Covid-19 Coronavirus and Macroeconomic Policy: Some Analytical Notes

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As we write, the Covid-19 coronavirus is spreading throughout the globe. Besides its impact on public health, this coronavirus outbreak is likely to have significant economic consequences. The consensus is that the virus will cause a negative supply shock to the world economy, by forcing factories to shut down and disrupting global supply chains (OECD, 2020). But how deep and persistent is this supply disruption going to be? Will aggregate demand be affected? What is the appropriate monetary policy response? What about fiscal policy? These questions are currently at the center of a heated debate.

Tackling these questions requires taking into account a range of possible scenarios. In this short note, we consider the (hopefully pessimistic) possibility that the supply disruption caused by Covid-19 will be severe and persistent. To be clear, we have no reasons to believe that this scenario is more plausible than other - more optimistic - ones. It might very well be, in fact, that the virus will end up causing a relatively mild and short-lived global recession, followed by a V-shaped recovery (Wren-Lewis, 2020). Given the huge uncertainty surrounding the future evolution of the epidemic, however, it is useful to workout the macroeconomic implications of more pessimistic scenarios.

To do so, we employ a very simple analytic framework. We highlight three results. First, the spread of the virus might depress global demand. In this case, monetary stimulus will be useful to mitigate the impact of the coronavirus on employment and output. Second, a supply-demand doom loop might take place, amplifying the supply disruption directly caused by the virus. Third, this epidemic might make the global economy vulnerable to stagnation traps, that is episodes of low growth and high unemployment driven by pessimistic animal spirits. In this case, aggressive fiscal policy interventions will be needed to push the global economy out of stagnation.

Before starting, one disclaimer is in order. Both the model and the results that follow draw heavily on existing works. In particular, the results in Sections 1 and 2 are based on Galí (2009) and Lorenzoni (2009). Sections 3 and 4 are instead based on Benigno and Fornaro (2018). The purpose of this note is to apply these existing insights to the coronavirus epidemic.

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1 A simple framework

We take as our starting point a stripped-down version of the standard New Keynesian model (Galí, 2009). For simplicity's sake, we consider the global economy as a whole, and thus ignore asymmetries across countries.

Time is discrete and indexed by t. Global output y_t is increasing in employment l_t and labor productivity a_t

$$y_t = l_t + a_t. \tag{1}$$

There is a maximum level of employment $\bar{l}$, which also corresponds to the efficient level of employment.[1] When $l_t = \bar{l}$ the economy operates at full employment and output is equal to potential, while when $l_t < \bar{l}$ there is some involuntary unemployment and a negative output gap. Moreover, we denote the growth rate of labor productivity by $g_t \equiv a_t - a_{t-1}$.

As in the Keynesian tradition, we assume that output and employment are determined by aggregate demand. In turn, aggregate demand depends on expectations of future output y_{t+1} and on the real interest rate r_t. First, demand in the present is increasing in expectations of future output. Consumers, the reason is, are more willing to spend in the present if they anticipate a higher future income. Second, a lower interest rate boosts aggregate demand, for instance by encouraging expenditure financed by borrowing. These effects are captured by the expression

$$y_t = -r_t + y_{t+1}, \tag{2}$$

which is similar to the standard intertemporal substitution (IS) equation of the New Keynesian model.

The interest rate is determined by monetary policy. More precisely, monetary policy controls the nominal rate i_t, while agents base their spending decisions on the real rate r_t. However, the two rates are related by the Fisher equation $i_t = r_t + \pi_{t+1}$, where π_{t+1} denotes expected price inflation. For the moment, we assume that inflation is fixed and equal to $\bar{\pi}$, so that the central bank effectively controls the real interest rate.[2] We will discuss inflation later on. Moreover, we assume that the central bank sets the policy rate according to

$$i_t = \bar{i} + \phi l_t, \tag{3}$$

where $\bar{i}$ and ϕ are two positive constants. Under this rule the central bank aims at stabilizing output around its potential level by cutting the interest rate in response to falls in employment.

[1] See, for instance, Benigno and Fornaro (2018) for the microfoundations behind this assumption. There agents experience no disutility from working, and can supply to the market up to $\bar{l}$ units of labor. Involuntary unemployment is possible due to the presence of nominal wage rigidities.

[2] All it takes for our results is some stickiness in nominal prices or wages. The assumption of constant inflation corresponds to the limit in which prices are fully rigid.

