Teaching the effect of COVID-19 with a manageable model

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Abstract

This note has one main ambition. It seeks to provide a very simple macroeconomic framework to explain the economic impact of the COVID-19 pandemic. The explanation for the unprecedented magnitude of the recession over a short span of time is to be found in the peculiar form of the shock due to the various lockdowns involving two recessive shocks simultaneously. Besides, this model is original in that although it is driven by demand it is capable of dealing with supply issues without entailing any additional technical difficulties.

Keywords: COVID-19, lockdown, recession, simultaneous shocks
JEL codes: E12, E22

1. Introduction

It is well known that the 2007–2009 crisis left a considerable mark on our economies as the first deep recession of the twenty-first century. Nevertheless, the unprecedented negative consequences of COVID-19 in such a short span of time could 'almost' make us forget the subprime meltdown. For example, in a recent study forecasting the economic impacts of the current pandemic, Silvestre (2020) uses the expression "the mother of all recessions" to emphasize the magnitude of the shock. In the same vein, IMF projections and the first estimates coming from various national statistical institutes show a dramatic collapse of GDP growth rates. Since the advent of the pandemic, several papers have emerged to explain the consequences of this supply shock on demand or the optimal lockdown (see, for instances, Guerrieri *et al.* 2020 and Alvarez *et al.*, 2020).

The main purpose of this note is to show in what way COVID-19 is unprecedented in terms of economic shock. Then we provide a first outline of practical explanations as to how an economy is severely affected by the pandemic with the help of a manageable macroeconomic model. We claim that the various forms of lockdown involve two simultaneous shocks: one on the supply side of the economy, the other on the demand side. We believe this original aspect is the major reason GDPs have fallen so sharply. Moreover, as a secondary purpose, we show that although it is demand-driven our model is able to deal with supply shocks without any additional complexity.

The note proceeds as follows. Section 2 explains why economies have been hit by supply and demand shocks simultaneously. Section 3 presents our model for a simple illustration of the double negative impact generated by the pandemic. Lastly section 4 draws some conclusions.

2. The worst scenario

When wondering why the recession is so brutal we have to recall that the first effect of COVID-19 was the implementation of a strict lockdown by the Chinese authorities in various industrial cities in the province of Hubei at the end of January. In March, similar measures were taken in other countries including Italy, Spain, Finland, France, Israel, Germany, the United States, the United Kingdom, India and several areas of the Russian Federation.

For a single country, this lockdown implies that some proportion of its employees is literally prevented from working, involving a substantial fall in output. This corresponds unambiguously to a negative supply shock and global domestic demand simply diminishes because the ability to spend on goods and services is constrained by the lockdown. However, another mechanism is also at work on the demand side. A recessive demand shock occurs simultaneously – in the form of a fall in exports – due to lockdowns implemented by other customer countries. Here the collapse of external demand directly hits firms that are still in business, intensifying the global negative

economic impact of the pandemic. We believe the simultaneity of these recessive shocks is the main reason for the unprecedented recessions over a short span of time.

Regarding the demand shock acting through the channel of exports, the trade forecasts made by the World Trade Organization (2020) are particularly informative. World trade is expected to fall by between 13% and 32% over the ongoing year as a consequence of the pandemic. Even the most optimistic scenario would represent a crash comparable to the subprime crisis whereas, in the pessimistic scenario, the volume of world trade vanishes. For example, North American and European exports could shrink by, respectively, 40.9% and 32.8% during 2020. These numbers emphasize that the contraction in external demand and, by extension, the existence of simultaneous supply and demand shocks is an unpleasant reality. Accordingly we are convinced it is of prime importance to present such an event in the scope of manageable macro-model.

3. Illustrating the double impact of COVID-19 with a manageable model

We use a structuralist short-run macro-model of growth and distribution to illustrate the effect of the pandemic. It is labelled 'structuralist' because it can be easily adapted to a variety of economic episodes. Such formal models were initially built to analyse developing economies. Nevertheless, their flexible structure makes them particularly useful for analysing mature economies as well. Since then, several extensions have been undertaken in the field of financial instability, wage bargaining with optimizing microfoundations or ecological economics (e.g. Dutt, 1997; Taylor *et al.* 2016; Nikolaidi and Stockhammer, 2017; Rezai *et al.* 2018). Moreover, despite this model being demand-driven, it allows us easily to take into account a supply shock such as the one following the pandemic. So, as a guideline, we follow Krugman's (2000) recommendation to use simple models in the specific case of practical applications.

