COVID-19 Pandemic, International Remittances and Economic Growth in Kerala: A Macroeconomic Analysis

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ABSTRACT

The paper develops a methodology for impact analysis of Coronavirus 2019 (COVID-19) pandemic based on Solow's growth theory for a migration-driven subnational economy by a case study of Kerala, India. A log-linear growth equation of output per capita is regressed on capital stock-gross domestic product ratio (CSDR) and real remittances per capita (RRPC) for the period, 1980-2015. The robust regression on regional growth shows that the growth elasticity of CSDR is 0.43 and that of RRPC 0.28 with an explanatory power of 95 %. From growth accounting principle, only 29 % of the remaining variation needs to be accounted by other factors affecting regional growth. The impact of remittances on growth rate of the economy is positive and statistically significant at 1 % level as against the negative and statistically significant relationship observed in majority of cross-country analysis. The gross state domestic product (GSDP) for the year 2020/21 using national accounting framework incorporating unorganised economic activities shows a reduction of 38.85% from the pandemic impact in the region. The corresponding shrinkage of investment share in GSDP is 24. 5 % from its trend value of 0.63 in 2020/21.This alone reduces the growth rate of output per capita by 10.5 %. Similarly, the reduction in trend value of RRPC is 43.1 % and its impact on growth rate of output per capita is a shrinkage of 12.1 %. The impact of COVID-19 on the overall growth rate of output per capita in the economy is- 22.6 %, the sum of the separate effects. It is interesting to note that reduction in growth rate is more from international remittances than from the share of investment in GSDP. Therefore, growth-revival strategy for the region requires special component plan compensating for the shortfall in the international remittances.

JEL classification: O40, O47 & F24

Key words: COVID-19, Solow's growth model, investment-gross domestic ratio, international remittances and Growth accounting.

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1. Introduction

Coronavirus 2019 (COVID-19) pandemic has put severe strains on the world economy ever since its announcement made by China in January 2020 and still continues its devastating journey among all the countries except in Antarctica region. Assessing its whole impact is extremely difficult since it is multidimensional-social, economic, environmental and demographic- in nature. Most of the studies on the economic impacts are at the national level with a few at the sub-national level. If sub-national studies exist, it lacks a macroeconomic framework in most cases. The present enquiry develops a macro-economic frame work for evaluating the impact of COVID-19 in a subnational economy by a case study of Kerala which is undergoing migration-led growth in India.

The literature on the impact analysis of the SARS-COV2 virus (COVID-19) that caused the present epidemic prefers macroeconomics to microeconomics so that it rules out the 'fallacy of the composition; the sum of the parts does not add up to the whole' as warned by Keynes way back in 1936 and is recently emphasised by Kumar (2020; p.75) in his impact analysis of the epidemic which he calls as the 'Indian economy's greatest economic crisis'. Following this suggestion, we have identified a simplest macroeconomic growth model proposed by Solow in 1956 and modified it to incorporate the role of labour migration and their remittances in the growth process. In other words, a second objective is to link the remittances impact on the regional growth analytically so that the large-scale migration to and return migration from the oil rich countries can also be assessed.

The outline of the paper is as follows. Section 2 provides the macroeconomic framework and the data base for the analysis. Section 3 reports the empirical results of the modified Solow growth model. Section 4 estimates the impact of COVID-19 on the State Domestic Product for the year 2020 using national accounting framework incorporating recent survey results on the impact on the unorganised sector. Section 5 deals with the impact of COVID-19 on international remittances due to return migration including the lockdown of economic activities in GCC countries. Section 6 evaluates the aggregate effect of COVID-19 on the

economic growth of the subregion from the empirical Solow growth model. Summary and conclusions are reported in the final section.

2. Macro-framework for the analysis of economic growth

The analytical framework for measuring economic growth was developed only in the 1950s by two papers of Solow (1956,1957), one on the theory of economic growth and the other on the role of technological progress for the sustainability of growth. Both ideas have produced several Nobel prize-winning theses as surveyed by Jones and Vollrath (2013). But its application at the sub-national level for developing countries is hardly undertaken especially for a migration-led growth process in India. In the present study we modify the theory of economic growth as developed by Solow (1956) so that COVID-19 impact can be evaluated at the regional/subregional level.

2.1 Basic Solow growth model

The model assumes that the economy produces a composite commodity, following the tradition of Harrod-Domar and Mahalanobis, with two primary inputs, labour and capital. Since our purpose is to understand economic growth, the appropriate variable is per capita output and per capita physical capital stock. The production function becomes:

$$y = f(k) \quad \ldots (1)$$

Where y is output per capita and k, stock of physical capital per capita. Solow specifies a simplest functional form for (1) in his analysis as given below;

