<u>Warning</u>: Economic (and Business Conditions) Forecasting are NOW more difficult than ever – Any forecast will be more dangerous than ever, if you rely on it, and do not understand how it was derived. Ask the provider!

This is a very important short note to complement and support my recordings for Business Essentials in the SpoundCartel series and my Webinar presentation for Mazars in late May.

Before (U know what!) economists either:

- (a) <u>cranked up their existing (computer-economic) models fed with generous doses of recent recorded economic data</u> e.g. GDP (national production/income/expenditure: same things) and produced forecasts that were little more than fancy extrapolations of what was already recorded. E.g. take a GDP growth quarterly series for the 4 quarters in Calendar year 2019 in Australia (from ABS, Cat. 5206.0): +0.5%, +0.6%, +0.6% and +0.5%. No existing model fed with recorded data could give you anything outside the +0.5% to +0.6% for the next quarter(s), or 2.2% for a year. Yet we hear forecasts of (MINUS) 8-15% annual drop in GDP, because of (U know what). In early June, the ABS released the March quarter data which was a moderate fall of 0.3%, making 1.4% for the year to 31/3/2020, and a certain recession to come, when the full thrust of the virus policies hit in the 3 months we are just about to end (June quarter, 2020). <u>There is no way that even this first 'glimpse' of the virus effects on our economy is consistent with the existing models and previous data.</u> So, anyone pretending to use "method (a)" has shot their credibility to bits. As these forecasts could not come from method (a), they must be method..
- (b) an unmitigated guess including surveys of other people's guesswork, which seem to be the method used by the British Office of Budget "Responsibility", because that's the only method they declared and they failed to answer my direct inquisition of them to explain anything else they used. But we might be saved, and remain explicit and logical, if we can develop and apply:
- (c) a new approach to computing economic (and business) damage done by (U know what)

   which is what I spent much of April and May devising, while corralled in Cambridge UK
   on a very extended stay.

**Method (c)** dispenses with recent, recorded data which are NO guide to the coronavirusrestrictions effects and instead imputes damage directly from the shares of industry sectors and the economy overall banned or brutalised by the restrictions themselves. That's how I got the estimates I presented to Mazars and in my Business Essentials presentations.

The model allows for chancing severity of restrictions and I used 3 scenarios – I have many more but three will do to cover the main credible scenarios:

# Scenario 1: Smooth and Careful Easing

Implies GDP in fye 2020: 4.75% down on fye 2019 GDP in fye 2021: 6.3% down

	Sept Qr 2020	Dec Qr 2020	Mar Qr 2021	June Qr 2021
Severity INDEX ('s' in VEM}	85	70	55	25
GDP index (2019=100)	82	85	92	98
Budget Balance YTD	90	75	60	50

The top line of data shows the degree of easing, which is faster in scenario 2. The workings to get to the gdp numbers are computable percentages that can be assembled by a hand-held calculator.

# Scenario 2: Fast and Fortunate Traverse Implies 1.6% growth in GDP fye 2021

	Sept Qr 2020	Dec Qr 2020	Mar Qr 2021	June Qr 2021
Severity INDEX ('s' in VEM}	80	50	30	0
GDP index (2019=100)	85	92	100	110
Budget Balance YTD	85	70	55	40

When we come to scenario 3 it starts like scenario 2 but "you know what" comes back, as do the restrictions and the economic picture turns sour.

# <u>Scenario 3</u>: Fast and Unfortunate: the 2W Implies 8.4% decline in GDP in fye 2021

	Sept Qr 2020	Dec Qr 2020	Mar Qr 2021	June Qr 2021
Severity INDEX ('s' in VEM}	80	50	80	80
GDP index (2019=100)	85	92	84	88
Budget Balance YTD	85	70	110	140

When it comes to your business, my suggestions are similar to those I used for forecasting the economy overall:

Compute what sales value and percentage of your business is banned or butchered by the regualtions, which in my view will be diminished fractions as Australia, at least, comnes out of the heavy restrictions. You will need to be conscious of the amouint and ratio of committed (fixed) expenses if (like a pub or restaurant) you decide to stay shut longer.

Pleae now read the "VEM" papers which should make more sense.

**Footnote:** In the UK we have monthly GDP rolling updates, unlike Aus, and an April 20% drop has just been confirmed by the ONS ( the local ABS), with a 10% drop in the 3 months to 30/4/2020. Things are often slower here in the UK, but they DO get their economic data out faster than in Oz.

Best regards,

Neville ( "Normally" in OZ, but corralled in Cambridge UK since February) Norman

## An Overture to a Virus Economic Model

I present a model about the virus which is currently consuming our attention, everywhere.

Actually, it's just about the <u>public policies</u> manifested in those 'restrictions' that dominate our lives, in this virus crisis. But none of that would have pervaded our history, without the **V**irus. So, it's a '**V-E-M'**.

Like any '**Model**', or map, it is <u>not reality</u>: rather, it is a drastic simplification to embody key features of our chosen subject, and to shed insights and guidance in a structured framework.

It is '**Economic**', because it uses 'economic' <u>methods</u>, that also involve the humanistic concerns of mortality and misery, with and 'economy' of words, just like Stephen Hawkins had to do.<sup>1</sup> I have blended what looks like neo-classical optimisation with non-mainstream 'Keynesian' sympathy for stimulus-type support packages.

**Confession**: I am an Australian academic economist, currently confined to quarters in Cambridge, England,<sup>2</sup> desperate to help CoVid-19 public policies get more structured, and more balanced. Yes, I am keen to get out of this lock-down, but even more desperate to avoid death and irresponsibility. Most of all, I want to help confront the deadly balancing acts imposed on all of us, and to crystallise that dilemma in this 'model'.

We are all prisoners of our upbringing. The Australian, the Cambridge and the Economist in me keep driving me on. I devoted most of the month of April, 2020, and early May, to devising this.

