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Covid-19 and Lockdown Policies:

A Structural Simulation Model of a Bottom-Up Recession in Four Countries

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Contents

ABSTRACT	iii
ACKNOWLEDGMENTS	iv
1. Introduction	1
2. Methodology: Modelling a Bottom-Up Recession	4
3. Empirical Analysis of the Pandemic/Lockdown Shocks	13
4. Macro Stimulation Impact of Income Support Programs	25
5. Conclusions	29
REFERENCES	31

Tables

Table 3.1–Macro Data, 2019.	13
Table 3.2–SAM Data for Four Countries.	14
Table 4.1–Keynesian SAM Multipliers.	26
Appendix Table 1– US SAM accounts. Industry accounts omitted, names same as commodities	33
Appendix Table 2–UK SAM accounts. Industry accounts omitted, names same as commodities.	38
Appendix Table 3–Mexico SAM accounts. Industry accounts omitted, names same as commodities.	41
Appendix Table 4–South Africa SAM accounts.	46

Figures

Figure 2.1–A Stylized Social Accounting Matrix (SAM).	7
Figure 3.1–GDP Projections by Month, Four Countries.	15
Figure 3.2A–Employment Impacts, US.	16
Figure 3.2B–Employment Impacts, UK.	17
Figure 3.2C–Employment Impacts, Mexico	17
Figure 3.2D–Employment Impacts, South Africa.	18
Figure 3.3–Changes in Sectoral Gross Production, Worst Month.	19
Figure 3.4–US, Actual and Projected GDP Index.	20
Figure 3.5–US, Actual and Projected Unemployment Rates (%).	21
Figure 3.6–UK, Actual and Projected GDP Index.	22
Figure 3.7–Mexico, Actual and Projected GDP Index.	23

ABSTRACT

This paper considers different approaches to modelling the economic impact of the Covid-19 pandemic/lockdown shocks. We review different modelling strategies and argue that, given the nature of the bottom-up recession caused by the pandemic/lockdowns, simulation models of the shocks should be based on a social accounting matrix (SAM) that includes both disaggregated sectoral data and the national accounts in a unified framework. SAM-based models have been widely used to analyze the impact of natural disasters, which are comparable to pandemic/lockdown shocks.

The pandemic/lockdown shocks occurred rapidly, in weeks or months, not gradually over a year or more. In such a short period, adjustments through smooth changes in wages, prices and production methods are not plausible. Rather, initial adjustments occur through changes in quantities, altering demand and supply of commodities and employment in affected sectors. In this environment, we use a linear SAM-multiplier model that specifies a fixed-coefficient production technology, linear demand system, fixed savings rates, and fixed prices.

There are three different kinds of sectoral shocks that are included in the model: (1) changes in demand due to household lockdown, (2) changes in supply due to industry lockdown, and (3) changes in demand due to induced macro shocks. At the detailed industry level, data are provided for all three shocks and the model imposes the largest of the three.

We applied the model on a monthly time step for the period March to June 2020 for four countries: US, UK, Mexico, and South Africa. The models closely replicate observed macro results (GDP and employment) for the period. The results provide detailed structural information on the evolution of the different economies month-by-month and provide a framework for forward-looking scenario analysis.

We also use the SAM-multiplier model to estimate the macro stimulus impacts of policies to support affected households. The model focuses attention on the structural features of the economy that define the multiplier process (who gets the additional income and what do they do with it) and provides a more nuanced analysis of the stimulus impact of income support programs than can be done with aggregated macro models.

Keywords: Covid-19, Social Accounting Matrix, SAM, SAM-multiplier model.

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1. INTRODUCTION

The SARS-Cov-2 pandemic is global. The virus is highly infectious, spread rapidly, and the disease (Covid-19) is causing serious illness and loss of life to many. Without an effective and widely used vaccine, countries pursued policies designed to contain the disease, limiting its spread, and bring the infection rate down to a manageable level. There has been a wide variation across (and within) countries, even within the groups of both rich and poor countries, in their capacity to implement policies designed to contain the pandemic.

Two different goals motivated the policy response in various countries:

1. Keep new infections at a negligible level, so that the vast majority of the population will avoid infection before a vaccine is widely available (e.g., New Zealand, China); or
2. Keep new infections at a slow enough pace so that medical systems are not overwhelmed (flatten the curve) and stabilize the incidence of the disease, preventing explosive spikes in its spread.

Pursuing the first requires a stronger policy response than the second and leads to less widespread illness and deaths. Most countries, either by choice or circumstances, have pursued the second option, with varying degrees of success.

The policies employed have two strands:

1. Household lockdown and physical distancing: keep at-risk individuals in their homes as much as possible and, when people must interact personally, have them maintain a safe distance apart and wear masks. These procedures may be voluntary (motivated by personal fear of infection and/or social norms) or mandated by governments.
2. Industry lockdown. Close non-essential, contact-intensive businesses to prevent spread of the virus among workers and/or between workers and customers. These policies have been mandated by many governments but can also be voluntary as firms shut down operations because their labor force has been infected or their customers are avoiding contact-intensive venues.

The two policy strands are independent but complementary. Experience indicates that the economy cannot recover fully until the pandemic is brought under control—both the disease and the lockdown policies (mandatory and voluntary) cause economic disruption. In the early phase, roughly through June 2020, most countries pursued strong lockdown policies that were, to varying degrees,

effective in limiting the pandemic. However, the combination of disease and lockdown led to a catastrophic decline in demand and production of goods and services, in contact-intensive industries, especially services (e.g., restaurants, theatres, sporting events, hotels, travel). There were important indirect impacts to linked sectors (e.g., fall in auto production affects the steel industry). These indirect effects served to spread the shocks across the economy, leading GDP (gross domestic product) and employment to fall with unprecedented speed in many countries, with percent declines not seen since the 1930s.

As the pandemic was brought under a degree of control, economies adapted and countries loosened the lockdown restrictions, leading to significant but incomplete economic recovery. In many countries (e.g., the US and Europe), the loosening was premature, and a second wave was apparent by the winter of 2020, requiring a new round of lockdown policies—again, of varying degrees—and a slowing or reversal of the recovery.

Countries also pursued policies to mitigate the economic impact of the pandemic and lockdowns on vulnerable groups. These included: (1) unemployment insurance, income transfers, and other programs to provide a safety net for the unemployed and poor households; and (2) support for industries to assist firms and, where possible, keep workers employed. These programs varied widely across countries and had mixed, generally significant, success in maintaining incomes of the poor and supporting suffering firms. They also significantly supported aggregate household demand, stimulating the macro economy, and helping the recovery in employment. The feedbacks between the micro shocks, support policies, and the macro economy were important.

With the advent of effective vaccines, the goal is, again, to limit the pandemic and provide economic support for those affected until widespread vaccination finally brings the pandemic to an end and policies are implemented to achieve economic recovery.

This paper provides a simulation modelling approach that incorporates sectoral detail needed to capture the nature of the initial shocks to contact-intensive sectors from the household and industry lockdowns and to trace the indirect impacts to the rest of the economy. The goal is to understand how the

initial shocks propagate across the economy, with empirical measures of the direct and indirect sectoral impacts, and to measure the impacts on macro aggregates such as GDP and total employment. These linkages involved macro “de-stimulation” as the pandemic/lockdowns took affect and stimulation as support programs were implemented. The modelling methodology combines detailed multisectoral input-output data with national income and product accounts in the framework of a Social Accounting Matrix (SAM), and so includes both micro and macro data. The SAM provides the data needed for structural multisector simulation models of the impacts.

There are a variety of SAM-based models that have been employed to analyze the impact of the Covid-19 pandemic. We develop a structural SAM-based multiplier model that incorporates the direct and indirect links characterizing the impacts of the pandemic and lockdown policies and apply the model to four countries: South Africa, Mexico, United Kingdom, and United States. We trace the evolution of the shocks over four months in 2020 (March, April, May, and June) that follow the progression of the first wave of the pandemic and lockdown policies. We use the model to compare how the shocks affected the different countries and also explore the macro stimulation effects of their economic support programs.

One goal is to demonstrate that a structural SAM-based multiplier model can realistically simulate the Covid-19 impacts, support scenario analysis, and provide a useful framework for analysis of the relative size of direct and indirect effects and of alternative policy regimes. The same model can be used to consider second-wave shocks, while other SAM-based model methodologies are needed for analysis of longer-run recovery scenarios.

2. METHODOLOGY: MODELLING A BOTTOM-UP RECESSION

A normal, top-down recession starts at the macro level in the asset markets: for example, credit crises, foreign exchange crises, and/or collapse of toxic financial instruments or asset bubbles). Macro models of top-down recessions focus on economic aggregates and the operation of asset and financial markets, with links to the real side through changes in expectations and behavior of economic actors (investors, firms, workers, households, government). In such a recession, the result is a decline in aggregate demand that hits commodity and factor markets, with declines in aggregate production and employment. Starting in asset markets, recessions take some time to hit the real economy. The policy goal is to fix the problems in the asset markets, restore confidence, and gradually increase aggregate demand, supply, and employment.

In contrast, the pandemic and lockdowns hit the economies hard and fast, akin to a natural disaster such as a hurricane or flood. The difference is that a natural disaster damages infrastructure, while the pandemic/lockdowns caused the economies to shut down temporarily. What occurred was a “bottom-up” recession emanating from the immediate collapse in demand and shutdown of important parts of the economy, with ripple effects that spread more widely. Unlike a hurricane that hits a small, geographically limited, part of the economy, the pandemic/lockdowns hit enough economic activity to have feedbacks at the macro level. The result was that aggregate demand fell enough to generate elements of a standard macro shock in addition to the micro shocks. The policy goal was to mitigate the impact on workers, households, and firms while maintaining the affected industries in stasis, minimizing the damage, until the pandemic could be brought under control. The mitigation policies help offset the macro shock by supporting aggregate demand—without the support policies, the recession would have been much worse.

The lockdown shocks occurred rapidly in weeks or months, not gradually over a year or more. In such a short period, adjustments through smooth changes in wages, prices and production methods were not possible and available evidence showed little or no changes in relative prices or wages in commodity or factor markets. The initial adjustment was through changes in quantities: demand and supply of

affected industries and employment, with the initial impact on contact-intensive services spreading along backward-linked supply chains for inputs.

Macroeconomic models

Macro models of standard top-down recessions work with economic aggregates and focus on the operation of asset and financial markets and an aggregated representation of major economic actors: households, investors, producers, factors of production (labor and capital), and government. Such models are not well suited to consider a bottom-up recession that starts with changes in households and industry behavior at a very disaggregated level where the pandemic affects behavior in special ways (e.g., collapse in supply of and demand for contact-intensive and/or “non-essential” activities).

Macro models have been widely used to analyze the pandemic/lockdown shocks.¹ Since they cannot directly incorporate the drivers of the micro shocks, they focus on the implications for macro aggregates and supplement the traditional models with detailed descriptive analysis of affected industries and disaggregated employment/household impacts. This approach is workable and useful for policy analysis but misses a lot of the action. The pandemic/lockdown shocks spread across the economy through indirect inter-industry linkages (supply chains) that are missed in industry studies that consider only direct effects. The macro feedback effects are sensitive to the distributional impacts of the shocks on different types of firms, labor, and households that are not incorporated in macro models, and are hard to capture in descriptive analysis.

Multisector SAM-based models

To consider how shocks at the disaggregated sectoral level are transmitted across the economy requires a multisector approach that captures the complexity of an inter-connected economy. Historically, empirical work focused on inter-industry linkages as measured by input-output tables.² An extension of that work

¹ See, for example, Maliszewska et al. (2020) and McKibbin and Fernando (2020). The OECD and commercial firms such as Moody’s Analytics provide such model-based projections. There are formal efforts to adapt macro models for analysis of Covid-19 shocks. See, for example, stylized extensions of new Keynesian models by Baqaee and Farhi (2020) and Bilbiie and Melitz (2020).

² An excellent textbook treatment of input-output analysis is Miller and Blair (2009).

is based on a Social Accounting Matrix (SAM) that expands the input-output table to include more linked economic actors than just industries.³ A SAM shows the full circular flow of income in the economy, including the generation of income in production value chains (value added), how that income is distributed to households and government, which in turn buy the goods and services produced in the economy.

A SAM is a square matrix where each entry represents a payment by a column account to a row account. Each account provides expenditure/receipt data for an economic “actor” and the table reflects double-entry bookkeeping. The table is square and the column and row sums for each account must balance. For a national SAM, the table provides a complete and potentially highly disaggregated picture of the domestic economy that includes all economic transactions and integrates sectoral (input-output) data with the national income and product accounts in a consistent framework.

Figure 2.1 provides a simplified example of a “standard” SAM. The first three accounts (industries, commodities, value added) provide disaggregated data for goods and services. “Industries” produce goods and services, buy intermediate inputs (“use” matrix), pay factors of production (value added or factor cost) and pay indirect taxes. Industries represent the “productive” side of the economy, generating Gross Domestic Product (GDP) at factor cost. The “commodity” accounts purchase all sectoral production net of intermediate demand (supply/make matrix) and also purchase all imports. This account represents the total supply of goods and services. The “supply/make” matrix allows the possibility of industries producing more than one commodity and commodities being produced by more than one industry. Total supply available for use in the domestic economy nets out exports.

In Figure 2.1, the link between the SAM and the national accounts is clear from accounting identities (row sums equal column sums):

$$\text{GDP}(\text{factor cost}) + \text{indirect taxes/tariffs} = \text{GDP}(\text{market prices}) = C + I + G + E - M.$$

$$\text{GDP} + M - E = \text{aggregate supply} = \text{aggregate demand} = C + I + G.$$

³ See Miller and Blair (2009), chapter 11, “Social Accounting Matrices”.

Figure 2.1–A Stylized Social Accounting Matrix (SAM).

