KOÇ UNIVERSITY-TÜSİAD ECONOMIC RESEARCH FORUM
WORKING PAPER SERIES

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Working Paper No: 2011
April 2020

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Abstract

The COVID-19 crisis can turn into the biggest emerging market (EM) crisis ever. EMs are observing record capital outflows and depreciating currencies, while trying to come up with fiscal resources necessary to fight the pandemic. This paper focuses on a large EM, Turkey. Turkey provides us with a good laboratory given its low foreign currency reserves, high foreign currency debt and a questionable record on monetary policy credibility, all of which are the characteristics of several EMs. We develop a simple framework incorporating a SIR model in a reduced form economic model. We proxy supply shocks with a measure that synthesizes infection rates with teleworkers, physical job proximity and lockdown policies. Demand shocks are captured with credit card purchases. We also incorporate the fact that Turkey is a small open economy with trade linkages. Our estimates show that the lowest economic cost, which saves the maximum number of lives, can be achieved under an immediate full lockdown. Partial lockdowns, which is the current policy, amplify the economic toll because the normalization takes longer. We highlight that it is necessary for the economic units to be compensated during the lockdown and yet Turkey's policy options are limited given its low fiscal space, and reliance on capital flows that require both external and domestic funding. The external funds can be secured through international financial institutions. On the domestic front, the Turkish Central Bank can provide funding with a well-targeted and transparent asset purchase program (QE). As an example of such a policy, we provide the details of a successful historical episode: Turkish Central Bank monetized the government debt with a clearly communicated disinflation program under an IMF Stand-By Agreement, in the aftermath of 2001 triple crisis (banking, sovereign, balance of payments).

Keywords: COVID-19; Financial Crisis; SIR; Input-Output Tables; Emerging Markets
JEL Codes: E61, F00, C51

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"Best safety lies in fear."
– William Shakespeare

1 Introduction

COVID-19 is a humanitarian problem, and containing the pandemic as soon as possible is an urgent obligation to save human lives. Nevertheless, we have to act now also to deal with the economic fallout from the pandemic as the economic costs will be substantial especially in emerging markets and developing countries. These countries are going through a multitude of shocks: health crisis, demand and supply shocks, commodity price shocks, financial shocks, sudden stops, and exchange rate crises. What makes it worse is the fact that these countries need to deal with all these shocks under limited fiscal space, low policy credibility and a need for foreign finance. As put by the IMF (2020), this is "a crisis like no other" with potentially far more disastrous implications for emerging markets and developing economies relative to advanced economies.

In this paper, we focus on the case of Turkey, a large representative emerging market (EM). The key characteristics of several large EMs are the fact they have low foreign currency (FX) reserves in spite of high private sector FX debt. In addition, they generally have lower central bank credibility relative to advanced economies (AEs) and most are heavily dependent on capital inflows to run their economies. EMs learned their lessons from the EM crises of 1990s and early 2000s in the sense that they have low fiscal deficits and better capitalized banking systems as they face the COVID-19 crisis. Nevertheless, they will still operate with low fiscal space during their response to the COVID-19 shock given the unprecedented nature of capital flow reversals they are currently experiencing. We argue that Turkey fits the bill to represent this group of EMs. Turkey is a large and an important EM from a global perspective given its size and the composition of its external debt both in terms of currency and foreign lenders. A large part of Turkey's external debt is intermediated through domestic banks, is in USD, and is owed to global (US and European) banks. As a result, the potential threat to global financial stability from elevated stress in EMs like Turkey is non-trivial.

The economics profession unanimously agrees that the prerequisite for economic recovery is the elimination of the virus.[1] Former Federal Reserve Chairman Bernanke noted in late March that "Nothing will work if health issues aren't resolved," sending a clear message to governments.[2] One should note that even if you have the central bank that prints the global reserve currency, even if your central bank reassures the markets that there will be no limits on the amount of liquidity that can be injected to the system, and even if the rest of the world wants to hold your currency at a time of panic and stress; unless you contain the virus, economic confidence will not return, businesses will not open and people will not return to their normal lives or maintain their usual patterns of consumption.

In the short run, the most effective way to contain the virus is through isolation policies. We first estimate the GDP cost of suppression policies (lockdown) using parameters specific to Turkey, incorporating the fact that Turkey is a mid-size open economy with strong trade linkages to the rest of the world. Following the theoretical literature on estimating the economic impact of COVID-19,[3] we use a similar SIR-Econ model and show that the total cost of containing the pandemic immediately, with a Chinese style full lockdown is about 4.5 percent of the GDP, which is less than delayed and/or partial lockdowns. The full lockdown is able to contain the pandemic more quickly, within approximately one month. This finding is consistent with the early experiences of New Zealand or Denmark. Both of these countries implemented full lockdown before the number of patients reached critical levels and contained the virus rather rapidly. Consequently, they declared victory and gradually began to lift lockdown restrictions before the end of April.

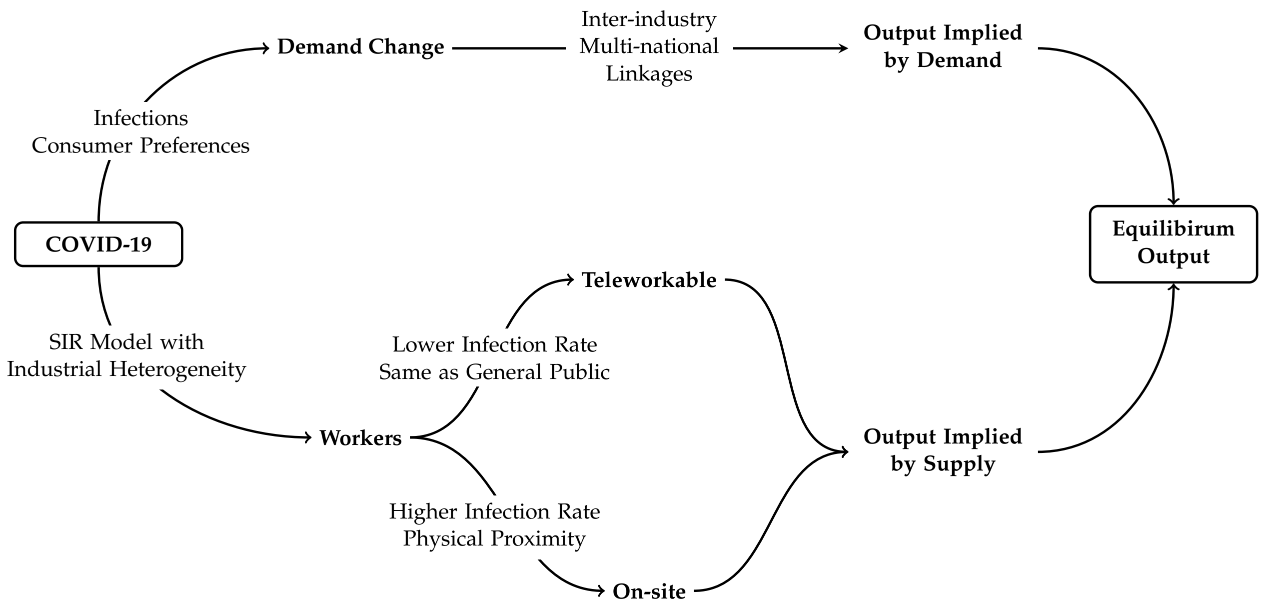
Figure 1 describes our theoretical framework, which illustrates both supply and demand channels through which COVID-19 affects an open economy. As shown in the lower half of this figure, we capture supply shocks by quantifying how susceptible each industry is to the transmission of the virus among its employees. The tasks required for production in an industry are fulfilled by the

[1] See IMF World Economic Outlook, April 2020. Also contributions in Baldwin and di Mauro (2020).

[2] The transcript of Bernanke's interview on March 25 is available at this link: https://www.cnbc.com/2020/03/25/cnbc-transcript-former-fed-chairman-ben-bernanke-speaks-with-cnbcs-andrew-ross-sorkin-on-squawk-box-today.html

[3] See Baker et al. (2020) and Ludvigson et al. (2015) on the role of uncertainty shock; Atkeson (2020a), Bendavid and Bhattacharya (2020), Dewatripont et al. (2020), Fauci et al. (2020), Li et al. (2020), Linton et al. (2020), and Vogel (2020) on mortality estimates; Anderson et al. (2020), Atkeson (2020b), Berger et al. (2020), Eichenbaum et al. (2020), Ferguson et al. (2020), and Stock (2020a), Atkeson (2020a), Neumeyer (2020), Eichenbaum et al. (2020); Hall et al. (2020); Dewatripont et al. (2020); ,Piguillem et al. (2020); Jones et al. (2020), Ferguson et al. (2020), Alvarez et al. (2020) on containment estimates; see Romer and Shah (2020) and Stock (2020b) on testing; Gonzalez-Eiras et al. (2020) on optimal lockdown choice; Guerrieri et al. (2020) on the effects of supply side disruptions; Barro et al. (2020) and Jorda et al. (2020) on medium and long run economic effects.

Figure 1: The effects of COVID-19 on the economy: The model



NOTES: We implement two main lockdown scenarios: *partial* and *full*. Under the partial lockdown, all industries remain open while the teleworkable portion of the employees work from home. The restrictive measures result in a low infection rate for the teleworkables and the general public, but the infection rate remains high for the on-site workers. Under the full lockdown, only the essential industries remain open and the workers in the non-essential sectors stay at home. With these extreme measures, the infection rates are lowered for almost everyone. The lockdowns affect the demand channel by mitigating the number of infected individuals, which in turn change the consumption profiles.

employees under a variety of occupational titles. Some professions can fulfill their tasks remotely while others need to be conducted on-site.[4] The transmission dynamics of the virus would differ depending on whether the workers are on-site or at a remote location like home. We use Dingel and Neiman (2020)'s list of teleworkable occupations to capture the proportion of employment that can be fulfilled at remote locations in each industry.[5] Among the professions that need to be carried out on the work site, we assume that the viral transmission depends on the physical proximity between the workers or between the workers and the customers. The physical proximity measure at the occupational level is readily available in the O*NET database. Using the teleworkable share of an industry and the physical proximity measure as part of the SIR model, we estimate the proportion of the work force in each industry that would be impaired during the time of the pandemic. Through this fraction, we obtain the supply shock. At this point, it should be noted that the viral transmission

[4]The occupational composition of the industries are provided at a detailed-level (close to a thousand occupations) by the Bureau of Labor Statistics (BLS) through the Occupation Employment Statistics (OES) tables.

[5]Dingel and Neiman (2020) use O*NET to characterize whether the occupations teleworkable or not.

dynamics will be affected by the implementation of different lockdown policies. Here, we mainly focus on two types of lockdown policies: partial and full. Under the partial lockdown scenario, we assume that all businesses are open, but the teleworkable share of the employees remain home. The viral transmission is lower among the teleworkable employees and the general public, but the transmission rate is still high among the on-site workers. Under the full lockdown scenario, we assume that all businesses except the essential ones are closed and all employees working in the closed sectors remain home. The viral transmission rates drop to a lower level for all the workers in the non-essential sectors.

The pandemic affects the demand side as well. In the upper half of Figure 1, we illustrate the changes in demand due to the pandemic that ultimately affects the equilibrium output. We convert the changes in the final demand to industry output. Furthermore, we capture the demand changes that are propagated through inter-industry linkages at the domestic and the multinational level by using inter-country I-O matrices. In this sense, we depart from the closed-economy models that estimate the economic costs of demand shocks due to COVID-19.

We define two scenarios for demand: one for the normal times and one during the brunt of the pandemic. To proxy for demand shocks during the peak of the pandemic, we use data on credit card purchases provided by Central Bank of the Republic of Turkey (CBRT).[6] We combine this data with other measures used in the literature on COVID-19.[7] During the course of the pandemic, we expect demand to fluctuate between these two extremes as a function of the number of infected individuals. We use a smooth function to accommodate the role of the pandemic in inducing changes in consumption patterns. Hence, the demand profile changes depending on the infection levels in the population, which is, in turn, mitigated by the lockdown decisions. The sooner the infection numbers decline, the sooner demand normalizes.

The last stage in Figure 1 combines demand and supply sides together to reach market equilibrium. We have industrial output implied by the supply channel and industrial output implied by the demand channel. In equilibrium, we expect the minimum of these two to determine the equilibrium

[6]Similarly, Andersen et al. (2020) uses transaction-level customer data from the largest bank in Denmark to estimate consumer responses to the COVID-19 pandemic and the partial shutdown of the economy.

[7]The list of demand changes and the resources that we used to arrive at the observed numbers are provided in Table A.3 of the Appendix.

level of production. Implicit in this discussion is the role of global coordination. If the lockdown can be implemented with global synchronization, demand returns to pre-pandemic levels faster and the economic costs of the pandemic can be kept at a minimum level.

Next, we ask how to finance the fall in GDP, which will be related both to lockdown and to capital outflows. We argue that Turkey will need both external and domestic finance since anything less will not cover the sizable cost. A targeted and transparent asset purchase program by the CBRT, accompanied by external funding granted by an international institution would be the best option. We emphasize the importance of an external anchor. Successful monetary financing/debt monetization requires policy credibility to keep inflation expectations under control. With rising risk premium and external borrowing costs due to COVID-19 shock and the existing low levels of policy credibility, Turkey cannot afford to do monetary financing/financial repression without an external anchor. We provide a historical example from the 2002 IMF program instituted after the triple crisis of 2001, where Turkey did debt monetization together with a successful disinflation program, obtaining external finance at the same time.

In Section 2, we briefly go over the policies adopted by Turkey to deal with the pandemic so far. Section 3 describes the model that allows us to estimate the costs of a full lockdown for the Turkish economy and compares these to the costs of a delayed action. Our findings are summarized in Section 4, where we find that each day that the lockdown is delayed, economic costs increase by about 0.2 percent of the GDP. Section 5 considers the policy alternatives to finance the economic costs of the pandemic and the recovery with their pros and cons. Section 6 describes the historical experience of debt monetization under an external anchor. Section 7 concludes.