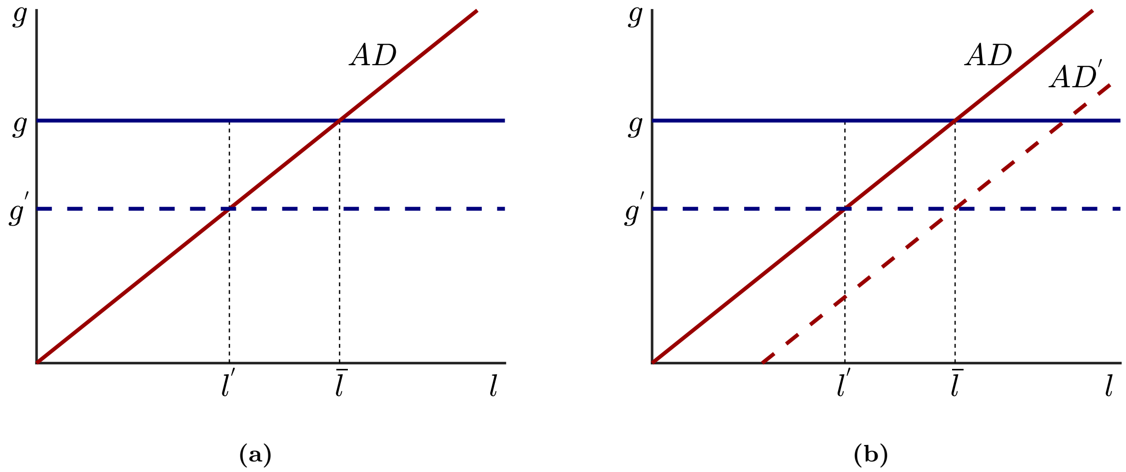


Figure 1: Impact of coronavirus on aggregate demand and employment.

Substituting (1) and (3) into (2) gives

$$l_t(1+\phi) = -\bar{i} + \bar{\pi} + l_{t+1} + g_{t+1}. \tag{AD}$$

This AD equation describes the demand side of the economy.

2 Impact of coronavirus on aggregate demand

As mentioned above, we consider a scenario in which the virus causes a long-lasting supply disruption. In the model, this can be captured by a persistent drop in labor productivity growth. It is analytically convenient to focus on the limit in which the fall in productivity growth caused by the coronavirus is permanent. This is, of course, an unrealistic assumption. But our results generalize to cases in which the drop in productivity growth is persistent, without being permanent.

Since we are assuming that g_t is constant, all the other variables are also constant over time. For instance, the AD equation becomes

$$\phi l = -\bar{i} + \bar{\pi} + g, \tag{AD}$$

where we have removed time subscripts to simplify notation. Figure 1 shows the AD schedule in the $l - g$ space. The curve is downward sloped, because lower productivity growth is associated with expectations of lower future income, and thus with weaker aggregate demand. Lower aggregate demand, in turn, depresses output and employment. As shown in the figure, for given g this equation determines employment l.

Now imagine that we start from an equilibrium characterized by full employment ($l = \bar{l}$). Suppose that the coronavirus epidemic causes a (previously unexpected) fall in g to $g' < g$. The outcome is illustrated by the left panel of Figure 1. The fall in productivity growth translates into lower aggregate demand. The central bank reacts by cutting the policy rate, but not enough to prevent unemployment from arising. The result is a drop in employment below its maximum level ($l' < \bar{l}$). In this simple model, therefore, the negative supply shock triggered by the coronavirus gives rise to a fall in demand and involuntary unemployment. The crucial assumption behind this result is that the supply disruption is persistent, so as to induce agents to revise downward their expectations of future income.[3]

What does it take to restore full employment? The model suggests a simple answer. The central bank needs to inject further monetary stimulus, i.e. it needs to lower $\bar{i}$. Graphically, this corresponds to a rightward shift of the AD curve. If the monetary stimulus is strong enough, full employment is restored, as illustrated by the right panel of Figure 1. This simple model thus lends support to the idea that central banks might need to respond to the Covid-19 outbreak by easing monetary policy.

Let us now spend a few words on inflation. Suppose that the prices set by firms are increasing in the marginal cost of production. Higher wages, therefore, will push up prices by increasing marginal costs. Higher labor productivity, instead, lowers prices by reducing the marginal cost of production. We can then write price inflation π_t as

$$\pi = \pi^w - g, \tag{4}$$

where π^w denotes nominal wage inflation. Let us also assume the existence of a wage Phillips curve $\pi^w = \xi l$, so that wage inflation is positively related to employment. Inflation is then determined by

$$\pi = \xi l - g. \tag{5}$$

Will Covid-19 lead to higher or lower inflation? Clearly, the answer is it depends. Lower productivity growth, in fact, tends to push inflation up. This is the classic notion that negative supply shocks are inflationary. But lower employment pushes wage inflation down. This effect points toward lower price inflation. The relative strength of these two effects depends on the slope of the wage Phillips curve. It is then hard, a priori, to say whether the coronavirus outbreak will lead to higher or lower inflation. As in the standard New Keynesian literature, however, the model suggests that central banks will face a trade off between stabilizing employment and inflation.