		Input-output accounts			Macro accounts			
		Industries	Commodities	Value added	Households	Investment	Government	World
I-O accounts	Industries		supply/make matrix					
	Commodities	use matrix (i-o matrix)			consume C	invest I	govt G	exports E
	Value added	factor cost						
Macro accounts	Households			household income	transfers		transfers	remittances
	Savings				private saving		govt saving	foreign saving
	Government	indirect taxes	indirect taxes/tariffs		direct taxes			
	World		imports M		remittances			

SAMs and models based on SAMs provide an appropriate empirical framework for analyzing a bottom-up recession driven by pandemic/lockdown shocks that start in the industry and household segments of the economy. They have been widely used to analyze the impact of natural disasters, which (as noted above) are comparable to pandemic/lockdown shocks.⁴

SAM-based models are economywide, multi-market, general equilibrium models. They solve for supply/demand balance in all commodity markets in an economy. These models fall into two broad classes: (1) nonlinear computable general equilibrium (CGE) models, and (2) linear SAM-multiplier models. The two types differ in the specification of production technology and behavior of agents (households, firms, factors of production) and the mechanisms they include to “clear” markets (endogenous prices and wages versus fixed-price, quantity adjustments). Both types have been used to analyze pandemic/lockdown shocks and the impacts of natural disasters.

Computable General Equilibrium (CGE) Models

CGE models simulate the behavior of profit-maximizing producers and utility-maximizing consumers interacting across commodity and factor markets. Production technology and household demand are specified using nonlinear functions and the model solves for equilibrium commodity and factor prices that

⁴ For an entry into this extensive literature, see Rose (2009).

equate supply and demand in all markets.⁵ CGE models focus on market mechanisms that work through changes in prices and wages operating smoothly in commodity and factor markets. While CGE models are very useful for considering shocks that work through market mechanisms, that is not what drove, and is driving, adjustment to rapid lockdown shocks that characterize the policy response to the COVID-19 pandemic. There are many examples of CGE models used to evaluate the impact of disasters where there is time for markets to adjust through both price and quantity changes, including discussion of “resilience” to shocks where the capacity for market adjustment is an important consideration.⁶ There are also examples of CGE studies of the impact of Covid-19 lockdown shocks where the models have been adapted to limit the operation of wage/price adjustments, imposing market adjustment through changes in quantities.⁷ Such adaptation is difficult since CGE models focus on market optimization behavior by producers and consumers and imposing quantity adjustments forces producers to operate off their supply curves, consumers are off their demand curves, and wages do not adjust to clear labor markets. While feasible and necessary for using the models to explore lockdown impacts, the imposition of ad hoc adjustment mechanisms on optimizing agents to make the models provide realistic results is difficult. Essentially agents are constrained to operate in a quantity-adjustment mode that can be achieved by simpler fixed-price multiplier models, which are discussed next.

As the pandemic is brought under control, economies recover, and normal market mechanisms come into play, CGE models will be useful to consider how post-crisis economies and markets will operate. CGE models will play an important role in the analysis of structural adjustment and change in the “new normal” environment that countries will face moving forward.

⁵ For an introduction to CGE models, see Burfisher (2016).

⁶ See, for example, Dixon et al. (2010), Rose and Wei (2013), Rose et al. (2009).

⁷ See, for example, Walmsley, Rose, and Wei (2020); Keogh-Brown et al. (2020); Kinda, Zidouemba, and Ouedraogo (2020). Swinnen and McDermott (2020) provides summaries of extensive COVID-19 SAM modelling work by the International Food Policy Research Institute (IFPRI), including country and global CGE models and SAM-multiplier country models.

SAM-Multiplier Models

Input-output and SAM-Multiplier models start from the SAM shown in Figure 2.1. They create a matrix of coefficients by dividing all column entries by column sums. These coefficients are assumed to be constant and define production technology (input-output and value-added coefficients), fixed-share demand systems for final demand (consumption, government, investment, and exports), and fixed savings rates by income recipients. Prices are also assumed to be fixed, so any adjustments to shocks occur through changes in quantities demanded and supplied rather than through changes in prices in commodity and factor markets.

These assumptions, while strong, are reasonable for analyzing the short-run impact of pandemic/lockdown shocks.⁸ The shocks were so rapid and extreme that adjustment could not involve changes in production technology or relative prices and wages. While there was some evidence of profiteering price increases, they did not act as incentives to stimulate production but rather as short run rent seeking and rationing devices. While affected service sectors did adapt (e.g., restaurants moving from in-house service to takeout), the quantity shocks from the lockdowns were dramatic. In this case, the use of a SAM-multiplier model that directly incorporates these assumptions is preferable to using a CGE model that requires extensive adaptation to capture them.⁹ The longer that the pandemic persists, and economies adjust, the more relevant will be CGE models.

Given fixed-coefficient technology and demand, the SAM-multiplier is a linear model where the drivers are changes in demand that drive changes in supply. SAM-multiplier models start by partitioning the SAM coefficients matrix into endogenous and exogenous accounts, where all final demand accounts (C, I, G, and E) are treated as exogenous. The partitioned SAM coefficients matrix has four submatrices:

$$A = \begin{bmatrix} A11 & A12 \\ A21 & A22 \end{bmatrix}$$

⁸ Guerrieri, et al. (2020) develop a theory of a Keynesian supply shock in a simple two-sector model that has a multiplied negative effect on aggregate demand. The model has much in common with a SAM-multiplier model.

⁹ A few examples of SAM-multiplier models of pandemic/lockdown shocks include Zhang et al. (2020), Arndt et al. (2020a, 2020b), Hinojosa-Ojeda et al. (2020), and Solis and Hernandez (2020).

A11 is a square matrix of demand for endogenous accounts by endogenous accounts, A12 is demand for endogenous accounts by exogenous accounts, A21 is demand for exogenous accounts by endogenous accounts, and A22 is demand for exogenous accounts by exogenous accounts.

Define the vector y of SAM account totals. Partitioning it into endogenous and exogenous components, for any balanced SAM an identity holds:

$$\begin{bmatrix} y1 \\ y2 \end{bmatrix} = \begin{bmatrix} A11 & A12 \\ A21 & A22 \end{bmatrix} \begin{bmatrix} y1 \\ y2 \end{bmatrix}$$

Expanding the first row:

$$y1 = A11 \cdot y1 + A12 \cdot y2$$

Solving for endogenous account values as a function of exogenous account values (where I is the identity matrix):

$$y1 = [I - A11]^{-1} A12 \cdot y2$$

The SAM-multiplier model works by changing the matrix of values or exogenous accounts (e.g., due to the pandemic/lockdown), $A12 \cdot y2$, and solving for new totals f for the endogenous accounts, $y1$. Solution values for payments of endogenous accounts to exogenous accounts are given by $A21 \cdot y1$. The inverse of the matrix of endogenous account coefficients captures indirect effects due to intermediate input demand (forward and backward linkages).

For analysis of pandemic/lockdown impacts, all components of final demand are treated as exogenous. There are three different kinds of shocks that are included in the model:

1. Changes in demand due to household lockdown.
2. Changes in supply due to industry lockdown.
3. Changes in demand due to induced macro shocks.

The first of these, household lockdown shocks, are modelled as changes in household demand for affected commodities. The third, macro shocks, are modelled as changes in commodity demands for consumption, investment, government, and exports. The mix of among the broad categories are determined using projections from macro economists.

Changes in supply due to industry lockdown are more complicated. In principle, a supply shock needs to be modelled differently, with changes in demand responding to the shock to supply rather than vice versa. There is a literature on imposing supply shocks in linear multiplier models and they have been used in modelling the impacts of disasters.¹⁰ The distinction is potentially important. In shocking final demand, the model considers only the impact of backward linkages along intermediate input supply chains, with related indirect effects (e.g., a cut in demand for restaurant meals affects the supply chain of food produced for restaurants). A supply shock considers forward linkages along supply chains. For example, closing down the steel industry damages all down-stream industries that use steel.

In the case of industry lockdowns due to the pandemic, the shocks hit sectors that largely produce for final demand, with little or no forward linkages. In this case, it is feasible to model the supply shock by cutting all sources of final demand uniformly, which leads to an endogenous supply shock value that matches the industry lockdown. The indirect effects are all due to backward linkages from the shocked industries.¹¹

At the industry level, we computed all three shocks and then imposed the largest of them in the model. In many cases, the household and industry lockdowns were similar—it does not matter whether a customer does not go to a restaurant because of fear or because it is closed.

SAM-multiplier models can also be used to estimate the macro stimulus impacts of policies to support affected household. In this case, households are classified as endogenous accounts in the SAM. The exogenous shock is a direct transfer of funds from the government to households. The model essentially calculates the Keynesian multiplier from the injection, capturing indirect effects of increased expenditures by households. Households increase their demand for commodities, generating a supply response by industries, which increases employment, increases household income and, finally, yields a further increase in demand. The underlying assumption is that there is excess capacity (e.g., significant

¹⁰ See Miller and Blair (2009), Chapter 12 on supply-side models.

¹¹ Rose and Wei (2013) use a combined demand-driven and supply-driven multiplier model to analyze the impact of a port shutdown. In their case, for a sector essentially producing only an intermediate input, they found that the indirect downstream supply impacts yielded about the same losses as the indirect upstream input demand effects.

unemployment) in the economy so that changes in aggregate demand will induce changes in supply/production. Given that the support program was targeted toward poor households with unemployed workers, a SAM-multiplier model that includes appropriate disaggregation by household types will provide a structural Keynesian multiplier analysis with a better estimate of the indirect impacts than would be provided by an aggregated macro model.¹²

The Keynesian household income multiplier model includes only the feedback from increases in household income to increased demand for commodities for consumption. In this model, household savings is a “leakage” that reduces the multiplier impact—the text-book Keynesian multiplier is one divided by the marginal propensity to save. Other leakages include direct taxes, remittances abroad, and purchases of imports. A savings-investment link can be specified where the increased household savings are assumed to increase aggregate investment. In the SAM-multiplier model, this savings-investment link is implemented by treating the savings/investment account as endogenous, so increased savings will increase aggregate demand through increased investment, increasing the multiplier impact. The underlying behavioral assumption is that the financial system succeeds in channelling the increased savings by households to increased demand for capital goods by industries. In the case of the pandemic/lockdown shocks, this link seems unrealistic—the evidence is that aggregate investment fell as firms postponed investment projects. As the economies recover and consumer/investor confidence improves, increased savings generated by further income support to households might yield increases in investment, although the assumed linear savings rates in the SAM may be unrealistic.

¹² See Ramey (2016) for an extensive survey of macro multipliers in theory and practice. She discusses the notion of “primitive” shocks as “primitive exogenous forces that are uncorrelated with each other” (pp 74-75), which certainly applies to pandemic/lockdown income support policies.

3. EMPIRICAL ANALYSIS OF THE PANDEMIC/LOCKDOWN SHOCKS

The SAM-multiplier model is used to analyze the impact of the first wave of pandemic/lockdown shocks in four countries: South Africa, Mexico, United Kingdom, and the United States.¹³ Table 3.1 provides descriptive macro data for the four countries. There are two “upper-middle-income economies” (World Bank classification based on per capita gross national income), South Africa and Mexico, and two high-income countries, the United Kingdom (UK) and the United States (US). The economies range in economic size (total GDP) from \$351 billion (South Africa) to \$21 trillion (US) and vary widely in total population. In terms of aggregate demand structure, aggregate consumption and investment shares are roughly similar, while shares of government demand and international trade (exports and imports) vary widely. The US is much more “closed”, with trade shares less than half those of the other countries.

Table 3.1—Macro Data, 2019.

Country	GDP	Population	GDP	C	I	G	E	M
	\$ Billions	Millions	\$ Per Capita	Ratio to GDP (%)				
South Africa	351.4	58.6	6,001	60.2	17.6	21.3	29.9	29.4
Mexico	1,258.3	127.6	9,863	65.4	21.4	11.6	39.1	39.1
United Kingdom	2,827.1	66.8	42,300	64.9	17.4	18.9	31.5	32.7
United States	21,374.4	328.2	65,118	68.2	20.2	14.1	11.7	14.7

Notes: C = Consumption, I = Investment, G = Government, E = Exports, M = Imports

Source: World Bank, World Development Indicators, 2019

The choice of these countries for comparative analysis is based on the availability of comparable data for both the underlying SAMs and monthly information about the evolution of the pandemic/lockdown policies and their effects in the first wave, March to June 2020. The availability of monthly data supported estimation and calibration of the SAM-multiplier models and their use for scenario analysis.¹⁴

¹³ The model was implemented using the GAMS (General Algebraic Modeling System) computer program. The code is available on request.

¹⁴ The model has been applied to other countries (e.g., China and Cote d’Ivoire) for “before-after” comparative static analysis of the impacts of the pandemic/lockdowns. See Zhang et al. (2020) and Go et al. (2020). Data were not available for these countries to support monthly analysis.

Table 3.2 presents characteristics of the SAM data base available for the four countries. The SAMs are highly disaggregated, with over 100 sectors and detail in services that were directly affected by the pandemic/lockdowns. They provided a good basis for specifying highly differentiated lockdown shocks and then tracking the indirect linkage effects back through their supply chains. For example, in the US model we were able to distinguish between the impact on hospital services, which expanded, and other medical services such as dentists and small physician practices, which were closed in the initial phase of the lockdowns. An advantage of linear multiplier models is that they can easily be scaled up to incorporate such sectoral detail when data are available.¹⁵

Table 3.2–SAM Data for Four Countries.

SAM	United States	United Kingdom	Mexico	South Africa
Year	2016, updated to 2019	20xx updated to 2019	2016 updated to 2019	2015 updated to 2019
Number of Industries	184	105	126	62
Number of Commodities	185	105	126	104
Number of factors of production	Capital: 1 Labor: 7	Capital: 1 Labor: 3	Capital: 1 Labor: 6	Capital: 1 Labor: 4
Number of household categories	9: income classes	10: deciles	18: gender and education	14: deciles and disaggregation of the top decile
Number of trade partners	1	3	7	1

The SAMs have enough detail in the labor markets to distinguish skill differences by sectors that were directly shocked by the lockdowns. The definitions differed across countries so that the comparisons presented below are illustrative, not precise.¹⁶ The SAMs also disaggregate households. Again, the definitions are not comparable across the four countries, but it is feasible to distinguish poor households which bore the brunt of the pandemic/lockdown shocks in each country. The data do support comparison

¹⁵ While it is feasible to scale up CGE models, it is more difficult, proliferating parameters that need to be estimated.