We make the following assumptions. (a) The open economy produces a single commodity which can be both consumed/saved and invested. (b) Output requires two homogenous factors of production, labour and capital, and it relies on (c) a fixed coefficient production function. (d) Firms set their price assuming a fixed mark-up on unit labour costs. (e) For simplicity, we ignore intermediate imports and fixed costs in the mark-up equation. (f) Firms may operate with excess capacity in order to respond immediately to an unexpected increase in demand.

The model is described by the following equations:

(1) $pY = wL + rpK$

(2) $a_0 = L/Y$

(3) $p = (1+m)wa_0$

(4) $S/K = s_w \frac{w}{p}\frac{L}{K} + s_\pi r + s_{LK}$

(5) $I/K = g_0 + g_u u$

(6) $g_G = G/K$

(7) $(X - IM)/K = x - m = x - m_u u$

(8) $S = I + G + X - IM$

(9) $l = a_0 u \quad \text{with} \quad l = L/K$

Equation (1) states that nominal income is split into wages and profits where p is the price level, Y is real income, w is the money wage rate, L the amount of employment and r is the gross rate of profit understood as the ratio of profits Π to the capital stock valued in terms of the commodity which gives $r = \Pi/pK$. Equation (2) is the fixed labour-output ratio, which is also the reverse of labour productivity. In equation (3) firms set prices according to a standard mark-up rule on exogenous unit-labour costs. Expression (4) shows that saving in terms of the capital stock comes from wage income and profits, respectively, at rates s_w and s_π between zero and unity where $s_\pi > s_w$. Here, the propensity to save out of profits is greater than the propensity to save out of wages mainly because of the existence of a substantial retention ratio by firms. The last term $s_{LK} \geq 0$ represents additional forced saving due to the lockdown, which is zero in normal times. This transitional surplus of saving is explained by the fact that, even though incomes are falling, the possibilities of spending all but vanish as the lockdown is implemented. Equation (5) stands for firms' investment function that depends on some base level g_0, representing the state of business confidence (or animal spirits), and on an index of capacity utilization $u = Y/K$ reflecting, in some sense, the buoyancy of the market through a coefficient $g_u > 0$. Note that the value of g_0 may well become negative as a result of deteriorated expectations about the future. This relationship can also be viewed as a standard accelerator function. Lastly, the net rate of accumulation is equal to gross accumulation minus the rate of depreciation of the capital stock: $g^{net} = I/K - \delta$. (6) is government consumption and investment spending, divided by the capital stock. (7) is the simplest way to deal with the trade balance in which exports, $x = X/K$, are exogenous and imports, $m = IM/K$, depend on the domestic level of activity through a propensity to import $0 < m_u < 1$. We do not enter into considerations concerning the exchange rate; this assumption is made for the sake of simplicity as we focus on a short-run horizon and the shock is generalized. (8) is the standard equilibrium condition on the goods market where $S = Y - C$. Equation (9) is derived from (2) and links the level of employment in terms of the capital stock to the rate of capacity utilization.

The model can be easily solved. From (1) and (2) we get the gross profit rate in terms of u: $r = \left(1 - \frac{w}{p} a_0\right) u$. Replacing the price level by its value from (3) gives:

(10) $r = \left(\frac{m}{1+m}\right) u = \pi u$

The rate of profit increases with both the mark-up (through an increase in the share of profit, $\pi = \Pi/pY$) and the rate of capacity utilization. The positive relationship between r and u holds until the economy reaches its short-run maximum level of utilization given by the existing stock of capital. Beyond this point, every rise in r comes entirely from an increase in prices through a higher mark-up.

Dividing (8) by K, replacing (4), (5), (6), (7) and (10) by their respective values and recalling that, from (1), $\frac{w}{p}\frac{L}{K} = u - r$, we find the equilibrium rate of capacity utilization:

$$u^* = \frac{g_0 + g_G + x - s_{LK}}{[s_w + (s_\pi - s_w)\pi - g_u + m_u]}$$

For realistic values of the parameters, the numerator and the denominator are positive and it is easy to compute fiscal and export multipliers. Animal spirits have a positive impact on the level of economic activity as does the accelerator coefficient. A rise in the savings rate or in the propensity to import unambiguously reduces the utilization rate. As expected, forced saving because of the lockdown, acts negatively in the short run.[1] Lastly, a decrease in the profit share has a positive impact on u^*. This result is possible because it corresponds to a rise in real wages and in consumption to which firms respond by increasing the rate of capacity utilization and investment. The equilibrium value for r^* is obtained simply by plugging u^* into (10). Lastly, after replacing u^* in (5), the gross rate of accumulation can be written:

$$g^* = \frac{g_0[s_w + (s_\pi - s_w)\pi + m_u] + g_u(g_G + x - s_{LK})}{[s_w + (s_\pi - s_w)\pi - g_u + m_u]}$$