2 What has Turkey done so far to fight COVID-19?

Turkey was caught with the pandemic at a bad time. The populist policies implemented in the period after 2017 led to an overheating economy. The inflation rate has been on the rise while TL depreciated. Triggered by the political tension between Turkey and US, August 2018 marked the beginning of an exchange rate crisis, where rapidly depreciating TL brought many companies with FX debt to the edge of bankruptcy. Accommodative monetary and fiscal policies were used to support the economy together with FX interventions and capital controls on domestic banks' swap operations in the period after August 2018. The most recent depreciation of TL associated with the capital outflows by non-residents due to COVID-19 required another round of FX interventions, which brought FX reserves to dangerously low levels. As of the first week of April 2020, net reserves of CBRT stood at merely $26 billion, of which $25 billion was borrowed from domestic banks. Meanwhile, the budget deficit stands close to 5 percent of GDP and current account deficit is around 6.5 percent of GDP.

In terms of monetary and financial policies, CBRT cut rates by 100 basis points immediately during their emergency meeting on March 18, 2020 and again on April 22. The announcement that came on March 31 eased collateral requirements to borrow from the CBRT and opened the door for unlimited bond purchases where it was stated that "...limits might be revised depending on market conditions."[8] CBRT and BSRA (Banking Supervisory and Regulatory Authority) introduced several financial repression measures in the following days that increase the risk exposure of the banking system, encouraging banks to lend at low rates or buy government bonds.[9] They have also introduced some capital flow management measures that reduced domestic banks' reserve requirements for foreign currency deposits and put limits on the daily amounts of domestic banks swap transactions.[10]

In terms of fiscal policy, the stimulus package announced by the government on March 17 is consistent with the general framework adopted by other countries. There is postponement of tax obligations, social security premiums and credit payments of the companies in the services sector. The limits of the Credit Guarantee Fund have been increased to make bank loans more accessible. Temporary income support is provided to those workers whose companies have ceased production due to the pandemic. However, the overall size of the package is about only 2 percent of GDP. [11] To

[8] https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Announcements/Press+Releases/2020/ANO2020-22

[9] https://www.bloomberg.com/news/articles/2020-04-18/turkey-announces-new-regulation-to-boost-lending-bond-purchase and https://www.reuters.com/article/health-coronavirus-turkey-banks/turkeys-banking-watchdog-sets-deposit-ratio-to-boost-loans-idUSL8N2C607I

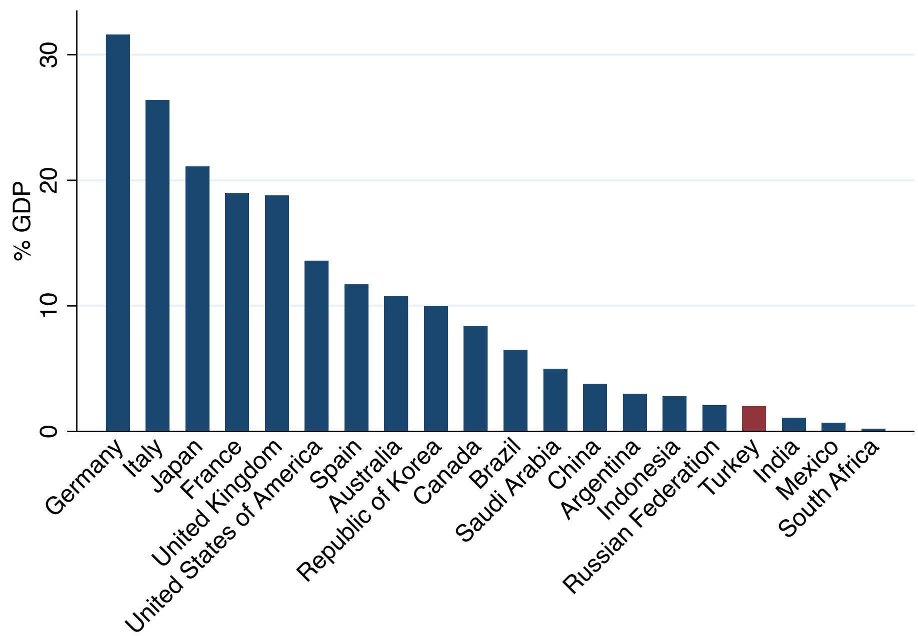
[10] https://www.reuters.com/article/health-coronavirus-turkey-banks/turkish-regulator-slashes-limits-on-banks-fx-transactions-idUSL5N2C00OI

https://www.bloombergquint.com/global-economics/turkish-lira-falls-as-regulator-limits-bank-forex-swap-deals

[11] Although the original relief package that was announced on March 18 was expressed to be 100 billion TL, the Minister of Finance and Treasury announced on April 25 that the pandemic related government expenditure has already reached 200 billion TL. Even with the revised numbers, the package still remains to be less than 4 percent of GDP

put this number into perspective, Figure 2 shows a comparison of the fiscal measures undertaken by the G20 countries, where the average size of the fiscal stimulus is about 10 percent with Germany leading the pack with 32 percent. It is clear that the Turkish package is small, lagging behind 16 of the G20 countries.

Figure 2: Fiscal Measures announced by the G20 countries



NOTES: This figure plots the COVID-19 relief packages adopted by the countries as a percentage of their GDPs. The fiscal policy measures that are shown in this figure are obtained from the IMF Policy Tracker (https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19) except for South Africa and the United Kingdom, for which the values of the stimulus packages are not explicitly stated. For these countries, we gathered the necessary information from alternative resources. A detailed comparison of the fiscal measures as well as the data sources are presented in Table A.1 of the Appendix.

One of the main components that is missing in the package is the absence of direct transfer payments to those who have lost their jobs or experienced interruptions in their income streams due to the pandemic, especially to SMEs who constitute the back-bone of the Turkish economy. If the lost income and salaries are not replaced by the government, it is impossible to keep the wheels of the economy turning. Should the transfer payments cover only those who lost their income or should they be in the form of "helicopter money" in the Turkish context, which has a sizeable informal economy. Answering all these questions depends on the extent of funding that is necessary to support the economy. In the next section, we provide a model that estimates these costs.

3 Estimating the Economic Costs of the Crisis Under Different Lockdown Scenarios

In this section, we develop a model that illustrates how COVID-19 affects the economy. The pandemic affects the economy from the supply side as well as the demand side, and these two effects feed into each other. The supply side will get hit due to disruptions in supply chains. In particular, disruptions in imports of industrial inputs from China is expected to generate secondary supply shocks in the rest of the world. Company closures, travel bans, school closures and consequent childcare all add to the supply shock (See contributions in Baldwin and di Mauro (2020)).

In the absence of any lockdown, the supply side reflects the decline in production solely due to the decline in employment as people get infected.[12] Taking the exposure to human contact at the sectoral level as our starting point, we estimate the total number of infections and how they affect production in each industry. In addition to the number of infected patients, interruptions in supply chains due to disconnections in imported inputs affect supply, which is extremely important for a small open economy like Turkey.

Turning to the demand side, the decline in demand reflects changes in consumption patterns as people stay home due to voluntary isolation and cannot continue their old consumption habits. Demand sinks due to several reasons. Certain goods cannot be consumed from home (mostly the services sector). On top of this, there are psychological factors where people adopt a wait and see approach and reduce their consumption until the uncertainty resolves. In order to capture the changes in demand patterns, we use the decline in credit card purchases.

As the lockdown kicks in, the economic costs increase at first. The companies that could otherwise remain in the production process but stop production due to the lockdown observe an immediate decline in their revenues, which prevents them from paying back their debts, leading to loan losses and NPLs if the problems persist. These are well known problems that will arise from

[12] In addition to the infected patients, people stay away from the work force as their family members get infected.

not meeting the short-term liquidity needs as extensively quantified in the literature. The liquidity needs cause the problem to spread to the broader economy. Eventually, liquidity problems lead to bankruptcies and an extensive decline in employment. On the demand side, there will be a second wave of decline in demand due to income effect as those people who lose their jobs due to interruptions in the supply chain will cut back on their consumption.

Despite the increasing costs due to business closures, a full lockdown contains the virus in the fastest way. Furthermore, if the lockdown is accompanied by a comprehensive economic stimulus plan that compensates for the lost incomes during the lockdown, productive capacity remains intact and a speedy recovery is possible once the lockdown period is over.

Our estimates indicate that the total cost of a lockdown ranges between 4.5 percent and 19.2 percent of the GDP under alternative scenarios. As we compare the recovery paths with and without the lockdown, we observe that a full lockdown lasts for approximately 40 days while the partial lockdown cannot contain the virus within a year. Because the duration of the lockdown increases substantially, the economic costs of a partial lockdown are significantly higher than the full lockdown. The mortality numbers present a stark contrast across alternative scenarios as well. The full lockdown, which has the lowest economic costs also stands out as the best option that minimizes the number of deaths. Only 0.002 percent of the population dies in a well implemented full lockdown whereas the numbers range between 0.32 to 0.96 percent in the case of partial lockdown.

3.1 The SIR Model for Pandemic

We start with introducing the model of the pandemic, which is the main workhorse in many epidemiological studies, see for example Allen (2017) among others. Let's take a population of size N. At any given time, we can split the population into three classes of people: Susceptible (S_t), Infected (I_t) and Recovered (R_t) as of time t. The susceptible group does not yet have immunity to disease, and the individuals in this group have the possibility of getting infected. The recovered group, on the other hand, consists of individuals who are immune to the disease.[13] The Susceptible-Infected-Recovered (SIR) model builds on the simple principle that fraction of the infected individuals in the population, $\frac{I_{t-1}}{N}$, can transmit the disease to susceptible ones S_{t-1} with an (structural) infection rate

[13]Immunity can be developed either because the individual goes through the infection or because she gets vaccinated.

of β. Therefore, the number of newly infected individuals in the current period is $\beta S_{t-1}\frac{I_{t-1}}{N}$. The newly infected individuals should be deducted from the susceptible individuals in the current period. Meanwhile, in each period, a fractionγ of the infected people recovers from the disease, which in turn reduces the number of actively infected individuals. To track any changes in the number of individuals in the above-mentioned three groups, the following set of equations is used:

$$\Delta S_t = -\beta S_{t-1}\frac{I_{t-1}}{N} \tag{1}$$

$$\Delta R_t = \gamma I_{t-1} \tag{2}$$

$$\Delta I_t = \beta S_{t-1}\frac{I_{t-1}}{N} - \gamma I_{t-1} \tag{3}$$

The law of motion for the number of infected individuals shows the trajectory of the pandemic at the aggregate level. Note that, $\Delta S_t + \Delta R_t + \Delta I_t = 0$ holds at any given time, assuming that the size of the population remains constant.

We modify the conventional SIR model to allow for sectoral heterogeneity in terms of the size and working conditions that can lead to distinct infection trajectories in each sector. The transmission of the virus requires close physical proximity. Hence, employees working in the industries with higher physical proximity are infected with a higher probability.[14]

We assume that the economy is composed of K sectors. We denote the industries by subscript $i = 1, \ldots, K$. Each industry has L_i workers and there is also the non-working population which we denote by N_{NW}. Each industry has two types of workers: (i) employees who can do their jobs remotely (i.e., teleworkable) and (ii) employees who need to be on-site to fulfill their jobs. In each industry, we denote the number of employees in the first group with TW_i and the second group with N_i. Hence:

$$L_i = TW_i + N_i. \tag{4}$$

For the disease propagation, we lump the non-working population and the employees in the teleworkable jobs together, and call them the at-home group. We denote the at-home group with index

[14] A report by DISK labor union in Turkey claims a three-fold increase in infection rates among workers: http://disk.org.tr/2020/04/rate-of-covid-19-cases-among-workers-at-least-3-times-higher-than-average/

$i = 0$. The total number of individuals in this group is:

$$N_0 = N_{NW} + \sum_{i=1}^{K} TW_i. \tag{5}$$

Suppose that the infection rate in the at-home group is β_0. In order to account for heterogeneous physical proximities across industries, we compute the rate of infection for each industry i, denoted by β_i, as:

$$\beta_i = \beta_0 \text{Prox}_i \qquad \text{for} \quad i = 1, \ldots, K \tag{6}$$

where Prox_i is the proximity index for industry i.[15]

Here, $S_{i,t}$, $I_{i,t}$ and $R_{i,t}$ denote the number of susceptible, infected and recovered individuals, respectively, with $N_i = S_{i,t} + I_{i,t} + R_{i,t}$ denoting the total number of on-site individuals in industry i and the at-home group ($i = 0$). Susceptible individuals in the at-home group can get infected from the infected individuals in the entire society:

$$\Delta S_{0,t} = -\beta_0 S_{0,t-1} \frac{I_{t-1}}{N} \tag{7}$$

where $I_t = \sum_{i=1}^{K} I_{i,t} + I_{0,t}$ captures the total number of infected individuals. An on-site worker in sector i, however, could be exposed to infection either at work, at the rate of $\beta_i S_{i,t-1} \frac{I_{i,t-1}}{N_i}$, or outside work, that involves all the remaining activities including family life, shopping and commuting at the rate $\beta_0 S_{i,t-1} \frac{I_{t-1}}{N}$. Hence, the number of susceptible individuals among the on-site workers in industry i changes as:

$$\Delta S_{i,t} = -\beta_i S_{i,t-1} \frac{I_{i,t-1}}{N_i} - \beta_0 S_{i,t-1} \frac{I_{t-1}}{N} \tag{8}$$

[15] We obtain the physical proximity values at the occupation level from O*NET datase. O*NET collects the physical proximity information through surveys with following categories: (1) I don't work near other people (beyond 100 ft.); (2) I work with others but not closely (e.g., private office); (3) Slightly close (e.g., shared office); (4) Moderately close (at arm's length); (5) Very close (near touching). We divide the category values by 3 to make category (3) our benchmark. Specifically, a proximity value larger than 1 indicates a closer proximity than the 'shared office' level and smaller than 1 corresponds a less-dense working conditions. We create a single physical proximity value for each occupation by doing a weighted average of the normalized category values. We calculate the proximity values at the industry level after removing the teleworkable portion from the employees. We use Dingel and Neiman (2020)'s list of teleworkable occupations to capture the proportion of employment that can be fulfilled at remote locations in each industry.