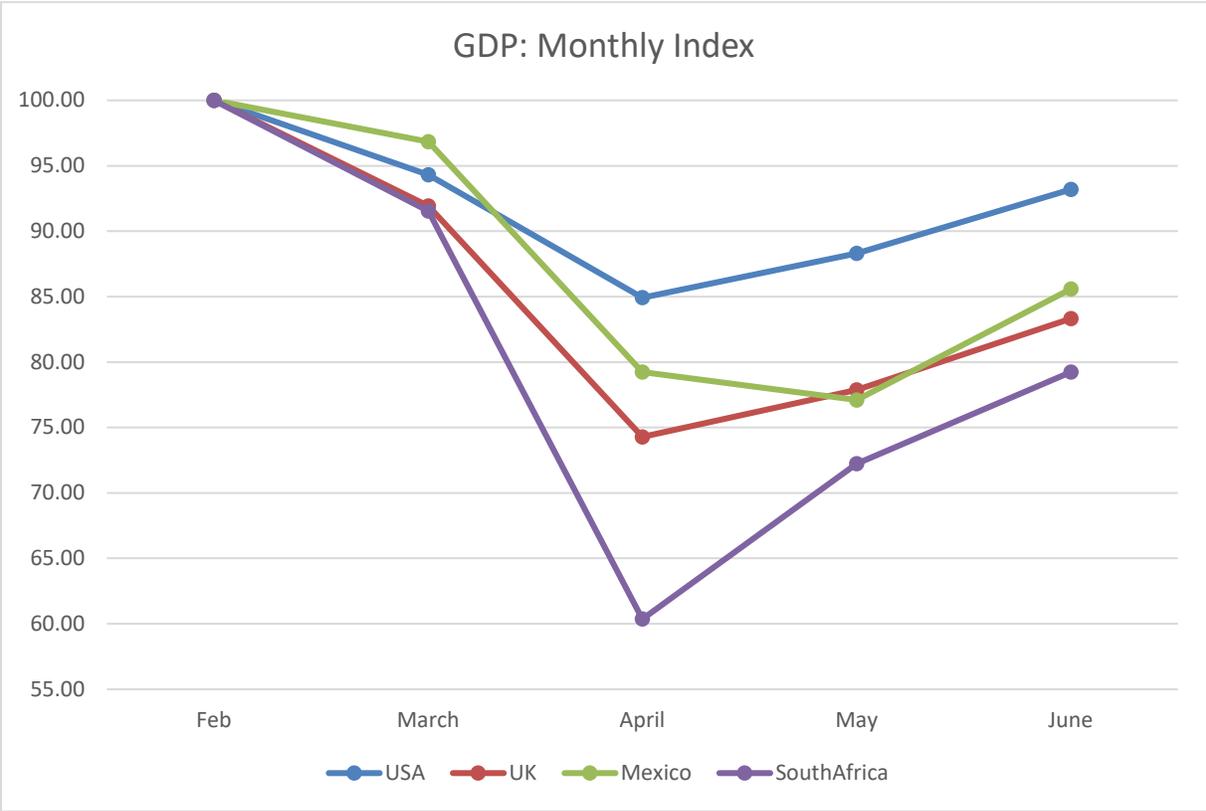
¹⁶ Country studies exploited the labor categorization relevant for each country. See Arndt et al. (2020a and b), Hinojosa-Ojeda et al. (2020), and Solis and Hernández (2020) for more detailed analysis of particular countries. The detailed Mexican SAM is described in INEGI (2020). The UK data set comes from the UK Office for National Statistics and the coefficients of the input-output matrix from input-output tables developed at the OECD.

across countries of the stimulus multiplier impact of income support policies targeted for these households.

Monthly Macro, Employment and Sectoral Results

Figure 3.1 provides model projections for changes in GDP from base values by month for the four countries. The impact on the UK started early and hit hard in March. The other three had lower initial impacts. April was the worst month for all but Mexico, whose economy continued to decline in May. South Africa had the most dramatic hit and had a V-shaped recovery in May, slowing after that. The other countries had slower recoveries.

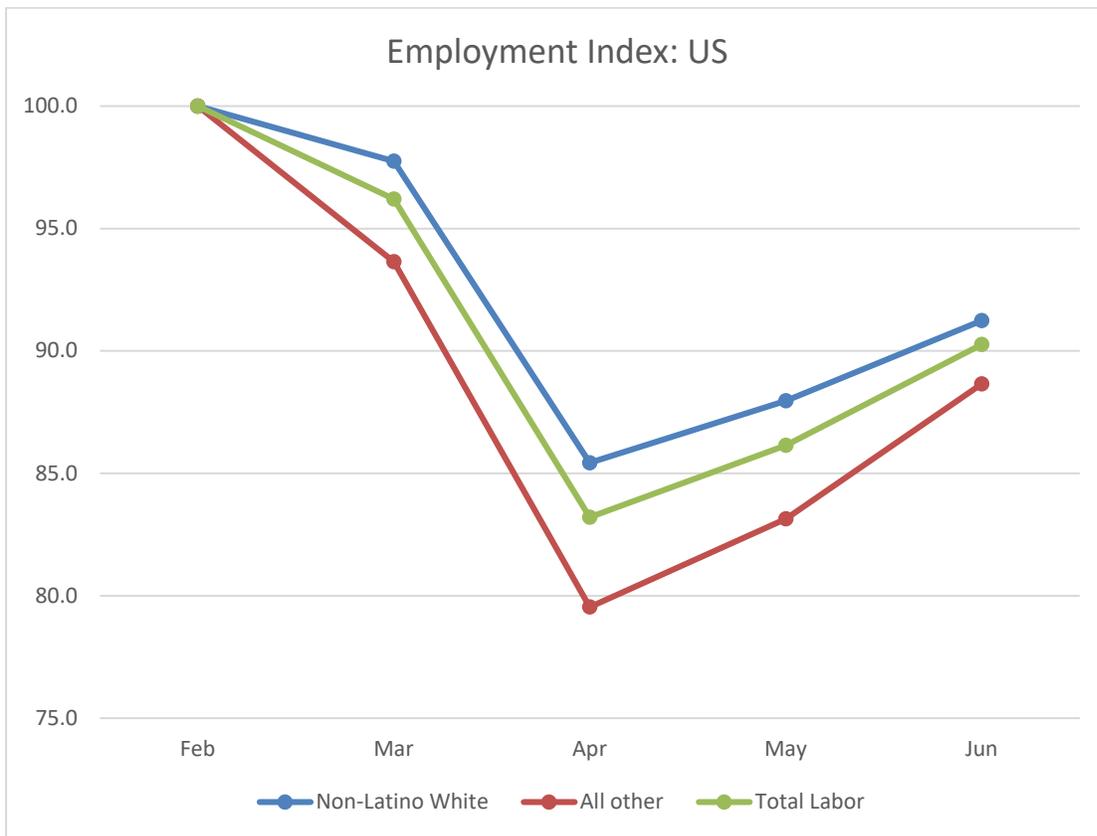
Figure 3.1—GDP Projections by Month, Four Countries.



Notes: Monthly GDP Index, February = 100.

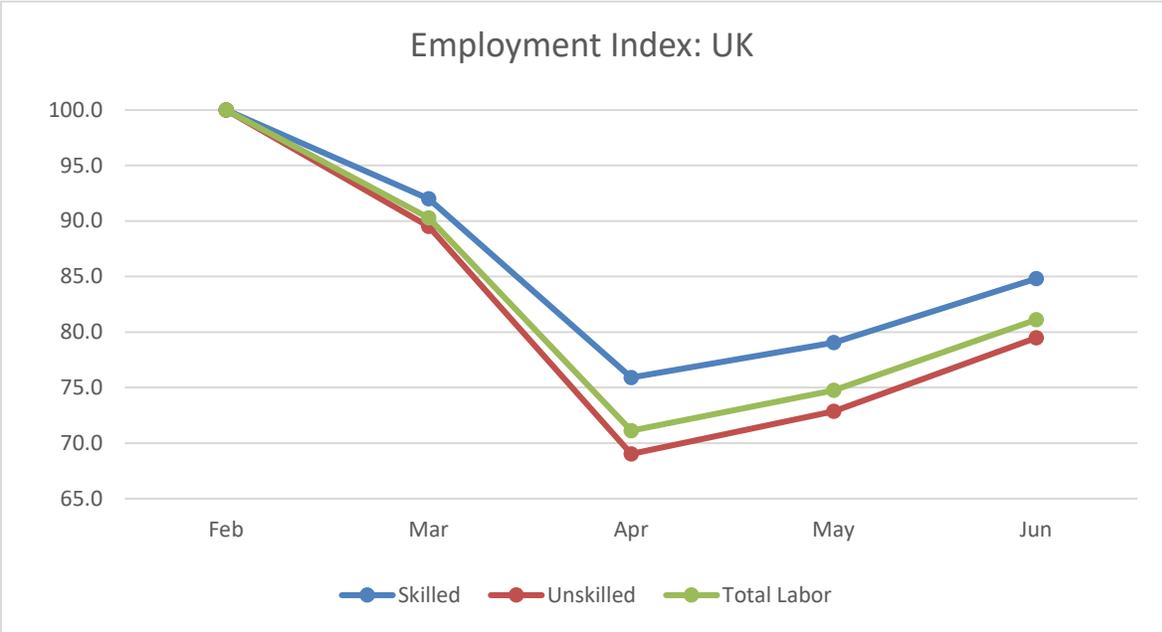
The employment shocks (changes in employment from base values) are shown in Figures 3.2 (A-D). The base values include any existing unemployment in the base data (i.e., February). The aggregate employment shocks are larger than the GDP shocks in all the countries, reflecting the fact that the pandemic/lockdowns had the strongest impact on labor-intensive sectors. Low-skilled, low-education labor that are concentrated in the contact-intensive service sectors were hit the hardest in all four countries, with large gaps between them and other labor.

Figure 3.2A—Employment Impacts, US.



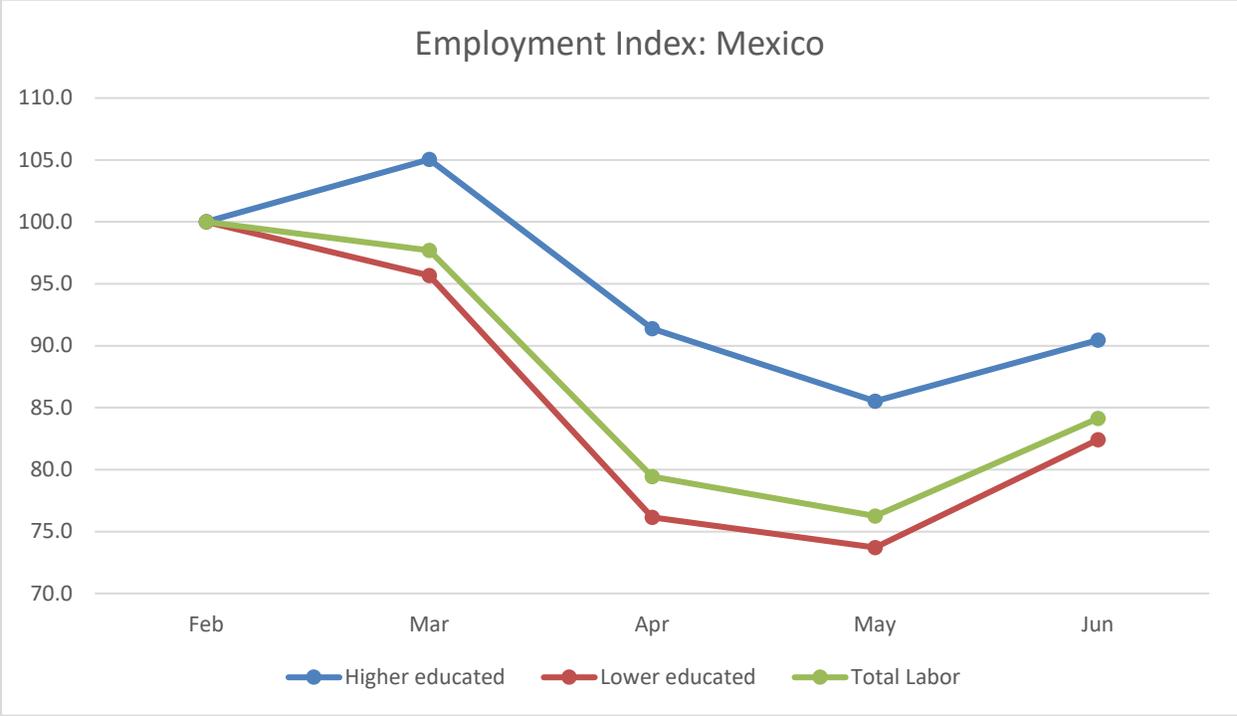
Notes: Employment index, Feb = 100.

Figure 3.2B—Employment Impacts, UK.