I imposed these rules on my exposition:

- A words-only exposition, as plain and parsimonious as possible, using square-bracketed insertions [like this one] for comments, encouragement and the lighter side wherever possible. [That avoids most of the footnotes, or the rock-back-and-forward annoyance of endnotes. But I sinned by including two pictures from the Gallery]:
- A **picture gallery** to show important 'relationships' that feature in all good economics, purged of acronyms, symbols or maths, which are shunted to other presentations [available on demand].
- A **Users' Manual**, for anyone wanting to apply these methods for themselves, and hopefully decisionmakers who, like most of us, have never been trained to deal with anything like this virus.

That ends the Overture. Now, a blunt summary of the setting for the model and what is designed to do or not do.

<sup>&</sup>lt;sup>1</sup> I met Stephen Hawking in October 1970, struggling on stairs in the Cambridge Economics building, to attend a mathematicaleconomics seminar. He then sat next to me to discuss the maths-economics connections in the seminar. Yes: I <u>did</u> finish his book. His arcane concept of time makes the way any of us treats time seem crude. His economy of words was admirable.

<sup>&</sup>lt;sup>2</sup> <u>n.norman@unimelb.edu.au</u>; <u>nrn1v@econ.cam.ac.uk</u>. There is a long line of better-known Australians who came to Cambridge to learn and then live here: Howard Florey, Herb Elliott, Germaine Greer, Clive James, Geoff Harcourt.

# The Virus Economic Model in a Nutshell

In a **virus-infected 'model' society** there are two dominant concerns: (1) minimising <u>further</u> <u>deaths</u>; and (2) minimising <u>economic damage</u> from policies adopted to pursue goal (1).

There are **NO extremists** who see value in just one of these goals, either goal 1 or goal 2.

There are **leaders** who need to combine and balance the impact of the antivirus virus policies (dominantly, the duration and severity of restrictions) they have imposed.

The **Virus Economic Model**, presented here, offers <u>a comparable measuring scale</u>: progress on a percentage-success basis, measuring (1) <u>BENEFITS</u>: eliminating virus deaths, as restriction periods and/or their severity increase; and (2) <u>DAMAGE</u>: economic activity being pulled away from normal activity rates, as restriction periods and/or their severity increase.

The user can assign relative degrees of significance, called 'weights' to the two goals. [Example: if the life-saving goal gets 75% weight, the economic damage goal gets 25%.]

Now the two scores <u>can</u> be combined, to show a (weighted) difference between the benefits and the burdens from that which drives ALL things here: the virus-provoked restrictions.

There is some (optimal, best for society) duration, severity and optimal path(scenario) for <u>easing the restrictions</u>, which the model reveals. Any scenario gets a score and the user gets to decide how important to make each of the two competing goals.

<u>Different societies</u>, with different 'virus-deaths destinies', speeds of policy effectiveness and views on how to 'weight' their divergent goals (meaning ways to combine death benefits and economic activity) will arrive at <u>different solutions</u>.

Without measurement, and ways of combining it, we are left only with guesswork, with consequences that are deadly, damaging or both.

That's the (VE) Model in a Nutshell, and why something like it is urgently needed.

[The rest of this Overture gives important notes on the background setting to the model, before the central 'Plain Words Exposition' a visual 'Picture Gallery' a 'User Manual' and applications in the Case studies.]

**The (Virus Economic) Model** is about a society, with a history, and a future on which I immediately speculate, so that we can ask, "If that's where we're going, **what can 'we' do now to make it better**?

The 'model society', briefly summarised below, has already:

- succumbed to the virus and imposed <u>restrictions</u>, which remain in force, at least in part;
- has gained some, but nowhere near enough, <u>knowledge</u> into the origin and effects of the virus;
- has leaders who make the virus-restriction <u>decisions</u> who agonise about when and how to relax them;
- has 'medical and scientific <u>advisers</u>' [I called them MASA in drafts but that broke my noacronyms rule];
- proponents desperately pressing for the end or radical <u>easing of the restrictions</u>; and has
- no real mechanism, to date, to help measure and balance the death benefits and economic damages.

The model is predicated on **two central propositions**:

- 1. If we **don't measure**, and measure dispassionately, **BOTH** the life-saving benefits **AND** the economic (and other) damage that flow from the 'severity' and 'longevity' of the restrictions, any virus-relevant public-policy decision, comment, or pleading, will be unsupported guesswork in a deadly setting;
- 2. Unless we measure <u>benefits and damage on the same measuring scales</u> (preferably **not** money), decisions, and pleadings, will be arbitrary and subject to manipulation.

The 'model' offers a consistent measuring scale and a mechanism for resolving the 'balancing' issues to give answers to the Biggest Questions of the day: How long, how severe, what else, as nations agonise over the balance between life and damage. I offer practical steps to use the model, incorporating step-down phases and even 'second waves', to get the debate quantitative and to enhance understanding.

The 'model' is <u>a structure or platform</u> that needs data and value-laden inputs, before it solves, which it does, for a 'model society'. If it captures the vital parts of <u>real decisions</u>, then it enables us to get back to economic forecasting and policy appraisal for an environment we have never seen before, and never been trained for.

As a prelude to the model description it is VITAL to place ourselves at a point in history.

In the following **Short History of the Virus** I have dreamt up the future, from the point we have already reached, to help take steps to avoid the worst of it happening.

### A Very Short History of the Virus

There were people, and economies and social interaction, and mental states, before the virus.

Then the virus came. It changed everything. Some lives, lifestyles and businesses would be lost, forever.

Decision-makers differed: some dithered; some contemplated letting the virus run wild; some acted fast.

The virus killed many people, but the anti-virus policies killed jobs, social activity, businesses and sanity.

Nations differed in the degree of preparedness they had made for the virus, and in mortality experiences.

People polarised when debating the virus restrictions, some seeing only life-saving benefits from lock-downs and social distancing, resisting increasingly-vocal calls from the other extreme (seeing only economic damage).

Decision-makers were not trained to handle the deadly consequences of resolving these debates. Some even struggled to comply with their own edicts. Many leaders just played 'not now' games or spoke mumbo-jumbo, or just blamed medical and scientific advisers [the MASA], of varying cogency, in front of the camera.

In the full, first restriction phase, many businesses crumbled, but Polarised People Type One kept ignoring this type of damage and just kept reminding all people about the morality risks of any liberating.

In the same phase, Polarised People Type Two kept disregarding the mortality risks, and just kept reminding all people about the material and psychological damage, as the restrictions continued.