$$y = k^{\alpha} \quad \ldots (2)$$

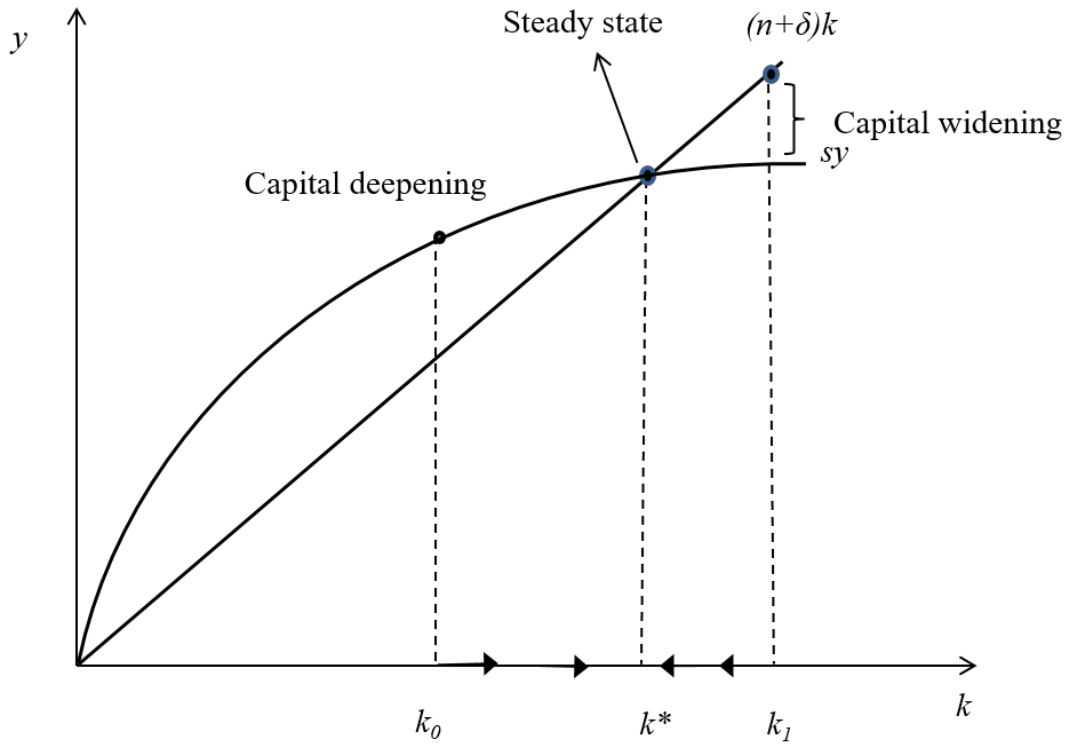
where α (<0) denotes the share of output paid to capital input in the production process . It may be noted that the production is subject to diminishing marginal returns to capital per worker and the production assumes away technical change. His second equation is the capital accumulation in the economy.

$$\dot{k} = sy - (n + \delta)k \quad \ldots (3)$$

Equation (3) expresses the capital accumulation per worker terms (continuous change in capital stock per period), where, s, is the saving rate in the economy, n, labour force growth

and, δ, the depreciation rate. In a closed economy, savings is equal to investment and the equation gives the net investment or the change in the capital stock in the economy. The highlights of growth model in this economy are shown in figure 1.

Figure 1: Basic Solow growth diagram



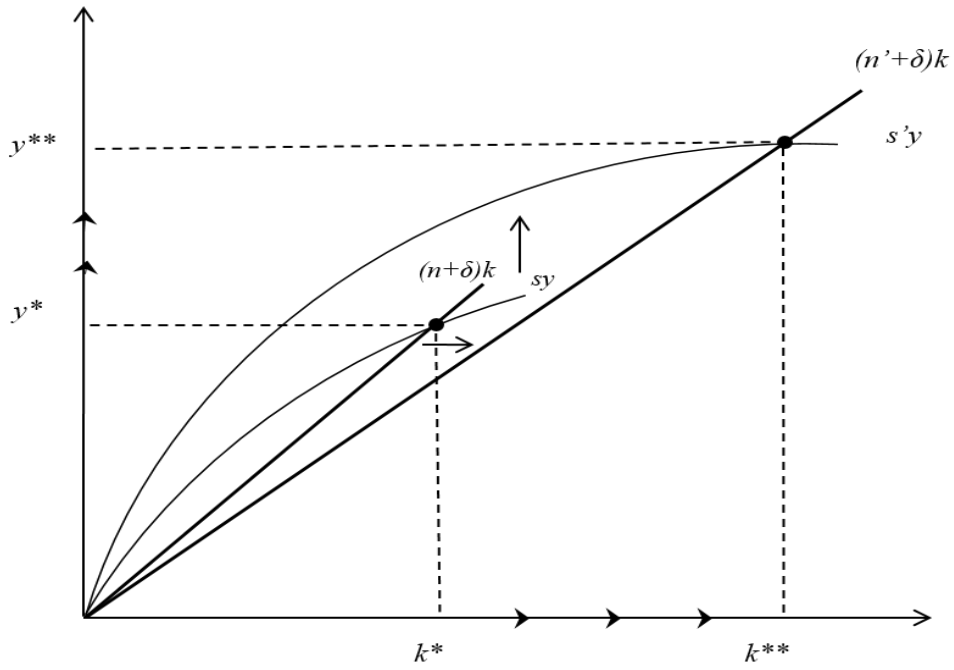
Source: Adapted from Jones and Vollrath (2013); fig 2.2; p.29

