



Regional Economic Models, Inc.

Memorandum re REMI Modeling of COVID-19 Economic Impacts

The COVID-19 pandemic is widely expected to have a variety of disruptive effects on the U.S. economy. This memorandum lays out some of the key types of disruptions and discusses how to model each of them using REMI in order to measure the full economic impact of a pandemic.

For all Tax-PI users, the calibration of your state's budget to economic and demographic drivers will also automatically generate a calculation of the state revenue impacts of COVID-19.

This is by no means an exhaustive list, and the severity may vary across regions. REMI staff is available to provide modeling support tailored to the circumstances of your particular region.

Disruptions:

1) Increased absenteeism/loss of productivity

Discussion: Pandemics impact the survivors in several ways. Importantly, people miss work more frequently for a variety of reasons, which include recovering from a bout of the illness, taking care of an ill family member, taking precautionary measures to avoid contracting the illness, and others. This supply-side effect manifests in reduced economic output per worker. Its economic impacts depend on whether and how businesses respond. If they do not respond, then the decrease in output per worker with no change in direct employment generates a direct loss in economic output. If businesses do respond, for example by hiring additional workers to pick up the slack, then the additional labor costs raise their overall production costs, putting upward pressure on prices and making the affected region relatively less competitive against other domestic and international regions. To the extent that the pandemic has comparable effects across regions, the impact on regional competitiveness may be muted and relatively more of the cost increase may be passed on into higher prices. This consideration will be especially important for regional models that do not include the rest of the U.S. Additional discussion of this issue is provided in Section 3 below.

REMI Methodology: In order to model the direct loss in economic output, either the Output or Employment Policy Variable (PV) is appropriate, and the Industry (Exogenous Production) option should be used. These variables can be specified for any Private Non-Farm industry, so heterogeneous industrial impacts can be reflected (e.g., a freelance writer may be able to continue working from home, while a manufacturing employee would not be able to). The choice of which PV to use simply depends on the data available, as shocking one will directly impact the other via the labor productivity for the given industry in the given region. In order to model the direct loss in labor productivity to which businesses respond via hiring, the appropriate PV to use is Labor Productivity, which affects both the required employment for a given level of output and businesses' labor costs. Again, this can be specified for any Private Non-Farm

industry. It may be appropriate to use either or both of these approaches. While there is no one-size-fits-all solution, it may be useful to think of the former as more of a short-term phenomenon and the latter as more of a long-term phenomenon, making the length of the pandemic a potentially important factor in deciding how to model its impacts.

2) Changes in consumer spending

Discussion: Domestic consumer spending patterns may change as a result of the pandemic, generating demand-side effects. For example, people may put off vacations, home and durable goods purchases, restaurant meals, and other nonessential spending during a pandemic, and may replace that with increased spending on medical care and medical products (e.g., surgical masks). It is important to distinguish between deferred and reduced consumption. For example, if a couple waits to purchase their home in July instead of January, then that transaction still occurs and simply gets counted later in the year. However, it is unlikely that a family would double up on restaurant meals after the pandemic subsides to make up for their not going out to eat during the pandemic. Only the latter should be counted as a change in consumer spending, especially since REMI is an annual model.

REMI Methodology: The Consumer Spending or Tourism Spending PV's should be used. The former allows for the modification of spending in each of the 75 detailed consumption categories in the model (which follow the BEA's NIPA tables). The Tourism Spending PV contains four tourism spending profiles (Resident households, Business, Government, Nonresidents) based on the BEA U.S. Travel and Tourism Satellite Accounts. Both of these variables affect demand for the industries associated with the consumption categories or tourism spending profiles, which in turn impacts their economic output.

3) Supply chain disruption

Discussion: Especially now that China has become such a large and integrated piece of the world economy and its supply chains, the impact of its economic slowdown associated with mass quarantine and travel restrictions to combat the spread of COVID-19 has been felt by companies all around the world who rely on intermediate inputs sourced from Chinese manufacturers. Furthermore, as the pandemic spreads around the globe, there is the potential for supply chain disruptions to move beyond China's borders. Depending on the severity of a given supply chain disruption, it can either raise business production costs via higher input prices or shut down production entirely if necessary parts completely run out.

REMI Methodology: In general, the Production Cost PV should be used to model higher input prices. However, as discussed above, this impacts both prices and regional competitiveness, and in the case of a pandemic in the modern interconnected global economy, it may be more appropriate to isolate the price impact and utilize the Consumer Price variable instead. The more geographically widespread the disruption, the less likely it is that regional production cost conditions change relative to one another; rather, they all rise together. In this case, the location decisions for businesses are not heavily affected and they have more leverage to pass through higher costs into price increases because costs are higher everywhere. Note that Consumer Price can be changed for the 75 detailed consumption categories, not the Private Non-Farm industries. However, the National Input-Output Matrix built into the model does have a section that corresponds each consumption category with the demand it generates for each industry, and these relationships can be used to convert increases in production costs into the

corresponding changes in prices. If a supply chain disruption shuts down production entirely, then either the Output or Employment PV should be used with the Industry (Exogenous Production) option.

4) Decline in global demand

Discussion: The other key trade impact of a pandemic is that decreased economic activity abroad may decrease demand for U.S. production, thereby lowering exports and overall domestic output.

REMI Methodology: The Output or Employment PV with the Industry (International Exports) option should be utilized. It is highly likely that any available data would be in dollars of lost demand rather than in employee equivalents, in which case the Output PV would be easiest to use.

5) Increased mortality rate

Discussion: The most direct and tragic impact of a pandemic are the lives that it takes. From an economic perspective, each death generates both a supply-side and demand-side loss. On the supply-side, the individual is no longer able to participate in the labor force. On the demand-side, the individual is no longer able to purchase consumer goods and services that generate demand for the businesses that provide them.

REMI Methodology: The increased mortality rate can be modeled in REMI by decreasing the Survival Rate PV in the affected year(s). Survival Rate can be shocked individually for 808 detailed demographic groups, composed of 101 single year of age cohorts, 4 race/ethnicity categories, and 2 genders. This level of detail is particularly helpful since it can be used to reflect the more acute impact a pandemic has on vulnerable populations, which often include children and the elderly. A decrease in the Survival Rate lowers population relative to the Regional Control, and since population directly affects both the labor force and consumer spending, both the supply-side and demand-side impacts are realized simultaneously.