In the absence of any mechanism by which to balance these life-or-economy debates that intensified, the decision makers kept dithering, or muttering more mumbo jumbo.

Then the pressures got too great: restrictions were eased, first microscopically, and with differing details and durations of the phase-down, nation by nation. For a time, the virus seemed to be beaten, in some places. Many people questioned whether the restrictions and all the damage they caused were worth it.

In other places, the virus flared up. But people did not know whether this was an inevitable second wave or just the impact of widespread ignorant or selfish non-compliance with the remaining anti-virus policies.

In the penultimate phase, social contact never returned to the way it was; work habits never fully reverted to what they were, and some people and commercial activities never survived.

In the final era the virus was gone. Now a different menace reared its head: Public Inquiries, after proposed inquiry 'members' were dumped in droves: too many extra-marital affairs, or not enough of them. Until the 'model society' realised that this was not what getting 'balance' really meant.

Among the blame games and recriminations to surface, there were also some positive things: <u>New Policies</u> to preserve the manifold benefits to the environment that were observed in the first, full dose of restrictions, with less traffic, travel and careless use of the earth; stopping wasteful business travel...and much better <u>preparedness</u> (for whatever next virus emerges) than we ever made before, for this virus.

This Virus history then ended. But if we knew all this now, what on earth could 'we' have done differently?

# The Virus Economic Model: A Plain-Words Exposition<sup>1</sup>

[This is the main, people-friendly version of the model. It follows the **Overture**. A **Picture Gallery** is also available. Less friendly technical notes I will send on request. **The Case Studies** are readable and bring the model to life. Why so many styles? It's my desperate attempt to reach a wide range of audiences. Square brackets, like this, contain my comments of elaboration, to avoid footnotes, and to offer some lighter touches. NRN]

A new crisis needs a new approach, with fresh minds, new words and new concepts.

The model has 'virus days', where history (and day counting) starts anew: when the virus came, when we recorded 'cases' (infections) and then when virus-related deaths followed, when the restrictions started, and then when they were, or will be, lifted, or at least eased, and each phase of that, if that's how it's liberated.

With what is at stake (human lives and whole economies), years, quarters and months are all too long as intervals of time. [If an apple had fallen on my head in Woolsthorpe Manor, I would have calibrated the model even more finely than 'days', done it all in *The Calculus*, and signed it Isaac Norman.]

The virus is still upon us, as are many restrictions, and much agony about everything to do with the virus.

Our delicate moment in time, right NOW, is still, if I'm, right, quite '**early**' in our **Short History of the Virus** (from late 2019 to 2025), which is found in the *Overture*. There's still much time to make changes, to save people, economic activity, and our sanity.

<sup>&</sup>lt;sup>1</sup> I dedicate VEM to four brilliant Cambridge-trained economists: Professors David Champernowne and Brian Reddaway, who taught me in Cambridge to model parsimoniously and use 'the alternative state' to analyse every relevant decision, J M (Lord) Keynes, who taught the world in the mid-1930s the value of support packages to curb Depressions, alas just too late to stop the last (Great) Depression, all three being path-breaking mathematicians before turning to relevant economics, and Jim Perkins, who didn't do maths but migrated to Melbourne to teach us in the 1960s the value of 'plain words'. It is ironic that I devised VEM entirely in lock-down in Cambridge, when I should have been back in Melbourne. I greatly appreciate the helpful comments and encouragement of Ken Coutts, Rachel Adeney, John Freebairn, Lewis Goldman and Hugh Videion on earlier drafts of these papers. My fellow-economist wife Margaret did more than anyone to encourage me and insisted on larger fonts than I used, undoubtedly to help my readers during bed-time reading of these diverse-style papers, in faint light. NRN

There are **terms and concepts, some new**, which you will discover on the journey of studying this model. The main ones you will need to follow the model are **bold**ened below.

### Up to now, we have observed, and we can record:

- The virus started in '<u>other' places</u>, some of which could have done far more than they did to contain it
- <u>Denials</u> that 'we' would get it, then we got it, with
- An <u>amazing daily flow of data</u>, on diagnosed infections, called '**cases**' and, tragically, '**deaths**.'; and
- People watching daily for '**curve-flattening'**, some pretending to understand, or remember, what logarithms are;
- Rising deaths, following rising cases, with a delay, and with differing **mortality rates** (meaning deaths divided by cases);
- Medical and scientific advisers making the case for restrictions to save lives; thus, then
- **Restrictions** that are imposed on travel, movements, activities and services people can do or buy, to save lives,
- Vigorous debates which divide society, with '<u>Type-One' extremists</u> focussing on the first virus-policy goal of saving lives, and '<u>Type-Two' extremists</u> focussing on the second virus-policy goal, of preventing economic damage;
- <u>Some progress in saving lives</u>, having observed already a peak (maximum) in the data for daily (new) deaths from the virus, meaning that progress is already being made against the first policy goal; but
- <u>Some significant damage to economic activity</u>, as the impact of the virus restrictions has already been to 'gouge' out huge parts of the restriction-imposing economies, which worsens policy performance against the second policy goal, leading to
- Further debates and pressures to end or ease the restrictions, not least because there is
- No mechanism for balancing benefits and burdens from the virus-policy restrictions.

That is the scene, right up to "now", the present.

The challenge for the balanced society is to make those decisions, based on balancing the firstgoal benefits and second-goal burdens that are within the control of those who made the virus-policy restrictions initially.

The model is designed for this balancing decision in a balanced society.

Balance means accepting that there are BOTH deadly consequences AND economic and other adverse consequences that stem <u>directly from the restrictions</u>.

# The Balanced Society: Its Essentials Described

#### A truly balanced society:

- enjoys the **good things** in life life itself, leisure, family interactions, work (if only the income it provides), entertainment, travel, playing and/or watching sport;
- is conscious of many **bad things that happen** death, distress, work (in many cases), paying for things, including taxes and many forms of anguish, many of them incurred in pursuit of the Good Things;
- debates intelligently, **Public Policies** promulgated by balanced leaders, which are enforced firmly and fairly;
- has already adopted virus restrictions, with vigorous public debate about them; and
- recognizes, tragically, that with few exceptions, the virus, and the restrictions <u>bring only Very Bad</u> <u>Things</u>.

