Written evidence submitted by Dr Thanos Verousis

I am a Senior Lecturer in Finance at the University of Essex, Essex Business School. My expertise is in big data, financial markets and innovation. This submission addresses 'Support to business and Financial services' as outlined in the terms of reference, it is based on a recent working paper that I have co-authored with Mr Lipeng Wang and Mr Mengyu Zhang at the University of Essex. The unpublished paper is titled "The road to economic recovery: pandemics and innovation".

Executive Summary

- We investigate the economic consequences of pandemics from an idea-based theory of economic growth
- Pandemics pose a threat to research productivity and we analyse the long run consequences of pandemic shocks to innovation output
- The effects of the pandemic on future innovation output and subsequently growth are expected to be felt for long into the future
- Following a pandemic, innovation output is disrupted for approximately seven years.
- This submission and our paper supports the policies designed to reduce the effect of the "Great Lockdown" on research productivity.
- Policies that target the more innovative firms are moving in the right direction in terms of reducing the time it will take for innovation to recover from the effects of COVID19.

Detailed response

1. On 20 April 2020, in response to the COVID-19 pandemic outbreak, the UK government announced the Future Fund, a billion pound support package for innovative firms. The objective of this policy is very clear: to support the road to economic recovery from the effect of the pandemic by increasing the intensity of innovation.
2. The link between innovation and GDP growth is undisputed: innovation waves are followed by an acceleration in per capita GDP and productivity and countries hosting more innovative firms also have higher economic growth. Importantly, increases in aggregate innovation dominate creative destruction therefore leading to real increases in output. Finally, such increases can be achieved more efficiently via a targeted policy response to encourage innovation by the more innovative firms.
3. Schumpeterian growth theory, depends on the ability of researchers to produce ideas. However, in the decades leading up to just before the explosion of the Covid-19 pandemic, research productivity has declined sharply. The subsequent slowdown in research ideas caused by “Great Lockdown” is only going to exacerbate the problem of the fall in research productivity as the social environment that affects the intensity of creativity is affected.
4. We investigate the effect of past pandemics on innovation output. To the best of our knowledge, this is the first attempt to provide evidence on the long-term effects of pandemics on research productivity output thereby shedding light on the ways pandemic episodes impact economic growth.
5. We focus on pandemic episodes with at least reported 100,000 deaths. Our measure of innovation output is the number of successful applications per year in the set of G7

countries (Canada, France, Germany, Italy, Japan, the United Kingdom and the United States) and China.

6. We show that following a pandemic, innovation output is disrupted for a period of approximately seven years, probably because of a drop in research productivity (Figure 1). This result is striking as it shows a much more long-term effect in innovation output than the one anticipated. Our model provides more reliable forecasts of the long-run rather than the short-run effects of pandemics on innovation output.
7. We show that the main result of the effect of pandemic shocks on aggregate innovation output is driven mainly by a significant reduction in innovative activity in the Information and Communication technology sector (Figure 2).
8. Furthermore, there are some notable differences in the magnitude of the pandemic shock across countries and the time to recovery (Figure 3).
9. Pandemic shocks lead to a short-term drop in the number of patent applications. Finally, pandemic duration is strongly associated with a drop in patent applications (Table 1). The results are robust to a number of robustness tests.
10. The results presented in this section have very important policy implications.
    a. First, given that the pandemic poses a clear threat to research productivity in the long-run, policies that may reduce the effect of the "Great Lockdown" on research productivity are needed.
    b. Second, whilst the pandemic shock has an effect on global innovation output, the results vary by country and sectors of economic activity. The response to Covid-19 needs therefore to have a global character[1] but countries also need to