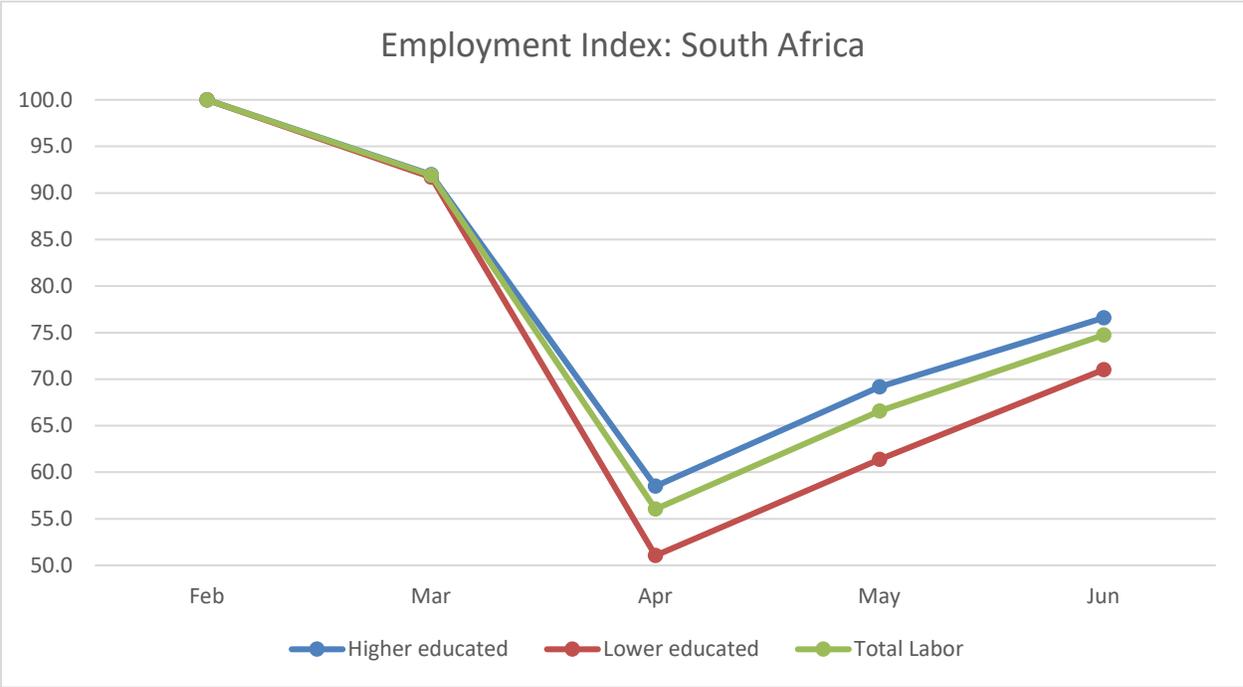
Notes: Employment index, Feb = 100.

Figure 3.2C—Employment Impacts, Mexico



Notes: Employment index, Feb = 100.

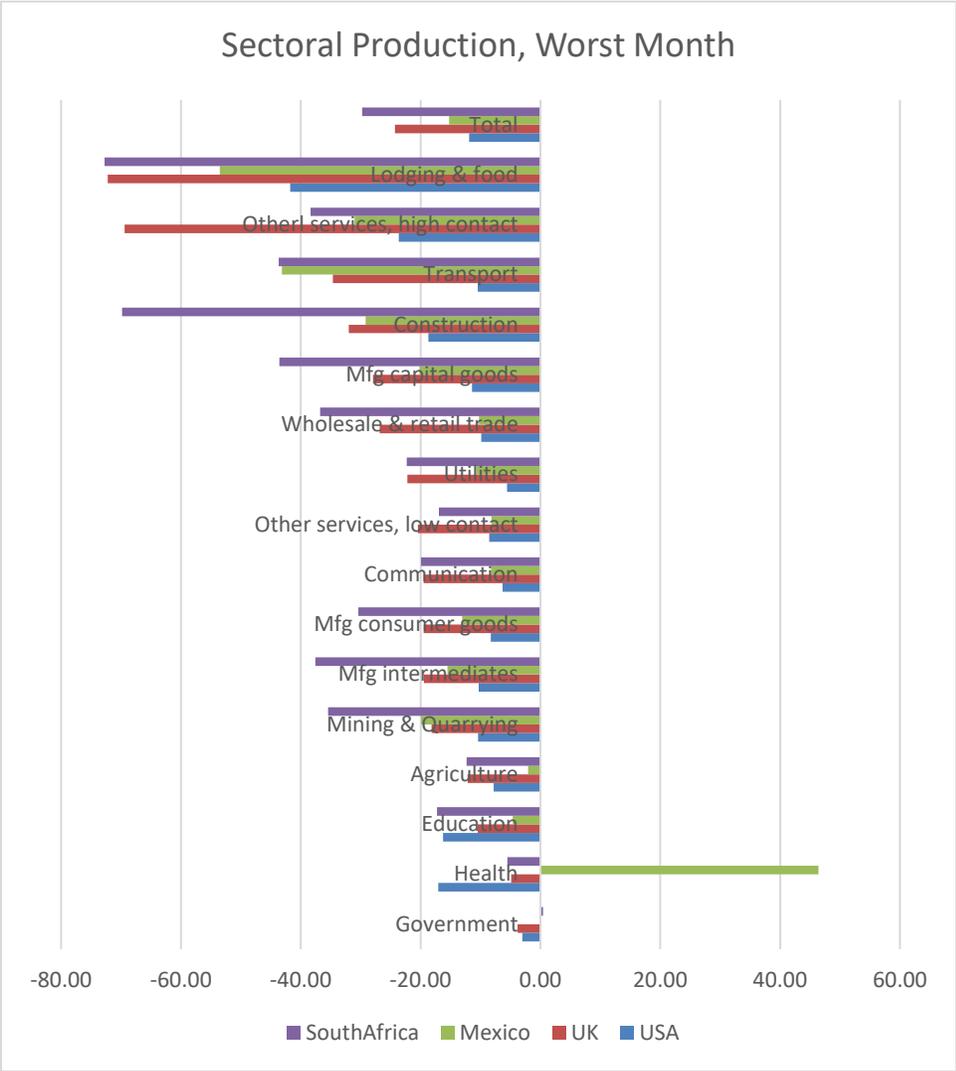
Figure 3.2D—Employment Impacts, South Africa.



Notes: Employment index, Feb = 100.

While the four models differ in level of aggregation (Table 3.2), the results can be aggregated to a common set of aggregate sectors. Figure 3.3 shows the impact of the pandemic/lockdowns on gross output for 16 comparable sectors, ranked by the size of the sectoral shocks in the UK. The same sectors were hit hard in all four countries: lodging & food, other high-contact services, transport, and construction. Construction was damaged because investor uncertainty caused postponement or cancellation of investment projects. The backward linkages from the affected services through supply chains spread the damage across other sectors. In addition, the induced standard recession led to broad cuts in consumption and exports, which varied across countries, affecting manufacturing sectors. The only example of a positive impact was demand for medical/health services in Mexico, which expanded. The US showed a significant cut in demand for health services, which reflected the impact of the lockdown on small medical practices (doctors and dentists) and the postponement of many discretionary medical procedures.

Figure 3.3—Changes in Sectoral Gross Production, Worst Month.



Notes: Percent changes in sectoral gross production for the worst month (April in US, UK, and South Africa; May in Mexico).

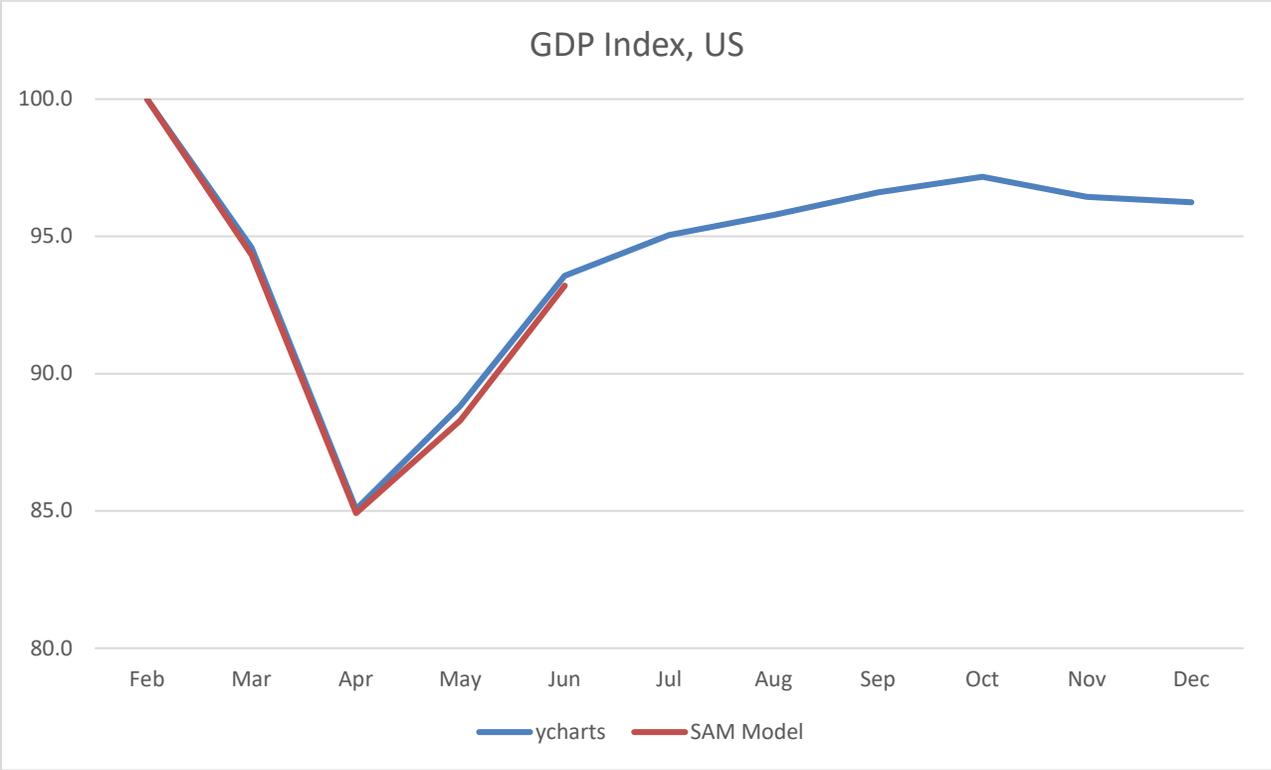
While the model projections run through June, data on some macro aggregates are available for all of 2020. These data provide a comparison of model results with actual data and show how the pandemic/lockdown effects continued through the year.

Model Projections and historical data

Three countries have monthly data for 2020 that we can compare with the model projections: US, UK, and Mexico. For the US, monthly real GDP data for 2020 are available from “Mycharts” that disaggregate

BEA (Bureau of Economic Analysis) quarterly data.¹⁷ Their monthly estimates for the year are shown in Figure 3.4 along with the model projections for March-June. The simulated values for monthly GDP are very close to the data for March-June. The model projects a slightly larger GDP shock than the data for all months—the largest deviation is half a percentage point in May. For the period July-December, the data indicate a dramatic slowing of the recovery, with GDP declining slightly in November and December.

Figure 3.4—US, Actual and Projected GDP Index.



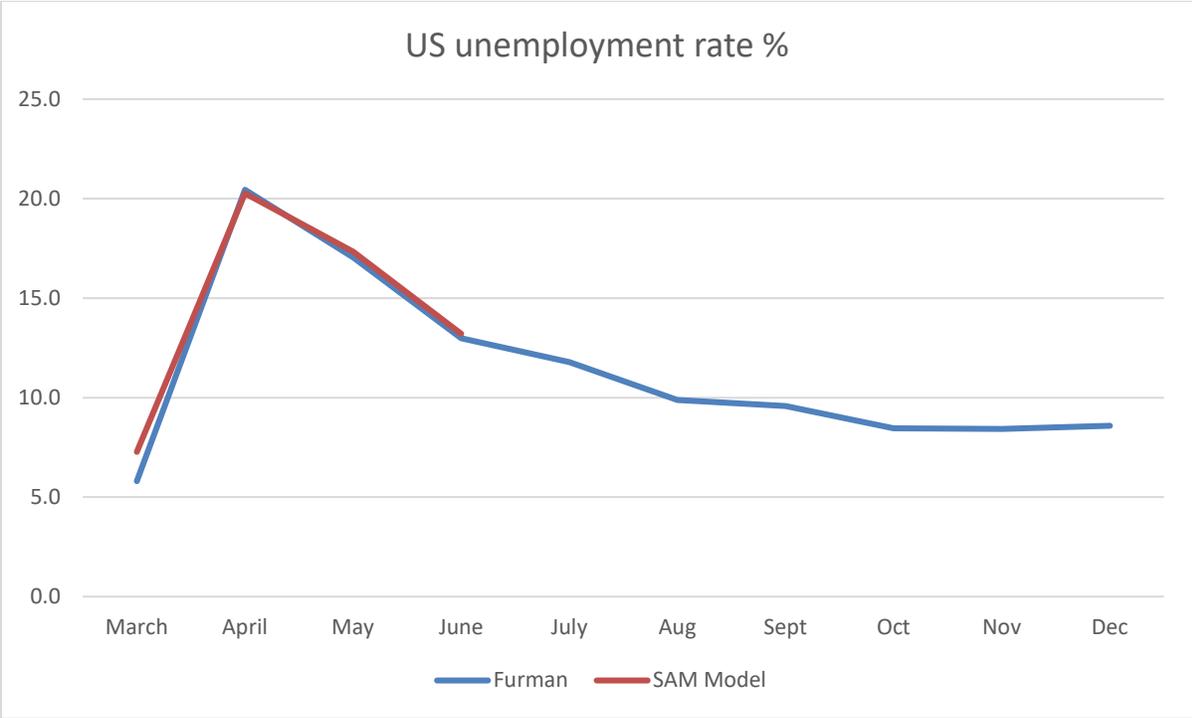
Notes: “ycharts”: monthly GDP data from https://ycharts.com/indicators/us_monthly_real_gdp. “SAM Model”: results from the SAM-multiplier model for March to June.