The recovery rate is the same for all types of infected individuals:

$$\Delta R_{i,t} = \gamma I_{i,t-1} \tag{9}$$

The number of infected individuals changes as the susceptible individuals get infected and some infected individuals recover from the disease:

$$\Delta I_{i,t} = -\left(\Delta R_{i,t} + \Delta S_{i,t}\right) \tag{10}$$

According the initial report by the World Health Organization (WHO),[16] the median recovery time for the mild cases is reported to be approximately 2 weeks. The mean recovery time could be longer when we include the severe cases. In this paper, we err on the optimistic side and set $\gamma = 1/14 \approx 0.07$ to establish a mean recovery time of 14 days. In the same report, the $R_0 \equiv \beta/\gamma$ of the disease, which captures the average number of individuals infected by a person carrying the disease, was estimated to be 2 to 2.5. Here, we use the lower end. In the absence of industrial heterogeneity, $R_0 = 2$ and $\gamma = 0.07$ implies $\beta = 0.14$.

With industrial heterogeneity, we match the employment size weighted average β_i's of the infected individuals to β. For an on-site worker in industry i, the implied β parameter can be approximated by $(\beta_0 + \beta_i)$.[17] For a non-working individual, this parameter is only β_0. Using Equation (6), we impose:

$$\beta_0 \frac{N_0}{N} + \sum_{i=1}^{K} (\beta_0 + \beta_i) \frac{N_i}{N} = \beta_0 + \beta_0 \sum_{i=1}^{K} \text{Prox}_i \frac{N_i}{N} = \beta \tag{11}$$

Hence, we solve for β_0 in terms of β, industry size, and the proximity levels as:

$$\beta_0 = \beta \left(1 + \sum_{i=1}^{K} \frac{\text{Prox}_i N_i}{N}\right)^{-1} \tag{12}$$

with $\beta = 0.14$ based on the WHO report.

[16] https://www.who.int/docs/default-source/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf

[17] According to the DISK report cited in Footnote 14, the infection rate is 3 times higher for workers compared to the non-working population. Here, we take a moderate stance and set the rate to be 2 times higher on average for the workers.

3.2 Production

We specify a simplified version of the production function where output is a linear function of labor. This treatment emphasizes the impact of the pandemic on production through changes in labor supply. Here, we implicitly assume that the amount of the capital stock remains the same, and therefore, can be omitted during normal times as well as the pandemic period. We model production as a function of the number of workers in industry i as:

$$Y_{i,t} = Z_i L_{i,t} \tag{13}$$

where Z_i denotes the productivity of workers in sector i.

During the pandemic period, the level of production decreases because the infected individuals cannot work until they recover from the disease. We have two groups of workers, at-home and on-site. Hence, the total number of available workers at time t will be:

$$\tilde{L}_{i,t} = (N_{i,t} - I_{i,t}) + TW_i \left(1 - \frac{I_{0,t}}{N_0}\right) \tag{14}$$

where $N_{i,t}$ is the number of on-site workers, $I_{i,t}$ is the number of infected workers among on-site workers, and TW_i is the number of at-home workers (i.e. those who can work remotely) in industry i. The ratio $I_{0,t}/N_0$ captures the fraction of individuals who are infected in the at-home group, which includes the non-working population as well as all at-home workers (i.e. teleworkers) in the economy. Therefore, the production in industry i will change to:

$$Y^S_{i,t} = Z_i \tilde{L}_{i,t} \tag{15}$$

3.3 Demand

During the pandemic period, consumer priorities and preferences change dramatically. We capture these changes in consumption using the credit card spending data, industry reports, previous literature and expert opinions. Expected final demand changes and the resources we use in this estimation are presented in Table A.3 of the Appendix. The demand changes we provide in the table correspond to brunt of the pandemic.

Let the change in final demand in industry i during the peak of pandemic be δ_i, with $\delta_i \leq 1$. If the demand for an industry i completely collapses during the pandemic, then $\delta_i = 0$. If there is no change in demand during the pandemic, then, $\delta_i = 1$. For instance, the airline industry faced a complete demand collapse worldwide, whereas the demand for the food industry remained close to pre-pandemic levels in all countries. We assume that δ_i is the most extreme demand change under fully developing pandemic. Changes in demand at any given time is a function of the number of infected individuals in the population. In other words, we assume that demand fluctuates between 1 when nobody is infected and δ_i when a very large number individuals get infected. We parameterize the demand change in industry i as a function of I_t as:[18]

$$\delta_{i,t} = \delta_i \frac{1 - \psi I_t}{\delta_i - \psi I_t}. \tag{16}$$

According to Equation (16), when $I_t = 0$, the demand change satisfies $\delta_{i,t} = 1$ and when $I_t \to \infty$ (i.e., at the peak of the pandemic), $\delta_{i,t} = \delta_i$. Throughout the analysis, we set $\psi = 0.2 \times 10^{-5}$, which leads to a smooth transition of demand as the pandemic progresses with the number of infected individuals evolving on a scale of hundred thousand (10^5) people.

Let's illustrate the final demand of country c in industry i with $F_{c,i}$. Accordingly, the new level of final demand in industry i in country c becomes:

$$\tilde{F}_{c,i,t} = F_{c,i} \delta_{i,t} \tag{17}$$

where $\tilde{F}_{c,i,t}$ represents the updated demand values during the pandemic period.

We use the Input-Output framework to map the effects of demand change on production. Turkey is an open economy with the trade-to-GDP ratio of 60% as of 2018. Therefore, we need to account for the international linkages to fully capture the impact of demand on production. We make use of OECD Inter-Country Input-Output (ICIO) Tables for this purpose.[19] ICIO provides us with input

[18] We use the pandemic levels of Turkey as the determinant of demand change. Some countries could be better in handling the pandemic than Turkey, some could be worse. Nevertheless, the Turkish levels would not be that far off from the global course of the pandemic.

[19] https://www.oecd.org/sti/ind/inter-country-input-output-tables.htm

usages of industry i in country c from any industry in any country. In case of ICIO, we have 36 industries and 69 entities (corresponding to 65 countries), giving us a matrix of 2484 $\times$ 2484 entries. The final demand vector has 2484 entries and we will index the entries of this vector by j corresponding to each country-industry combination. By dividing the rows of ICIO matrix with the total output of industry j, we obtain the direct requirements matrix A. This matrix summarizes the usage of each intermediate input to generate $1 worth of output. Output of each industry is either used as intermediate input or consumed as final demand. Using matrix notation, we can decompose the output into intermediate and final usage as:

$$Y = AY + F \tag{18}$$

Here, Y denotes the output vector and F denotes the final demand vector. Therefore, we can solve for the output to satisfy the final demand as:

$$Y = (I - A)^{-1} F \tag{19}$$

Using the demand change from Equation (17) during the infection, the demand channel changes the output to:

$$Y_t^D = (I - A)^{-1} (\tilde{F}_t). \tag{20}$$

where Y_t^D represents the output and $\tilde{F}_t$ represents the vector of demand at time t. Note that the demand change is a function of number of infected individuals at a given time, hence the output also changes with the dynamics of pandemic.

3.4 Equilibrium

We have two channels present in the economy. On the supply side, as the workers become infected and cannot work until they recover from the disease, production decreases due to a reduction in labor supply during the pandemic period. The output changes to Y^S in Equation (15). On the demand side, the consumer preferences suddenly and temporarily change following the COVID-19 outbreak. The output, in this case, is denoted by Y^D in Equation (20). In equilibrium, initially we expect the production to decrease to the minimum levels implied by the demand side and the supply side. In other words, during the times of pandemic, we expect the output vector to be:

$$Y_t^{EQ} = \min(Y_t^S, Y_t^D) \tag{21}$$

where min represents element by element minimum function for two vectors, namely Y_t^S and Y_t^D. Consequently, we expect that in early days of the pandemic period, demand side prevails, whereas in later days of the pandemic period, the supply side prevails.

3.5 Data

In our analysis, we use OECD ICIO Tables for 2015. As industrial classification, OECD uses an aggregation of 2-digit ISIC Rev 4 codes to 36 sectors. Throughout our analysis, we will make use of this classification labeled as OECD ISIC Codes.

To calculate the industry level teleworkable share and the physical proximity measures, we use the occupational composition of the industries. We use the list provided by Dingel and Neiman (2020) for the occupations which can fulfill their tasks remotely For the workers that continue to do their jobs on-site, we assume that the infection rate depends on the physical proximity that is required in their workplace. To calculate the proximity requirements for the occupations, we use the self-reported Physical Proximity values available in the Work Context section of the O*NET database.[20] We divide the O*NET categories into 3 to have values larger than 1 if the reported category for the physical proximity is 3 (Slightly close (e.g., shared office)) or higher. We create a single proximity value for each occupation by weighting the normalized score with the percentage of answers in each category. To obtain industry-level teleworkable share and proximity values, we calculate the weighted average of the values corresponding to the occupations in each industry using the Occupational Employment Statistics (OES) provided by the U.S. Bureau of Labor Statistics (BLS). OES data follows four-digit NAICS codes to classify industries. In order to convert proximity data to OECD ISIC codes, we make use of the correspondence table between 2017 NAICS and ISIC

[20] "O*NET OnLine Help: Find Occupations." O*NET OnLine, National Center for O*NET Development, www.onetonline.org/help/online/find_occ. Accessed 1 April 2020. Dingel and Neiman (2020) also use several measures from O*NET to identify which occupations are teleworkable.

Revision 4 Industry Codes, provided by the U.S. Census Bureau. We provide the teleworkable share and the proximity index for the industries in Table A.2 of the Appendix.

We obtain employment data from the Turkish Social Security (SGK) Agency. SGK follows four-digit NACE Revision 2 codes to classify industries. In order to aggregate employment data to 36 OECD ISIC codes, we make use of the Eurostat correspondence table between NACE Revision 2 and ISIC Revision 4 Industry Codes. SGK lacks the data on the number of employees working in the "Public Administration Sector," so we fill this information using the relevant data provided by the President's office.

We used publicly available data and credit card spending data from the Central Bank of Republic of Turkey (CBRT) to calculate the estimated demand changes during the pandemic in each industry. The list of OECD ISIC industries, and the expected changes are listed in Table A.3 of the Appendix along with explanations. In Table A.5 of the Appendix, we provide the matching we used with CBRT spending data and OECD ISIC industries.

Under full lockdown, only a few industries are active. We use the decree issued by Turkish Ministry of Interior on April 10, 2020 to identify these industries. This lockdown was for only two days and did not include some critical sectors. We supplemented the list with the food sector and household and sanitary goods. The list of these sectors is given in Table A.4 of the Appendix. From these industries and using the employment data at 4 digits, we calculated the share of each OECD ISIC industry that would remain active during the lockdown. Finally, we calculated the share of public employees that are not affected by the lockdown using the publicly available information, which is listed in Table A.6 of the Appendix.

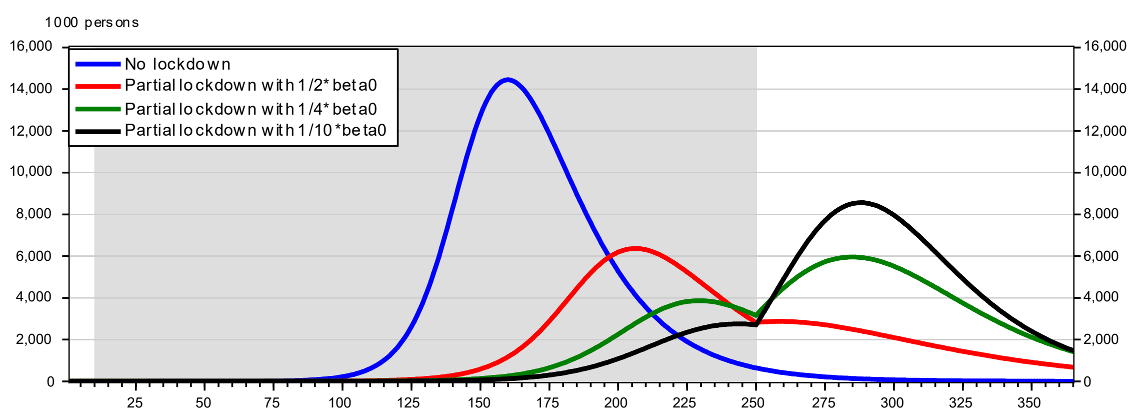
4 Findings

4.1 Economic Costs under Alternative Scenarios

In this section, we illustrate the consequences of alternative lockdown scenarios within our framework. In these scenarios, we impose changes on β_0 (i.e., the infection rate of the non-working population) and possibly on β_i for (i.e., the infection rate of the working population in industry i). Furthermore, we assume that the pandemic is successfully contained if the number of total infections declines to 5000 after observing the peak.[21]

We start with the no lockdown scenario and compare it to the partial lockdown where certain restrictions are imposed on daily life while businesses remain open. This implies that under partial lockdown β_0 is diminished compared to the case where no action is taken, but β_i for $i = 1, \ldots, K$ remain unchanged. We consider three cases of partial lockdown where the infection rate, β_0 is reduced by the proportion of 0.5, 0.25 and 0.10 compared to the reference setting. Figure 3 displays the evolution of the number of infected patients under these four scenarios when a hypothetical lockdown is implemented for 240 days, starting early on the 10^{th} day and remains active until the 250^{th} day.

Figure 3: No lockdown versus Partial Lockdown Scenarios



As can be seen from the figure, in case no action is taken against the COVID-19 pandemic, which is shown with the blue line, the pandemic advances at a rate implied by the benchmark reproduction rate of $R_0 = 2$. This implies that the pandemic reaches its peak around the 150^{th} day with a total toll of around 14 million infections. Following this state of "herd immunity", the number of infections starts to decline. After approximately 300 days, the virus is taken under control. Under the no

[21]We note that the 5000 threshold that is assigned for the containment of the pandemic differs from the notion of Critical Community Size (CCS) (Bartlett, 1960). CCS is the threshold for the number of susceptible individuals to die out by itself. Instead, the 5000 threshold that we set in the model represents the number of infectious individuals who can be feasibly tested, traced, and eventually quarantined so that the pandemic can be contained successfully. We assume that for each infected individual, we need to test ten additional people on average. Thus, if there are 5000 patients, tracing the infection requires about 50,000 tests, which is close to the current testing capacity in Turkey.