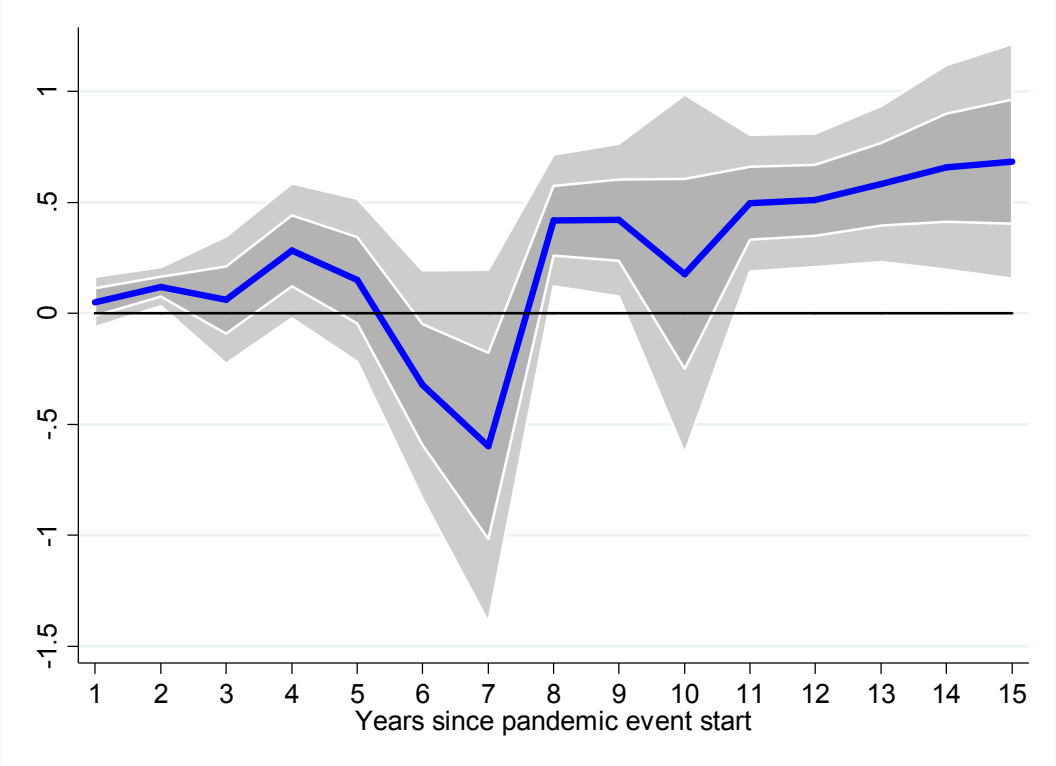
[1] The "Next Generation EU" support fund with a total value of €750B is such an example. The fact that the European Commission has also recommended changes to the long-term European Union budget for 2021-2027 is in-line with the policy recommendation relating to the duration of the pandemic.

introduce support schemes for the sectors that are more exposed to the pandemic shock. Overall, policies which target the more innovative firms are expected to remedy the effect of Covid-19 on future growth.

c. Third, the pandemic shock is expected to have a strong negative effect on patent applications. Governments, need to be prepared to support innovators in the immediate aftermath of the pandemic. Patent offices may have to speed up the process of approving new patents. Bloom et al. (2020, p. 1139) show that "ideas are non-rival", meaning that "they can be used simultaneously by any number of people". Supporting inventors and expediting the patent application process is therefore key to supporting economic growth.

d. Finally, innovation output is significantly and negatively affected by the duration of the pandemic and it is therefore important to implement support policies for the duration of the pandemic rather than as one-off expenditures only.