Furman and Powell (2021) provide monthly data on unemployment for all of 2020. They adjusted the official unemployment data to reflect what they argue is a “realistic” unemployment rate, given the changed nature of the pandemic/lockdowns labor market. Their results are shown in Figure 3.5, which

¹⁷ The data are available on the web: https://ycharts.com/indicators/us_monthly_real_gdp. The value for December is an estimated extrapolation.

also includes the SAM model projections for March-June. To be comparable with Furman and Powell, the unemployment rate for February (3.5%) is added to the SAM model monthly projections. The fit between the model projections and their data is very close for the March-June period. They then show a slowing in the recovery in the latter half of the year, with unemployment flattening out in the last quarter (October-December) to 8.5-8.6 percent. They argue that the recovery stalled at the end of 2020, which is also consistent with the GDP data, and that, with a second-wave resurgence in the pandemic, the economy will do worse in the first part of 2021.

Figure 3.5—US, Actual and Projected Unemployment Rates (%).

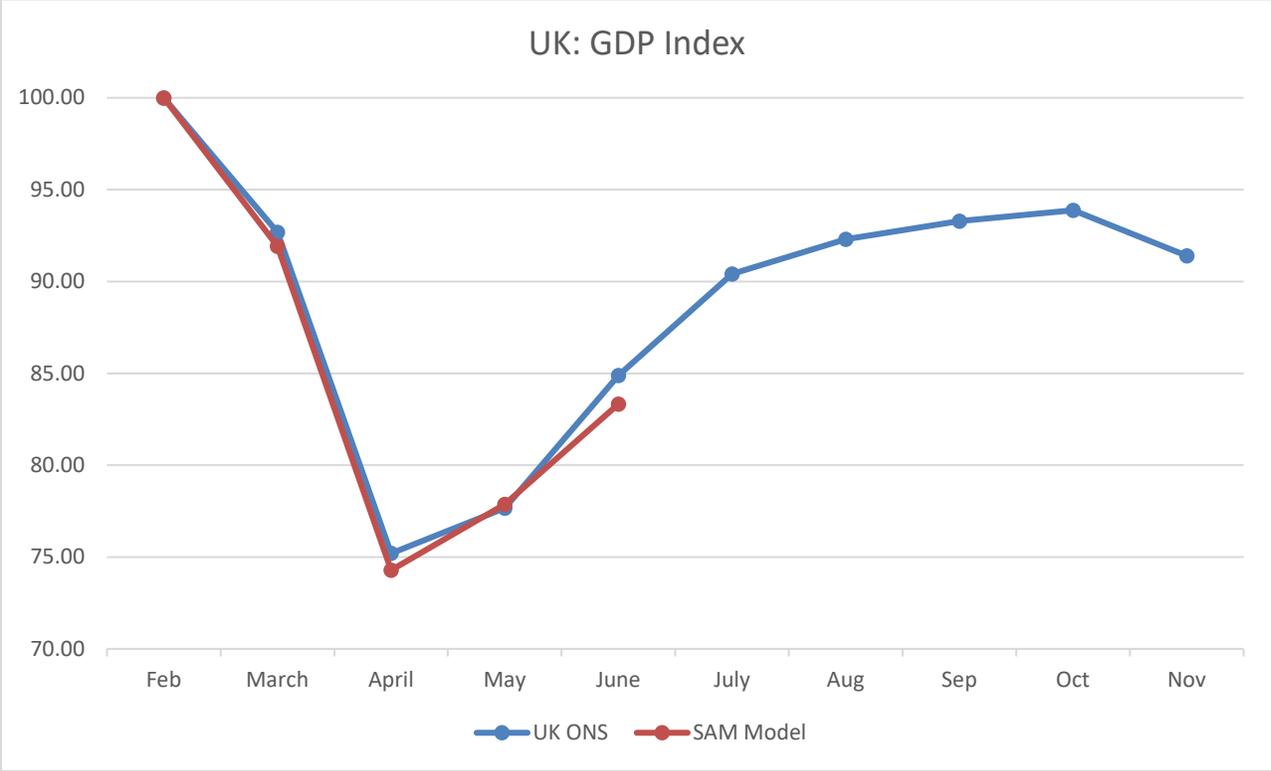


Notes: “Furman” are estimated unemployment rates by Furman and Powell (2021). “SAM Model” are projected unemployment rates from Figure 3A, adding an initial unemployment rate of 3.5%.

Monthly GDP data and model projections for the UK are shown in Figure 3.6. Monthly employment data are available for the UK, but they provide the data as a three-month moving average,

which is not comparable with the monthly model projections.¹⁸ The monthly GDP data fit very closely with the model projections through June.

Figure 3.6—UK, Actual and Projected GDP Index.



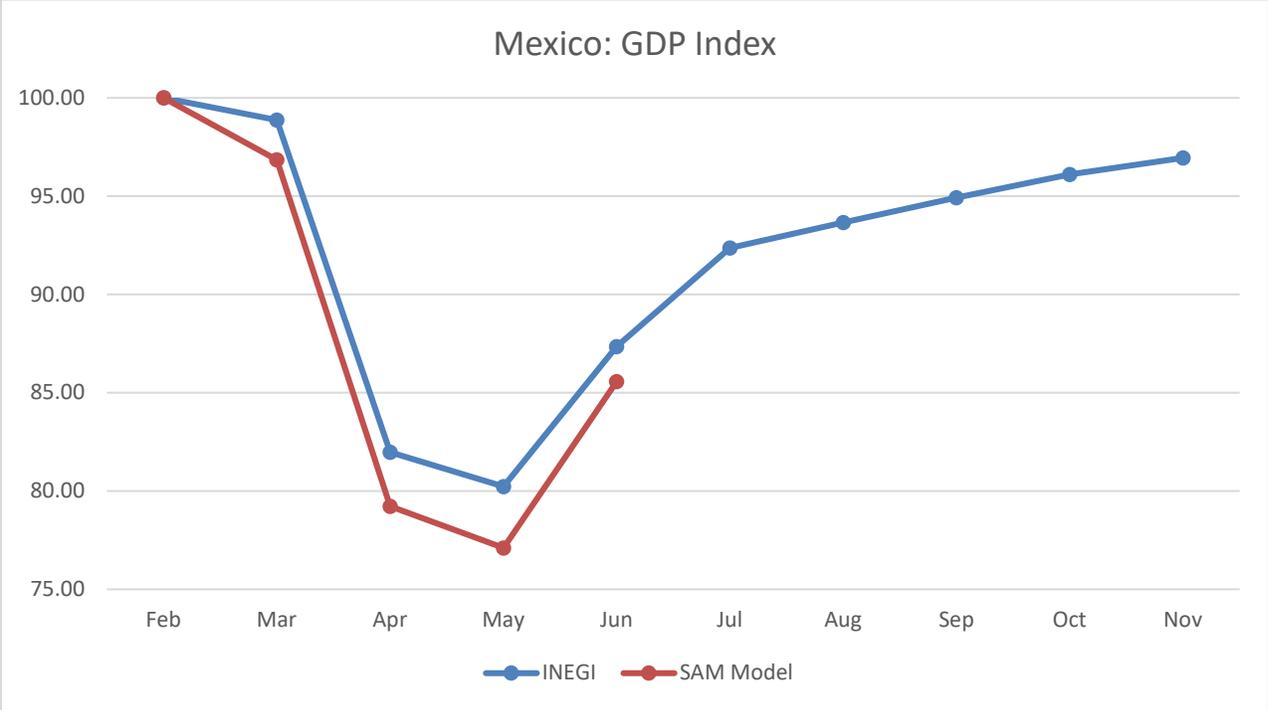
Notes: “UK ONS: monthly GDP data from the UK Office of National Statistics <https://www.ons.gov.uk/economy/grossdomesticproductgdp/bulletins/gdpmonthlyestimateuk/december2020> “SAM Model”: results from the SAM-multiplier model for March to June.

Monthly GDP data and model projections for Mexico are shown in Figure 3.7.¹⁹ The data are provided by the Mexican National Institute of Statistics and Geography, INEGI. Researchers at INEGI report that they had similar problems as the UK in generating monthly employment data, so we can only compare GDP projections. In the case of Mexico, the model consistently overestimates the GDP shock, largely because the model estimates a larger impact in March—the month-to-month shocks are close for

¹⁸ The UK Office of National Statistics describe difficulties they had in doing employment surveys due to the pandemic that made the data less accurate.
¹⁹ Although a monthly GDP index is not available for Mexico, INEGI publishes a monthly Global Economic Activity Index, which when aggregated has a perfect correlation with quarterly GDP.

April, May, and June. The overestimate for March is likely due to the fact that the shock hit hard late in the month, which the model captures, while the official March data provide an average across the entire month.

Figure 3.7—Mexico, Actual and Projected GDP Index.



Notes: “INEGI”: data from Mexican National Institute of Statistics and Geography, INEGI.
 “SAM Model”: results from the SAM-multiplier model for March to June.

Monthly GDP and employment data are not readily available for South Africa, as official statistics on these indicators are produced on a quarterly basis. Recent surveys of the impact of the pandemic, however, do provide useful indicators against which model predictions can be compared. Bassier, Budlender, and Zizzamia (2021) find that, compared with February 2020, active employment was 41 per cent lower in April 2020, during the strictest lockdown level, and 20 per cent lower in June 2020, as lockdown restrictions subsequently eased. Based on this study, the model moderately overestimates the employment shock by around 5 percentage points in both April and June. Sectoral

production data suggest that a number of model projections are overestimated particularly in April, as indicative data on household and export demand at the time suggested larger declines than had occurred.

Summarizing, projections of the economic impact of the pandemic/lockdowns provided by the SAM-multiplier models of these four countries agree closely with available data. The results indicate the validity of a detailed structural, multisectoral, model to capture the mechanisms at work in a bottom-up recession that originates in highly differentiated sectoral shocks. In addition, official macro data do not do a good job of measuring what is going on in these shocked economies, especially in the labor market. Even monthly averages miss some of the action, given the speed of the shocks. Presenting monthly data as a three-month moving average is uninformative. Methods of statistical seasonal adjustment are also likely to be affected by the size and speed of the shocks. The goal is to understand the immediate impact of the shock on economic activity and employment, how it evolves in the short run, and what the recovery looks like.

4. MACRO STIMULATION IMPACT OF INCOME SUPPORT PROGRAMS

In the model specification of the pandemic/lockdown shocks, we exogenously specified the impacts on aggregated demand. Since household expenditures were exogenous, with no income constraint, the monthly scenarios implicitly included the impact of income support programs that were implemented in the April-June period. If those programs had not kicked in, providing an economic stimulus that partly offset the income losses, the May-June recovery results would have been much worse. As discussed above, we can use the SAM-multiplier model to explore how the income support programs work through the economy. In effect, the SAM-multiplier model is a structural Keynesian model, incorporating linkages from household incomes through commodity markets, factor markets, and back to households in an economy that starts from a situation of significant unemployment.

We follow a two-step procedure to specify how the multiplier process works in shocked economies. First, we run the scenario simulations monthly through June, which implicitly include the support programs. We then save the solution SAM for June for all four countries. In the simulation, all endogenous accounts (activity, commodity, and factors) are balanced. The exogenous accounts (C, I, G, E) are not balanced since the model does not adjust the matrix A22 endogenously. These accounts included inter-institution flows (see Figure 1). We use a cross-entropy Bayesian estimation procedure to create a balanced SAM, adjusting inter-institution flows to bring the exogenous accounts in balance with the endogenous accounts.²⁰ The result is that we produce balanced SAMs for the shocked economies in June that provide the basis for analyzing income support scenarios.

Second, the SAM partition is changed, moving the household account into the set of endogenous accounts. We then specify scenarios for all countries where we increase exogenous government transfers to poor households. The results indicate the strength of Keynesian income multipliers in the shocked economies.

²⁰ An early version of the cross-entropy estimation method is described in Golan, Judge, and Robinson (1994). The information-theoretic Bayesian estimation approach is described in Golan (2018) and Golan, Judge, and Miller (1996). The GAMS code for the estimation procedure is documented in the GAMS model library, CESAM2, and is available on the web: https://www.gams.com/latest/gamslib_ml/libhtml/.

In a variant of the second step, we endogenize both the household and savings/investment accounts. In this case, the SAM multiplier includes feedbacks from income transfers to households on consumption and from increased household savings on investment. As discussed above, this savings/investment link assumes fixed savings rates by households and that the increased savings result in increased investment (they do not get trapped in the financial system). As discussed above, these assumptions are strong and the multiplier results with endogenous savings/investment should be viewed as upper bounds on what might occur.

The results from the income multiplier scenarios are presented in Table 4.1. For each country, the first column presents the multiplier for various macro aggregates due to a transfer of income from government to poor households without consideration of savings/investment effects while the second column includes the link to investment. The transfers are assumed to be perfectly targeted on poor households, and so would be expected to be associated with large Keynesian multipliers.

Table 4.1—Keynesian SAM Multipliers.

Description	Mexico		South Africa		United Kingdom		USA	
	Household	Hhld + invest	Household	Hhld + invest	Household	Hhld + invest	Household	Hhld + invest
Consumption	1.48	1.79	1.50	1.54	1.34	1.42	1.66	2.06
Investment	0.00	0.49	0.00	0.10	0.00	0.15	0.00	0.49
GDP	1.17	1.75	1.17	1.26	1.05	1.23	1.48	2.26
Total tax revenue	0.21	0.30	0.35	0.38	0.55	0.62	0.46	0.68
HH income	1.90	2.32	1.77	1.83	1.66	1.78	1.95	2.49

Notes: Changes in aggregates as a ratio to transfers of income to low-income households. “Household” columns refer to the model with only households as endogenous accounts. “Hhld + Invest” columns refer to the model with endogenous households and feedback loop from savings to aggregated investment.

The results in Table 4.1 show the increase in each macro variable for a unit increase in the income of poor households. For example, for Mexico, the entry for aggregate consumption is 1.48 indicating that an income transfer of 100 would yield an increase in aggregate consumption of 148, accounting for all indirect effects. If the savings/investment link is included, the multipliers all increase

since the indirect links through investment further increase the demand for commodities compared to the multiplier that only includes household demand.