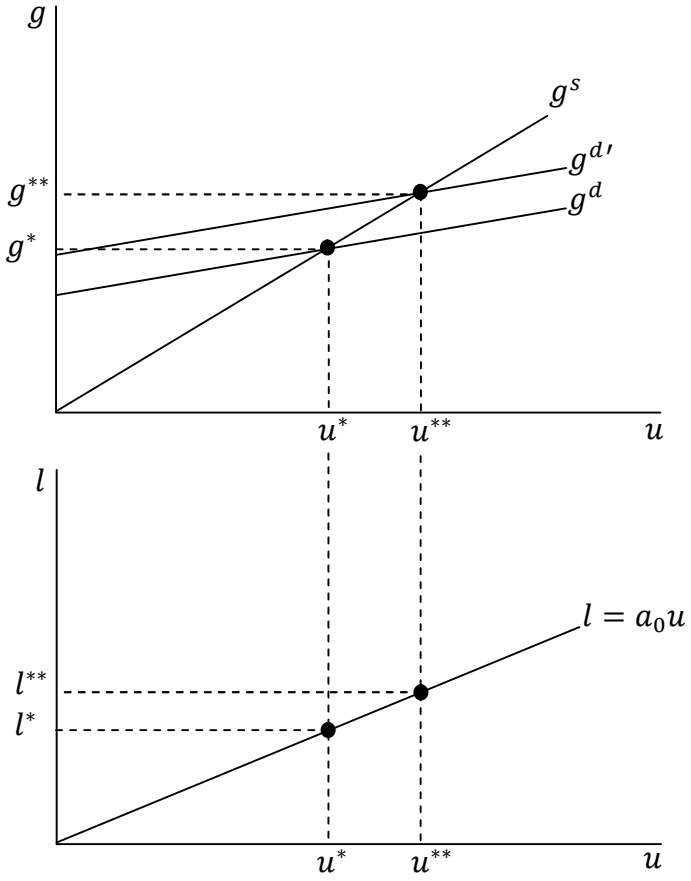
with the net rate being equal to $(g^{net})^* = g^* - \delta$.

The model can be displayed in two diagrams as shown in Figure 1. In the upper part, we show the equilibrium on the goods market. Let us note $g^s = S/K + m$ and $g^d = I/K + g_G + x$, when the two curves cross we obtain u^* and g^*.[2] The lower part gives the equilibrium amount of employment from (9) as $l^* = a_0 u^*$. As long as there are surplus capacities, supply adjusts to demand. For example, suppose the rates of capacity utilization and of accumulation are too low, entailing persistent unemployment. A standard reaction by governments would be to increase public spending, which shifts the g^d curve, containing aggregate demand components, upward and moves the economy closer to full employment. Then, in the event of excess capacity, a positive shock on demand raises the level of activity and the amount of employment.

[1] Reciprocally the end of the lockdown may make this forced saving disappear so leading to an increased capacity utilization rate. This vanishing of forced saving for households might open the way to catching-up on consumption spending and to a strong recovery.

[2] The two curves can be written as: $g^s = [s_w + (s_\pi - s_w)\pi + m_u]u + s_{LK}$ and $g^d = g_0 + g_G + x + g_u u$. In normal times, $s_{LK} = 0$ and g^s starts from the origin.