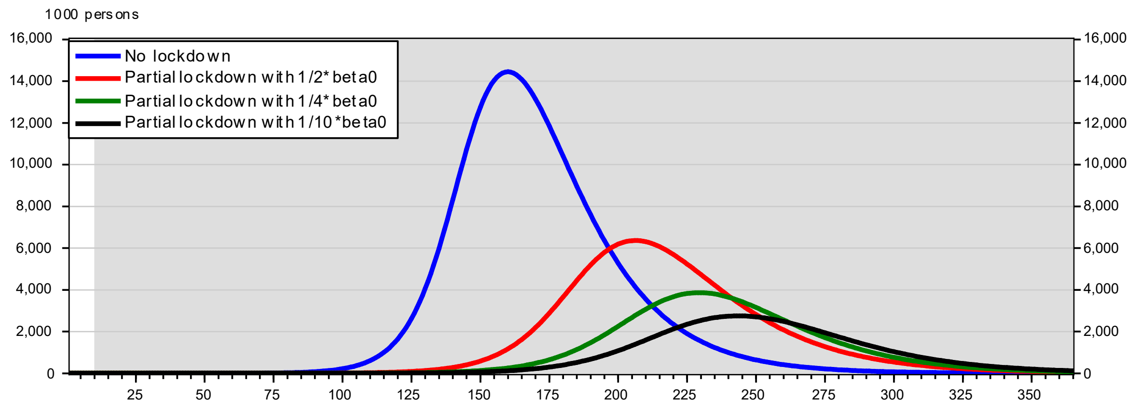
lockdown scenario, 1.13 percent of the population dies if we assume a 1.5 percent mortality rate. The GDP declines 11.0% in this case. We should note that the economic costs that are expressed in terms of GDP should not be misinterpreted as annual growth forecasts. We merely express the cost of the lockdown in terms of the GDP.

Under partial lockdown scenarios, the reproduction number declines below 2 due to lower infection rates but remains above 1 in all three scenarios. Specifically, we assume that the lower infection rate dampens the rate at which the pandemic evolves, nevertheless it is not sufficient to contain it altogether. This is due to the fact that businesses remain open, which feeds the virus within the industries and affects the overall course of the pandemic. If the infection rate is relatively high ($0.5 \times \beta_0$), which is shown with the red line, the GDP declines 11.6 percent. If the infection rate is moderate ($0.25 \times \beta_0$), shown with the green line, the GDP declines by 10.9 percent. If the infection rate is relatively low ($0.1 \times \beta_0$), shown with the black line, the GDP declines by 10.5 percent.

None of the 240-day partial lockdown scenarios that we considered in Figure 3 were successful in containing the pandemic. When the lockdown is removed on day 250, all three partial lockdown scenarios have approximately the same number of infections. Once the lockdown is removed, however, the virus follows a different course in each scenario. For the low infection rate scenarios (green and black lines) the number of new cases increase rapidly, leading to peak levels within 50 days after the lockdown. Meanwhile the high infection rate and no lockdown scenarios show a steady decline (the blue and red lines). This is because less people get infected during the partial lockdown (and get immunity) under the low infection rate scenarios, shown by the area under the black and green lines. Hence, by the time the lockdown is removed, the number of susceptible people are significantly higher under the low infection rate scenarios, increasing the effective R_0 ($= \beta/\gamma$). Thus, in the absence of an efficient drug or vaccination, a partial lockdown may need to continue indefinitely, until the number of cases decline to 5000. Figure 4 shows the simulation results if the partial lockdown lasts for a full year. As in Figure 3, we assume that the industries are operating as usual and thus β_i's (for $i = 1, \ldots, K$) remain unaffected.

Compared to Figure 3, we observe that the main advantage of an extended partial lockdown is that it flattens the curve by spreading the number of infections over time and allowing for a larger recovery rate. In terms of the economic costs, the additional economic costs of the longer partial

Figure 4: Alternative Scenarios under Partial Lockdown for the Full Year

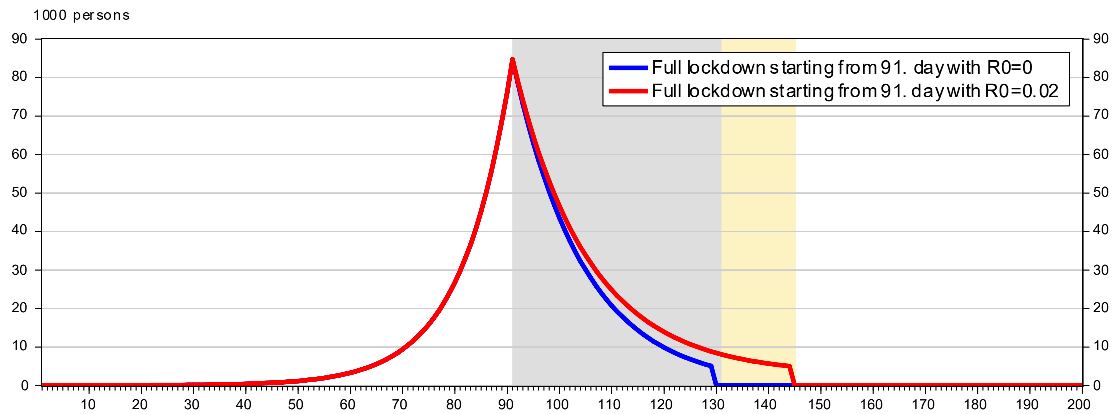


lockdown hover around 0.5 percent of the GDP. The added costs despite the extended duration of the lockdown are limited. This is due to the fact that the decline in demand already reaches a maximum level at the earlier stages of the lockdown and successive reductions in production only reflect the decline in supply due to increased number of infections.

Figure 5 illustrates the implications of our model under full lockdown. If the lockdown is put into practice when the number of infections is around 80,000, a fully effective procedure lowers the reproduction rate to zero ($R_0 = 0$), which is shown by the blue line, and contains the pandemic within 39 days (the gray shaded area). The consequent decline in GDP is about 4.5 percent. If the lockdown is not very effective and the infection continues to spread with some minimal reproduction number ($R_0 = 0.02$), then the duration of the lockdown increases by 15 days (yellow shaded area) to 54 days and the GDP declines by 5.6 percent.

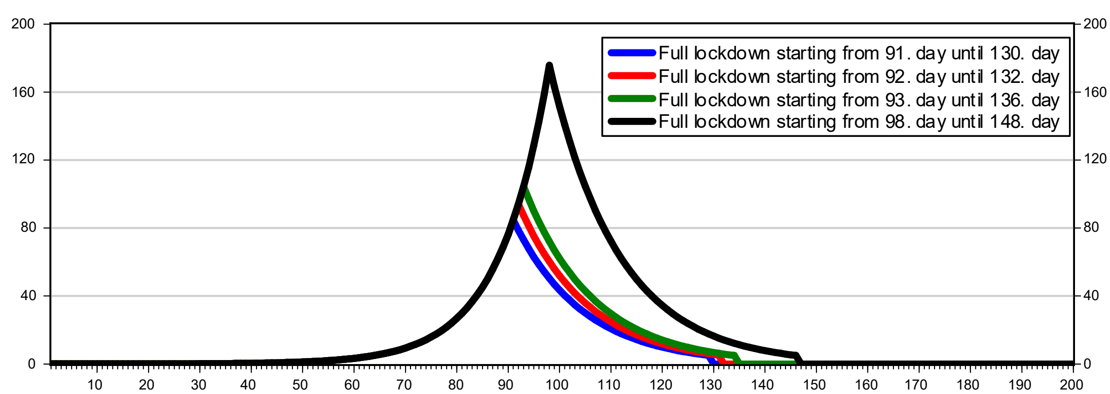
The costs of delaying the full lockdown are shown in Figure 6. The benchmark scenario that is illustrated in Figure 5 is shown with the blue line. If the lockdown is delayed by only one day, the number of infections increases by more than 10,000. In the model, we assume that the number of infections increases faster than the official statistics, which report only the tested patients. Under these circumstances, a 39-day lockdown is no longer sufficient to control the pandemic. Thus, in exchange for a one-day delay, the lockdown needs to be extended by two more days (the red line), which increases the costs of the lockdown to 4.7 percent of the GDP. If there is a two-day delay (the

Figure 5: Alternative Scenarios under Full Lockdown



green line), this time the duration of the lockdown increases to 43 days and the decline in GDP is 4.9 percent. If the lockdown is delayed by one week (the black line), the decline in GDP is 5.8 percent. After 100 days, the virus starts to spread again and hence prematurely ending the lockdown is rather ineffective.

Figure 6: Costs of Delay in Implementing Full Lockdown



As we compare the economic costs under full lockdown (Figures 5 and 6) with those of partial lockdown (Figures 3 and 4), we note that the costs of full lockdown are lower than any of the partial lockdown scenarios.

As we compare the the number of deaths under alternative scenarios, we observe that 0.001 percent of the population dies under an effective full lockdown, compared to 1 percent of the population under no lockdown and about 0.8 percent of the population under partial lockdown scenarios that last for 250 days. If the partial lockdown is extended to a full year, then the number of deaths decline to about 0.5 percent of the population.

4.2 Sectoral Breakdown of Economic Costs

In this section, we illustrate how the economic costs related to the COVID-19 virus differ across industries under the alternative lockdown scenarios mentioned in the previous section. Figures 7–9 count the days in which output implied by the demand channel or supply channel prevails to bring about the equilibrium output in a given industry. Among the 35 industries,[22] we focus on the top ten industries that are most adversely affected from the pandemic.

To interpret the findings present in these figures, we consider several scenarios: Figure 7 compares the no lockdown (blue line in Figure 3) scenario against full and effective lockdown (blue line in Figure 5), and full and less effective lockdown (red line in Figure 5). Panel (a) suggests that under the no lockdown scenario, the demand channel, shown by the red bars, drives output in almost all days until the virus is fully contained. The supply channel, shown by the blue bars, prevails only in the early days of the pandemic. Among the 35 industries, "Accommodation and food services," "Arts, entertainment, recreation and other service activities," and "Textiles, wearing apparel, leather and related products" are those that result in the highest economic costs of 36 %, 33 %, and 27% of the GDP, respectively. This is not only because goods produced in those categories (which are mostly in the services sector) cannot be consumed from home, but also because people prefer delaying their consumption until the uncertainty regarding the containment of the pandemic resolves.

Under the full lockdown scenario, the supply channel drives output due to the closure of all non-essential industries, whereas the demand channel prevails approximately 30 days before the restrictions are implemented (Figure 7 Panel (b)). Among the 35 industries, "Accommodation and food services," "Textiles, wearing apparel, leather and related products" and "Mining and non-

[22] We use OECD ISIC Codes to categorize the economy into 35 different industries, which are listed in the first column of Table A.2

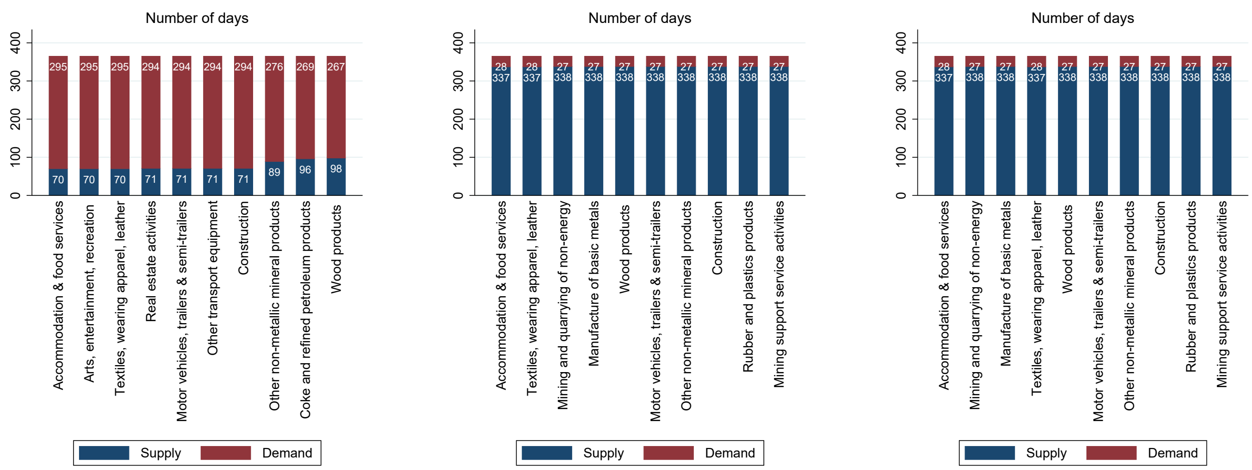
quarrying of non-energy producing products" are those that result in the highest economic costs of 12%, 10%, and 9.9% of the GDP, respectively. Panel (c) shows the less effective full lockdown scenario where the infection continues to spread at a low rate. We note that the sectoral composition is very similar to Panel (b).

Figure 7: Lockdown Scenarios

(a) **Scenario 1:** No Lockdown, $\beta = 0.14$

(b) **Scenario 2:** Full Lockdown, 91-131, R_0 =0

(c) **Scenario 3:** Full Lockdown, 91-145, R_0 =0.02

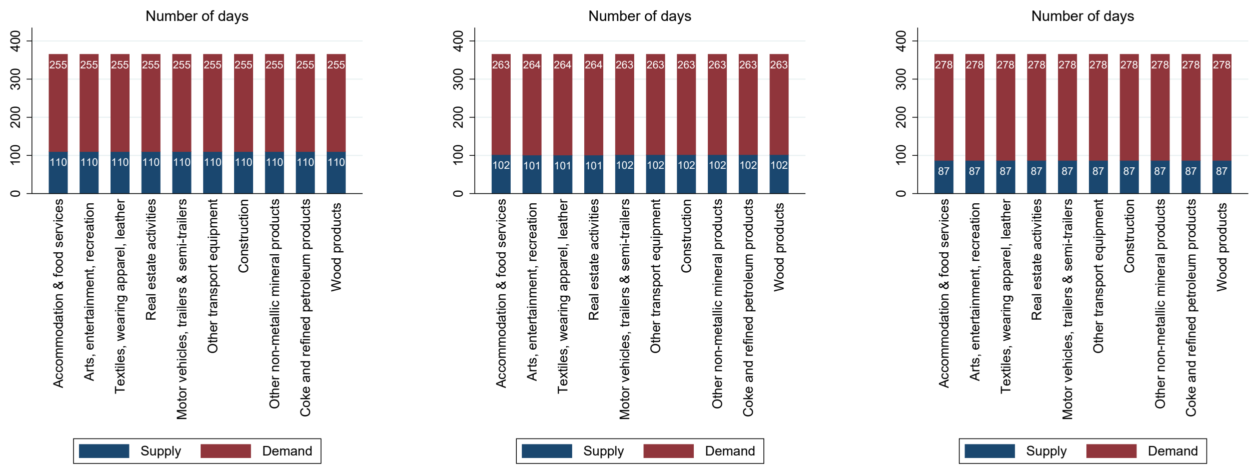


NOTES: In this figure, each bar shows the number days in which the supply channel (shown by the blue bars) or the demand channel (shown by the red bars) prevails to bring the economy into equilibrium in a given industry. The panels show three alternative scenarios: (a) No action is taken against the COVID-19 pandemic; (b) A lockdown is put into practice between the 91^{th} and 131^{st} days of the pandemic and is fully effective with zero reproduction number; (c) A lockdown is put into practice with some minimal reproduction number (R_0 =0.02) between the 91^{th} and 145^{th} days of the pandemic. In each sub-figure, the industries are ranked in a descending order according to the magnitude of economic costs (in terms of GDP) under the corresponding scenario.