#### The main Bad Thing, post-virus, is Mortality and Distress, in the Balanced Society.

Propositions propounded by medical and scientific advisers, that <u>virus-based restrictions will curb mortality</u> <u>rates</u> and thus distress associated with (family and friend) deaths, are accepted as evident and credible in the balanced society.

#### The balanced society:

- has observed that <u>daily virus deaths have declined since the restrictions were imposed</u>, and is
  inquisitive about 'how rapidly' this process occurs, and is predicted to continue, in the assessment of
  balanced demographers;
- looks to other societies with <u>markedly different experiences</u> of deaths and virus 'cases' (diagnosed virus illnesses), and questions why other societies are faring better that they are;

- seeks guidance on how the length and severity of the restrictions is connected to its experience, to
  date, and their destiny, in the near future, of virus deaths, manifested in daily (new) deaths data, on
  which the public has become obsessed; and
- understands that longer and more severe restrictions diminish daily (new) deaths, in the balanced society, with a lag, but at a declining rate of success.

### The Second, Main Bad Thing is Damage to the Economy of the Balanced Society

It is the VIRUS RESTRICTIONS directly, a balanced response to the virus itself, that cause the economic damage.

### The "economic damage' in a Balanced Society:

- is not merely a direct loss in economic activity (measured, typically, by 'real' gross domestic product), but also associated losses of skills, infrastructure, sanity and civil order, and also rising budget deficits, taxes, debts and debt-serving costs, each dependent on the severity and length of the virus restrictions;
- starts from the day the virus restrictions were imposed and escalates in proportion, or more than in proportion, as the duration of the restrictions increases;
- is intensified by the 'severity' of the restrictions, which can be assessed by studying the details and enforcement of the restrictions, which make illegal, impossible or impracticable huge proportions of society's work, spending and specific activities that were part of the pre-virus balanced economy; and
- can be reduced by support packages to individuals and firms damaged in this process, which limit the degree of 'gouging' of the balanced society's economy, albeit at significant financing costs.

#### Leaders in a balanced society:

- will consciously combine the impact of virus-provoked restrictions on society considering <u>BOTH the</u> <u>mortality bad things and the economic-activity-related bad things</u>, knowing that mortality experience (in the first goal) is improved by longer and more severe restrictions, and the economy-related bad things (in the second goal) are worsened by them;
- seek to measure everything they can, even the value of life, debating and learning what the measures mean;
- <u>balance progress</u> on their death-saving targets <u>against damage</u> on their economic-damage indicators;

- realise that there are <u>many different ways in which to express and measure the 'progress' and the</u> <u>'damage'</u>, being competing forces connected to the virus restrictions, and that the alternative for them is just dithering and further distress, or sheer guesswork;
- are honest enough not to let <u>'(infection) second-wave' speculation</u> drive vital policy decisions, but if it happens, to reinforce restrictions and give MORE WEIGHT to the first goal than otherwise; and
- realise that <u>death</u>, <u>distress</u> and <u>damage</u> from the virus is inevitable</u>, and any balanced decisions they make will inevitably trade off death and damage, uncomfortably.

# **Measuring in Percentage Scores**

All measures in the model that ultimately matter are <u>percentage scores</u>, like school marks. Any zero-performance score is total disaster and 100% should be perfection, which is seldom ever reached.

Before describing the meaning of these performance scores for goal-achievement, the **restrictions themselves** have to be studied and placed on a percentage scale, so they can be compared between places and when they change, like being phased down or out. Restriction-researchers make the study and give the scores.

Since the virus came, it is difficult to find anywhere that does <u>not</u> have some restrictions, so zero % for restriction severity is very unlikely. Even 100% is rare, but almost conceivable: Draconian prohibitions on almost all movement, with everyone working at home (so what about farm, mine and factory workers?).

We set up the model with trial example numbers and used 80%, for realistically-tough restrictions, because we want to study their socially-right time for relaxation or ending and to <u>lower them in phase-down scenarios</u>.

In the crudest form of the model, the decision makers using the model find a specific (virus) date – so many days after the restrictions started, to end the restrictions, in one hit. Phase-out scenarios follow, each with performance scores embodying 'success' which, in this model, always embraces BOTH goals.

It is critical to keep in mind that the main driver in this model is the length (and severity) of the restrictions, and how the benefits and damage (scores) change as the restrictions lengthen, shorten or get more or less severe. But how?

# Measuring Social Benefits for the First Policy goal

Every evaluation in economics or special policy needs comparisons, usually between what is, or will be, against an 'alternative state' that might have been. The alternative states here are life, and economies, without the virus, or without the restrictions. [Cambridge economists pioneered this concept.]

For measuring progress in relation to the **first goal – life saving** – the model requires investigating what we already know – the pattern of daily (new) deaths, thus total deaths, SINCE the date when daily deaths reached a peak.

Real countries are already in this zone and have a three-part **deaths-destiny** specific to each of them:

- (a) the mortality rates: deaths divided by cases;
- (b) **time patterns** with the (percentage average) rates at which daily deaths have been declining; and
- (c) a survival-speed indicator, called 'velocity' in the model.

The Picture Gallery helps explain each of these and how they differ between countries.

We offer here a brief explanation in words

**Mortality Rates** – simply the percentage of diagnosed virus cases who die. Like 6% for the world average, 14% for the UK and 1.2% for Australia. The model demonstrations use 5%.

**Death-decline rates** – based on research, the model takes 2% a day as a poor outcome that would have occurred if restrictions had been removed at the peak point of daily virus deaths. The model has 5%, with UK less and Australia greater. This is the deaths-destiny scenario, basically reflecting a country's health and hygiene, testing and virus transmission features. [I called it 'q' because it must at some time be questioned.]

**Velocity** – crudely, this is how **fast** an extra day's duration [for some, agony] in the lockdown pays off in working to make headway on the first goal of saving lives. The deaths data are plotted on a time scale, but longer lockdowns shift the deaths-decline curves down – greater decline rates, meaning more 'success'. So, we see the success score <u>rising</u> for longer lockdown durations but at a <u>decreasing</u> rate of improvement. [The diagram following is taken form the

Picture Gallery, contradicting my plain-words promise, because it tells so much on close inspection.]