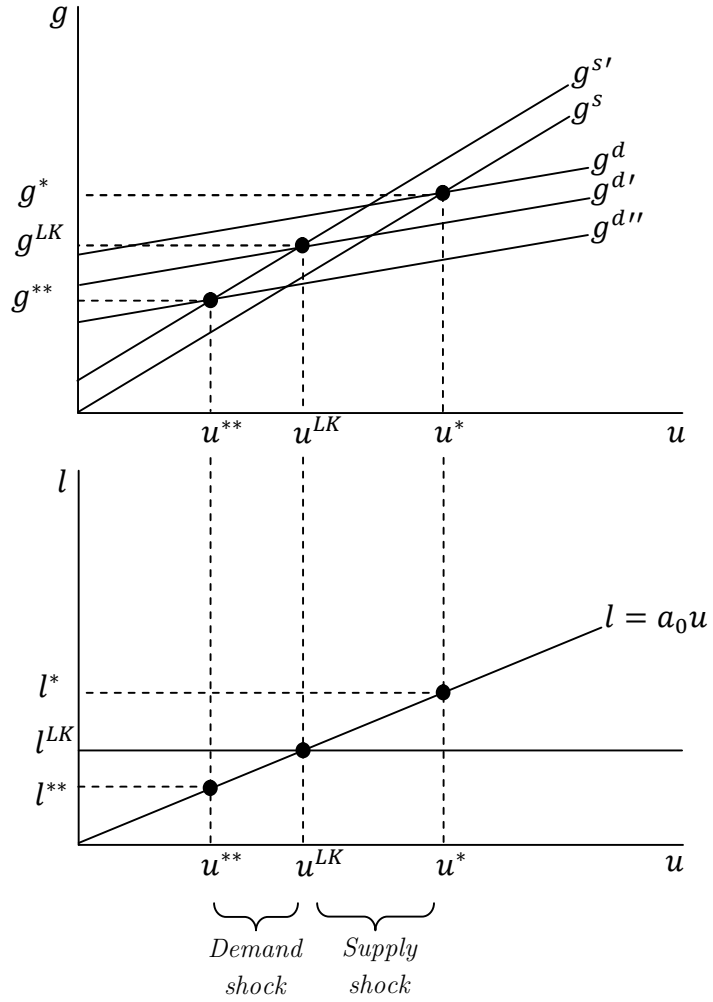
Figure 1: A no-lockdown situation and an increase in public spending



Now, turning back to the various impacts of COVID-19 we can easily use the above diagram to illustrate our main argument: it is the existence of simultaneous supply and demand shocks that engenders substantial economic turmoil.

One of the first responses to the pandemic was to impose a lockdown on people, with the direct consequence of reducing the number of workers *effectively* available in various sectors and the level of output. This corresponds to an exogenous negative supply shock on the labour force, reversing the central causality of the model. In the specific lockdown case, the level of demand decreases because it is forced to adjust to the new supply conditions triggered by the shutdown of significant parts of the economy. In the second part of Figure 2, this new level of employment is represented by the horizontal line l^{LK} (the superscript LK refers to lockdown) and corresponds to a lower rate of capacity utilization. We now have: $u^{LK} = l^{LK}/a_0$. The adjustment towards the new equilibrium u^{LK} in the upper diagram proceeds in two steps. A collapse of the state of business confidence g_0 shifts the g^d curve downward to $g^{d\prime}$ and the appearance of forced saving, since s_{LK} becomes positive, shifts the g^s curve upward to $g^{s\prime}$.

Figure 2: A lockdown situation following the pandemic – supply and demand shocks



Nevertheless, the lockdown has a second simultaneous negative impact that makes itself felt through external demand. As already said, for an open economy, the lockdowns implemented in other countries involve a major contraction in the level of its exports, shifting the g^d curve downward again in $g^{d\prime\prime}$. In this case, the level of supply adjusts to the new conditions imposed by demand as is standard in structuralist models. The downturn in the rates of utilization and accumulation[3] cause the labour–capital ratio to fall to l^{**}: the amount of employment is thus reduced below the level imposed by the national lockdown.

4. Conclusion

This paper is a first attempt to evaluate the immediate impact of Corona virus disease using a simplified model. It is shown that the lockdowns imposed because of the pandemic generate two simultaneous negative shocks. The internal lockdown leads to a

[3] Although the accumulation rate in Figure 2 is still positive, it must be remembered that it is the gross accumulation rate. When depreciation is removed the net accumulation rate becomes negative.

negative supply shock whereas the external lockdowns involve a negative demand shock through exports. We believe that the main explanation for the major recessions of 2020 is to be sought in the simultaneity of such shocks. National cases may diverge from one country to another for several reasons: on the one hand, the size of the supply shock depends on the scale and duration of the lockdown; on the other hand, the size of the demand shock may vary with the strength of the recession for trading partners.

Ultimately the impact of COVID-19 will also depend on economic policy responses to the present crisis. Although it is beyond the scope of our basic model, we believe future research is needed in order to fully analyse government and central bank interventions in response to the current economic disaster.

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