Figure1 has two curves which are functions of capital-labour ratio (k). The first curve is the amount of investment per capita which is the scaled down version of the economy wide production function by the saving rate of population. The second curve is the line indicating the net investment per person required to keep the capital-labour ratio constant. The difference between the two curves gives the change in the capital per worker in the economy. If the difference is positive, then capital per worker is increasing which may be termed as capital deepening in the economy. On the other hand, if the change is zero and k is growing then only capital widening is taking place due to population growth. Suppose an economy starts form k_o, then the investment per worker is higher than it is required for making capital-

labour ratio constant. In such situations, capital deepening begins (k increases overtime) so that capital-labour ratio becomes constant. Such a point, k^*, is called steady state equilibrium as shown in the Solow diagram. Instead, suppose the capital stock per worker is higher than the available investment in the economy, as in k_1, then investment will be used for widening the capital base of the economy so that capital-labour falls towards the steady state equilibrium so that it becomes constant. This highly simplified model provides justification for the three 'stylized facts' observed in the development literature:(1) no trend in capital-labour ratio (Jones and Vollrath; 2013; pp.13-15); (2) higher per capita stock of capital (capital deepening) leads to higher per capita income; (3) higher population growth leads to lower capital-labour ratio (capita widening) and lower per capita income (Jones and Vollrtah,2103; pp 33-35). This model is closed and therefore it cannot explain the growth arising from large scale migration from Kerala to Gulf Countries in the 1970s for meeting the labour demand from oil export booms.

There exists enough empirical evidence to show that Kerala's impressive growth among the subnational economies in India since 1970s is mainly migration-led despite its failure to follow the conventional structural transformation theories of economic growth [Zachariah, et.al. (2003), Pushpangadan (2003 and 2013), Acemoglu (2009), chapter 20; Pushpangadan and Murugan (2019), and Kannan and Hari (2020)]. Our task is to modify Solow model to explain the economic growth of the subnational economy with migration. For this purpose, we consider an open economy version of Solow model which allows migration to influence capital per worker and saving rate in the economy so that it explains migration-led growth of the reginal economy since 1970. In this case, the flows of production, income and expenditure are influenced by four participants: households (consumers), firms (business enterprises), government (public sector) and the foreign sector.

Figure 2: Solow's growth model with migration



By adding the foreign sector, the model opens up economic activity beyond the border of the regional/subnational economy. In the present case, labor services are traded with foreign governments/business enterprises and the service providers become migrants in the foreign country. The savings from wages and salaries of the migrants become remittances to their respective mother countries. In such situation, both investment function and capital-labor function shift instead of moving along the curves as in the closed model. For example, when migration starts, the immediate effect is that it reduces the slope of the capital-labor curve which scales down the curve in the closed model. In other words, it moves in the right direction $(n' + \delta)$. This is due to the shortage of labor resulting from out-migration and the ongoing demographic transition taking place in the regional economy. At the same time, the remittances by the migrants increase the investment rate especially in the construction sector and in infrastructure needed for meeting the additional demand for time-saving consumer durable goods from migrant households. In other words, the investment function moves in the upward direction (s'y) and to the left of the closed model. The highlights of the model are: (1) the economy reaches a new steady state equilibrium (k**) as a result of capital deepening leading to higher capital-output per capita; (2) This leads to higher output and higher capital

formation in the economy. The open economy model thus provides the simplest explanation for the migration-led growth of the regional economy.

This would mean that international remittances (hereafter remittances) become an exogenous variable in the Solow model and the growth equation becomes:

$$y = f(k, R) \quad \ldots \quad (4)$$

where y and k as in equation (2), R is the real remittances per capita (migrant).

The Solow model without technical progress as considered here will not produce sustained growth (Acemoglu, 2009; p.69; Jones and Vollrath, 2013; p.34). Solow resolves the problem by introducing technical change as 'labour augmenting' which is exogenously determined (Solow 1957; Jones and Vollrath, 2013; pp.36-44). In this model, the steady state equilibrium per capita output growth is not zero but equal to technical progress (total factor productivity growth, TFPG) (Jones and Vollrath, 2013; p.38). But measurement of this TFPG at the subnational level is difficult since it is endogenously determined for which there exists hardly any time series data as will be evident from the section 2.2 on the data base of the region.

There are two ways of justifying sustained pe capita output growth in the present context without revoking technological progress. One is to assume that the production process is ultimately linear in capital stock (AK model) but its drawback is that the equilibrium is knife-edged (Acemoglu, 2009; p.56). This rules out comparative static analysis and transition dynamics in Solow model as applied in the formulation of the open economy model with migration. The second possibility is the value of constant returns to scale very close to 1 but not equal to one so that AK model is not valid. In such situation adjustment to steady state is very slow which has the flavour of sustained growth (Acemoglu, 2009; p.55). Moreover, the economy has been subjected to two major global crises during the period of analysis: First was the financial crisis during 2007-2009; and the second is the COVID-19 pandemic started in February 2020 which continues its impact on slowing down and shutting down economic activity worldwide. The effect of the second external shock is still on and the status of bouncing back to steady state is very uncertain. In such situations, the sustainable growth of the economy without technical progress is a distinct possibility and we assume that such a situation exists during our period (1980/81-2015/16) of analysis. In addition, the multivariate growth analysis generates per capita output growth even in the absence of technical progress

as a result of exogenously determined remittances included in the specification. But the limitations of the model, as Acemoglu, 2009 (pp.68-69) pointed out, that the proximate causes of economic growth emerging from Solow's pioneering studies are black boxes. The black boxes should be endogenously formulated and empirically verified for understanding the causes of economic growth. This is very challenging empirically particularly at the subnational level since data base for such an analysis is yet to be created.