After all that we have the scores for the first goal, considered separately, as plotted above for every day the restrictions might exist. For 'extremists Type One', with little or no regard for the second goal (economic and related damage), this is the end of the exercise and the lock-downs and other restrictions can go on indefinitely. There is no point in pretending there is ANY balancing.

For any sense of balance, we must go further to...

## Measuring Economic Damage for the second policy goal

The model society investigates seriously, and predicts, the economic damage. In any proper analysis this should include losses of jobs and skills, disappearing firms, government debts sustained from the support packages, further ('multiplied') ongoing damage from all that, not forgetting psychological damage, as the restrictions bite. [Phew! And the Goal Type One extremists want to leave all that out.]

To get on with it, we just measure the shortfall of national income, also called national production, from the path it would have taken. [For countries like the UK that was a fairly flat path of close-to-zero growth.]

We economists persistently used to refine our economic activity forecasts in ways that must now be seen as microscopic adjustments. That's because the virus – correction the 'virusbased <u>restrictions'</u> - came along and ripped huge chunks out of the economy, affecting some sectors more than others – like London Heathrow air traffic being 97% lower in April 2020 than it was in April 2019. [Also, condom sales slumped, almost as much as all activity got stopped in clubs, restaurants, travel; and entertainment: Source: the **I**, 2May2020, p.11. However, there is recorded a <u>massive increase in the demand for rat-catchers</u>, as ravenous foot-long rodents raided homes, and people responded (naively) to (professional) ratcatcher recommendations that "Supermarket rat poison is no longer as good a rat-killer as it used to be" (*Daily Star*, 2/5/20, p.11)]

We need new names for this unprecedented virus-restrictions-driven economic damage. The model calls it 'gouging'. [I used a '*classical-economic*' set-up to capture the agonising policy choices. My treatment of how economic activity reacts to (a) severe restrictions and (b) 'Keynes-like' support packages to substantially LIMIT gouging is anything but 'classical'. Given the ubiquitous adoption of such packages, I can only assume that 'classical economists' (who hate them to a passion) must have been rolled in the policy-making processes, in 2020.]

Economists use fancy models to combine mountains of PAST data, stretching back decades [e.g. VAR], but none of them gives any guidance to predicting the massive degree of 'gouging' of our economies, in 2020.

If on any day after the restrictions were imposed, forty percent of the national income/production were gouged away by the restrictions, then our 'damage' score is 40%, which means we 'saved' 60 % of our economic activity, but a 20% damage score would have been 'better'.

The path of the second performance score – an entirely negative one – is plotted in the next picture.



### Combining and Solving for BOTH policy goals

We are getting close now to our first set of solutions, which are designed for illustration to solve for the duration (in days) that serves society best if it operates a one-shot duration of the restrictions, that will end right after that date: called the 'cliff-face' scenario. [Fairly easy to imagine if you travel fast towards it and see nothing ahead as the land drops away, precipitously, ahead of you.]

We have percentage scores now for benefits and damage. Both rising with the duration and severity of the restrictions. Let's hold severity for the moment and exploit the impact of longer durations.

The success scores that excite Goal-One people keep on rising, but at a <u>diminishing</u> rate.

The Goal-Two damage score also rises, but at an <u>accelerating</u> daily rate.

That suggest that some (best) duration of the restrictions is found where the daily improvement in the first-goal score is just offset by the daily increase in damage registered on the second-goal test.

That's broadly true, but don't be too hasty. Doing that attributes the same degree of importance to each of these two goals and that's not what balance means. **Balance means debating and deciding the weights**, for and on behalf of the society.

# A Vital Interruption:

# **Comparable Measuring Scales**

# You should not try to combine the measurement of two or more different things unless they are measured on <u>'comparable' measuring scales</u>.

[These principles and example were developed for remotely-delivered home-school with our English nine-year old grandson, Oscar, who lives one mile away in Cambridge.]

There are **2 farms**, one with 2 pigs and 20 rabbits, the second with 10 pigs and 2 rabbits.

The first has 22 animals, the second only 12, so the first farm is a bigger: it has more animals, surely.

**Statistical advisers** <u>object</u>: the head-count measures are useless – different things are being combined.

**Engineering advisers** <u>suggest</u> weighing the animals. Each pig weighs 300 kilograms; each rabbit weighs 2kg, so farm 1 has a 640 kilograms mass of animals, but farm 2 has 3004 kilograms (more than 3 tonnes) of animals, so farm 2 is now the biggest.

**Economic advisers** <u>suggest</u> finding market values of the animals. Each pig gives 100 kilograms of pig-meat (pork/bacon) and each rabbit 1 kilogram of rabbit-meat. Each meat has a market value of \$10 per kilogram. The economic value of the animals is (1) \$2,200, and (2) \$10,020.

**Biology advisers** <u>warn</u> that all such estimates can change quickly over time due to reproduction. A month later the rabbit populations of both farms double, people get confused and nobody gets a clear answer, at least on the 'by how much' questions.

The virus-policy debates are a lot like this. Even if a society agreed on how to measure lives saved and economic activity lost, you can't measure people and pounds sterling, dollars (or whatever money unit attaches to gross domestic product) <u>on the same scale</u>. Or can you?

We think the 'percentage-of-goal' achieved device comes very close. NRN]

With comparable measuring goals and explicit, declared policy-choice 'weights' we now have some answers.

The 'best for society' (optimal) duration of the restrictions in the base case solves as **103 days**: where the marginal benefit for prolonging the restrictions one more day – saving more lives – is just outweighed by the marginal value of damage to the economy. For the one-shot model we experiment with:

(i) three different weights – 50% to the first goal, then 75 then 25%,

(ii) slower conversion speed of restriction days into saving lives,

(iii) greater acceleration of the economic damage,

(iv) fuller force of the restrictions,

(v) less 'gouging' from more-fulsome support packages (despite classicist economist objections) and

(vi) an "Oops" realization, belatedly, that the economy might suddenly matter more.