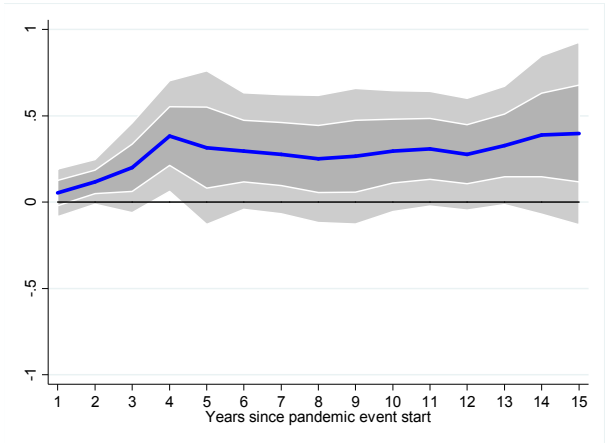
Figure 1
The impulse response of innovation output to a pandemic episode



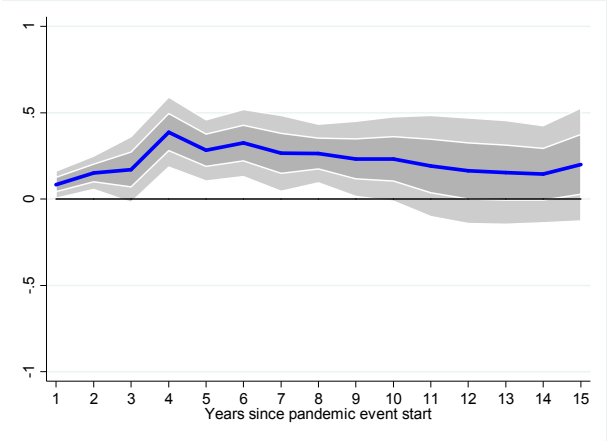
Note: The vertical axis refers to the percentage change to innovation following a pandemic episode. The shaded areas refer to 70% and 95% error bands.

Figure 2
The impulse response of innovation output to a pandemic episode by sector of economic activity