The explicit specification of eqn. (4) and its estimation provides the Solow's open economy growth equation for the region. This is taken up next after discussing the data base for the estimation.

2.2 The Data

(i) Output per capita (y) is defined as the net state domestic product per capita (PCNSDP) in constant prices (2011-12 prices) published by Department of Economics and Statistics, Government of Kerala (http://www.ecostat.kerala.gov.in/index.php/state-income). The net state domestic product (NSDP) data with different base years have been spliced with the base year, 2011-12.

(ii) The stock of physical capital per capita is the crucial variable in the specification which is not available on a continuous basis for the subnational economy of Kerala even though it is available for most of the major states in India. Our search effort on the time series data on the capital stock reveals the following: (1) The series is available for the period, 1970-80, which is published by the Department of Economics and Statistics (DES), Government of Kerala, but not to be traced for its inclusion; (2) DES has published it again for the period, 1993-94 to 1997-98 (in CD format) and after a break of 13 years, for the period, 2011-12 to 2015-16 (in the website: http://www.ecostat.kerala.gov.in/index.php/state-income). Our data search shows that EPW research foundation (1993) has published the series for the period, 1980-81 to 1985-86. In other words, the series on the prime mover of growth, capital stock, is not properly accounted continuously and consistently for the region. As a result, no macroeconomic analysis exists for the subregion. Our major task is to generate continuous timeseries data on the

capital stock for the period starting from 1980-81 onwards. This is possible only if we develop a methodology for generating the missing values among the three discontinuous series. The following methodology is applied for estimating the missing values of the subnational economy from the national (India) capital stock. It is assumed that the share of capital stock of a subnational economy in the national series is same as the share of its GDP in the national GDP. In other words, the share of subnational GDP in any year if multiplied by the corresponding capital stock of the national economy would provide the capital stock of the subnational economy for that year. First, we have generated this proxy capital stock series for the discontinues years, 1985-86 to 1993-94 and 1997-98 to 2011-12 and its growth rates by taking log differences. This growth rate is then applied to the actual capital stock series for generating the missing values. The three series were then spliced to generate the capital stock series in current prices with base year 2011-12. The investment rate (INVR) is defined as the share of the capital stock in current prices to GSDP in current prices. The crucial assumption is that the capital-output series is the best proxy available for investment rate in the economy. The ratio measure in current prices is taken for adjusting partly for the price effect and partly for neutralising the depreciation effect.

(iii) Real remittances are obtained by deflating total remittances using state income deflator (Net state domestic product) where total remittances in current prices are from Table 1 of Kannan and Hari (2020); national income deflator is derived from NSDP estimates from DES, Government of Kerala. Real remittances per capita (RRPC) is obtained by normalising real remittances with the total number of migrants from Kerala to Gulf countries as given in Table 15 of Kannan and Hari (2020).

(iv) Data required for the computation of COVID-19 effect on gross state domestic product (GSDP) for 2020 is collected from many primary and secondary sources. Details are given in section 4 of this paper.

3. Empirical results

The following explicit specification of equation (4) is estimated using data given in section 2.2. The Solow open economy growth equation in log form is:

Ln PCNSDP= $a + a_1$ ln INVR + a_2 ln RRPC + u … (5)

Where, PCNSDP is per capita Net State Domestic Product in constant prices;

Investment rate, INVR, is the share of capital stock in GSDP, RRPC is real remittances per capita (migrant) and u, the standard error term.

Equation (5) is estimated for the period, 1980-81 to 2015-16. Although it has high explanatory power (94 per cent) the result is not reported here, since the INVR is not statistically significant. This may be due to the problem of lagged effect of investment rate. Therefore, lag structure for INVR has been introduced in the specification. Three lag structures were considered for the investment share in the growth equation (Gujarati, 1988; pp.512-538): (1) Ad-hoc lags; (2) Koyck lag; and (3) Almon's lag. Only Ad-hoc lag model provided a positive effect of migration on growth with a single lag for investment rate. But the coefficient of investment ratio is statistically significant only at 10 %. The equation is again estimated using robust regression method which yielded significant coefficient for investment ratio, although the lag structure is still not significant. The use of this version is also justified as an instrumental variable method of estimating the Koyck lag structure when one lag INVR is used as an instrument for the auto-regressive term in the transformed Koyck model (Gujarati, 1988; p.524; Liviatin, 1963). The results are reported in Table 1.