I ran several experiments to give policy pointers. Here are the results, in tabular form:

# Main Model Experiments for One-Shot Restrictions: The Results

Run	Experiment	Description	Result	Comment
1	Base-case Solution	50/50 weights	103 days	Plausible 'best duration for a balanced society with world-typical numbers for mortality and economic 'gouging'
2	Heavier First-Goal weights	75/25 weights	>300 days	Scant concern for economic (etc.) impacts favours a long, unchanged duration – and a much more damaged economy
3	Heavier Second-Goal weights	25/75 weights	Zero days	Scant concern for life saving eliminates ANY Restrictions – and kills many more people

4	Poorer speed in restrictions saving lives	The speed ('Velocity') factor is cut	93 days	The slower impact on life-saving does too much (economic) damage to let them run past 93 days
5	Less second-goal (economy, etc.) acceleration	Goal 2 accumulator reduced	71 days	More scope for saving lives if the economic damage accelerator is lessened, without any changes in policy-choice weights
6	Severity of the Restrictions is raised at all times	Full severity factor (100%)	148 days	Shift up in both goal curves favours a longer period of restrictions, despite heavier economic damage
7	Less "Gouging" of the economy	Gouging factor cut: 0.5 to.03	145	Support packages (thanks Keynes) let longer restrictions save more lives with less economic damage than in the base case
8	Oops! We forgot about the economy	Switch the weights at day 60 from 50/50 to 25/75	60 days – Full Stop. All restrictions end	Any sudden shift in policy priorities changes the game. Curbing Goal 1 'weights' at 60 days 'optimally' ends the restrictions, abruptly, at 60 days. This highlights the policy dilemma.

[The pictures show all this very compactly, and visually].

A great advantage of this model is that we can argue with everything in it, change it, and we still get precise answers.

### Some comments:

The model captures the deadly and damaging dilemma faced by CoVid-19 policy makers.

The model solutions tell us that, in any balanced set-up:

1. Restrictions **do** save lives – rightly this IS the "First Goal" but they also damage the economy and at some time they need to be relaxed and/or removed. The model shows what that depends on.

- 2. Minor swings in the policy weights toward either goal change the 'optimal' length of the restriction period significantly and should be discussed/exposed much more than they are.
- 3. More severe or faster-working restrictions, paradoxically to some, make the case for even longer restrictions to do the job [scan closely the results from runs 4 and 6 in the table above.]
- 4. Lesser 'gouging' of the economy, say, with extended support packages, favours longer restrictions and save more lives.
- 5. Faster acceleration of the appraised economic (etc.) damage shortens the optimal duration of the restrictions.
- 6. Sudden changes in policy weights (as with any radical change in government in a democracy) alters the optimal virus strategy suddenly. [Keynes, who built the first support-package-justifying economic model said to a critic: When things change fundamentally, I change. What do you do?]

[For an Unbalanced Society, the model [bent, against the rules, to include it] captures directly the message that comes home when extremists take charge:

- <u>Deaths-dominated doomsters</u> with no interest in the economic damage should NEVER STOP the economy-damaging restrictions
- <u>Materialist moguls</u> with concern ONLY for 'the' economy should NEVER implement ANY restrictions.]

The results reported to date show the model as run to solve how long a single-phase of restrictions should last, using openly-declared, rational methods. The world now wants to move beyond one phase into potentially several new phases to execute the process of relaxation (sic!). The model handles that. So, we present, as a finale (for now):

# **Severity Slackening Scenarios**

I have some good news.

We have entered a more complex (multi-shot) world where quick [calculus-algebra] answers are no longer possible. The **Good News** is that <u>Computer Calculations</u> are really easy, so we use and demonstrate them here. They also handle realistic amendments for a return ('second-

wave') of the virus and associated re-evaluation of the relative significance that is given to saving life (the weight on the First Goal).

[That's the end of your chance to renew your basic calculus, with exponential differentiation using log tricks to get x ('n' here) out of the exponent. There's always dynamic programming if you're up to it.]

### CAMEO NEWS FLASH: Death and Damage - A 60-day Review for the Model Society

It is now two months since the virus restrictions started in the Model Society. Deaths continue to happen; and damage to the economy is mounting. Pressure comes to the decision-makers like a pincer from two divergent directions: (1) hold and tighten the restrictions to save lives; and/or (2) get rid of, or loosen, them to save firms and jobs: "the economy."

The balanced model society has a mechanism for balance. But answers to the Biggest Dilemma of our time depend on publicpolicy 'goal weights' that swing between, but never at, 0% and 100%, so dithering and difficulty abound instead of clear-cut, confident decisions.

Yes, things are very 'percentage' in the Model Society. Scores on how well the land is going in the virus-combatting policies are measured in percentages, for both the twin goals of saving lives that would have been lost without the restrictions, and measuring the economy from disappearing entirely as 'percentages of it gouged away''. Even the restrictions that cause both these things are measured in percentages of 'severity' by our 'restrictions researchers'.

But leaders in the 'model society' are also politicians. To save isolating either set of extremists, the political compromise is obvious – keep the restrictions for the rest of the year and ease them, like every country in the real world is doing.

I experimented, initially, with **five genuine phase-down scenarios (numbered 2 to 6 below: the** simple cliff-face one being a non-starter, with nothing after day 60, just left in for comparison. The others are:

They are tested by using the basic Virus Economic Model to calculate cumulative scores AFTER day 60 of the restrictions:

- [Scenario 1: One-shot restrictions for 60 days only, after which none: *the cliff-edge*];
- <u>Scenario 2</u>: One step phase-down for 2 months after 60 days: *the one-step quickie*;
- <u>Scenario 3</u>: a 4 step, progressive phase-down, each of the 4 phases lasting 60 days: *flighty*;
- <u>Scenario 4</u>: As for scenario 3, with a second wave in the period 180 to 240 days: *waved-flighty;*

- Scenario 5: As for scenario 4, with restrictions back up; the jack-knife;
- <u>Scenario 6</u>: As for scenario 5, but with all First-Goal 'weights' bumped up 25 percentage points, after which the restrictions are returned to pre-phase-down intensities; so, then I added:
- <u>Scenario 7</u>: restrictions maintained right from day 60 for the full 300 days.