3 The supply-demand doom loop

So far, we have taken the rate of labor productivity growth as an exogenous variable. In reality, labor productivity depends at least in part on investment by firms. Firms, in fact, can increase their labor productivity by investing to increase their capital stock, or to develop innovations that increase the quality of their products. It is reasonable to assume that firms' investment decisions in turn depend on aggregate demand. When demand is strong, the reason is, the return from investment tends to be higher. Weak aggregate demand, conversely, depresses the return to

[3] This effect is well known from the literature on news shocks (e.g., Lorenzoni, 2009).

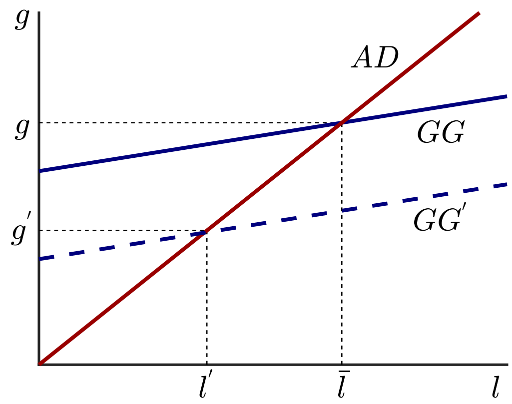


Figure 2: The supply-demand doom loop.

investment. Investment and labor productivity, therefore, tend to be positively related to aggregate demand.

These effects can be captured through a microfounded model, as done by Benigno and Fornaro (2018). Here, instead, we simply assume that productivity growth evolves according to

$$g = \chi l + \bar{g}, \tag{GG}$$

where χ and $\bar{g}$ are two positive constants. The term χl captures the endogenous component of productivity growth. The rationale behind this term is that higher aggregate demand, which is associated with higher employment, leads to higher investment and faster productivity growth. $\bar{g}$, instead, captures all the factors that can affect productivity independently of demand - such as the spread of the Covid-19 coronavirus. The GG schedule summarizes the supply side of our simple model.

Figure 2 plots the AD and GG schedules. The GG schedule is, for reasons explained above, upward sloping. The equilibrium is thus determined by the intersection of two upward sloped curves. As usual, this signals the presence of amplification effects.

Let's now go through the macroeconomic impact of a negative supply shock triggered by the coronavirus spread, which we capture by a fall in $\bar{g}$. As shown in Figure 2, the fall in $\bar{g}$ makes the GG curve shift toward the right. If monetary policy holds $\bar{i}$ constant, the new equilibrium features lower productivity growth and lower employment.

What is interesting, is that now a supply-demand doom loop takes place. As before, the initial negative supply shock depresses aggregate demand. But now lower demand induces firms to cut back on their investment, which generates an endogenous drop in productivity growth. Lower productivity growth, in turn, induces a further cut in demand, which again lowers productivity growth. This vicious spiral, or supply-demand doom loop, amplifies the impact of the initial supply shock on employment and productivity growth.

Now monetary interventions aiming at sustaining demand have a multiplier effect - because they reverse the supply-demand doom loop. Suppose that the central bank eases monetary policy, by lowering $\bar{i}$. This intervention increases aggregate demand. Moreover, higher demand induces firms to increase investment. In turn, this sustains consumers' expectations of future income, leading to a further rise in demand, and so on. Under this scenario, a monetary expansion has a particularly large impact on employment and productivity, because it counteracts the supply-demand doom loop.

4 Animal spirits and stagnation traps

We have so far ignored a fundamental constraint on monetary policy, given by the effective lower bound on the interest rate. As we will see, this is no small omission. Let us now assume that the central bank cannot push the interest rate below i_l, so that

