What Is the Optimal Fiscal Policy Response to the COVID-19 Recession?

Carlos A. Abadi

April 13, 2020

Abstract

In this article I develop a simplified recession-recovery model as a single process. I conclude that the optimal policy response for countries with fiscal space is large fiscal stimulus but delivered gradually.

1 Introduction

The study of growth and recession has been central to economics ever since its beginning (Quesnay (1888), Smith (2000), Ricardo (2004), Keynes(2007), Solow (2000), Schumpeter (1980), Romer (1990), Robbins (2000)). Since recessions and subsequent recoveries are usually split into distinct episodes in economic analysis, the factors of contraction and growth have been investigated separately (e.g., Popov (2006), Kolodko (2000), Cernat (2002)) and little attention has been devoted to the intrinsic relationship between regression and recovery.

In this article, I argue that:

1. Recessions and their subsequent recoveries can be fitted rather well by a single 3-parameter function that contains both the recession and the recovery segments. It assumes that, at any time during recession-recovery periods, a fraction of the economy is shrinking exponentially while the rest is growing exponentially. As a consequence, the two parts of the GDP curve are inextricably linked and cannot be considered as separate events. In particular, I show why this model results in better estimates of the contraction and expansion rates.

2. The shape of this function is the *simplest one* that respects the underlying economic process: economic activity grows and shrinks exponentially. A more complex superposition of exponentials or non-constant parameters is of course possible, as discussed below.

3. This model is valid as long as no other shock occurs, and can therefore be used *a contrario* to separate GDP time series into episodes of economic growth, thus providing a new way of reading the fluctuations of GDP time series. This leads to the conclusion that this model is, in fact, the *response function* of the economy as a whole to rare negative shocks, such as COVID-19.

In Section 2, I introduce the rationale for the model.

In Section 3, I introduce a simple two-sector model of growth with economic transfer. I also discuss why a simple two-sector model is able to reproduce faithfully the global dynamics of recession-recovery. I then exploit this understanding to find an effective transfer rate that minimizes the depth and duration of the recession and maximizes both the GDP value and the final growth rate.

Section 4 concludes by proposing a means to differentiate static and dynamic effective policies.

2 The Recession-Recovery Continuum

For a variety of reasons, the economic activity of a country periodically suffers dramatic output decreases followed by recoveries. The contraction-expansion pattern is commonly known as a J-shape (Cernat (2002)), and depending on its unfolding, the pattern will be, V, U, or L-shaped. Recently, recessions precipitated by a natural disaster sudden stop (e.g., the 2010 Haiti earthquake) have followed a V-shaped recovery. However, going further back in time, the 1918 Spanish flu pandemic exhibited a very slow U-shaped recovery. In this article, our avenue of inquiry is the expected shape of the post-COVID-19 recovery.

For the reasons explained below, we parametrize the shape of the contraction-expansion curve in terms of the following formula:

$$W(t) = W(t_0)[fe^{\lambda_+(t-t_0)} + (1-f)e^{\lambda_-(t-t_0)}], \tag{1}$$

where

- $W(t_0)$ is the initial GDP at time t_0 of occurrence of the triggering event;
- f is the fraction of the economy that grows at rate λ_+; and
- $(1-f)$ is the remaining fraction of the economy, which shrinks at rate λ_-

  The recession phase starts when $W'(t_0) < 0$, i.e. if $f\lambda_+ + (1-f)\lambda_- < 0$.

  The fitting function of Eq.(1) can be considered as the simplest model of recession and recovery that is economically meaningful. Indeed, it only assumes that one part of the economy shrinks while the other one grows, both exponentially. It does not include many other *a priori* parameters. Krugman (2020) classified this sectors, with respect to the COVID-19 recession as non-essential (NE), and essential (E), respectively. While it might fit tempting to fit a recession-recovery trajectory with a parabola, it would be a very bad fit because GDP curves are asymmetric and have an asymptotic constant exponential growth rate. Because of the auto-catalytic nature of growth and contractions, only a sum of exponentials makes sense.[1]

3 The Model

3.1 Model Setup

My 3-parameter model is nothing more than a simplification of the AB model (Shnerb et al., 2000, 2001), a reaction-diffusion lattice model where discrete particles of two types diffuse, meet, reproduce and die auto-catalytically.