Again, I break my words-only rule to show the story in a picture.



The results, now following, are a striking demonstration of the value of the model, why we need both major goal-types in the one process – not extremists – and why we need the public or its representative to openly place weights on those goals, which become critical selecting the right policy, and when to implement it.

<u>Warning, again</u>: The results, all of them, depend on the set-up of the model. That said, here's the blunt summary of the step-down analysis using the model:

1. Almost every extension of the restrictions after 60 days is beneficial to a 'balanced society', unless very little significance is given to saving lives and a huge amount (of 'weight') is placed on the mounting economic damage;

- 2. With middling-weights to the two goals (e.g. 50/50) stepped reductions after 60 days are far better than not stepping them down at all, or reverting to harsh restrictions, unless there is a pronounced 'second wave';
- 3. With heavy emphasis on life-saving (e.g. a first-goal weight of 75%) longer restrictions always help, but the economic damage is large and is made a distant second-place;
- 4. With heavy weights on 'economic and other damage' accumulated with long restrictions, short and more drastically-reduced restrictions help though [Economist point: continued support packages can mitigate these problems and then save more lives: Keynes was more a savior than he ever realized. The (keep-gouging) Keynesian sceptics may be both damaging both the economy and human life;
- 5. If a second wave came, it is better to wait until it does, move quickly to reinstate heavier restrictions and then release them as soon as possible. It is critical to do everything to prevent the second wave to save BOTH the people and the economy. But this sensible- sounding strategy directly affirmed by the model, suggests a 7<sup>th</sup> scenario, which I added after these striking results emerged:
- 6. Would it be better to keep the restrictions ON for the full 300 days at the intensity maintained in the first 60 days? The model says a definite "NO". Scenario 7 is a bad choice, under almost any configuration of the model.

[People night ask: (1) where is the **epidemiology**? (2) where are jobs, debts, deficits, **support packages** and how to finance the support packages? And (3) where is the **politics and emotions** towards human life, the economy, liberty and personal trauma as restrictions are prolonged?

#### Answer: they're all IN the model: and this is where...

(1) Lying behind the 'ceiling' limiting the first goal [ which the pictures make plainer] are patterns of death rates both over time and as affected by the restrictions, which

presume that after 60 days "R" remains below 1, but all that is changed when the second wave comes, as in Scenarios 4,5 and 6

- (2) Behind the 'gouging factor' and linked always to the mounting economic damage (GDP), as explained in the *Manual*, the second-goal score accelerates and also it includes psychological distress from confinement, and adjustment brought out more fully in the "Second Wave" treatment in this model
- (3) Always present in the 'weights', which can, as scenario 6 shows, be changed during the course of combatting the virus.]

So, **we do have** epidemiology, economics, politics, psychology, *inter alia*, all combined here, and solved by a special application of what we call 'optimization', with the stepped-down scenarios solved by computer-assisted computations. And users can change almost anything to experiment themselves.

I end what is only the start of this unveiling with hopes, and a dedication.

**One hope** is that the (Virus Economic) Model will help people with power to make the best, certainly better, decisions: CoVid-19 and the restrictions provoked by it are human and economy killers. Informed, balanced decisions have to be made, on what is killed and when. **I also hope** that people will use the model as a framework, understand it, change things within it, improve it and help society, any society.

**An Admission and Finale:** I devised this Virus Economic Model, because I answered "YES" to every one of the following propositions.

Neville R Norman n.norman@unimelb.edu.au; nrn1v@econ.cam.ac.uk 8th May 2020; [VE day, in 2 senses]

### **Addendum: Some Virus Crisis Propositions**

[If you **disagree**, seriously, with ANY of these propositions, please consider my <u>bracketed comments</u>, like this one, before leaving.]

a. CoVid-19 (the Virus) came upon the Earth in later 2019 and is the greatest threat to global life and liberty, also material and other wellbeing, that we have known.

[You must have been on a yacht, without communications, for the last six months]

b. The Virus has spread, globally, and infected (cases) and killed (deaths), provoking 'Restrictions', of varying details of severity, longevity and compliance, that save further lives, while damaging our material and/or emotional existence.

[Same yacht. Please return to base and examine the evidence.]

c. Our lives, and liberty, would have been vastly better if we had never had the virus.

[Please do your best to compare our May 2020 situation with 2019 or, more professionally, the 'alternative state' of no CoVid-19]

d. A Balanced, Open Society will seek research-based advice on the spread and life-threatening incidence of the virus, from its medical and scientific advisers, and both respect and interrogate them about it.

[I have no cure to offer if you cannot accept this.]

e. That Society will seek to establish linkages between the restrictions and <u>both</u> (1) the <u>beneficial</u> (lifesaving, ...) and (2) the <u>detrimental</u> (material, ...) effects, of prolonging or intensifying the restrictions.

[Society and its leaders should decide what is beneficial and detrimental, not economists, nor the MASA. Each can help otherwise.]

f. The main, but not the only, <u>benefit</u> of prolonging or intensifying the restrictions is the direct and indirect (through lessened virus transmission) saving of lives and prevention of illness.

[The 'Swedish' approach of limited or no restrictions does not seem to be working.]

g. The main, but not the only, <u>detriment</u> of prolonging or intensifying the severity of the restrictions is economic damage.

[It's fine to put less or little weight on this, if you want to: but how could this proposition be denied?]

h. Every increase in the extent of support packages lessens the economic damage, at the cost of higher deficits and debts.

[Join the group using job-destroying Classicists, which John Maynard Keynes put asunder. The Classicists are quiet, for now.]

i. Any decisions concerning the length and severity of the restrictions, or their amendment, are not rational or logical unless they <u>balance</u> the benefits and burdens.

[You care only about death-saving, or only about economy effects. You are not part of a balanced society.]

j. However irksome measurement might seem, only the <u>measurement</u> of virus restriction benefits and burdens on <u>comparable scales</u> can facilitate a balanced decision about their longevity, their specific details and any relaxation.

[The alternative is dangerous dithering or decisions based on guesswork.]

k. The measured impact of the restrictions, of testing, wearing masks, personal hygiene and social distancing is speculative and incomplete, despite what MASA may say, but it improves with experience as the restrictions are prolonged, at the cost of intensifying the detriments; the toughest trade-off society has ever had to face.