$$i = \max\left(\bar{i} + \phi l, i_l\right). \tag{6}$$

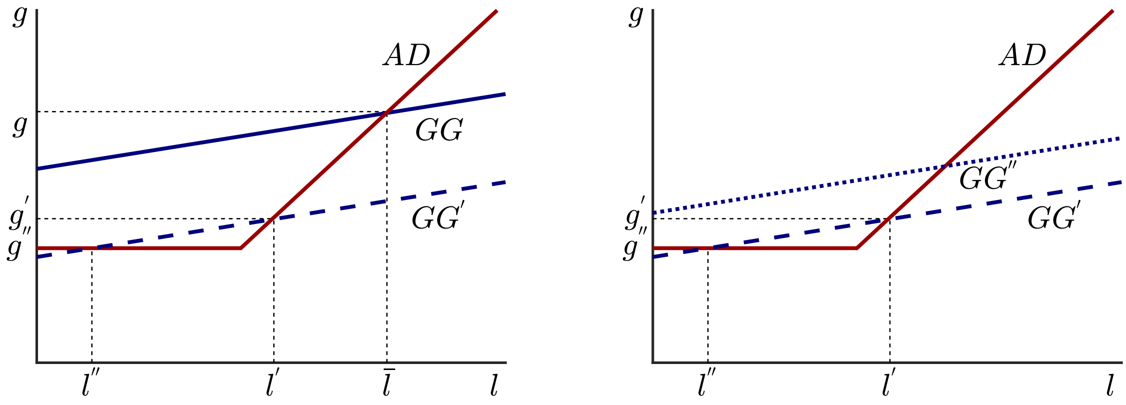
In this case, if demand is weak enough the interest rate hits the lower bound and the economy experiences a liquidity trap. The AD equation now becomes

$$\max\left(\bar{i} + \phi l, i_l\right) = \bar{\pi} + g. \tag{AD}$$

As shown in the left panel of Figure 3, the AD equation now exhibits a kink, and it becomes horizontal for values of l low enough to trigger a liquidity trap.

As before, imagine that the coronavirus outbreak induces a downward shift of the GG curve, from GG to GG′. As drawn in the figure, there are now two intersections between the AD and the GG′ curve. This means that two equilibria are possible. The first equilibrium, corresponding to the point (l', g'), has already been described in the previous section. The second equilibrium, corresponding to the point (l'', g''), is new. In this equilibrium the economy is stuck in a liquidity trap ($i = i_l$), and both growth and employment are depressed ($l'' < l'$ and $g'' < g'$). This second equilibrium can then be thought of as a stagnation trap (Benigno and Fornaro, 2018). Notice that nothing fundamental determines which equilibrium will prevail. In fact, agents can coordinate their expectations on either of the two equilibria. Therefore, pessimistic animal spirits can push the economy into a stagnation trap.

Now the coronavirus shock not only triggers a supply-demand doom loop, it also places the economy in a danger zone in which animal spirits and agents' expectations can affect employment and productivity growth. To see how this can happen, imagine that agents become pessimistic about future productivity growth. Due to the zero lower bound, the central bank cannot counteract the associated drop in demand. As a result, employment and economic activity drop. Firms react by cutting investment, which negatively affects productivity growth. Initial pessimistic expectations of weak growth thus become self-fulfilling. Importantly, this self-fulfilling feedback loop can take place only if the fundamentals of the economy are sufficiently weak (notice that the equilibrium is unique before the coronavirus causes a drop in $\bar{g}$). The coronavirus epidemic, therefore, can open



(a) **(b)**

Figure 3: Stagnation traps and fiscal policy.

the door to expectation-driven stagnation traps precisely by weakening the growth fundamentals of the economy.

Which policy interventions can prevent a stagnation trap from taking place? There is little that conventional monetary policy can do, since the policy rate is constrained by the zero lower bound. Luckily, fiscal policy - and in particular policies that sustain investment - can be of help. Imagine that the government can implement policies to sustain investment, so that now the GG equation becomes

$$g = \chi l + \bar{g} + s, \tag{GG}$$

where s captures government policies aiming at increasing investment. A higher s, for instance, can be interpreted as a rise in subsidies to firms' investment or to an increase in public investment. Both policies, in fact, lead to a rise in aggregate investment - and therefore in labor productivity growth - for given aggregate demand.

Now suppose that the government reacts to the coronavirus outbreak by increasing s. As can be seen in the right panel of Figure 3, this policy induces an upward shift of the GG curve, from GG′ to GG″. If this shift is large enough, the stagnation trap equilibrium disappears. In economic terms, this means that only a sufficiently aggressive policy intervention can rule out stagnation traps. A timid intervention, in fact, will not do the job (think about a small upward shift of the GG curve). Taking stock, monetary policy might not be enough to maintain the economy at full employment following the coronavirus outbreak. Monetary policy, in fact, might need to be supplemented with aggressive fiscal policy interventions aiming at sustaining investment.

We conclude by reiterating that in this note we have focused on a pessimistic scenario. Hopefully, the coronavirus will cause just a short-lived negative supply shock. In this case, agents' expectations about future growth will not be greatly affected, and the impact on aggregate demand will be small. But unfortunately, at present we cannot rule out more pessimistic outcomes, in which the supply disruption caused by the virus is going to be severe and protracted. If this possibility materializes, this simple model suggests that drastic policy interventions - both monetary and fiscal - might be needed to prevent this negative supply shock from severely affecting employment and productivity.

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