Table 1: **Solow growth equation with one ad-hoc lag in investment rate**

Dependant Variable: ln PCNSDP		
Independent variables	**Standard regression**	**Robust regression**
ln INVR	0.428* (0.215)	0.428*** (0.152)
ln INVR (-1)	-0.193 (0.221)	-0.193 (0.184)
ln RRPC	0.277*** (0.038)	0.277*** (0.038)
Constant	6.047*** (0.207)	6.047*** (0.173)
Number of observations	35	35
F (3, 31)	194.83***	275.74***
Adj. R-square	0.944	0.950

Note: *** indicates significance at 1 per cent level; * indicates significance at 10 per cent level; standard errors are in parenthesis.
Source: Data described in section 2.2, ibid.

Time derivative of the equation gives the growth rate version of Solow equation. Differentiating partially with respect to the endogenous variables, we get investment elasticity of growth as 0.43 and that of remittance as 0.28. It is interesting to note that when the study is restricted to a subnational economy with a macroeconomic framework and estimated using time series data the impact of remittances becomes positive and statistically significant as against the negative and statistically significant relationship observed by Adams and Richard. (2011) from a review of 50 empirical studies on the same theme. This may be due to the validity of ceteris paribus assumption in the model more at the subnational level temporally than at the national level cross-sectionally. This hypothesis needs careful evaluation for any final conclusion.

Section 4. COVID-19 and its impact on GSDP and investment: National accounting framework

The evaluation of impact on growth using Solow's modified growth model is possible only if we have a measure of investment share during the pandemic period. In order to estimate the investment rate, we need estimate on GSDP. No reliable estimates on GSDP are available for the region during the pandemic except the one based on lock down days by Prakash (2020). Two problems emanate from the study. First it does not follow the national income accounting principles wherever possible in the estimation of GSDP. Instead, it works out the average loss during the lockdown period from the previous year GSDP instead of the predicted GSDP in the pandemic year. Further, the estimate is only partial since the variation in the lack down days, in the rates and proportions spatially particularly at the district levels is not considered in the aggregation. Therefore, the reliability of such estimates is very low. The other major limitation is that the impact measured from the previous year GSDP do not capture the impact on the unorganised sector, the worst hit sector by the pandemic (Kumar, 2020). The present study overcomes both this limitation as far as possible subject to the availability of data during the pandemic year as discussed below.

We have used the national accounting framework as far as data permit for assessing the impact on GSDP of the regional economy. For carrying out such an exercise, one should follow the guidelines issued by the Ministry of Statistics and Program Implementation on the measurement of National Income. However, the data available do not permit us to implement the guidelines fully in the immediate run leaving us to devise alternate methods of estimation that are very close to reality.

It may be noted that estimates on Gross State Value Added (GSVA) are available only up to 2018-19 and hence the value for the year 2019-20 is projected by multiplying the GSVA of 2018/19 by its previous annual growth rate for all the subsectors. Obviously, the assumption is that the estimates in 2019/20 will not be lower than in 2018/19, although COVID-19 has appeared in February of the same financial year. For the pandemic period, GSVA of sub sectors were estimated using data from secondary sources in 2020/21. These figures of GSVA were then aggregated at three-sectoral level (primary, secondary and tertiary). GSDP figures were then obtained by adding taxes and subtracting the subsidy to the aggregated GSVA as shown in Table 2 during the Covid-19 period for impact assessment[1]. Our main aim is to measure the gain/losses due to Covid-19 in the GSVA and thereby in the GSDP for the year 2020-21. As stated supra it is not possible to have the estimates from the same source of for all the sub sectors for the year 2020/21. In such cases, it is estimated from secondary and primary sources where ever possible. The summary of the computation is presented in the Table 2.

Table 2. COVID-19 effect on Gross State Value Added and GSDP at Current Prices by Sectors, Kerala- 2020-21(Base year 2011-2012)

(Rs. in lakh)

	Item	2019- 20*	2020/21@	COVID-19 loss from 2019/20 to 2020/21 (%)
1	***GSVA Primary Sector***	7735277.079	**5360497.9**	**-30.7**
2	***GSVA Secondary Sector***	19633965.88	11267924	**-42.61**
3	***GSVA Tertiary Sector***	50139803.08	**31284392.1**	**-37.6**
4	**TOTAL GSVA at basic prices (1+2+3)**	77398431.93	**47912814.1**	**-38.09**
5	Taxes on Products (18.3 %)	10436253.93	6468229.9	
6	Subsidies on products-(-2.35 %)	714210.0623	1125951.13	
7	**Gross State Domestic Product (4+5-6)**	87086875.42	53255092.8	**-38.85**

Source: Murugan (2021); DES 2020,
* Estimated from that of the previous year using previous growth rate.
@ Estimation is carried out using the data as on November 2020, under the expectation that the same scenario will continue till the end of financial the year.

[1]These projected estimates are available upon request from the authors.

The main observations of the methodology at three sub-sectoral level estimation of GSVA are discussed below.