The rationale behind my model is that the after-shock economy is supposed to consist of two sectors, E, with activity w_E, growing intrinsically at a rate $\alpha_E > 0$, and the other with activity w_{NE}, shrinking, also intrinsically ($\alpha_{NE} < 0$). The two sectors

[1] This also excludes splines, which need many more than three parameters.

interact through economic activity transfer at a rate of β, which is a function of the activity differential; i.e.:

$$\frac{\partial w_E(t)}{\partial t} = \alpha_E w_E(t) + \beta\{[w(t)] - w_E(t)\} \tag{2}$$

$$\frac{\partial w_{NE}(t)}{\partial t} = \alpha_{NE} w_{NE}(t) + \beta\{[w(t)] - w_{NE}(t)\} \tag{3}$$

where $w = (w_E + w_{NE})/2$

The actual result of the government's policies is assumed to be equivalent to taking a fraction $\beta/2$ of the activity differential from the larger sector and conveying it to the smaller one; i.e. β is not assumed to be the optimal transfer rate but the actual one (this distinction holds for the remainder of the article). The result is that, when the essential sector is small relative to the total size of the economy, resources are transferred to it from the non-essential sector, accelerating the transition to a new equilibrium.

Solving the dynamics of this system is straightforward by computing the eigenvalues and associated eigenvectors of the system of differential equations above, following standard procedure. The two eigenvalues are:

$$\lambda_\pm = \frac{\delta[\sigma/\delta - \vartheta \pm \sqrt{1+\vartheta^2}]}{2} \tag{4}$$

where $\delta = \alpha_E - \alpha_{NE}$, $\sigma = \alpha_E + \alpha_{NE}$, and $\vartheta = \beta\delta$.
The unnormalized eigenvectors are $(\vartheta, -1 \pm \sqrt{a+\vartheta^2})$.
Let us denote by $\mathbf{v}_\pm = (v_{\pm E}, v_{\pm NE})$ the respective orthonormal eigenvectors. We can then decompose $\mathbf{w}(t=0)$ into the basis $\mathbf{v}_\pm$, which gives us $\mathbf{w}(t) = \omega_+ \mathbf{v}_+ e^{\lambda_+ t} + \omega_- \mathbf{v}_- e^{\lambda_- t}$, where $\omega_\pm = \mathbf{w}(\mathbf{0})\mathbf{v}_\pm$ are the projections of the initial conditions onto the sector decomposition above. In other words, both w_E and w_{NE} have an increasing and a decreasing part. The steady state is reached when the weight of the contracting component becomes very small relative to the one of the growing component for both w_E and w_{NE}. The typical time for reaching this asymptotic regime is $O[1/(\lambda_+ + |\lambda_-|)]$ units of time. Then the two sectors grow at the same rate, λ_+. In this regime, the growth of the contracting component is entirely due to the transfer of economic activity from the expanding component.

In this article we are interested in the total economic output $W = w_1 + w_2$; i.e. GDP, and the dynamics of divergence between sectors, measured by $\Delta = w_E/w_{NE}$. Note that empirical data can only partially determine the parameters of Eq. (1). While the rates $\lambda_\pm$ can be measured directly, more information is required to determine all three parameters α_E, α_{NE} and β. This is due to the fact that f does not correspond exactly to $w_E(0)$ since, even at the beginning of the curve, the NE sector has a growing part (i.e., $v^+_{NE} \neq 0$).