Figure 8 considers the three partial lockdown scenarios that were illustrated in Figure 4. Panel (b) shows that under partial lockdown that is put into practice between 10^{th}-250^{th} days of the pandemic and evolves with a moderate infection rate ($0.25 \times \beta_0$), the supply channel dominates in the first 100 days of pandemic. On the other hand, demand drives output for the rest of the year, including the days in which new peak levels are reached after the partial lockdown is prematurely removed. This is because of the fact that businesses remain open, which feeds the virus within the industries and increases the uncertainty about the containment of the pandemic. Among the 35 industries, "Accommodation and food services," "Arts, entertainment, recreation and other service activities," and "Textiles, wearing apparel, leather and related products" are those that result in highest economic costs of 36%, 34%, and 27% of the GDP, respectively. The sectoral compositions are comparable for alternative rates of infection as shown in Panels (a) and (c).

Figure 8: Lockdown Scenarios

(a) **Scenario 4:** Partial Lockdown, 10-250, $0.1 \times \beta_0$ (b) **Scenario 5:** Partial Lockdown, 10-250, $0.25 \times \beta_0$ (c) **Scenario 6:** Partial Lockdown, 10-250, $0.5 \times \beta_0$



NOTES: In this figure, each bar counts the number of days in which the supply channel (shown by the blue bars) or the demand channel (shown by the red bars) prevails to bring the economy into equilibrium in a given industry. The panels stand for three alternative scenarios: (a) A partial lockdown is put into practice between 10^{th}-250^{th} days of the pandemic that evolves with a relatively low infection rate ($0.1 \times \beta_0$); (b) A partial lockdown is put into practice between 10^{th}-250^{th} days of the pandemic that evolves with a moderate infection rate ($0.25 \times \beta_0$); (c) A partial lockdown is put into practice between 10^{th}-250^{th} days of the pandemic that evolves with a relatively high infection rate ($0.5 \times \beta_0$) In each sub-figure, the industries are ranked in a descending order according to the magnitude of economic costs (in terms of GDP) under the corresponding scenario.

Figure 9 presents the analogous analysis if the partial lockdown is extended for a year. Compared to Figure 8 we note that the additional economic costs of the extended partial lockdown are limited. Specifically, among the 35 industries, "Accommodation and food services," "Arts, entertainment, recreation and other service activities," and "Textiles, wearing apparel, leather and related products" are those that result in the highest economic costs of about 35%, 33%, and 26% of the GDP, respectively.

4.3 Taking Stock

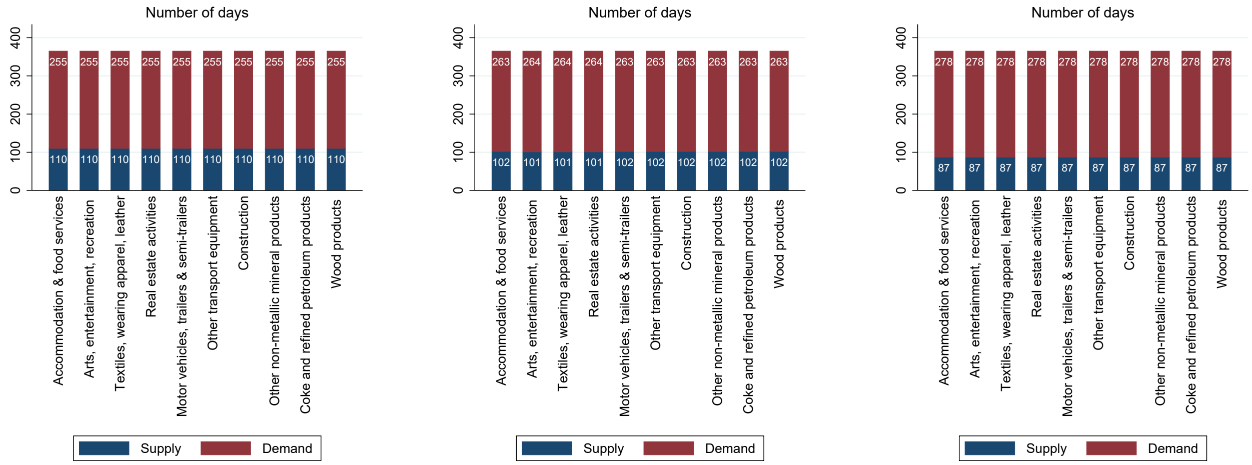
When we look at the experiences of the countries over the course of the pandemic, we note that there are several paths adopted by different countries:

Figure 9: Lockdown Scenarios

(a) **Scenario 7:** Partial Lockdown, 10-365, $0.1 \times \beta_0$

(b) **Scenario 8:** Partial Lockdown, 10-365, $0.25 \times \beta_0$

(c) **Scenario 9:** Partial Lockdown, 10-365, $0.5 \times \beta_0$



NOTES: In this figure, each bar counts the days in which the supply channel (shown by the blue bars) or the demand channel (shown by the red bars), prevails to bring the economy into equilibrium in a given industry. The panels stand for three alternative scenarios: (a) An "extended" partial lockdown is put into practice between 10^{th}-365^{th} days of the pandemic that evolves with a relatively low infection rate ($0.1 \times \beta_0$); (b) A "extended" partial lockdown is put into practice between 10^{th}-365^{th} days of the pandemic that evolves with a moderate infection rate ($0.25 \times \beta_0$); (c) A "extended" partial lockdown is put into practice between 10^{th}-365^{th} days of the pandemic that evolves with a relatively high infection rate ($0.5 \times \beta_0$) In each sub-figure, the industries are ranked in a descending order according to the magnitude of economic costs (in terms of GDP) under the corresponding scenario.

(i) **Full lockdown:** New Zealand and Denmark provide good examples for an effective full lockdown. Our analysis indicates that this is the policy that minimizes economic costs by containing the pandemic in the most effective way.

(ii) **No lockdown followed by a full lockdown:** At the beginning of the crisis, UK adopted a no lockdown approach to develop "herd immunity." However, this approach was abandoned later on due to public pressure as the death toll rose. UK then adopted a full lockdown policy to contain the pandemic. Our analysis indicates that if the lockdown was not delayed, there would be less mortality and the economic costs would be lower because the lockdown would begin with a smaller number of infections.

(iii) **Partial lockdown followed by full lockdown:** Many countries followed this route including Italy, France, Germany, Spain, Iran, Russia among others. Several of these counties recently announced that they will gradually lift restrictions. Similar to (ii), the duration of the full lockdown is longer than it could have been, had it been implemented earlier. In Italy, for example, a full lockdown went into effect on March 10, and the restrictions are announced to be removed by May 4, after approximately two months under full lockdown.

(iv) **Enhanced Partial lockdown:** Turkey started with immediate partial lockdown measures which were enhanced over the course of the pandemic. Schools were closed on March 16 and the businesses were encouraged to work remotely where possible. On March 21, a curfew was imposed for people above the age of 65 and those with chronic diseases. The curfew was extended to those younger than 20 on April 5, effectively putting close to 40% of the population under full lockdown. Furthermore, a full lockdown was implemented on weekends and national holidays starting on April 9 in 31 largest cities which constitute approximately 87% of the population.[23] After about 45 days since the beginning of enhanced partial lockdown measures, R_0 is reduced below 1 and the number of new patients is lower than the number of recovered patients as of the last week of April.

Where does this take us? Our analysis indicates that a full lockdown at the early stages of the crisis brings the pandemic under control quicker and yields the lowest economic costs. If an enhanced partial lockdown is already in place, which is successful in lowering R_0 below 1, then the need for full lockdown may not be imminent. However, our results reflect that the duration of the lockdown would have been shorter if more restrictive measures were adopted right away. The takeaway at this stage is that if a second wave of the COVID-19 virus hits, then an immediate and potentially global lockdown would work in the most effective way.

5 What are the policy options?

The previous section illustrated the economic costs of the pandemic due to a fall in the GDP given the large supply and demand shocks for a small open economy. A lockdown increases the short-term costs but increases the long-term gains by leading the way to a faster recovery. One of the shortcomings of the model is that it does not incorporate the damage to the productive capacity

[23]These cities include the 30 metropolitan municipalities and Zonguldak, which constitute close to 79% of the population. On top of these, the age-based restrictions are intact in the rest of Turkey, which increases the number close to 87%.

that are caused by company closures. We simply assume that the productive capacity remains intact and the companies jump back to production once the pandemic is over. This is an overly optimistic assumption and in the absence of a comprehensive support program, the liquidity issues would turn into solvency issues. This could lead to unnecessary bankruptcies, a deeper recession and a sluggish recovery.[24] Indeed, this is exactly why our estimates in the previous section should be interpreted as the approximate costs of a domestic stimulus package that is necessary to offset the damages of the COVID-19 crisis and keep the economic units alive.

A quickly implemented stimulus package that compensates the income loss due to the lockdown and enables a faster recovery would minimize the long term damage in the production capacity. If the stimulus packages are delayed, on the other hand, more companies would fail, more workers would be laid-off, and demand would decline further. This would then feed into more bankruptcies and elevate the economic costs that quickly become unmanageable. In fact, just as a drowning person needs immediate help or else her organs start to fail, the economy needs immediate help before the companies start to fail. Thus, it is essential to provide fiscal transfers to ensure that the supply chains are not destroyed, the economic units are functional and ready to go back to production once the pandemic is contained and demand returns.

5.1 Quantitative Easing or Debt Monetization? What is the difference?

Our estimates in the previous section highlight that the current 100 bn TL (approximately $15 bn) stimulus package that is about 3.5 percent of the GDP is insufficient given the costs of the pandemic that is about 4.5 percent of the GDP under the most cost effective full lockdown scenario (which more than doubles when we consider partial lockdown scenarios). As we have shown earlier, among the G20 countries Turkey has one of the smallest relief packages.Clearly, policy accommodation should be expanded substantially in Turkey. But, where will the funding come from?

The buzz-word in advanced countries for the funding needed to deal with the crisis is "helicopter money." In economists' jargon, this is called monetary financing (or debt monetization) where the central bank prints money and transfers resources to firms and households either directly, as in the Federal Reserve's recent policy of purchasing commercial paper and corporate debt, or indirectly by

[24] See Kalemli-Özcan et al. (2019), and https://voxeu.org/article/proposal-negative-sme-tax

purchasing bonds and enabling the government to use the proceeds to deal with the crisis.

In the process of monetary financing of the debt, the central bank's balance sheet will enlarge, either through direct loans to institutions or through large scale asset purchases (i.e. the so called "quantitative easing" (QE) programs). In a QE, the central bank prints money and buys sizeable amounts of government bonds. In the recent history, this was observed after the Great Recession both in the US and in Europe. The advantage of money printing through direct loans is that it is drained more easily when the loans are paid back.

How is debt monetization different? A central bank typically purchases securities through open market operations to meet the liquidity needs, consistent with its goal of price stability. The technical difference between money printing through an open market purchase and monetizing the debt is slim (Mishkin, 2007). Thus, one might argue that QE policies are effectively debt monetization (Orphanides, 2017). The Federal Reserve begs to differ and argues that debt monetization refers to a "permanent" source of funding for the government by the central bank and separates QE policies from debt monetization.[25, 26] So as long as the central bank commits to inflation targeting and normalizes its balance sheet when inflationary pressures kick in, asset purchases in the form of QE are not considered debt monetization (Andolfatto and Li, 2013). Based on this nuance, one can argue that QE and debt monetization are "observationally equivalent" in the short run, and the difference becomes apparent in the long run, with the central bank's ability to shrink its balance sheets to counteract inflationary pressures. Hence, using the Federal Reserve's usage of the term, the criterion for bond purchases to be considered debt monetization is whether the central bank fails to drain the money effectively later on and the money remains in the system permanently such that it leads to inflationary pressures.

In advanced economies, the distinction between QE and debt monetization can be easier to ascertain where the inflation rate is well-anchored and central bank credibility is well established. In fact, the inflation rate has not exceeded the 2 percent target in the US or Europe in the aftermath of

[25] In the FAQs prepared by the Federal Reserve Board (https://www.federalreserve.gov/faqs/money_12853.htm), it is noted that "The term "printing money" often refers to a situation in which the central bank is effectively financing the deficit of the federal government on a permanent basis by issuing large amounts of currency. This situation does not exist in the United States."

