COVID-19 IMPACT ON INTERNATIONAL MIGRATION, REMITTANCES, AND RECIPIENT HOUSEHOLDS IN DEVELOPING ASIA (AUGUST 2020)

ONLINE APPENDIX

Model Description, Assumptions, and Other Technical Notes

To assess the economic impact of COVID-19, we use the Bilateral Labor Migration (GMig2) Model and Database to model GATS mode 4, or the temporary mobility of "natural persons". The database used with the GMig2 is based on the GTAP 10A Data Base (Aguiar et al., 2019) and is augmented with the bilateral migration database developed by Knomad data documented by Global Migration Group (2017).[1] The procedures involved in developing this dataset are well-documented in Aguiar (2020).

Like the GTAP Data Base, the GMig2 Data Base covers 141 regions and 65 sectors and can be extended as the number of regions in the GTAP database increases. We have expanded the country coverage to include economies missing from the dataset, such as all the Pacific Island countries, as well as Macau, China; Myanmar; and Timor-Leste. We have based the entire input-output data for these countries on their 2018 gross domestic product (GDP) from the World Bank and the Asian Development Bank (ADB) Multi-Region Input-Output (MRIO) dataset. Furthermore, we have updated the entire dataset to 2018 by using these two datasets again (World Bank and ADB MRIO). For updating migration data, we assume that wage rates grow at the rate of per capita GDP, between 2014 and 2018, in all these countries. The following is a list of new regions and economies included in this analysis—which are not available in the standard GTAP model:

- Afghanistan
- Bhutan
- Commonwealth Pacific Islands (Kiribati, Nauru, Papua New Guinea)
- Democratic People's Republic of Korea
- Fiji
- French Pacific Islands (French Polynesia, New Caledonia)
- Macau, China
- Maldives
- Marshall Islands
- Myanmar
- New Zealand Pacific Islands (Cook Islands, Niue, Tokelau)
- Other Pacific Islands (Federated States of Micronesia, Palau, Solomon Islands)
- Samoa
- Timor-Leste
- Tonga
- Turkmenistan
- Tuvalu
- US Pacific Islands (American Samoa, Guam, Northern Mariana)
- Uzbekistan

The GMig2 model traces the migrants from their home country, which is the destination of the remittances, and their host country, which is the source of such remittances from these migrants. All countries can be home to some migrants and host to others at the same time. Labor force in a host country is the sum of labor migrated from all home countries to the given host country, and the local labor force in the host country.

If labor demand in a host country increases, it may mean an increase in demand for migrants from all home countries to this country, and may get further translated into a decrease in labor supply in these home countries, as the labor may migrate away from these countries into the host countries. Such changes in migration can be either exogenous, and therefore defined by the model user, or endogenously determined by the parameter that captures the responsiveness of the laborers to changes in relative real wage differences between the two countries in question. Two-way migration is possible in these cases, meaning that the migrants can go from the home to host country or the other way round. We can control the extent of migration through closure assumptions.

The degree of increase in wages in the host countries for a given migrating laborer depends on the wages in the home country and those in the host country. In particular, it is the sum of home country wages and a fraction of the differences between the wages in home and

[1] Refer to the following document for a detailed explanation of this dataset: Global Migration Group. 2017. *Handbook for Improving the Production and Use of Migration Data for Development.* Washington, DC: Global Knowledge Partnership for Migration and Development (KNOMAD), World Bank.

host countries. This captures the productivity differences and income differences in labor from the two countries, which may explain why the migrants do not earn as much as locals. Furthermore, laborers are classified into temporary and permanent residents; the latter may not return to the home country even if they lose their jobs.

Among temporary migrants, there may be three more types: existing migrants in a host country, return migrants to their home country, and new migrants in a host country. The income, remittances, and migration are modeled differently for these categories, because they have different levels of dependencies on the income from endowments in the two countries. We can also model sector-specific migration, by specifying which sectors are allowed to accept migrants to work. The model is comparatively static in nature, with no specific timeline, and therefore the dynamics of inward and outward movement of labor is not modeled here; instead, net changes in migration are shocked exogenously or captured endogenously depending on the closure assumption.

For this study, we assume an endogenous change in the number of migrants based on changes in the wage differential between home and host countries. In turn, wages grow at the rate of GDP. And remittances are kept as a fixed proportion to income earned by guest foreign workers in the host countries. In this regard, the shock from COVID-19 to remittances is transmitted through the decline in GDP growth of all countries (source and host) which affect the wage differential and the bilateral flow of labor between source and host countries. In turn, remittances also fall along with the decline in income earned by foreign workers.

In the model, regions are expressed as labor exporting and importing regions, denoted by *LEXP_REG* and *LIMP_REG*, respectively, for all types of labor *LAB_COMM*. The model has two types of labor: skilled (*SkLab*) and unskilled (*UnSkLab*); the former comprises managerial officials and technical professionals, while the latter comprises agricultural workers, shop-floor and service workers, clerks, and other unskilled workers.

Technically, following is our closure assumption, in addition to the usual standard assumptions, such as fixed technological changes and taxes/tariffs/subsidies and endogenous prices and quantities except factor endowments:

This first statement implies that the change in number of migrants (*c_MIGNOSP*) is endogenously determined by the model, while the aggregate migration in an importing region (*qop*) is made exogenous according to the second one. The third statement makes return migration (*c_RMIGS*) fixed and exogenous. The final statement models the existence of unemployment in all regions, in the unskilled labor, while their real wages (*pfactreal*) are held constant although the nominal wages can still change, while their aggregate employment (*empl*) in unskilled labor is flexible and variable endogenously.

swap c_MIGNOSP(LAB_COMM,LEXP_REG,LIMP_REG) = c_slackmigin(LAB_COMM,LEXP_REG,LIMP_REG) ;

swap qop(LAB_COMM,LIMP_REG) = c_smigin(LAB_COMM,LIMP_REG) ;

swap c_SLACKRMIGS(LAB_COMM,LEXP_REG,LIMP_REG) = c_RMIGS(LAB_COMM,LEXP_REG,LIMP_REG) ;

swap empl("UnSkLab",REG) = pfactreal("UnSkLab",REG) ;

The combined implication of our model closure assumptions is that we allow for limited migration changes, as the aggregate migration in the host countries are fixed and return migration is not allowed for, while the migrants can stay in the host country unemployed as the job losses and nominal wage reductions may happen in unskilled labor. For skilled labor, we assume full employment, implying that laborers losing jobs in one sector may be absorbed in other sectors with a possible pay cut, but their real wages are completely flexible, so they can also face reductions in real wages. Therefore, most of our results to changes in GDP would affect remittances directly, and migration to a lesser extent.

In addition to the first scenario above, we also accounted for the changes in oil production, which disproportionately affect the oil-exporting countries—and their outward and inward remittances. For this we did the following for these countries, listed in a subset of *REG*, named *OEXP_REG:*

Swap qo("Oil",OEXP_REG) = aoall("Oil",OEXP_REG) ;

In simple terms, this means that we let the productivity adjust so as to let the oil production be shocked based on real data in the past few months, so as to capture this as a supply shock.

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