3.2 Model Intuition

In order to understand how the deceivingly simplistic Eq.(1) can describe the recession-recovery cycle, we need to go back to Shnerb et al.'s (2000) two-dimensional autocatalytic AB model which describes spatially-distributed and heterogeneous logistics systems. Yaari et al. (2008) proved Shnerb's model's ability to reproduce both the spatial and temporal dynamics of Poland's GDP. Interestingly, Yaari et al. find that the local level of education is the most relevant factor for growth, in line with Fischer and Sahay (2000). In fact, the model successfully predicted the pattern of recession and recovery of each of Poland's regions: while the activity of each region reaches a nadir at different times, while the final growth rate is the same for all regions, strongly suggesting that an economic activity transfer process is at work; i.e. plotting the economic activity evolution of various sectors as a function of time produces a range of J-shaped time series, all converging to the same growth rate. The simplification to two sectors works because the economy is an autocatalytic process: the sectors that reach their minima later than the healthier sectors have often contracted so much that their contribution to total GDP is negligible afterwards.

3.3 Static Policy-Making

Assume that the rates α_E and α_{NE} are constant and fixed by constraints beyond the government's control. The government's only influence is in the transfer rate through fiscal policy. This is in itself a very powerful instrument because employment is a function of economic activity and, therefore, a fast-contracting sector results in social inequality and voter dissatisfaction. If the rate at which the shrinking sector contracts is much larger than the rate of labor transfer between the two sectors, inequality between sectors is an upper bound to social inequality. Note that β is the real rate of transfer, not the one hoped for by the government. Indeed, if the government is not able to collect taxes or if its authority is undermined by inadequate rule of law due to the collapse of institutions, the effective β may turn out much smaller.

The final growth rate depends much on the policy: increasing β reduces both eigenvalues, hence the total growth rate in steady state: maximal asymptotic growth is achieved when there is no transfer of wealth.

However, the growth rate is not the only measure of the success of a fiscal policy: we also need to consider inequality. Indeed, since $\lambda_- < 0$, the NE sector would simply disappear in the absence of redistribution. Decision-makers who only focus on growth will therefore be inclined to choose a β that is as small as socially responsible and electorally possible, while some others may try to minimize inequality between sectors. Since both w_E and w_{NE} end up growing at the same speed, their asymptotic ratio $\Delta = \lim_{t\to\infty} w_E(t)/w_{NE}(t)$ is a measure of economic inequality.

Through simple algebra, the equation above results in

$$\Delta = \frac{v_{+,E}}{v_{+,NE}} = \frac{1}{(\frac{-1}{\vartheta} + \sqrt{1+\vartheta^2})} \approx \frac{2}{\vartheta} = \frac{2(\alpha_E - \alpha_{NE})}{\beta} \tag{5}$$

If $\vartheta \ll 1$, reducing the sector inequality by half requires doubling the transfer rate; in addition, sector inequality is proportional to the difference between the growth rates.

Since the growth rates are fixed by assumption, sector inequality only depends on the transfer rate, not on initial conditions. Inequality disappears only for large values of β, at the expense of the terminal growth rate.

Therefore, assuming a fixed transfer rate, the head of state of a country facing a recession may be able to choose between a shallow but long with anemic final growth or a steep but short-lasting recession with a vigorous recovery. A cynical politician would ensure that the wealth of the majority of voters has increased by the end of his or her tenure or, at least, that the recovery has begun.

3.4 Lockdowns Versus Herd Immunity

The COVID-19 crisis presents two different policy alternatives. The first one is one, adopted by most European countries, emphasizes public health at the expense of the economy. The strict European lockdown policies aim to minimize the virus' direct death toll, resulting in sharp output decreases, hopefully followed by vigorous recoveries. At least initially, the U.S., Mexico, and Brazil adopted, at their respective federal levels a laissez-faire attitude towards the virus, emphasizing a minimization of disruption for economic activity. Since these pro-economy policies were largely frustrated by state governments, which led the U.S., Brazilian, and Mexican federal governments to follow suit, we will never have empirical data about a pure "herd immunity" policy response. However, it is safe to intuit that it how have led to a shallower and longer contraction than in Europe, followed by a more gradual recovery.