4.1 Primary Sector

The primary sector consists of agriculture and allied activities, mining and quarrying as in national accounts. The sub sectors in agriculture and allied activities include, crop production, livestock, forestry& logging, and fishing & aquaculture. GSVA calculation for each of the subsectors is based on different methods as follows. It is ideal to have production and cost of cultivation data for the estimation of GSVA for crop production. Only a few crops have such information. In the absence of required data, the impact on production of crops is based on market arrivals from Agmark network (agmarknet.gov.in) of the Government of India for the state of Kerala as is done by Rawal and Verma (2020) for all India. In the case of livestock, the information is from Integrated Sample Survey (Government of Kerala) and from MILMA, for arriving at GSVA. The estimates for fisheries were obtained from catch and arrivals of fish collected from Central Marine Fisheries Research Institute for the pandemic period and for the previous year. Primary data were also collected on forestry and logging (F&L) from the Forest authorities and the same method applied for fisheries is used for obtaining the GSVA of F&L. No data are available on mining and quarrying for the COVID-19 period. The estimate is only an informed guess from the discussions we had with stake holders in the sub-sector. The simple average of the subsectors (-30.7 %) is taken as the impact of COVID-19 on GSVA in the primary sector as indicated in Table 2. It may be noted that the impact in the crop subsector as pointed out by Kumar (2020) is very minimal, though negative, since the crops ready for harvest particularly paddy were delayed due to non-availability of harvesters at the right time owing to problems in transportation. The horticrops were also found very difficult to sell owing to declining demand and the limited off take for exports. Further the excessive rains during monsoon also might have contributed to the fall reflected in the market arrivals. There was an apprehension among the people that the disease could even spread through meat and hence the demand for meat has fallen, leave alone the fact that people were deficient in resources since employment was also very minimal. Off take of milk in many of centres were also reduced during initial days of the lockdown but could catch up subsequently since the excess milk was converted to milk powder. People were reluctant to go for fishing in trawlers and other machineries, as they have to be together, unlike conventional fishing of snake boats or ‘catamerans’ in which only

one or two of the family members or near relative's venture to the sea for fishing and is riskier, besides can go only to the neighbourhood. Being a perishable commodity, even if they venture to the sea marketability was a big issue and exports were also reduced considerably. In forestry and logging the auctions and movement of wood and minor forest products were very less and tribes were not dare enough to venture to forests to collect the minor products. This has resulted in a huge loss in GSVA in this sub sector, rather the highest in proportion. The need for primary investigation of the pandemic effect in mining & quarrying is essential for a realistic assessment of the subsector which is now in progress (see Murugan, 2021, for further details).

Let us comment on the estimation of GSVA in the secondary sector where the major subsector is manufacturing.

4.2 Secondary Sector

The major subsectors in the secondary sector consist of`: (1) Manufacturing; (2) Electricity, Gas and Water Supply; and (3) Construction. One of the prominent remarks of Kumar (2020) is that the estimates based on Index of Industrial Production or Purchasing Manger's Index etc., which by and large covers only the organised manufacturing sector alone but not the unorganised segment of it. In such situations, the estimates are biased to the extent of MSMEs in the manufacturing sector. This has been taken care of to a large extent in the estimation. The study carried out by the Department of Economics and Statistics (DES, 2020) provides a detailed investigation on the impact of COVID-19 on the lock down and post lock down on the unregistered segment of the secondary sector according to NIC classification. The survey provides number of operational days for each month during the field survey. Assuming the same operational days for the organised manufacturing, we have calculated the losses in the manufacturing sector. If one considers the loss in receipts by the units it comes to - 44% during the year, where as if we consider the periods under lock down and closure it comes to about -38% for the year. We consider the latter as the loss since the same yardstick of losses is applicable to that of the registered units also. The findings validate the hypothesis of Kumar (2020) that the lockdown effect is higher for unorganised sector than for organised since the difference is -11%, substantially high. This is used for computation of GSVA. From the previous year GSVA of the manufacturing sector, we have computed the average contribution of GSVA per month. Percentage of days on lockdown is available for each month from the DES (2020) survey data. Assuming that production levels remained the same

for organised and unorganised sectors we worked out the loss for each month, though it can be higher in the unorganised sectors of the industry.[2]

As regards Electricity, the Central Electricity Authority provides information on the state wise consumption of power. The power consumption for the months, from April 20 to Nov. 20, for the year 2020 was compared with that of the previous year. The reduction is only 7% during the current year and is taken as GSVA reduction due to pandemic.

Gas and water are bare necessities and hence there is only a marginal decline which is assumed to be to the tune of 3% in gas. In the case of water, hotels and restaurants were not operational but household demand could be higher and water supply does not have any significant change. Moreover, the use of water by offices and industrial units is very minimal. Our informed guess is 10% reduction in all the three sub-sectors as the impact of COVID-19. Using the same methodology as in the manufacturing, the losses were computed and accounted.

Construction sector has faced the deepest crisis during the pandemic. In the absence of any reliable data on cement, steel and other building materials, we had informal chat with skilled workers like masons and carpenters, painters etc. for their unemployment rates during the period. The information shows they were employed only about 50% of the time during the period and therefore, we take 50 % reduction in GSVA in this sub sector, though it is possible that the losses can be more. The averages of the subsectors in the secondary sector shows a decline of 42.61 % in GSVA during the pandemic as shown in Table 2.