The magnitudes of the multipliers depend on the nature and size of the “leakages” that cause increases in household income not to be spent on commodities: savings, taxes, foreign remittances, and expenditures on imports. The US, with low savings and tax rates for poor households and a lower share of imports than the other countries, has the largest multipliers. The UK has the lowest multipliers, given its higher tax rates and very high trade shares. Mexico and South Africa have similar income multipliers and differ in multipliers that include savings/investment.

The GDP multipliers range from a low of 1.05 for the UK to 1.48 for the US. For the US, the macro impact of household income support is high, with an income support of 100 leading to an increase in GDP of 148. The UK has the highest tax multiplier. An increase in income support of 100 yields an increase in tax revenue of 55, offsetting more than half the budgetary cost of the income support program. For the US, the increase in tax revenue would be 46, offsetting under half the program cost. The tax offsets would be smaller, but still significant, in Mexico and South Africa.

With savings/investment links included the tax multiplier in the US rises to 0.68, indicating that two-thirds of the program cost of income support would be offset by increased tax revenue. The GDP multiplier rises to 2.26, indicating that the indirect effects may be very large for the US, much larger than any other country.

The multiplier process also runs in reverse. In the US, when the support programs ran out in December, there were immediate “de-stimulation” effects, and the more limited support programs that were eventually implemented provided less stimulation than the original programs implemented in April-May. A SAM-multiplier analysis of the potential de-stimulation effect of cutting Covid-19 support programs for the US indicated that a cut in support of \$500 billion would cause a decline in US GDP of

3.8 percent.²¹ This de-stimulation, as well as a second wave of the pandemic, likely explains much of the poor economic performance of the US in the final quarter of 2020.

The size of the multiplier depends on the shares of the various leakages in income and is very sensitive to the distributional incidence of the support programs. If the transfers go to high-income households, the multipliers fall.²² The assumption of fixed average leakage rates in the SAM model is strong. The use of shocked SAMs captures the higher savings rates arising from the pandemic/lockdowns but recipient households may use the additional income to pay off debts accrued during the pandemic, effectively increasing their savings and transferring income to creditors with different behavior, lowering the multipliers. The model also does not consider any overhang of forced savings by richer households because they had to postpone consumption during this period and may use those savings for increased consumption as the pandemic recedes. Given empirical estimates of these effects, it would be feasible to incorporate them in the SAM model by adjusting leakage rates of the various affected agents. The SAM model is a good host for such analysis.

²¹ Robinson and Hinojosa-Ojeda (2020).

²² In a separate sim for the US, not reported, if all the transfer goes to high-income households, the multiplier falls to 0.8.

5. CONCLUSIONS

The results of this comparative model-based analysis of the economic impact of the pandemic and lockdowns in four countries indicate that the bottom-up recession that started from shocks to contact-intensive sectors and then spread across the economy had broadly similar effects. Employment was hit harder than GDP since the contact-intensive sectors are also labor-intensive. Unskilled labor was especially hard hit, and so also were poor households. These empirical results are consistent with descriptive studies of the impact of the pandemic/lockdowns in many countries.

Methodologically, the results also indicate that a SAM-based multisector model is essential to capture the mechanisms at work in a bottom-up recession that originates in highly differentiated sectoral shocks. The shocks to GDP and employment were unprecedented both in size and speed. A simulation model that captures these shocks needs to be able to capture both the initial direct impact to shocked sectors and the ripple effects across the economy through indirect impacts on demand for intermediate inputs (supply chains) and on household incomes.

The SAM-multiplier model used in this analysis does a good job in capturing the causal chains from sectoral shocks to ultimate economic impacts. Comparison with available data indicates that the model operates well on a monthly time step, which is important given the speed of the shocks. In the short run, a period of months, the model's assumption of fixed prices, quantity adjustment to clear markets, and fixed coefficients in production, are empirically valid, so the model is realistic (or "descriptive"). As the pandemic recedes and the policy focus changes to issues of recovery and the nature of post-pandemic growth paths ("build back better"), SAM-based models that incorporate price-responsive market mechanisms such as computable general equilibrium (CGE) models will be appropriate tools of analysis.

The SAM-multiplier model incorporates detailed linkages between changes in household incomes that lead to increased demand, increased production, increased employment, and additional rounds of increases in household income and demand. The result is a multisector, multi-agent version of the standard Keynesian multiplier that operates when the economy starts with significant unemployment. The

SAM-multiplier simulation model focuses attention on the structural features of the economy that define the multiplier process (who gets the additional income and what do they do with it) and can be used for a more nuanced analysis of the stimulus impact of income support programs than can be done with aggregated macro models.

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APPENDIX

Appendix Table 1– US SAM accounts. Industry accounts omitted, names same as commodities

Ccrops	Crop production
Clvstk	Animal production
Cforest	Forestry and Logging
Clogs	Logging
Cfish+	Fishing, hunting and trapping
Cag-sup	Support activities for agriculture and forestry
Coil-gas	Oil and gas extraction
Ccoal-min	Coal mining
Cmetal-min	Metal ore mining
Cnonmet-min	Nonmetallic mineral mining and quarrying
Cmining-sup	Support activities for mining
Celctrcty	Electric power generation, transmission and distribution
Cgas-dist	Natural gas distribution
Cwater	Water, sewage and other systems
Cconstrct	Construction
Canimal-food-mfg	Animal food manufacturing
Cgrain-prc	Grain and oilseed milling
Csugar-mfg	Sugar and confectionery product manufacturing
Cfruit+mfg	Fruit and vegetable preserving and specialty food manufacturing
Cdairy-mfg	Dairy product manufacturing
Canimal-prc	Animal slaughtering and processing
Cseafood-mfg	Seafood product preparation and packaging
Cbread+	Bakeries and tortilla manufacturing
Cother-food-mfg	Other food manufacturing
Cbeverage	Beverage manufacturing
Ctobacco	Tobacco manufacturing
Ctextiles	Textile mills and textile product mills
Capparel	Apparel, leather and allied product manufacturing
Cwood-mfg	Sawmills and wood preservation
Cwood-prdcts	Veneer, plywood, and engineered wood product manufacturing
Cother-wood-prdcts	Other wood product manufacturing, including wood tv, radio and sewing machine cabinet manufacturing
Cpaper-mfg	Pulp, paper, and paperboard mills
Cpaper-prdcts	Converted paper product manufacturing
Cprinting+	Printing and related support activities
Cpetrol-prdcts	Petroleum and coal products manufacturing
Cchemical-mfg	Basic chemical manufacturing
Cchem-prdcts	Resin, synthetic rubber, and artificial synthetic fibers and filaments manufacturing
Cag-chem-mfg	Pesticide, fertilizer, and other agricultural chemical manufacturing
Cmedicine-mfg	Pharmaceutical and medicine manufacturing

Cpaint+	Paint, coating, and adhesive manufacturing
Csoap+	Soap, cleaning compound, and toilet preparation manufacturing
Cother-chem-prdcts	Other chemical product and preparation manufacturing
Cplastic-prdcts	Plastics product manufacturing
Crubber-prdcts	Rubber product manufacturing
Cclay-prdcts	Clay product and refractory manufacturing
Cglass-mfg	Glass and glass product manufacturing
Ccement-mfg	Cement and concrete product manufacturing
Cnonmet-min-mfg	Lime, gypsum and other nonmetallic mineral product manufacturing
Ciron-steel	Iron and steel mills and ferroalloy manufacturing
Csteel-prdcts	Steel product manufacturing from purchased steel
Caluminum-mfg	Alumina and aluminum production and processing
Cnon-ferrous-mfg	Nonferrous metal (except aluminum) production and processing
Cfoundries	Foundries
Cforging	Forging and stamping
Ccutlery+	Cutlery and handtool manufacturing
Cstruc-metal-mfg	Architectural and structural metals manufacturing
Cboilers+	Boiler, tank, and shipping container manufacturing
Chardware-mfg	Hardware manufacturing
Cwire-prdcts	Spring and wire product manufacturing
Cmetal-prdcts	Machine shops; turned product; and screw, nut, and bolt manufacturing
Cmetal-finish-mfg	Coating, engraving, heat treating, and allied activities
Cother-metal-prdcts	Other fabricated metal product manufacturing
Cconstruct-mchnry	Agriculture, construction, and mining machinery manufacturing
Cindust-mchnry	Industrial machinery manufacturing
Csvc-mchnry	Commercial and service industry machinery manufacturing, including digital camera manufacturing
Chvac-mchnry	Ventilation, heating, air-conditioning, and commercial refrigeration equipment manufacturing
Cmetal-wrk-mchnry	Metalworking machinery manufacturing
Cengine+mfg	Engine, turbine, and power transmission equipment manufacturing
Cother-mchnry	Other general purpose machinery manufacturing
Ccomputers	Computer and peripheral equipment manufacturing, excluding digital camera manufacturing
Ccommun-eqpmnt	Communications equipment manufacturing
Caudiovid-eqpmnt	Audio and video equipment manufacturing
Celectronic-mfg	Semiconductor and other electronic component manufacturing
Cmeasuring-instrmnts	Navigational, measuring, electromedical, and control instruments manufacturing
Cmag-media-mfg	Manufacturing and reproducing magnetic and optical media
Clighting-eqpmnt	Electric lighting equipment manufacturing
Capplicances	Household appliance manufacturing
Celec-eqpmnt	Electrical equipment manufacturing
Cother-elec-eqpmnt	Other electrical equipment and component manufacturing
Cmotor-vehicles	Motor vehicle manufacturing
Cvehicle-body	Motor vehicle body and trailer manufacturing

Cvehicle-parts	Motor vehicle parts manufacturing
Caerospace+parts	Aerospace product and parts manufacturing
Crailroad-stocki	Railroad rolling stock manufacturing
Cship-building	Ship and boat building
Cother-trnsprt-eqpmnt	Other transportation equipment manufacturing
Chshld-furniture	Household and institutional furniture and kitchen cabinet manufacturing, excluding wood tv, radio and sewing maching cabinet manufacturing
Coffice-furniture	Office furniture (including fixtures) manufacturing
Cother-furniture	Other furniture related product manufacturing
Cmedical-eqpmnt	Medical equipment and supplies manufacturing
Cother-misc-mfg	Other miscellaneous manufacturing
Cwholesale-trade	Wholesale trade
Cvehicle-dealers	Motor vehicle and parts dealers
Cfood-stores	Food and beverage stores
Cgeneral-stores	General Merchandise stores
Cother-retail	All other retail
Cair-trnsprt	Air transportation
Crail-trnsprt	Rail transportation
Cwater-trnsprt	Water transportation
Ctruck-trnsprt	Truck transportation
Ctransit-trnsprt	Transit and ground passenger transportation
Cpipeline-trnsprt	Pipeline transportation
Cscenic-trnsprt	Scenic and sightseeing transportation and support activities for transportation
Ccouriers	Couriers and messengers
Cwarehousing	Warehousing and storage
Cnewspapers+	Newspaper, periodical, book, and directory publishers
Csoftware	Software publishers
Cmotion-pictures+	Motion picture, video, and sound recording industries
Cradio-tv	Radio and television broadcasting
Ccable-tv	Cable and other subscription programming
Cwired-telecom	Wired telecommunications carriers
Cwireless-telecom	Wireless telecommunications carriers (except satellite)
Cother-telecom	Satellite, telecommunications resellers, and all other telecommunications
Cdata-prc-svc	Data processing, hosting, and related services
Cother-info-svc	Other information services
Cmonetary	Monetary authorities, credit intermediation, and related activities
Cfin-invest-act	Securities, commodity contracts, fund, trusts and other financial investments and vehicles and related activities
Cins-carrier	Insurance carriers
Cins+	Agencies, brokerages, and other insurance related activities
Crlestate	Real estate
Cauto-rental	Automotive equipment rental and leasing
Cconsumer-rental	Consumer goods rental and general rental centers
Ccmmercial-rental	Commercial and industrial machinery and equipment rental and leasing
Clease-assets	Lessors of nonfinancial intangible assets (except copyrighted works)

Clegal-svc	Legal services
Cacct-svc	Accounting, tax preparation, bookkeeping, and payroll services
Carchitect+	Architectural, engineering, and related services
Cspec-desg-svc	Specialized design services
Ccomputer-svc	Computer systems design and related services
Cmanagement+	Management, scientific, and technical consulting services
Cscience	Scientific research and development services
Cadvertising	Advertising and related services
Cother-professional	Other professional, scientific, and technical services
Cmanagement	Management of companies and enterprises
Coffice-admin	Office administrative services
Cfac-sup-svc	Facilities support services
Cemp-svc	Employment services
Cbusi-sup-svc	Business support services
Ctravel-svc	Travel arrangement and reservation services
Cinves+	Investigation and security services
Csvc-bldg-dwe	Services to buildings and dwellings
Cother-sup-svc	Other support services
Cwaste-svc	Waste management and remediation services
Celem-sec-school	Elementary and secondary schools
Ccolleges+	Junior colleges, colleges, universities, and professional schools
Cother-educ-svc	Other educational services
Coffice-phy	Offices of physicians
Coffice-dental	Offices of dentists
Coffice-other-hp	Offices of other health practitioners
Coutpatient-center	Outpatient care centers
Cmed-dx-lab	Medical and diagnostic laboratories
Chome-care-svc	Home health care services
Cother-health-svc	Other ambulatory health care services
Chospital	Hospitals
Cnursing	Nursing and residential care facilities
Cindv-faml-svc	Individual and family services
Crehab-svc	Community and vocational rehabilitation services
Cchild-care-svc	Child day care services
Cperf-arts-co	Performing arts companies
Csports	Spectator sports
Cpromoter+	Promoters of events, and agents and managers
Cindep-artist	Independent artists, writers, and performers
Cmuseum+	Museums, historical sites, and similar institutions
Camuse-park	Amusement parks and arcades
Cgambling	Gambling industries (except casino hotels)
Cother-recreation	Other amusement and recreation industries
Caccomdn	Accommodation
Cfood-svc	Food services and drinking places
Cauto-repair	Automotive repair and maintenance

Celec-eqpmnt-repair	Electronic and precision equipment repair and maintenance
Ccommercial-repair	Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance
Chousehold-repair	Personal and household goods repair and maintenance
Cpersonal-svc	Personal care services
Cdeath-care-svc	Death care services
Claundry-svc	Drycleaning and laundry services
Cother-prsn-svc	Other personal services
Creligious-org	Religious organizations
Csocial-org	Grantmaking and giving services and social advocacy organizations
Ccivic+	Civic, social, professional, and similar organizations
Cpvt-hshld	Private households
Cpostal-svc	Postal Service
Cgovt	Government, state, local, and federal
Cowner-dwe	Owner-occupied dwellings
Cnoncomp-imp	Noncomparable imports
Cscrap	Scrap
Flabor	Salary and wages
Fkptl	Operating surplus
itax	Output taxes
dtax	Direct taxes
entrprs	Enterprises
Mrgn	Trade margins
Hld-lt15	Households LT 15 thousand
Hld-15-30	Households 15-30 thousand
Hld-30-40	Households 30-40 thousand
Hld-40-50	Households 40-50 thousand
Hld-50-70	Households 50-70 thousand
Hld-70-100	Households 70-100 thousand
Hld-100-150	Households 100-150 thousand
Hld-150-200	Households 150-200 thousand
Hld-gt200	Households GT 200 thousand
Gov	Government account
S-I	Savings/investment account
Invntry	Inventory investment
RoW	Rest of the world
Total	Total

Appendix Table 2–UK SAM accounts. Industry accounts omitted, names same as commodities.