In the absence of empirical data, my model makes it possible to delve into this issue. I assume that α_E and α_{NE} are intrinsic to the economy and, therefore, constant. The government influences the economy by adjusting the effective transfer rate, $\beta(t)$. The European approach consists in increasing β from the low ex-ante level to a high level. This European policy implies a sharper mathematical function for $\beta(t)$.

3.4.1 Constant Policy: European Policy

The European policy is characterized by an abrupt output contraction resulting from the generalized lockdown, met with a high-β policy response. In turn, this results in a deep recession coupled with a faster final growth rate and a higher GDP. Therefore, after the recession is over, the tenants of this policy are vindicated since their courageous but harsh recommendations are proven right as regards the growth rate and magnitude of output *compared to other policies.* This policy is correct, but only in a static context, as it maximizes the *final* growth rate but not the instantaneous one.

3.4.2 Dynamic Policy: Envelope

As the U.S. initial reluctance to avoid strong mitigation policies at the onset of the crisis reveals, few experiences are more frustrating for a politician than to have implemented a policy that will lead to economic recovery, but too late to be reelected. That is especially true when, like in the U.S., the output shock comes on an election year.

One theoretical policy response to this agency problem is a policy set that would allow the country to stay on the upper envelope of all possible scenarios, thereby avoiding extreme hardship while maximizing the terminal growth rate. This clearly requires a dynamic policy, i.e., $\beta(t)$. If we ran thousands of scenarios, $W_i(t)$, with different β_i and selected at each time t the value of β that corresponds to the maximum W, we would get $\beta_{env}(t) = \beta_{arg\, max_i\, W_i(t)}$: redistribution would be maximized for a while, then β_{env} would decrease exponentially fast in the domain encompassing the worst phase of the recession, and then start decreasing faster than exponentially. Regretfully for a head of state, especially one seeking reelection, this view is illusory. Indeed, it is impossible to stay on the envelope by controlling $\beta(t)$ on the basis of W alone: when the $W(t)$s of two scenarios intersect, their components $w_E(t)$ and $w_{NE}(t)$ are not equal. Thus the European therapy works better than trying to stay on the envelope.

3.4.3 Optimal Policy: Maximum W

Another policy alternative would be to maximize W at each time step, which is equivalent to maximizing the growth rate with respect to β:

$$\frac{\partial \dot{W}}{\partial \beta} = 0$$

Unfortunately, this minimization leads to a transcendental equation requiring to be solved numerically at each time step. By solving numerically, the resulting $W_{\beta_{opt}}$ exceeds the output of both the European policy and the envelope policy at every time step, which unambiguously proves the benefits of the proposed optimal dynamic policy. Indeed, under the W-maximizing policy, the value of GDP in the recovery phase is a multiple as that corresponding to the European and envelope policies, while sharing the same asymptotic growth rate. I conclude from this comparison that the European policy is maladapted to crises of the COVID-19 nature. Patience and gradualism are better solutions.

Turning to the value of β, I conclude that fiscal stimulus (including helicopter money) should be provided rapidly, but not instantaneously. This means that the intuition behind the European policy is correct, but only at later stages. What matters is the path to maximum stimulus, since economies follow multiplicative processes: the ultimate fate of the economy is highly sensitive to the timing of the stimulus. This optimal policy both increases the apparent fraction of the growing sector of the economy and decreases the rate of contraction of the contracting sector, while keeping constant the final growth rate.

4 Conclusion

The idea that economies are affected by shocks is by no means new (e.g., Slutzky (1937)). My point is that a single negative shock as rare as that inflicted by COVID-19 has a lasting influence on output because of the existence of an intrinsic response function.

I posit that the simple Eq. (1) is at very least a good approximation to that response function.