} X_A + a_{LM} X_M + U = \overline{L} \quad (6)$$

$$a_{KA} X_A + a_{KM} X_M + a_{KS} X_S = \overline{K} \quad (7)$$

Taking total differential of eq. (6) we get,

$$a_{SS}dX_S = 0 \quad (\text{Since } d\bar{S} = 0)$$

$$\Rightarrow \lambda_{SS}\hat{X}_S = 0$$

$$\Rightarrow \hat{X}_S = 0$$

$$\Rightarrow \frac{a_{SS}X_S}{\bar{S}} \frac{dX_S}{X_S} = 0$$

$$\Rightarrow \hat{X}_S = 0$$

Similarly totally differentiating eq. (5) and eq. (7) we get,

$$\lambda_{LA}\hat{X}_A + \lambda_{LM}\hat{X}_M = -\lambda_U\hat{U} \quad , \quad \text{where} \quad \lambda_U = \frac{U}{\bar{L}} \quad (5.1)$$

$$\lambda_{KA}\hat{X}_A + \lambda_{KM}\hat{X}_M = \hat{\bar{K}} \quad (7.1)$$

Using Cramer's Rule we get,

$$\hat{X}_A = \frac{-(\lambda_{KM}\lambda_U\hat{U} + \lambda_{LM}\hat{\bar{K}})}{\Delta}$$

$$\hat{X}_M = \frac{\lambda_{LA}\hat{\bar{K}} + \lambda_{KA}\lambda_U\hat{U}}{\Delta}$$

$$\text{Here, } \Delta = \lambda_{LA}\lambda_{KM} - \lambda_{KA}\lambda_{LM} > 0$$

$$\text{By assumption, } \frac{a_{LA}}{a_{KA}} > \frac{a_{LM}}{a_{KM}} \Rightarrow \frac{\lambda_{LA}}{\lambda_{KA}} > \frac{\lambda_{LM}}{\lambda_{KM}}$$

$$\Rightarrow \lambda_{LA}\lambda_{KM} > \lambda_{KA}\lambda_{LM}$$

$$\Rightarrow \lambda_{LA}\lambda_{KM} - \lambda_{KA}\lambda_{LM} > 0$$

$$\bar{W}_M \left(\frac{a_{LM}X_M}{a_{LM}X_M + U} \right) = W_A \quad (4)$$

Eq.(4) can be rewritten as

$$\Rightarrow \overline{W}_M a_{LM} X_M = W_A (a_{LM} X_M + U) \quad (4.1)$$

Totally differentiating eq. (4.1) we get,

$$\Rightarrow \overline{W}_M a_{LM} dX_M = W_A (a_{LM} dX_M + dU) + (a_{LM} X_M + U) dW_A$$

$$\Rightarrow (\overline{W}_M - W_A) a_{LM} dX_M - (a_{LM} X_M + U) dW_A = W_A dU$$

$$\Rightarrow (\overline{W}_M - W_A) a_{LM} X_M \hat{X}_M - (a_{LM} X_M + U) W_A \hat{W}_A = W_A U \hat{U}$$

$$\Rightarrow \left(\frac{\overline{W}_M - W_A}{W_A} \right) a_{LM} X_M \hat{X}_M - (a_{LM} X_M + U) \hat{W}_A = U \hat{U}$$

$$\Rightarrow U \hat{X}_M - (a_{LM} X_M + U) \hat{W}_A = U \hat{U}$$

$$\Rightarrow \hat{X}_M - \left(\frac{a_{LM} X_M}{U} + 1 \right) \hat{W}_A = \hat{U}$$

Statistical Appendix

Table 1 Unemployment rate in India-Rural and Urban

Month	Unemployment Rate (%)		
	India	Urban	Rural
Nov 2020	6.51	7.07	6.26
Oct 2020	6.98	7.15	6.90
Sep 2020	6.67	8.45	5.86
Aug 2020	8.35	9.83	7.65
Jul 2020	7.40	9.37	6.51
Jun 2020	10.18	11.68	9.49
May 2020	21.73	23.14	21.11
Apr 2020	23.52	24.95	22.89
Mar 2020	8.75	9.41	8.44
Feb 2020	7.76	8.65	7.34
Jan 2020	7.22	9.70	6.06
Dec 2019	7.60	9.02	6.93

Month

Unemployment Rate (%)

Table 2 Volume and rate of regional migration in India

States	Total out migrants, (based on place of the last residence, 0-9 years)	Number of out-migrants by major destination states					Number of return migrants Due to COVID 19 and lockdowns	Number of districts for which return migration
		Maharashtra	Delhi	Gujarat	Punjab	Others		
Bihar	31.88	3.27	5.22	2.52	1.78	19.08	23.6	32
UP	50.46	12.11	9.69	5.37	3.02	20.28	17.48	31
Rajasthan	14.1	2.36	0.98	3.30	0.70	6.75	12.09	22
MP	12.19	3.48	0.57	1.50	0.16	6.49	10.72	24
Odisha	6.26	0.71	0.22	1.18	0.06	4.09	2.19	4
Jharkhand	6.92	0.64	0.38	0.38	0.11	5.41	1.1	3