Ccrop-anml	Products of agriculture, hunting and related services
Cforest	Products of forestry, logging and related services
Cfish-aqua	Fish and other fishing products; aquaculture products; support services to fishing
Cmining	Coal and lignite
Cpetr-gas-extr	Crude Petroleum And Natural Gas & Metal Ores
Cothr-mining	Other mining and quarrying products
Cmin-servc	Mining support services
Cmeat-procss	Preserved meat and meat products
Cfish-procss	Processed and preserved fish, crustaceans, molluscs, fruit and vegetables
Cmanf-oils	Vegetable and animal oils and fats
Cmanf-dairy	Dairy products
Cmanf-grain	Grain mill products, starches and starch products
Cmanf-bakery	Bakery and farinaceous products
Cmanf-othrfood	Other food products
Cmanf-anml-fd	Prepared animal feeds
Calcohol-tbcc	Alcoholic beverages & Tobacco products
Cmanf-dmks	Soft drinks
Cmanf-text	Textiles
Cmanf-apprl	Wearing apparel
Cmanf-leathr	Leather and related products
Cmanf-wood	Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials
Cmanf-paper	Paper and paper products
Cprint-reprdctn	Printing and recording services
Crefnd-ptrlm	Coke and refined petroleum products
Cmanf-paints	Paints, varnishes and similar coatings, printing ink and mastics
Cmanf-soap-clng	Soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations
Cmanf-othr-chmc	Other chemical products
Cmanf-fertl	Industrial gases, inorganics and fertilisers (all inorganic chemicals) - 20.11/13/15
Cmanf-petrchml	Petrochemicals - 20.14/16/17/60
Cagr-chmcl	Dyestuffs, agro-chemicals - 20.12/20
Cmanf-phrmc	Basic pharmaceutical products and pharmaceutical preparations
Cmanf-rbbr-plstc	Rubber and plastic products
Cmanf-cement	Manufacture of cement, lime, plaster and articles of concrete, cement and plaster
Cmanf-glass	Glass, refractory, clay, other porcelain and ceramic, stone and abrasive products - 23.1-4/7-9
Cmanf-iron-steel	Basic iron and steel
Cmanf-othr-ntl	Other basic metals and casting
Cweapons	Weapons and ammunition
Cmanf-fabr-ntl	Fabricated metal products, excl. machinery and equipment and weapons & ammunition - 25.1-3/25.5-9
Cmanf-comptr	Computer, electronic and optical products
Cmanf-elctr-eq	Electrical equipment
Cmanf-machnr	Machinery and equipment n.e.c.
Cmotor-vhcl	Motor vehicles, trailers and semi-trailers

Cships-boats	Ships and boats
Cair-spac-craft	Air and spacecraft and related machinery
Co-transp-equ	Other transport equipment - 30.2/4/9
Cmanf-furnt	Furniture
Cothr-manf	Other manufactured goods
Crepair-ships	Repair and maintenance of ships and boats
Crepair-air	Repair and maintenance of aircraft and spacecraft
Cothr-repair	Rest of repair; Installation - 33.11-14/17/19/20
Celectr-pwr	Electricity, transmission and distribution
Cgas-ditrbt	Gas; distribution of gaseous fuels through mains; steam and air conditioning supply
Cwater	Natural water; water treatment and supply services
Csewage	Sewerage services; sewage sludge
Cwaste-collct	Waste collection, treatment and disposal services; materials recovery services
Cothr-waste	Remediation services and other waste management services
Cconstructn	Construction
Cwhols-motor	Wholesale and retail trade and repair services of motor vehicles and motorcycles
Cwhols-trade	Wholesale trade services, except of motor vehicles and motorcycles
Cretail-trade	Retail trade services, except of motor vehicles and motorcycles
Ctransp-rail	Rail transport services
Ctransp-land	Land transport services and transport services via pipelines, excluding rail transport
Ctransp-water	Water transport services
Ctransp-air	Air transport services
Cwarehs-transp	Warehousing and support services for transportation
Cpost-ourier	Postal and courier services
Caccomdtn	Accommodation services
Cfood-bev-servc	Food and beverage serving services
Cpublishing	Publishing services
Ctv-radio-film	Motion Picture, Video & TV Programme Production, Sound Recording & Music Publishing Activities & Programming And Broadcasting Activities
Ctelecmm	Telecommunications services
Ccomp-prgr	Computer programming, consultancy and related services
Cinfo-servc	Information services
Cfin-srv-othr	Financial services, except insurance and pension funding
Cinsuranc	Insurance, reinsurance and pension funding services, except compulsory social security
Cothr-insrnc	Services auxiliary to financial services and insurance services
Creal-estate	Real estate services, excluding on a fee or contract basis and excluding imputed rent
Chousng-othr	Imputed rents of owner-occupied dwellings
Creal-estat-act	Real estate activities on a fee or contract basis
Clegal-act	Legal services
Caccountg	Accounting, bookkeeping and auditing services; tax consulting services
Cmangmt-act	Services of head offices; management consulting services
Carch-enginrn	Architectural and engineering services; technical testing and analysis services
Csc-r&d	Scientific research and development services
Cadvertsg	Advertising and market research services
Cothr-techn-act	Other professional, scientific and technical services

Cveterinary	Veterinary services
Crental-act	Rental and leasing services
Cemplmt-act	Employment services
Ctravel-act	Travel agency, tour operator and other reservation services and related services
Csecury-act	Security and investigation services
Cservc-buildg	Services to buildings and landscape
Cadmn-servc	Office administrative, office support and other business support services
Cpub-admin	Public administration and defence services; compulsory social security services
Ceducation	Education services
Chealth	Human health services
Csocial-work	Residential Care & Social Work Activities
Cart	Creative, arts and entertainment services
Cothr-cultural	Libraries, archives, museums and other cultural services
Cgamblg	Gambling and betting services
Csport	Sports services and amusement and recreation services
Cmembrshp-o	Services furnished by membership organisations
Crepair-comptr	Repair services of computers and personal and household goods
Cothr-persn-srvc	Other personal services
Chh-dom-personl	Services of households as employers of domestic personnel
Fibr	Labor
Fkptl	Capital
Mrgn	Margins
Adjust	Adjust
Hshld01	Households Decile 1
Hshld02	Households Decile 2
Hshld03	Households Decile 3
Hshld04	Households Decile 4
Hshld05	Households Decile 5
Hshld06	Households Decile 6
Hshld07	Households Decile 7
Hshld08	Households Decile 8
Hshld09	Households Decile 9
Hshld10	Households Decile 10
Entrprs	Enterprises
Govt	Combined government
dtax	Direct
ctax	Com taxes
itax	Indirect taxes less subsidies
S-I	Savings/Investment account
EU-Com	EU commodities
RoW-Com	RoW commodities
RoW-Svc	RoW services
Dstk	Change in Stocks
Total	Total

Appendix Table 3—Mexico SAM accounts. Industry accounts omitted, names same as commodities.

c1-Crops	c1 - Crop Production, Support Activities for Agriculture and Forestry
c2-Animals	c2 - Animal Production and Aquaculture
c3-Forestry	c3 - Timber Tract Operations, Forest Nurseries and Gathering of Forest Products
c4-Logging	c4 - Logging
c5-FishHunting	c5 - Fishing, Hunting and Trapping
c6-OilGas	c6 - Oil and Gas Extraction
c7-CoalMining	c7 - Coal Mining
c8-MetalMining	c8 - Metal Ore Mining
c9-NonMtlMining	c9 - Nonmetallic Mineral Mining and Quarrying
c10-MiningSupport	c10 - Support Activities for Mining
c11-Electricity	c11 - Electric Power Generation, Transmission and Distribution
c12-WaterSewage	c12 - Water, sewage and other systems
c13-NatrGas	c13 - Natural gas distribution
c14-Construction	c14 - Construction
c15-MeatPrd	c15 - Animal Food Manufacturing
c16-Milling	c16 - Grain and Oilseed Milling
c17-SugarPrd	c17 - Sugar and Confectionery Product Manufacturing
c18-FruitVegPrd	c18 - Fruit and Vegetable Preserving and Specialty Food Manufacturing
c19-Dairy	c19 - Dairy Product Manufacturing
c20-AnimalPrd	c20 - Animal Slaughtering and Processing
c21-FishPrd	c21 - Seafood Product Preparation and Packaging
c22-Bakery	c22 - Bakeries and Tortilla Manufacturing
c23-OthrFdPrd	c23 - Other Food Manufacturing
c24-Beverage	c24 - Beverage Manufacturing
c25-Tobacco	c25 - Tobacco Manufacturing
c26-Textiles	c26 - Textile Mills, Textile Product Mills
c27-Apparel	c27 - Apparel Manufacturing, Leather Allied Product Manufacturing
c28-WoodPrd	c28 - Sawmills and Wood Preservation
c29-Plywood	c29 - Veneer, Plywood, and Engineered Wood Product Manufacturing
c30-OthrWdPrd	c30 - Other Wood Product Manufacturing
c31-Paper	c31 - Pulp, Paper, and Paperboard Mills
c32-PaperPrd	c32 - Converted Paper Product Manufacturing
c33-Printing	c33 - Printing and Related Support Activities, Newspaper Periodical Book and Directory Publishers
c34-Petroleum	c34 - Petroleum and Coal Products Manufacturing, Basic Chemical Manufacturing
c35-ResinRubberPrd	c35 - Resin, Synthetic Rubber, and Artificial Synthetic Fibers and Filaments Manufacturing
c36-FertPest	c36 - Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing
c37-Pharma	c37 - Pharmaceutical and Medicine Manufacturing
c38-PaintChem	c38 - Paint, Coating, and Adhesive Manufacturing, Other Chemical Product and Preparation Manufacturing
c39-Soap	c39 - Soap, Cleaning Compound, and Toilet Preparation Manufacturing
c40-PlasticPrd	c40 - Plastics Product Manufacturing
c41-RubberPrd	c41 - Rubber Product Manufacturing

c42-NonMtlPrd	c42 - Nonmetallic Mineral Product Manufacturing
c43-IronSteel	c43 - Iron and Steel Mills and Ferroalloy Manufacturing
c44-SteelPrd	c44 - Steel Product Manufacturing from Purchased Steel, Alumina and Aluminum Production and Processing, Nonferrous Metal (except Aluminum) Production and Processing, Foundries, Forging and Stamping, Cutlery and Handtool Manufacturing, Architectural and Structural Metals Manufacturing
c45-MetalPrd	c45 - Boiler Tank and Shipping Container Manufacturing, Hardware Manufacturing, Spring and Wire Product Manufacturing, Machine Shops Turned Product and Screw Nut and Bolt Manufacturing, Coating Engraving Heat Treating and Allied Activities, Other Fabricated Metal Product Manufacturing
c46-AgConMach	c46 - Agriculture, Construction, and Mining Machinery Manufacturing
c47-IndstMach	c47 - Industrial Machinery Manufacturing, Other General Purpose Machinery Manufacturing
c48-SvcMach	c48 - Commercial and Service Industry Machinery Manufacturing
c49-HvacPrd	c49 - Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing
c50-MetalMach	c50 - Metalworking Machinery Manufacturing
c51-Equip3	c51 - Engine, Turbine, and Power Transmission Equipment Manufacturing
c52-Computer	c52 - Computer and Peripheral Equipment Manufacturing
c53-CommEqp	c53 - Communications Equipment Manufacturing
c54-AudioEqp	c54 - Audio and Video Equipment Manufacturing, Semiconductor and Other Electronic Component Manufacturing
c55-NavCntlEqp	c55 - Navigational, Measuring, Electromedical, and Control Instruments Manufacturing
c56-OpticEqp	c56 - Manufacturing and Reproducing Magnetic and Optical Media
c57-LighEqp	c57 - Electric Lighting Equipment Manufacturing
c58-HldAppl	c58 - Household Appliance Manufacturing
c59-ElctrcEqp	c59 - Electrical Equipment Manufacturing
c60-OthrElctrEqp	c60 - Other Electrical Equipment and Component Manufacturing
c61-Vehicles	c61 - Motor Vehicle Manufacturing
c62-VhclBody	c62 - Motor Vehicle Body and Trailer Manufacturing, Ship and Boat Building, Other Transportation Equipment Manufacturing
c63-VhclParts	c63 - Motor Vehicle Parts Manufacturing
c64-AeroPrd	c64 - Aerospace Product and Parts Manufacturing
c65-RailPrd	c65 - Railroad Rolling Stock Manufacturing
c66-Furniture	c66 - Household and Institutional Furniture and Kitchen Cabinet Manufacturing, Office Furniture (including Fixtures) Manufacturing
c67-OthrFurn	c67 - Other Furniture Related Product Manufacturing
c68-MedicalPrd	c68 - Medical Equipment and Supplies Manufacturing
c69-OtherMfg	c69 - Other Miscellaneous Manufacturing
c70-WholesaleTrd	c70 - Wholesale Trade
c71-RetailTrd	c71 - Retail trade
c72-AirTrns	c72 - Air Transportation
c73-RailTrns	c73 - Rail Transportation
c74-WaterTrns	c74 - Water Transportation
c75-TruckTrns	c75 - Truck Transportation, Transit and Ground Passenger Transportation