[26] In response to a question from the lawmakers on June 3, 2009, then-chairman Bernanke had noted that the "Federal Reserve will not monetize the debt": https://www.c-span.org/video/?c4546512/user-clip-bernanke-debt-monetization

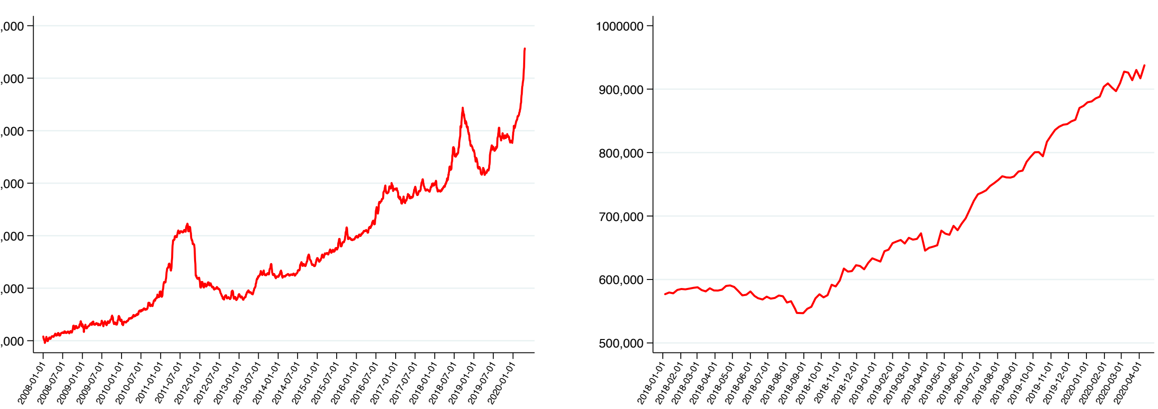
large scale quantitative easing policies after the Great Recession. The distinction between QE and debt monetization gets blurry in the context of an emerging market like Turkey, however. Even though Turkey adopted implicit inflation targeting as early as 2003 and explicit inflation targeting in 2006, central bank credibility is shaky and price stability is not well established.

Following the Federal Reserve's usage of the term, the above discussion suggests that in order for QE to be a viable policy alternative in Turkey, it should be distinguished from debt monetization that leads to an increase in inflation. The key to successful monetary financing is policy credibility. Unfortunately, Turkey scores low on this front. A badly managed QE would erode whatever credibility the monetary policy making has left in Turkey and de-anchor inflation expectations further. This would only escalate the existing crisis by pushing the inflation rate on a higher trajectory and causing sharp depreciations in TL. Hence, if it is not executed properly and the money is not drained from the system at the right time, QE can turn into inflationary debt monetization. The rapid increase in the monetary base since the beginning of April (Figure 10a) combined with the increase in CBRT's bond holdings (Figure 10b) is concerning in this regard, because it reflects sizable bond purchases in the absence of a well defined and transparent QE program (Figure 10a)

Figure 10: CBRT Actions

(a) Evolution of Monetary Base

(b) CBRT's Holdings of Government Bonds



NOTES: (a) This figure plots the evolution of monetary base for Turkey. Monetary base is expressed in terms of millions of TL; 10-days moving average. (b) This figure plots the holdings government bonds of the CBRT. Source: Turkey Data Monitor

If you face a 1.5 percent inflation rate as in the US, and a deep recession is on its way, inflationary consequences of QE may not be imminent. This is because the public does not expect inflation to get out of control despite these excessive measures. There is still belief that the Fed will drain the money from the system at the right time and establish price control. Furthermore, because market participants do not expect the US government to default on its debt, there will not be a sharp decline in demand for US government bonds, which will keep interest rates under control.

Things are different in Turkey. Turkey could hardly reach its 5 percent inflation target even at the most favorable times and gave into populist policies. Central Bank credibility eroded substantially over the course of years (see Cakmakli and Demiralp (2020)). Thus, mismanaged debt monetization can lead Turkey all the way to hyperinflation. The way to prevent inflation is to drain the money effectively just as demand starts to pick up. The past inflation performance suggests that this is a rather challenging task for the CBRT. Without policy credibility, the increase in inflation expectations and the associated risk premium can end badly.

What should be done to defeat these challenges and implement a successful QE program? The ultimate goal is to convince the market participants that QE will not turn into inflationary debt monetization. That is, CBRT will not effectively finance the government deficit on a permanent basis and the money will be injected and drained from the system in a very transparent way. An opaque QE that merely inflates the monetary base without explaining the calendar through which government bonds are purchased and where the money is spent would most likely backfire and risk inflationary pressures and excessive currency depreciation. Unfortunately, the current policy implementation in Turkey very much resembles our definition of an opaque QE and it is worrisome.

Instead, a QE program that determines priorities accurately to channel limited resources, and signal the correct messages going forward would have a chance to be successful. Such a program should clearly spell out a detailed bond purchase calendar with spending targets and the conditions under which the money will be drained from the system. One way to increase the transparency of QE could be through a Special Purpose Vehicle (SPV). An SPV would allow CBRT to buy government bonds through this entity and separate these COVID-19 related bond purchases from the daily maintenance of monetary policy. The extent of monetary expansion that is solely due to COVID-19 crisis could be easily trackable in this manner. In turn, the money that is generated through this program should be spent in targeted sectors and announced by the government.

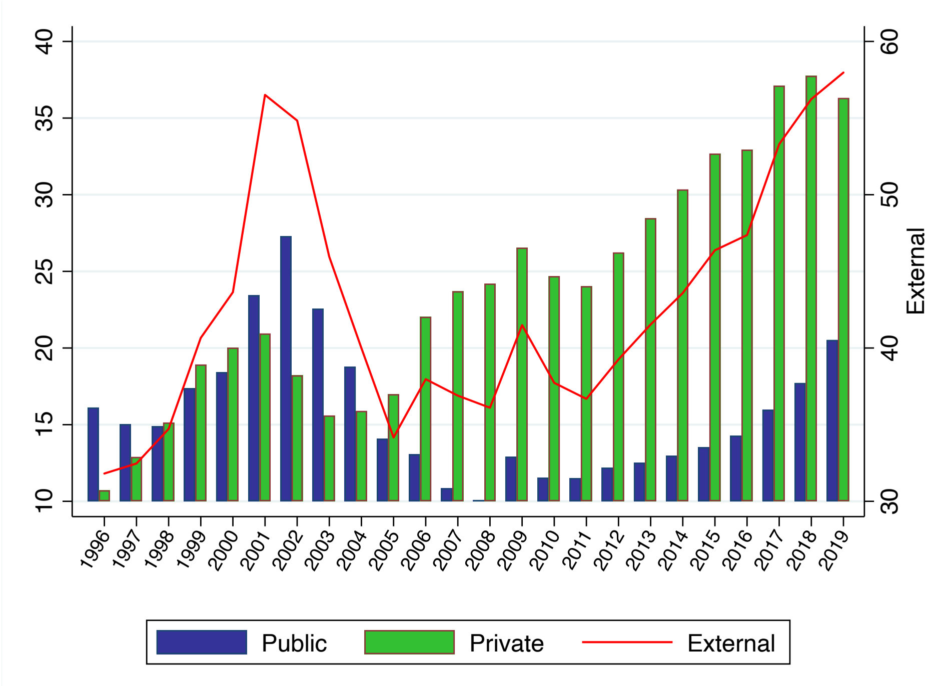
While a transparent and well executed QE would provide immediate funding that is necessary to deal with COVID-19 crisis, it would be insufficient to contain it. The first step to deal with COVID-19 crisis is to provide TL liquidity through an extensive stimulus program to keep the economic units alive during the lockdown. A well-executed QE could address the first leg without triggering inflationary expectations. The second step is to supplement the first leg with foreign capital. Increasing the domestic money supply in the absence of FX inflows would unavoidably cause significant depreciation in the Turkish Lira and trigger the inflation rate. Given Turkey's Achilles heel, foreign financing needs and foreign currency debt with low foreign currency reserves, policy credibility is essential. In fact, the domestic macroeconomic policies that we formulate to deal with the crisis cannot be developed independent of the external/exchange rate policies. Cooperation with an international organization is essential at this point, which would not only help at the first leg but more importantly, it would help secure FX during a sudden stop crisis and improve policy credibility. The cheap source of external funding that is granted through a credible international institution would keep inflation expectations under control by preventing a sharp depreciation in TL. Furthermore, by ensuring the markets that TL liquidity will be spent at targeted sectors and it will be drained effectively, the presence of an international institution would keep inflationary expectations under control by supplementing the rather damaged credibility of CBRT. In the next section, we discuss the magnitude of external funding needs in Turkey to make the case for the importance of an external anchor.

5.2 External Funding Needs, Capital Controls, and the Role of External Anchor

Turkey relies heavily on capital flows to finance its external debt, which stood at 60 percent of GDP at the end of 2019. Figure 11 shows the changes in the composition of external debt over time. In 2001, total external debt was 57 percent of GDP. Of this, public sector debt was 24 percent, while the private sector debt was 22 percent. Macroprudential measures that were implemented in the aftermath of the crisis led to a substantial reduction in total external debt in the years immediately after the crisis. Nevertheless, the abundant liquidity provided by the major central banks in the post-2010 period changed the borrowing patterns in Turkey. The external debt gradually increased with the composition tilting towards private sector borrowing. By the time we reached 2019, total external debt was once again comparable to 2001 levels with 56 percent of the GDP. Different from

2001, however, this time the lion's share was held by the private sector debt which was 36 percent of the GDP while the public debt was 21 percent of GDP.

Figure 11: External Debt and its Decomposition



NOTES: This figure plots external debt (right x-axis) alongside with its debt composition (left x-axis) for Turkey. Debt values are expressed as percentage of GDP. Source: Turkey Data Monitor.

As of December 2019, out of a total external debt of \$437 billion, \$124 billion was short-term (17 percent of GDP), and \$93 billion of this was held by the private sector. Meanwhile, the external debt that needs to be rolled over in 2020 is \$169 billion, which is approximately 23 percent of GDP.[27] Depending on the rollover ratios, Turkey will likely need more than \$30 billion in 2020.[28]

Since the beginning of 2020, Turkey experienced capital outflows triggered by the geopolitical risks in the South East border. The outflows accelerated as COVID-19 spread globally and Turkey's risk premium, as measured by five-year CDS premium increased sharply as shown in Figure 12.

From the beginning of the year until the week of April 10, 2020, \$2.4 million of equity and \$5.0 million of government bonds held by foreign investors were sold-off to domestic investors in the

[27] We use the annual GDP of 2019 to express the January 2020 values as a percentage of GDP in this section.

[28] In a recent report, Bürümçekçi (2020) notes that the current rollover ratio for the banking system is around 73 percent, which receded to 45 percent during 2007-2009 crisis, and 35 percent during 2001 crisis.

Figure 12: The Risk Premium as Measured by CDS Spread

NOTES: This figure plots risk premimum for Turkey, which is measured by the 5-year CDS rate (World Government bonds) for Turkey. Source: Turkey Data Monitor.

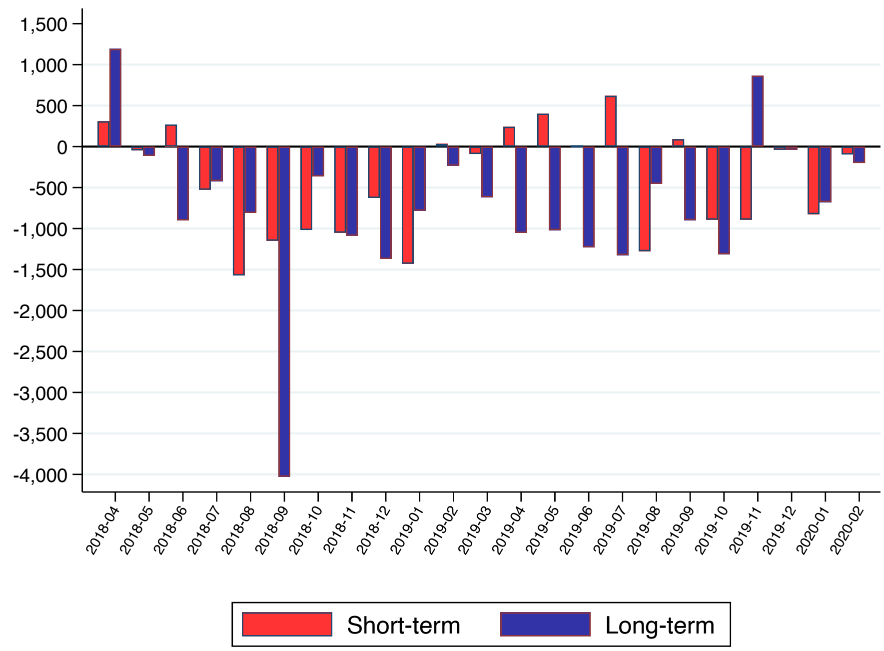
secondary market.[29] If we annualize these numbers, equity flows amount to 1.2 percent of GDP and government bond outflows amount to 2.5 percent of GDP. Notice that these are local currency government bonds that were held by foreign investors. These numbers suggest that, there is quite a bit of foreign investment still in the country given the extent of external debt.

In addition to bonds and equities held by nonresidents, more than 1/3 of total external funding is obtained through bank loans in Turkey. These loans finance the foreign currency debt in the non-tradeables sector. Half of the entire corporate sector debt is in foreign currency in Turkey and most of it is borrowed from domestic banks.[30] To dig deeper into the short-term risks, and considering the market dynamics in the aftermath of the 2007-2009 global financial crisis for EMs, we also need to look at cross-border loans. As shown in Figure 13, Turkish banks had been net payers in the external long-term loans for a while.

[29] As for corporate bonds, the sell off started in the last week of February but the total volume of these transactions are rather negligible with a total of $85 million outflow from January 3 to April 10, 2020. This is due to the low share of corporate bonds relative to bank loans and government bonds in external debt. See di Giovanni et al. (2019).

[30] See di Giovanni et al. (2019).

Figure 13: Rollovers of External Loans by Turkish Banks



NOTES: This figure plots rollovers of external loans belonging to Turkish Banks. Loan rollovers refer to monthly-net values expressed in terms of millions of USD. Source: Turkey Data Monitor.

In January 2020, Turkish banks paid to foreign financial institutions a net of \$0.8 billion over what they borrowed in short-term loans and \$0.7 billion in long-term loans, which amount to 1 percent of annual GDP. This suggests that they need to rollover (borrow) 1 percent of GDP each month to prevent any interruptions in their domestic lending at home. The net decline in rollovers were smaller in February.

The policy implications of the external picture is rather alarming: Considering the facts that (i) the total amount of external debt that needs to be paid or rolled-over in 2020 is 23 percent of GDP and (ii) the current open FX position of the entire corporate sector as of January 2020 (which is -\$175 billion) is almost 25 percent of GDP, it looks very unlikely that Turkey can meet its external funding needs in the risk-off environment of COVID-19 crisis. The rapid increase in our risk premium (Figure 12) raises our cost of external borrowing despite the decline in global interest rates. Indeed, even if Turkey offers higher rates to compensete the risk premium , this policy will most likely be ineffective and the TL will continue to depreciate as shown by Kalemli-Özcan (2019).