Next, we examine the tertiary sector which has been the lead sector of growth during the last three decades.

4.3 Tertiary Sector

The sub sectors of tertiary sector are: trade, repair, hotel and restaurants, transport, railways, air lines, storage, communication, financial services, real estate etc. There is no uniform methodology for making the estimation in all the sub sectors in the tertiary sector. Hence, we followed different methods for arriving at the estimation of losses. All sub sectors of the tertiary sector excepting, Railways, Air Transport, Public Administration are estimated using data from the sample survey carried out by the DES (2020) as in the case of secondary sector.

[2] Data on post lock down periods were also collected and made available in the DES data, though occurrence of Covid cases have not declined drastically during post lockdown, which has a definite influence on the manufacturing and output. Unlike farms social distancing in the factory is rather extremely difficult.

As regards, Air transport we have used the data collected from the Airport Authority of India, while data from Railway Board during COVID-19 period were used for the railways. Analysis of Public administration was carried out using data from budgetary sources. The loss for the tertiary sector is the average of all the subsectors which is about 37. 6 %. Major losses are in the transport sub sector, mostly in railways, road transport and airways, as they require close contact among the fellow travellers and the operating staff as customers. The real estate sub sector also suffered heavily and may take more time to recover, partly because of remittance reduction and off take losses. Trade, financial services, communication and hotel and restaurant also suffered but lower than that of other subsectors in the tertiary sector.

The economy wide loss in GSDP is obtained by adding the taxes and subtracting the subsidies to the sum of loss of GSVA in the three broad sub sectors (primary, secondary and tertiary). The aggregate loss of GSDP is 38.85 % of goods and services in 2020/21. This loss will be translated to investment rate for impact evaluation of economic growth in Kerala using Solow growth model, as shown in section 6 below.

5. COVID -19 and its impact on international remittances

Remittances' impact on growth can be assessed from Solow's open economy growth model for the region which requires an estimate of real remittances per capita (RRPC) during the beginning of COVID-19 year, 2020-21. It may be noted that real remittances per capita is calculated on the basis of total migrants in GCC countries from Kerala. The actual figures for RRPC can be calculated until 2019-20 from Kannan and Hari (2020, Table 15). But for analysis we consider only the trend value so that it is free from cyclical and irregular components. The following methodology is applied for obtaining the predicted/trend value of RRPC for the year 2020-21.

First, we estimate a semi-log trend equation from the time series on RRPC for the period, 1980-81 to 2019-20. The trend equation is given in Table 3 below.

Table 3: Semi-log trend equation of real remittances per capita for Kerala, 1980-81 to 2019-20

Dependent variable: Ln RRPC		
Independent variables	**Coefficient**	**Standard Error**
t	0.144	0.0044
Intercept	7.736	0.1028
Number of observations	40	
Prob > F	0.000	
Adjusted R-squared	0.966	

Source: Kannan and Hari (2020); Table 1 and Table 15

The exponential growth rate of RRPC from the trend equation is 14.4 % for the period of study. The predicted or trend value of RRPC for the year 2020-21 is obtained by substituting, t = 41 in the trend equation:

In RRPC = 7.736 + 0.144 x 41= 13.66.

RRPC (Rs) = antilog (13.66)

= Rs. 8,54,681 (in 2011-12 prices).

The reduction of RRPC has to be estimated from the predicted value for the year 2020-21 using with and without COVID effect as follows. Assume RRPC without COVID effect as the trend estimate, 854681, for the year 2020-21. With COVID effect, RRPC is reduced in two different ways: (1) the reduction due to slow down and lock down of economic activities in GCC countries and its impact on the income and remittances of immigrants from Kerala; and (2) the loss of remittances from migrants returning from GCC countries resulting from job loss and expiry of visas. According to UN, 2020 (No33), GCC countries have introduced a 14 % economy wide cut in wages and salaries to counteract the slow down and lock down of their economic activities during the COVID period. If we assume the same reduction in the predicted RRPC, then it reduces to (8,54,681 x 0.86) = Rs. 7,35,026. In other words, the estimated loss in RRPC is (854681-735026) = Rs. 1,19,655 in 2020-21.

But the new RRPC, 7,35,026, is further reduced due to job loss and non-renewal of visas resulting return migration. The latest figures show that 6.4 lakh migrants of Kerala origin have returned from GCC countries as of November 2020 (Planning board, Govt. of Kerala, 2020). This reduces the total migrants from Kerala to GCC countries from 18.94 lakh to 12.54 lakh (=18.94-6.4) in 2020-21 (Kannan and Hari, 2020). This would imply the return migration further reduces the RRPC to (7,35,026 x 12.54)/18.94=4,86,654. In other words, the RRPC reduces to 486654 per capita, which is 56.9% of the RRPC without COVID effect in 2020. Therefore, the combined effect of COVID on RRPC would be a reduction of 43.1 % (=100-56.9). The summary of the COVID impact on remittances is given in table 4.

Table 4. Impact of COVID-19 real remittances per capita under case-control methodology for 2020-21.