c76-PipeTrns	c76 - Pipeline Transportation
c77-LeisureTrns	c77 - Scenic and Sightseeing Transportation, Support Activities for Transportation
c78-Postal	c78 - Postal Service and Couriers and Messengers
c79-Storage	c79 - Warehousing and Storage
c80-Software	c80 - Software Publishers
c81-Movies	c81 - Motion Picture and Sound Recording Industries
c82-Radio	c82 - Broadcasting (except Internet), Wired Telecommunications Carriers
c83-WirelessComm	c83 - Wireless Telecommunications Carriers (except Satellite)
c84-SatComm	c84 - Satellite Telecommunications, Other Telecommunications, Data Processing Hosting and Related Services, Other Information Services
c85-Financelns	c85 - Finance and Insurance
c86-RealEstate	c86 - Real Estate
c87-AutoRent	c87 - Automotive Equipment Rental and Leasing
c88-ConsumRent	c88 - Consumer Goods Rental, General Rental Centers, Commercial and Industrial Machinery and Equipment Rental and Leasing
c89-NonFinAssets	c89 - Lessors of Nonfinancial Intangible Assets (except Copyrighted Works)
c90-Legal	c90 - Legal Services, Accounting Tax Preparation Bookkeeping and Payroll Services, Architectural Engineering and Related Services, Specialized Design Services
c91-ComptrDesign	c91 - Computer Systems Design and Related Services
c92-TechMngmnt	c92 - Management, Scientific, and Technical Consulting Services
c93-SciRsrch	c93 - Scientific Research and Development Services
c94-AdvPubRel	c94 - Advertising, Public Relations, and Related Services
c95-OthrPrfsnl	c95 - Other Professional, Scientific, and Technical Services
c96-EntMngmnt	c96 - Management of Companies and Enterprises
c97-OfficeAdmn	c97 - Office Administrative Services
c98-FacltSupport	c98 - Facilities Support Services
c99-EmpIsv	c99 - Employment Services, Business Support Services
c100-TrvlSvc	c100 - Travel Arrangement and Reservation Services
c101-SecuritySvc	c101 - Investigation and Security Services
c102-BldgSvc	c102 - Services to Buildings and Dwellings
c103-OthrSupSvc	c103 - Other Support Services
c104-WasteMngmnt	c104 - Waste Management and Remediation Services
c105-Education	c105 - Educational Services
c106-Physician	c106 - Offices of Physicians
c107-Dentist	c107 - Offices of Dentists
c108-OthrHealth	c108 - Offices of Other Health Practitioners, Outpatient Care Centers
c109-MedicalLab	c109 - Medical and Diagnostic Laboratories
c110-HomeHlth	c110 - Home Health Care Services, Other Ambulatory Health Care Services
c111-Hospital	c111 - Hospitals
c112-Nursing	c112 - Nursing and Residential Care Facilities
c113-SocialSvc	c113 - Social Assistance
c114-PrfArtSport	c114 - Performing Arts, Spectator Sports, and Related Industries
c115-Museum	c115 - Museums, Historical Sites, and Similar Institutions
c116-Reclnd	c116 - Amusement, Gambling, and Recreation Industries
c117-Accomd	c117 - Accommodation

c118-FoodSvc	c118 - Food Services and Drinking Places
c119-AutoRepair	c119 - Automotive Repair and Maintenance
c120-ElectrncRepair	c120 - Electronic and Precision Equipment Repair and Maintenance
c121-MachRepair	c121 - Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance
c122-HldPrdRepair	c122 - Personal and Household Goods Repair and Maintenance
c123-PersonalSvc	c123 - Personal and Laundry Services
c124-ReligiousSvc	c124 - Religious, Grantmaking, Civic, Professional, and Similar Organizations
c125-HshldSvc	c125 - Private Households
c126-GovSvc	c126 - Public Administration
FlabHM1	Employees - High education, Male, 15-29 years old
FlabMM1	Employees - Medium education, Male, 15-29 years old
FlabLM1	Employees - Low education, Male, 15-29 years old
FlabHM2	Employees - High education, Male, 30-49 years old
FlabMM2	Employees - Medium education, Male, 30-49 years old
FlabLM2	Employees - Low education, Male, 30-49 years old
FlabHM3	Employees - High education, Male, more than 50 years old
FlabMM3	Employees - Medium education, Male, more than 50 years old
FlabLM3	Employees - Low education, Male, more than 50 years old
FlabHF1	Employees - High education, Female, 15-29 years old
FlabMF1	Employees - Medium education, Female, 15-29 years old
FlabLF1	Employees - Low education, Female, 15-29 years old
FlabHF2	Employees - High education, Female, 30-49 years old
FlabMF2	Employees - Medium education, Female, 30-49 years old
FlabLF2	Employees - Low education, Female, 30-49 years old
FlabHF3	Employees - High education, Female, more than 50 years old
FlabMF3	Employees - Medium education, Female, more than 50 years old
FlabLF3	Employees - Low education, Female, more than 50 years old
Fkptl	Operation Surplus, gross
Tcom	Commodity taxes, net
Tact	Production taxes, net
Tinst	Income taxes
HHM1	Households - High education, Male, 15-29 years old
HMM1	Households - Medium education, Male, 15-29 years old
HLM1	Households - Low education, Male, 15-29 years old
HHM2	Households - High education, Male, 30-49 years old
HMM2	Households - Medium education, Male, 30-49 years old
HLM2	Households - Low education, Male, 30-49 years old
HHM3	Households - High education, Male, more than 50 years old
HMM3	Households - Medium education, Male, more than 50 years old
HLM3	Households - Low education, Male, more than 50 years old
HHF1	Households - High education, Female, 15-29 years old
HMF1	Households - Medium education, Female, 15-29 years old
HLF1	Households - Low education, Female, 15-29 years old
HHF2	Households - High education, Female, 30-49 years old

HMF2	Households - Medium education, Female, 30-49 years old
HLF2	Households - Low education, Female, 30-49 years old
HHF3	Households - High education, Female, more than 50 years old
HMF3	Households - Medium education, Female, more than 50 years old
HLF3	Households - Low education, Female, more than 50 years old
Ent-pub	Public non-financial corporations
Ent-prv	Private non financial corporations
CentBank	Central Bank
BanksPrv	Deposit-taking corporations except the Central Bank
MMFunds	Money market funds
nonMMFunds	Non money market funds investment funds
FinIntermed	Other financial intermediaries
FinAux	Financial auxiliaries
FinCaptive	Captive financial institutions and money lenders
InsurancePrv	Insurance corporations
PensionFnd	Pension funds
FedGov	Federal government
FedOrg	Decentralized Organizations
MexCityGov	Mexico City government
StateGov	State government
LocalGov	Local government
SocSecFunds	Social security funds
GOV	Government consumption
S-I	Savings-Investment
Dstk	Change in inventories
Germany	Germany
Canada	Canada
Chiina	China
US	United States
France	France
UK	United Kingdom
RoW	Rest of the World
RoWCap	Capital account
Total	Total

Appendix Table 4—South Africa SAM accounts.

aagri	Agriculture
afore	Forestry
afish	Fishing
acoal	Mining of coal and lignite
agold	Mining of gold and uranium ore
amore	Mining of metal ores
aomin	Other mining and quarrying
afood	Food
abevt	Beverages and tobacco
aweav	Spinning, weaving and finishing of textiles
aknit	Knitted, crouched fabrics, wearing apparel, fur articles
aleat	Tanning and dressing of leather
afoot	Footwear
awood	Sawmilling, planing of wood, cork, straw
apapr	Paper
aprnt	Publishing, printing, recorded media
apetr	Coke oven, petroleum refineries
abchm	Nuclear fuel, basic chemicals
aochm	Other chemical products, man-made fibres
arubb	Rubber
aplas	Plastic
aglss	Glass
anmmi	Non-metallic minerals
abisc	Basic iron and steel, casting of metals
anfme	Basic precious and non-ferrous metals
afabm	Fabricated metal products
amach	Machinery and equipment
aemch	Electrical machinery and apparatus
ardtv	Radio, television, communication equipment and apparatus
amopt	Medical, precision, optical instruments, watches and clocks
amtyp	Motor vehicles, trailers, parts
aotrp	Other transport equipment
afurn	Furniture
aomnf	Manufacturing n.e.c, recycling
aelcg	Electricity, gas, steam and hot water supply
awatd	Collection, purification and distribution of water
acnst	Construction
awtrd	Wholesale trade, commission trade
artrd	Retail trade
amtv	Sale, maintenance, repair of motor vehicles
aacct	Hotels and restaurants
altrp	Land transport, transport via pipe lines
awtrp	Water transport

aatrp	Air transport
atrps	Auxiliary transport
apost	Post and telecommunication
afins	Financial intermediation
ainsp	Insurance and pension funding
aofin	Activities to financial intermediation
areal	Real estate activities
arent	Renting of machinery and equipment
acomp	Computer and related activities
arsea	Research and experimental development
aobus	Other business activities
apuba	Government
aeduc	Education
aheal	Health and social work
awast	Sewerage and refuse disposal
among	Activities of membership organisations
arecr	Recreational, cultural and sporting activities
aoact	Other activities
anobs	Non-observed, informal, non-profit, households,
cagri	Agriculture
clani	Live animal
cfore	Forestry
cfish	Fishing
ccoal	Coal and lignite
cmore	Metal ores
comin	Other minerals
celcg	Electricity and gas
cwatr	Natural water
cmeat	Meat
cpfis	Fish
cvege	Vegetables
cfroi	Fruit and nuts
cfats	Oils and fats
cdair	Dairy products
cgrai	Grain mill products
cstar	Starches products
cafee	Animal feeding
cbake	Bakery products
csuga	Sugar
cconf	Confectionary products
cpast	Pasta products
cofoo	Food n.e.c.
calcb	Alcohol, beverages
csftd	Soft drinks
ctoba	Tobacco products

ctexf	Textile fabrics
ctexm	Made-up textile, articles
ccarp	Carpets
cotex	Textile n.e.c.
cknit	Knitting fabrics
cwear	Wearing apparel
cleat	Leather products
cfoot	Footwear
cwood	Wood products
cpapp	Paper products
cprnt	Printing
cpetr	Petroleum products
cbchm	Basic chemicals
cfert	Fertilizers, pesticides
cpain	Paint, related products
cphar	Pharmaceutical products
csoap	Soap, cleaning, perfume
coche	Chemical products, n.e.c.
ctyre	Rubber tyres
corub	Other rubber products
cplas	Plastic products
cglas	Glass products
ccera	Non-structural ceramic
cclay	Structure non-refractory clay
ccmnt	Plaster, cement
cconc	Articles of concrete
conmp	Non-metallic products n.e.c.
cfurn	Furniture
cjewl	Jewellery
comnf	Manufactured products n.e.c.
cwast	Wastes, scraps
cirst	Iron, steel products
cnfme	Non-ferrous metals
cstrm	Structural metal products
ctank	Tanks, reservoirs
cofbm	Other fabricated metal
cengt	Engines, turbines
cpump	Pumps, compressors
cgear	Bearings, gears
clift	Lifting equipment
cgenm	General machinery
cspcm	Special machinery
cdoma	Domestic appliances
coffm	Office machinery
celcm	Electrical machinery

crdtv	Radio, television
cmeda	Medical appliances
cmtvp	Motor vehicles, parts
cship	Ships and boats
crail	Railway and trams
cairc	Aircrafts
coteq	Other transport equipment
ccnst	Construction
ccsrv	Construction services
ctrad	Trade services
cacco	Accommodation
ccats	Catering services
cptrp	Passenger transport
cftrp	Freight transport
ctrps	Supporting transport services
cpost	Postal, courier services
celcd	Electricity distribution
cwatd	Water distribution
cfins	Financial services
cinsp	Insurance, pension
cofin	Other financial services
creal	Real estate services
crent	Leasing, Rental services
crsea	Research, development
clacc	Legal, accounting
cobus	Other business services
ctelc	Telecommunications
csupp	Support services
cmnfs	Manufactured services n.e.c.
cpuba	Public administration
ceduc	Education services
cheal	Health, social services
cosrv	Other services n.e.c.
trc	Margins
flab-p	Labor with primary school education (grades 1-7)
flab-m	Labor with middle school education (grades 8-11)
flab-s	Labor completed secondary school education (grade 12)
flab-t	Labor with tertiary education (certificates, diplomas or degrees)
fcap	Capital
ent	Enterprises
hhd-0	Households - Decile 1
hhd-1	Households - Decile 2
hhd-2	Households - Decile 3
hhd-3	Households - Decile 4
hhd-4	Households - Decile 5

hhd-5	Households - Decile 6
hhd-6	Households - Decile 7
hhd-7	Households - Decile 8
hhd-8	Households - Decile 9
hhd-91	Households - Percentile 90-92
hhd-92	Households - Percentile 92-94
hhd-93	Households - Percentile 94-96
hhd-94	Households - Percentile 96-98
hhd-95	Households - Percentile 98-100
gov	Government
atax	Activity taxes
dtax	Direct taxes
mtax	Import tariffs
stax	Sales taxes
s-i	Savings & investment
dstk	Change in stocks
row	Rest of world
total	Total

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