A swap agreement with the Federal Reserve could help. A recent Bloomberg news article noted that Turkey's application to be eligible for the swap lines were not considered favorably by the Federal Reserve.[31] An alternative could be IMF swap lines that are granted to address the liquidity needs arising from COVID-19 crisis.[32]

Yet another alternative is to introduce capital controls to trap both residents' and non-residents' foreign currency assets in Turkey. The trade-off with capital controls is that such controls might further erode the policy credibility and scare foreign capital during the recovery phase when it will be most needed, especially for a country who is already heavily dependent on external funding. Thus, capital controls can tilt the balance between quantitative easing and inflationary debt monetization towards the latter if policy credibility is eroded . Such controls can hinder external finance that will be needed throughout the entire recovery period. It could be argued that capital controls would prevent further dollarization that might be triggered by the TL liquidity injected through the QE program. This possibility can be eliminated by enhancing the policy credibility with an international institution and stabilizing the exchange rate in that manner, rather than imposing capital controls. This is because even if capital controls were only applied to residents' holdings of foreign currency deposits, this might either end up with a bank-run by residents and/or non-residents fleeing at a faster rate.

One final alternative is a debt moratorium on foreign lenders. However, since foreign lenders are private creditors (and not official creditors like the IMF or WB), this would involve complicated debt default and debt restructuring. Unless private creditors offer the moratorium in a synchronized way as suggested by Rogoff and Reinhart (2020), this would again hamper the medium to long-term credibility.

A transparent QE program can meet the immediate liquidity needs of a lockdown and can be complemented with guaranteed external finance through an international institution. This recipe is rather familiar in Turkey. 2001 crisis is a case in point. 2001-2002 crisis was a combination of banking crisis, sovereign debt crisis and a balance of payments crisis. During that time, Turkey did sizable

[31] The Bloomberg article titled "Only Question for Erdogan is Which Economic Taboo to Break" dated on April 9 is available here: https://www.bloomberg.com/news/articles/2020-04-09/only-question-left-for-erdogan-is-which-economic-taboo-to-break

[32] https://blogs.imf.org/2020/03/16/policy-action-for-a-healthy-global-economy/#.Xm9rH3Oc-7A.twitter

asset purchases under an IMF program, keeping inflation expectations in check with an inflation targeting framework. We will lay out the details of this episode in the next section.

6 Lessons from History: Debt Monetization under IMF program: Turkey, 2001-2002

When the financial crisis hit in February 2001, Turkey already had a standby agreement with the IMF, ongoing since December 1999.[33] State banks and Saving Deposit Insurance Fund (SDIF) experienced significant losses during the 2001 crisis, which elevated their liquidity needs. In order to meet their liquidity needs and recapitalize these institutions, government securities were transferred to these institutions. The securities were then sold to the CBRT to receive cash to cover their liquidity needs. In turn, the CBRT drained the excess liquidity through its overnight borrowing facility through conventional methods (i.e., reverse repo or its overnight borrowing facility) in order to prevent an unintended decline in market rates (see Statement of Intent, 2001).[34] When the ongoing 1999 program was deemed to be insufficient, a new and more comprehensive standby agreement was signed in 2002 which particularly aimed at lowering inflation expectations by strengthening policy credibility.[35]

The asset purchases that were undertaken in the post-2001 period took place at the same time Turkey started a new regime to take inflation under control. An amendment to the Central Bank Law (no: 1211) in 2001 granted operational independence. In the same amendment, it was stated that direct bond purchases from the government would continue until November 2001. The bond

[33] The history of lending arrangements with the IMF are available at the following link: https://www.imf.org/external/np/fin/tad/extarr2.aspx?memberKey1=980&date1key=2008-03-31

[34] https://www.imf.org/external/np/loi/2001/tur/02/index.htm

[35] As stated in Statement of Intent, 2001: "This program is a continuation of the one initiated in late 1999, with the support of a stand-by arrangement with the International Monetary Fund. It shares the same strategy: disinflate the Turkish economy, strengthen the fiscal accounts, and reform the structure of the Turkish economy as a condition for setting economic growth on a sustainable basis and moving Turkey closer to its goal of joining the European Union. However, the program's policies have been significantly strengthened, in response to the recent crisis that led to the float of the Turkish lira on February 22, 2001, including through increased emphasis on transparency, accountability, and good governance in both the private and public sectors. In support of our strengthened program, we request that the arrangement be augmented by the equivalent of SDR 6.3624 billion and that the purchases scheduled through end-2001 be rephased and would consequently be subject to reviews which are expected to be completed during May, June, July, September, and November 2001."

purchase program (debt monetization) was acknowledged in the 2002 agreement as well.[36]

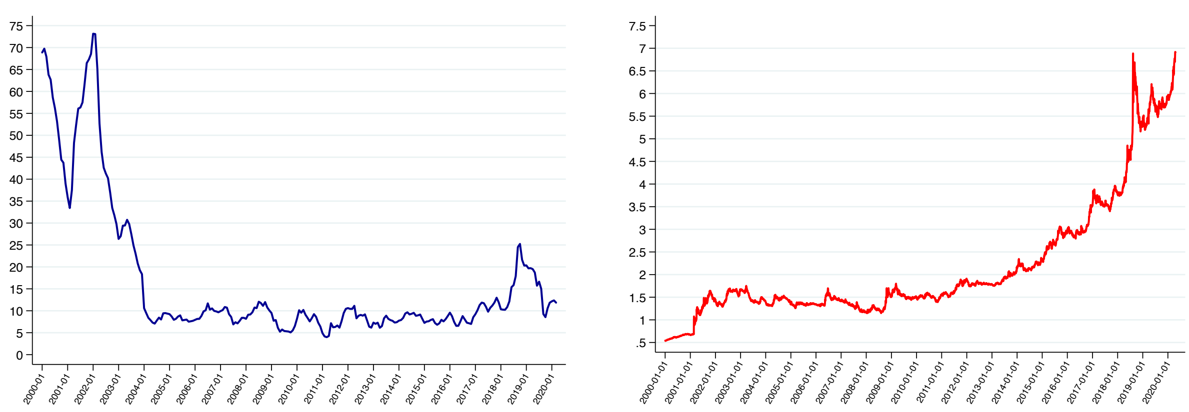
The 2002 standby agreement with the IMF not only met the external funding needs but it also provided the much needed credibility to boost confidence in the program and prevent excessive depreciation in the local currency. Furthermore, it limited domestic funding needs and hence restricted the volume of asset purchases, taking the pressure off inflation expectations. Once the liquidity needs subsided, the liquidity was drained from the system promptly and transparently. As a result of these coordinate efforts, there was a successful disinflation performance as shown below in the absence of volatility in the exchange rate (Figures 14a and 14b).

An essential part of disinflationary policies in the post crisis period involved lowering inflation expectations. The program anchored inflation expectations by ensuring that QE would not turn into debt monetization. In order to prevent QE from causing a substantive increase in inflation expectations and restore investor confidence in the program, public finance and debt management laws were introduced to improve fiscal transparency and accountability. Furthermore, the budgetary impact of the additional funds needed to restructure the banking system was offset by increasing public savings in other areas to keep the overall budget under control. This step limited the extent of public borrowing and prevented market interest rates from rising further.

Figure 14: Inflation and Exchange rate

(a) Inflation Rate

(b) USD/TL Exchange Rate



NOTES: (a) This figure plots inflation rate for Turkey, which measured as year-on-year change of CPI. (b) This figure plots USD/TL nominal exchange rate for Turkey. Source: Turkey Data Monitor

[36]https://www.imf.org/en/Publications/CR/Issues/2016/12/30/Turkey-2002-Article-IV-Consultation-and-First-Review-Under-the-Stand-By-Arrangement-Staff-15925

7 Conclusions

The cost of the COVID-19 crisis that we estimated in this paper is about 4.5 percent of the Turkish GDP (or approximately $34 bn) under the most cost effective full lockdown scenario. The upcoming external debt payment is 23 percent of the GDP. In the face of a major global crisis, it seems rather challenging for Turkey to roll over its foreign currency and local currency debt to foreign private creditors. The average emergency swap agreement granted by the IMF is about $11bn,[37] and the total outstanding amount granted by the Federal Reserve's international swap lines is $18.9 bn as of April 14.[38] These numbers imply that the arrangement of a swap line alone would likely be insufficient and should be accompanied by a more sizable international arrangement and monetary financing by the central bank.

At this point all the policy options should be on the table given the dynamic nature of this crisis with new information arriving every day. Supporting the economy through monetary financing/debt monetization contains substantial risks going forward. Nevertheless, the priority at the moment should be to keep the patient alive and minimize the risks. What would be the best way to go about this? Given the lack of credibility of CBRT and the increasing difficulties to meet external funding needs, we argue that the best combination is similar to our post-2001 experience with asset purchases supplemented with external funding.

[37]This estimate is based on the announcement by the IMF managing director on April 9, 2020 about the $1 trillion package to service 90 member states. https://www.imf.org/en/News/Articles/2020/04/07/sp040920-SMs2020-Curtain-Raiser

[38]As of 4/14/2020, amounts outstanding of US dollar liquidity swap is $18.9 billion (12.3 and 6.6 for South Korea and Mexico, respectively). Source: https://apps.newyorkfed.org/markets/autorates/fxswap On March 19, 2020, the Federal Reserve added temporary swap arrangements with Brazil as well, but no position is settled so far

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A APPENDIX

List of Tables:

Table A.1: FISCAL RESPONSES TO THE COVID-19 SHOCK IN THE G20 COUNTRIES

Country	% GDP	Explanation
Argentina	3	Adopted measures (totaling about 3.0 percent of GDP, 1.2 percent in the budget and 1.8 percent off-budget, based on authorities' estimates)
Australia	10.8	Total expenditure and revenue measures of A$194 billion (9.9 percent of GDP). The Commonwealth government has committed to spend almost an extra A$5 billion (0.3 percent of GDP). State and Territory governments also announced fiscal stimulus packages, together amounting to A$11.5 billion (0.6 percent of GDP)
Brazil	6.5	The authorities announced a series of fiscal measures adding up to 6.5 percent of GDP. Public banks are expanding credit lines for businesses and households, with a focus on supporting working capital (credit lines add up to over 3 percent of GDP), and the government will back a 0.5 percent of GDP credit line to cover payroll costs.
Canada	8.4	Key tax and spending measures (8.4 percent of GDP, $193 billion CAD).
China	3.8	An estimated RMB 2.6 trillion (or 2.5 percent of GDP) of fiscal measures or financing plans have been announced. The overall fiscal expansion is expected to be significantly higher, reflecting the effect of already announced additional measures such as an increase in the ceiling for special local government bonds of 1.3 percent of GDP.
France	19	The authorities have announced an increase in the fiscal envelope devoted to addressing the crisis to €110 billion (nearly 5 percent of GDP, including liquidity measures), from an initial €45 billion included in an amending budget law introduced in March. A new draft amending budget law has been introduced on April 16. This adds to an existing package of bank loan guarantees and credit reinsurance schemes of €315 billion (close to 14 percent of GDP).
Germany	31.6	The federal government adopted a supplementary budget of €156 billion (4.9 percent of GDP). The government is expanding the volume and access to public loan guarantees for firms of different sizes and credit insurers increasing the total volume by at least €757 billion (23 percent of GDP). In addition to the federal government's fiscal package, many state governments (Länder) have announced own measures to support their economies, amounting to €48 billion in direct support and €73bn in state-level loan guarantees (Authors: Another 3.7% of GDP).
India	1.1	Finance Minister Sitharaman on March 26 announced a stimulus package valued at approximately 0.8 percent of GDP. These measures are in addition to a previous commitment by Prime Minister Modi that an additional 150 billion rupees (about 0.1 percent of GDP). Numerous state governments have also announced measures thus far amount to approximately 0.2 percent of India's GDP.
Indonesia	2.8	In addition to the first two fiscal packages amounting to IDR 33.2 trillion (0.2 percent of GDP), the government announced a major stimulus package of IDR 405 trillion (2.6 percent of GDP) on March 31, 2020.
Italy	26.4	On March 17, the government adopted a €25 billion (1.4 percent of GDP) 'Cura Italia' emergency package. On April 6, the Liquidity Decree allowed for additional state guarantees of up to €400 billion (25 percent of GDP).
Japan	21.1	On April 7 (partly revised on April 20), the Government of Japan adopted the Emergency Economic Package Against COVID-19 of ¥117.1 trillion (21.1 percent of GDP)
Mexico	0.7	to request additional resources from Congress, that could reach up to 180 billion pesos (0.7 percent of 2019 GDP). AND The week of April 19 the President further announced an austerity program for public expenditures including wage reductions and a hiring in order to free up 2.5 percent of GDP to finance additional health expenditures and priority investment.
Republic of Korea	10	Direct measures amount to 0.8 percent of GDP (approximately KRW 16 trillion. On March 24, President Moon announced a financial stabilization plan of KRW 100 trillion (5.3 percent of GDP). This was augmented by a further KRW 35 trillion (1.8 percent of GDP) on April 22 through additional measures. On April 22, President Moon announced a key industry stabilization fund would be established for KRW 40 trillion (2.1 percent of GDP)
Russian Federation	2.1	The total cost of the fiscal package is currently estimated at 2.1 percent of GDP.
Saudi Arabia	5	A SAR 70 billion ($18.7 billion or 2.8 percent of GDP) private sector support package was announced on March 20. they will reduce spending in non-priority areas of the 2020 budget by SAR 50 billion (2.0 percent of GDP) to accommodate some of these new initiatives within the budget envelope. on April 3, the government authorized the use of the unemployment insurance fund (SANED) to provide support for wage benefits, within certain limits, to private sector companies who retain their Saudi staff (SAR 9 billion, 0.4 percent of GDP). On April 15, additional measures to mitigate the impact on the private sector were announced, including temporary electricity subsidies to commercial, industrial, and agricultural sectors (SAR 0.9 billion) and resource support to the health sector was increased to SAR 47 billion.
South Africa	0.2	https://www.globalpolicywatch.com/2020/04/south-africas-economic-response-to-the-covid-19-pandemic/
Spain	11.7	Key measures (about 1.6 percent of GDP, €18 billion; depending on the usage and duration of the measures the amount could be higher). In addition, the government of Spain has extended up to €100 billion government guarantees for firms and self-employed. Other measures include additional funding for the Instituto de Credito Oficial (ICO) credit lines (€10 billion); introduction of a special credit line for the tourism sector through the ICO (€400 million);
Turkey	2	A TL100 billion package was announced. This consists of TL75 billion ($11.6 billion or 1.5 percent of GDP) in fiscal measures, as well as TL 25 billion ($3.8 billion or 0.5 percent of GDP) for the doubling the credit guarantee fund.
United Kingdom	18.8	Policy measures adding £86 billion in 2020-21. Coronavirus business interruption loan scheme and the Covid Corporate Financing Facility: the business interruption loan scheme was announced as up to £330 billion of support for businesses. Source: https://obr.uk/coronavirus-reference-scenario/
United States of America	13.6	US$484 billion Paycheck Protection Program and Health Care Enhancement Act . An estimated US$2.3 trillion (around 11% of GDP) Coronavirus Aid, Relief and Economy Security Act ("CARES Act"). US$8.3 billion Coronavirus Preparedness and Response Supplemental Appropriations Act and US$192 billion Families First Coronavirus Response Act . They together provide around 1% of GDP.