Description	**Calculation formula**	**RRPC**
1. RRPC (predicted) without COVID effect in 2020-21 (Rs.)	Trend value at t = 41	Rs. 8,54,681 (2011-12 prices)
2. RRPC with COVID effect: (i) reduction due to slow down and lock down in GCC countries in 2020-21 (14 % reduction wages and salaries) (ii) The reduction due to return migration of 6.4 lakh out of 18.94 lakh Keralites in 2020-21	8,54,681 x (100-14) 735026x (12.54/18.94)	Rs. 7,35,026 Rs. 4,86,654
3. The RRPC with COVID-19 effect as a % of without in 2020-21	4,86,654 / 8,54,691	56.9 %
4. The reduction in RRPC due to COVID effect in 2020-21	100 - 56.9	43.1%

Source: (1) Ratha et. al. (2020); (2) UN (2020); (3) Planning Board, (2020); (4) Kannan and Hari, (2020).

Having estimated the impact of COVID-19 on GSDP in section 4 and remittances in section 5, we now proceed to evaluate the COVID's combined impact on economic growth in Kerala.

Section 6. Impact of COVID-19 on economic growth in Kerala.

The overall effect of COVID-19 on growth is the weighted average of investment rate and real remittances per capita. It is estimated in section 4 that COVID -19 has reduced the GSDP of the region by 38.85 per cent. The trend rate of the investment rate predicted for 2020-21is 63.1 per cent. The corresponding reduction in investment rate is equal to 38.85 per cent of 63.1 = 24. 5 per cent.

From section 5 the reduction in real international remittances per capita (RRPC) is 43. 1 %. The overall impact is a weighted average of investment rate and real remittances effects, the weights being taken from the empirical Solow open growth equation. The weight for the investment rate is 0.43 and that of remittances is 0.28 from the robust regression analysis. The weighted average of the two effects is given by:

Growth rate of output per capita = 0.43x24.5 + 0.28x43.1 =10.5 + 12.1 =22.6

The summary of this calculations is reported in Table 5. From Table 5, it is clear that the total reduction of growth rate, output per capita, is 22.6 per cent during the COVID-19 pandemic year which is subject to change in either direction depending on the recovery of the regional economy after November 2020in the GSDP.

Table 5

Overall impact of COVID-19 on economic growth in Kerala for the year, 2020/21

Source	**Weight**	**Reduction (%)**	**Weighted reduction of growth rate**
(a)investment/GSDP ratio	0.43	24.5	10.5
(b)International remittances (b)	0.28	43.1	12.1
Overall reduction in per capita output [(a) +b)]	-	-	22.6

Source: Section 4 & 5 and Table 4.

From table 5, it is evident that the weight of international remittances is slightly below half of the investment, but its growth contribution outweighs the former. This indicates that the

welfare implication of the return migrants is equally important as that of the non-emigrant population in dealing with the pandemic effect in Kerala. The latest figures on return migrants are 12.4 lakh (as of April 2021) which would mean that remittances effect, ceteris paribus, would reduce the growth by 24.2 %, indeed an alarming impact.

7. Summary and Conclusions

The paper develops a methodology for impact analysis from Solow's open model of growth and applies it to a subregional economy, Kerala, India, in the case of COVID-19 pandemic. A log linear growth equation of output per capita is regressed on capital stock-gross domestic product ratio (CSDR) and real remittances per capita (RRPC) for the period, 1980-81 to 2015-16. The robust regression method on regional growth shows that the growth elasticity of investment share in GSDP is 0.43 and that of RRPC 0.28 with an explanatory power of 95 %. It is interesting to note that when the study is restricted to a subnational economy with a macroeconomic framework and estimated using time series data the impact of remittances becomes positive and statistically significant as against the negative and statistically significant relationship observed by Adams and Richard (2011) from a review of 50 empirical studies on the same theme. This may be due to the validity of ceteris paribus assumption in the model more at the subnational level temporally than at the national level cross-sectionally. The growth accounting principle shows that only 29 % of the remaining variation needs to be accounted by other factors affecting the regional growth. During the post pandemic year, 2020-21, gross state domestic product (GSDP) shows a reduction of 38.89% for organised and unorganised sectors together arising from the slow down and lock down in economic activities in the regional economy. The trend value of CSDR for 2020 is 0.63 and its value for the shrinkage of GSDP by 38.89 % is 24.5 %. The partial impact of growth rate on output per capita for the shrinkage of GSDP of 24.5 % is -10.5 %. Similarly, the trend reduction in RRPC is 43.1 % and its partial impact on growth rate of output per capita is -12.1 %. The impact of COVID-19 on the aggregate growth rate of the economy, therefore, becomes - 22.6 %, which is the weighted sum of the growth rate from CSDR and from RRPC. It is interesting to note that reduction in growth rate is more from international remittances than from investment share in GSDP. Therefore, growth-revival strategy for the region requires special component plan compensating for the shortfall in the international remittances from return migration.

The proximate causes of economic growth, physical capital formation and technical progress, will remain to be black boxes at the subnational level unless they are endogenized and measured regionally. Looking at the data base of subnational states in India., the endogenizing physical capital on growth itself is a distant possibility especially for a state like Kerala.

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