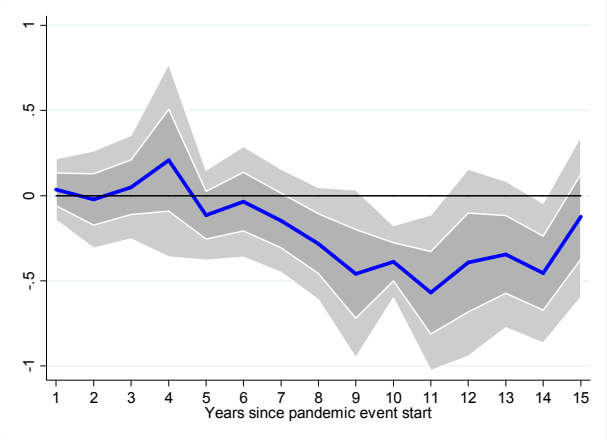
Manufacturing



Construction

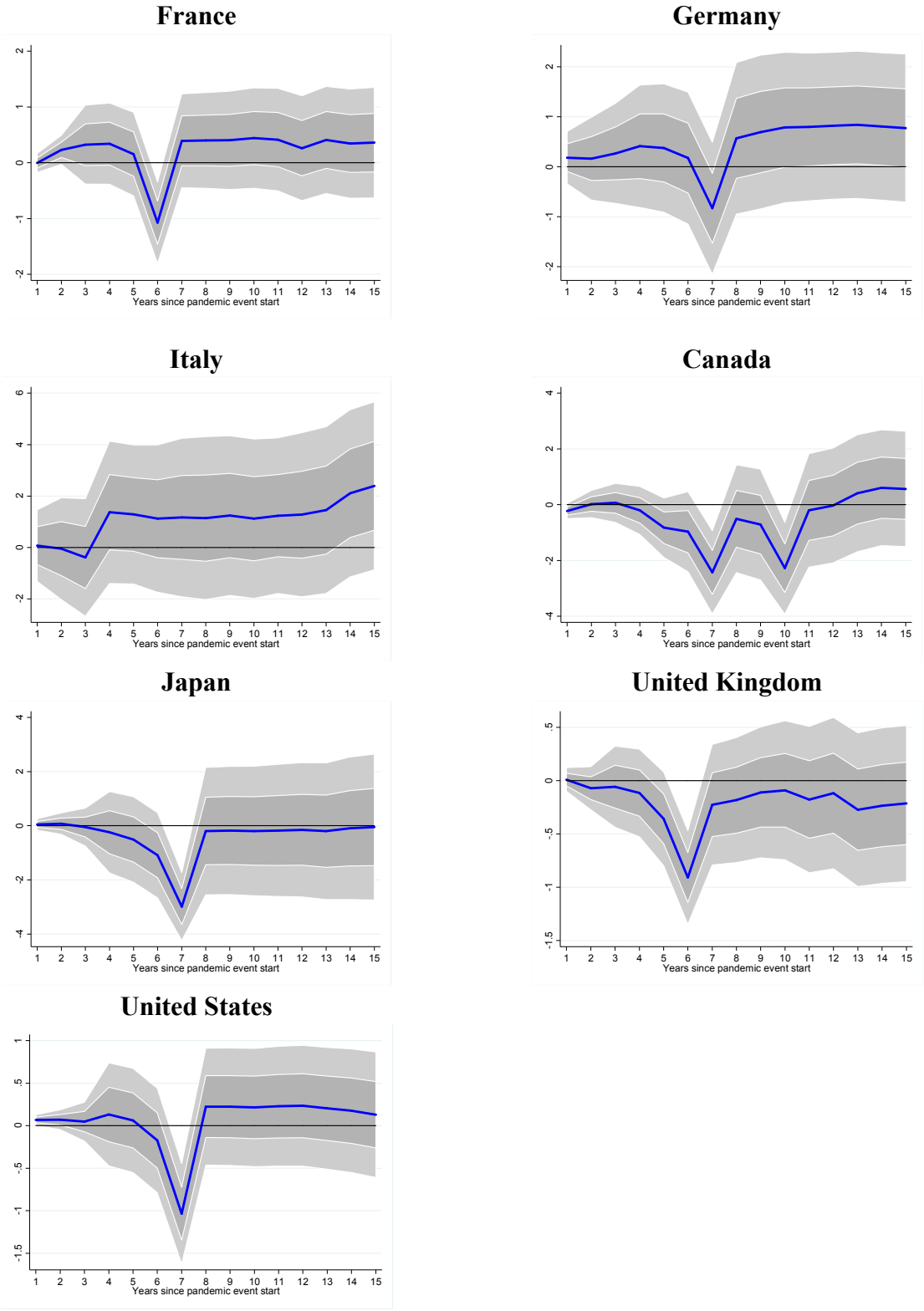


Information and communication



Note: The vertical axis refers to the percentage change to innovation following a pandemic episode. The shaded areas refer to 70% and 95% error bands.

Figure 3
The impulse response of innovation output to a pandemic episode by country



Note: The vertical axis refers to the percentage change to innovation following a pandemic episode. The shaded areas refer to 70% and 95% error bands.

Table 1
Effect of pandemic shocks on patent applications

Dependent variable:	**Ln(Innovation$_{i,t+1}$)**							
Sample	G7				T10			
	(1)		(2)		(3)		(4)	
P^{End}	-0.60***	-0.63***			-0.10	-0.09		
	(0.15)	(0.15)			(0.28)	(0.30)		
P^{Dur}			-2.24***	-2.34***			-2.24***	-2.24***
			(0.19)	(0.19)			(0.23)	(0.23)
N	712	712	712	712	859	859	859	859
Country FEs	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.002	0.114	0.074	0.193	0.001	0.102	0.060	0.166

Note: This table presents the results of the effect of pandemic shocks on next year's innovation output. The dependent variable is the natural logarithm of one plus the number of submitted patent applications at year *t+1* for each country *i*. $P_t^{End/Dur}$ refers to the dummy variables of pandemic (P^{End} *and* P^{Dur}) at time *t*. P^{End} is 1 if there is a pandemic end, 0 otherwise. P^{End} is 1 if there is a pandemic, 0 otherwise. Standard errors are in parentheses. ***, ** and * indicates significance at 1%, 5% and 10% level, respectively.

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