NOTES: This table reports the COVID-19 relief packages (as percent of GDP) by the G20 countries along with the details of the fiscal packages. Source: IMF Policy Tracker unless otherwise noted. Access Date: April 29, 2020.

Table A.2: PROXIMITY INDEX AND TELEWORKABLE SHARE ACROSS INDUSTRIES

OECD ISIC Code	Definition	Proximity Index	Teleworkable Share
01T03	Agriculture, forestry and fishing	0.86	0.06
05T06	Mining and extraction of energy producing products	1.08	0.32
07T08	Mining and quarrying of non-energy producing products	1.06	0.14
9	Mining support service activities	1.21	0.20
10T12	Food products, beverages and tobacco	1.12	0.13
13T15	Textiles, wearing apparel, leather and related products	1.09	0.20
16	Wood and products of wood and cork	1.03	0.15
17T18	Paper products and printing	1.08	0.22
19	Coke and refined petroleum products	1.11	0.22
20T21	Chemicals and pharmaceutical products	1.06	0.25
22	Rubber and plastic products	1.10	0.18
23	Other non-metallic mineral products	1.08	0.18
24	Basic metals	1.09	0.14
25	Fabricated metal products	1.08	0.21
26	Computer, electronic and optical products	1.03	0.54
27	Electrical equipment	1.07	0.29
28	Machinery and equipment, nec	1.06	0.29
29	Motor vehicles, trailers and semi-trailers	1.09	0.19
30	Other transport equipment	1.06	0.31
31T33	Other manufacturing; repair and installation of machinery and equipment	1.07	0.32
35T39	Electricity, gas, water supply, sewerage, waste and remediation services	1.08	0.29
41T43	Construction	1.21	0.19
45T47	Wholesale and retail trade; repair of motor vehicles	1.13	0.37
49T53	Transportation and storage	1.18	0.21
55T56	Accomodation and food services	1.26	0.10
58T60	Publishing, audiovisual and broadcasting activities	1.11	0.69
61	Telecommunications	1.07	0.58
62T63	IT and other information services	1.01	0.88
64T66	Financial and insurance activities	1.02	0.79
68	Real estate activities	1.10	0.54
69T82	Other business sector services	1.09	0.46
84	Public admin. and defence; compulsory social security	1.16	0.39
85	Education	1.22	0.86
86T88	Human health and social work	1.28	0.35
90T96	Arts, entertainment, recreation and other service activities	1.18	0.34

NOTES: This table provides the physical proximity index along with the share of those who can work remotely for the industries. To obtain these two industry-level values, we calculate the weighted average of the values corresponding to the occupations in each industry using the Occupational Employment Statistics (OES) provided by the U.S. Bureau of Labor Statistics (BLS). OES data follows four-digit NAICS codes to classify the industries. In order to convert the proximity data to OECD ISIC codes, we make use of the correspondence table between 2017 NAICS and ISIC Revision 4 Industry Codes, provided by the U.S. Census Bureau. We obtain the physical proximity values at the occupation level from the O*NET datase. O*NET collects the physical proximity information through surveys with the following categories: (1) I don't work near other people (beyond 100 ft.); (2) I work with others but not closely (e.g., private office); (3) Slightly close (e.g., shared office); (4) Moderately close (at arm's length); (5) Very close (near touching). We divide the category values by 3 to make category (3) our benchmark. Specifically, a proximity value that is larger than 1 indicates a closer proximity than the "shared office" level, and a proximity value that is smaller than 1 corresponds to sparse working conditions. We create a single physical proximity value for each occupation by taking the weighted average of the normalized category values. We calculate the proximity values at the industry level after removing the teleworkable portion of the employees. We use Dingel and Neiman (2020)'s list of teleworkable occupations to capture the proportion of employment that can be fulfilled at remote locations in each industry.

Table A.3: DEMAND CHANGES ACROSS INDUSTRIES

OECD ISIC	Definition	Change	Explanation
01T03	Agriculture, forestry and fishing	100%	Effects of COVID-19 will be seen through intermediate linkages.
05T06	Mining and extraction of energy producing products	100%	Effects of COVID-19 will be seen through intermediate linkages.
07T08	Mining and quarrying of non-energy producing products	100%	Effects of COVID-19 will be seen through intermediate linkages.
9	Mining support service activities	100%	Effects of COVID-19 will be seen through intermediate linkages.
10T12	Food products, beverages and tobacco	120%	Effects of COVID-19 will be seen through intermediate linkages.
13T15	Textiles, wearing apparel, leather and related products	50%	Extreme declines in credit-card spending. We expect it to be higher due to non-credit card and transition of seasons. CBRT sector 9 (27%) https://www.nytimes.com/interactive/2020/04/11/business/economy/coronavirus-us-economy-spending.html
16	Wood and products of wood and cork	90%	We will assume that the decline in manufacturing to be 90% if we cannot find a reliable resource.
17T18	Paper products and printing	90%	We will assume that the decline in manufacturing to be 90% if we cannot find a reliable resource.
19	Coke and refined petroleum products	75%	Average of CBRT sector 4 (59%) and 90% (Average manufacturing decline).
20T21	Chemicals and pharmaceutical products	90%	Push and pull factors present. No reliable number. We will assume 90% inline with manufacturing. CBRT sector 19 (%60) https://www.nytimes.com/interactive/2020/04/11/business/economy/coronavirus-us-economy-spending.html
22	Rubber and plastic products	90%	We will assume that the decline in manufacturing to be 90% if we cannot find a reliable resource. https://www.plasticsnews.com/news/materials-firms-work-fortify-supply-chains-despite-coronavirus
23	Other non-metallic mineral products	90%	We will assume that the decline in manufacturing to be 90% if we cannot find a reliable resource.
24	Basic metals	90%	https://tr.steelorbis.com/celik-haberleri/guncel-haberler/abd-ham-celik-uretimi-haftalik-181-dustu-1141735.htm
25	Fabricated metal products	90%	We will assume that the decline in manufacturing to be 90% if we cannot find a reliable resource to estimate.
26	Computer, electronic and optical products	120%	From CBRT sector 8.
27	Electrical equipment	90%	We will assume that the decline in manufacturing to be 90% if we cannot find a reliable resource to estimate. https://www.ibisworld.com/industry-insider/media/4637/covid-19-special-report.pdf
28	Machinery and equipment, nec	90%	We will assume that the decline in manufacturing to be 90% if we cannot find a reliable resource to estimate. See Maliszewska et al. (2020), Thailand 0.95
29	Motor vehicles, trailers and semi-trailers	70%	A decline of 30-40% in many countries. https://edition.cnn.com/2020/04/01/business/car-sales-coronavirus/index.html https://econsultancy.com/how-coronavirus-is-impacting-sales-marketing-in-the-automotive-industry/
30	Other transport equipment	70%	Same as automobiles.
31T33	Other manufacturing; repair and installation of machinery and equipment	90%	See Maliszewska et al. (2020), Thailand 0.95
35T39	Electricity, gas, water supply, sewerage, waste and remediation services	100%	See Maliszewska et al. (2020). Thailand 0.95
41T43	Construction	75%	https://www.ft.com/content/3c27d23e-befe-4a53-be52-325adacdb929
45T47	Wholesale and retail trade; repair of motor vehicles	110%	Weighted average of CBRT sectors 3, 6, 7 & 16
49T53	Transportation and storage	80%	International Decline, Domestic Increase. Airline demand close to 0. Thailand 0.95 https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Risk/Our%20Insight/COVID%2019%20Implications%20for%20business/COVID%2019%20March%2030/COVID-19-Facts-and-Insights-April-3-v2.ashx
55T56	Accomodation and food services	25%	Weighted average of CBRT sectors 12, 13, 14 & 24
58T60	Publishing, audiovisual and broadcasting activities	85%	CBRT sector 11
61	Telecommunications	100%	Push and pull factors present. No reliable number. We will assume it does not change. CBRT sector 22 (79%)
62T63	IT and other information services	100%	https://www.reuters.com/article/us-heatlh-coronavirus-technology/coronavirus-may-cut-global-corporate-tech-spending-4-1-in-2020-survey-idUSKBN21I38C https://www.fiercetelecom.com/telecom/coronavirus-flushes-it-spending-to-a-2-7-decline-idc
64T66	Financial and insurance activities	100%	Weighted average of CBRT sectors 21 & 26
68	Real estate activities	60%	Average of CBRT sector 11 (83%) https://www.mansionglobal.com/articles/coronavirus-halting-real-estate-activity-in-the-u-k-213298
69T82	Other business sector services	85%	CBRT sector 11 (83%)
84	Public admin. and defence; compulsory social security	125%	Median Package size 5%. Public spending is close to %20 of GDP.
85	Education	85%	In line with other business services.
86T88	Human health and social work	125%	1 trillion dollars extra healthcare spending for Covid-19 out of close to 4 trillion dollars yearly healthcare spending. https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NationalHealthAccountsHistorical https://www.fairhealth.org/publications/briefs
90T96	Arts, entertainment, recreation and other service activities	25%	https://www.nytimes.com/interactive/2020/04/11/business/economy/coronavirus-us-economy-spending.html

NOTES: This table provides the demand changes at the sectoral level along with the explanations. We use publicly available data and the credit card spending data from the Central Bank of Republic of Turkey (CBRT) to calculate the estimated demand change during the pandemic in each industry, which is categorized based on OECD ISIC Codes.

Table A.4: LIST OF THE LOCKDOWN SECTORS

Panel A: Lockdown Sectors

NACE Rev. 2	Definition
01	Crop and animal production, hunting and related service activities
1071	Manufacture of bread; manufacture of fresh pastry goods and cakes
1811	Printing of newspapers
1920	Manufacture of refined petroleum products
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
35	Electricity, gas, steam and air conditioning supply
36	Water collection, treatment and supply
4646	Wholesale of pharmaceutical goods
4730	Retail sale of automotive fuel in specialised stores
4773	Dispensing chemist in specialised stores
4774	Retail sale of medical and orthopaedic goods in specialised stores
4920	Freight rail transport
4941	Freight transport by road
5224	Cargo handling
53	Postal and courier activities
60	Programming and broadcasting activities
61	Telecommunications
639	Other information service activities
75	Veterinary activities
86	Human health activities
87	Residential care activities

Panel B: Additional Sectors

NACE Rev. 2	Definition
10	Manufacture of food products
1722	Manufacture of household and sanitary goods and of toilet requisites
463	Wholesale of food, beverages and tobacco
4711	Retail sale in non-specialised stores with food, beverages or tobacco predominating
472	Retail sale of food, beverages and tobacco in specialised stores
4781	Retail sale via stalls and markets of food, beverages and tobacco products

NOTES: This table provides the list of the lockdown sectors. We use the decree issued by the Turkish Ministry of Interior on April 10, 2020 to identify these industries. This lockdown was effective for only two days and cover those given in Panel A. We supplement the list with those available in Panel B.

Table A.5: CBRT Credit Card Spending Titles Corresponding to OECD ISIC Sectors

CBRT	Definition	OECD ISIC Code
1	Total	
2	Car Rental	69T82
3	Car Rental-Sales/Service/Parts	45T47
4	Petrol Stations	19
5	Various Food	10T12
6	Direct Marketing	45T47
7	Education/Stationary	45T47
8	Electric & Electronic Goods, Computers	26
9	Clothing and Accessory	13T15
10	Airlines	49T53
11	Service	58T60 & 68 & 69T82
12	Accomodation	55T56
13	Club/Association/ Social Services	55T56
14	Casino	55T56
15	Jewellery	45T47
16	Marketing and Shopping Centers	45T47
17	Furnishing and Decoration	31T33
18	Contractor Services	41T43
19	Health/Health Products/Cosmetics	20T21
20	Travel Agencies/Forwarding	69T82
21	Insurance	64T66
22	Telecommunication	61
23	Building Supplies, Hardware, Hard Goods	25
24	Food	55T56
25	Government/Tax Payments	84
26	Private Pensions	64T66
27	Others	
28	E-commerce Transactions	62T63
29	Mail or Phone Shopping	
30	Customs Payments	84

NOTES: This table provides the concordance that we use to match the titles used in the CBRT's credit card spending data with the OECD ISIC Codes.

Table A.6: List of the Active Sectors in Public Administration during the Full Lockdown

Type	Size	Source
Public (All)	2820095	http://www.sbb.gov.tr/kamu-istihdami/
Security	273000	https://tr.wikipedia.org/wiki/Emniyet_Genel_M%C3%BCd%C3%BCrl%C3%BC%C4%9F%C3%BC
Gendarmerie	150000	https://www.jandarma.gov.tr/jandarma-genel-komutanligi-2019-yili-faaliyet-raporu
Health	642184	https://www.saglik.gov.tr/TR,11588/istatistik-yilliklari.html
Share	37.77%	

NOTES: This table provides the list of occupations in Public Administration that work during the full lockdown, together with the number of people within those occupations. The data sources are provided as well. The share of the active sub-sectors in the entire sector is 37%.