[Please name anything tougher, with any more difficult deaths-lifestyle trade-offs, in recent history.]

I. Human lives saved and damage to economic activity are measured by numbers of persons and monetary units, respectively, which are <u>not</u> comparable scales, unless either (a) human lives saved are converted to monetary units, which is a difficult and potentially repugnant exercise; or (b) they are placed on one consistent scale, like (but not necessarily) scores of success or failure, as we have presented in the model.

[Please check the economics literature on Value of Life.]

m. VEM is a crude portrayal of reality, but it offers the best chance to provoke debate and research to make better, balanced decisions.

[I have no alternative, as a place to start in never-seen-before circumstances. 'Yes' to all above led me to devise the model.]

n. Without something like the model, we have the current situation of debate and decision-making.

[I'm an academic, but I study the world around us. Are you impressed with the standard of debate and the quality and timing of public policy? If not, and without a 'model', **What is your** 

#### alternative?]

[A testing end to this exposition comes in the form of a test. Please do not turn your exam paper over until the bell rings.... Once a teacher, ALWAYS a teacher....

#### A Quick Quiz on Testing How Well you can Evaluate 'Balance' in Public Comments on the Virus Policies

In the spirit of Percentage Scores in VEM, and to test how well you've absorbed the meaning of a balanced society, please consider these statements made recently in the real world.

### You are encouraged to score the following as

- A. Balanced give them up to 100%
- B. All or mostly about the first goal saving lives, pressing to prolong the restrictions, a low %
- C. All or mostly about the second goal, seeking to get the restrictions ended or focussing just on material things gouged away by the restrictions, also a low %

#### TIME ALLOWED: 5 MINUTES – IT SHOULD NOT TAKE THAT LONG!

- 1. 'The Lockdown cannot be lifted until the transmission process is totally understood' *The Observer* 3 May 2020, p.5
- 2. 'The coronavirus is not as dangerous as the government claims. The lockdown is a great mistake '*Mail on Sunday* 3 May 2020 p.35
- 3. 'Someone pulled the rug under sport in the whole of summer' *The Guardian,* 3 May 2020
- 4. 'The British Government can ONLY take the advice of its medical and scientific advisers and warn people pressing for the restrictions to end of the dangers to human life by doing so (UK Government representatives ,called Secretaries in UK, every evening.)
- 5. 'Critics should realise that football cannot wait forever' The Observer, 3 May 2020, p.68
- 6. 'Should we cripple the economy to stop coronavirus deaths?' (Tim Congdon, *The Critic*, May 2020, p.15)
- Former UK Chancellor Javid: "We need to open the economy as soon as possible' (*The i*, 9/5/20, p.12)

And the winner is ....

# The Virus Economic Model: A Picture Gallery

[If you've gotten this far, with the opening and words' exposition, the set of figures and graphs in this presentation may further assist the reader to see the model in operation. The solution for the decision problem is a pleasing crossing of curves. The Words version is best read before this, or with it. NRN]

# The setting for the vital decisions in the model

Everything relevant in the model is on a time scale.

We have, here, a new calendar, where history starts anew: when the virus came, when we recorded cases (infections) and then virus-related deaths that followed, when the restrictions started, and then when they were, or will be, lifted, or at least eased.

The main epochs are depicted in the first Figure. Phased easings make further specific divsions of our time.



We have much better information that they had back in 1665: daily updated data on virus cases, deaths for hundreds of countries, showing a cyclical sequence: the virus, cases (diagnosed infections), deaths, dithering then the restrictions, thankfully some case and death reductions, but more immediately the 'economic' (not just material) damage.

We embody all this in **the virus-model sequence**, pictured below. Let's hope we go round only once, which our Virus Economic Model assumes.



The **VEM sequence diagram** reveals the **main links** (using the same numbers below) that make the VEM tick:

- 1. How virus cases (infections) emerge and lead on to virus <u>deaths</u>, with time lags and mortality rates that differ markedly between countries;
- 2. The virus deaths provoke <u>restrictions</u> affecting work, travel, spending, hygiene and distancing, with details, and degrees of severity, enforcement and obedience, that differ markedly between countries;

- 3. The restrictions **immediately** do <u>economic damage</u>, in proportion, or more, to their duration, and also how much 'gouging', official support packages and adaptability occur, which differ markedly between countries;
- 4. The restrictions <u>reduce virus cases</u>, then (link 5.) <u>virus deaths</u> in a defined period after they were imposed, as compared with an 'alternative state' scenario for deaths if no restrictions ever happened, a matter that differs seemingly more markedly than anything else, between countries.

# Answering the <u>Biggest Question</u>: How long?

The model computes the 'best' (perhaps 'least-worst') <u>number of days</u> that restrictions can last.

We mentioned **two goals**: (1) getting virus deaths down, and (2) getting the economy back to normal.

The percentage by which 'we', in each country, travel from our worst 'dailyvirus-deaths experience' towards our death-saving target is the **first component of our societal goals.** Zero is disastrous failure; 100% is unreachable perfection. Figures like 30%, 50%, even 80% are more realistic for this (first) goal.

This journey during which the Good Thing gets better, is along our new calendar, starting from when the restrictions began, and measuring in virus-restriction-days. [As almost everyone can tell you, we've had this lockdown for 'XX' days already.]

The scores on the first goal show how well the (model) country is doing in saving lives, based on its record already in keeping (virus) mortality rates low

and using its burdensome restrictions to work quickly to save lives. [Complex but fully explained in the Manual.] In the pictures we see (a) a ceiling, based on these features and the slope of the First-Goal function – steep for high 'velocity" and flatter for lesser effectiveness.

Before we get the first-goal scores there is much work to study a country's mortality to be able to set up the scoring system. This is technical work and placed in the User Manual. These pictures might help.

Every real country – hundreds of them- have track records of daily virus deaths – [reported to living-room TVs everywhere.]



Which are daily differences derived from reports like this:

# The UK outbreak has so far followed the expected pattern for an epidemic

This is the same information as the chart above but shown in a different way



In nearly every case in the 'real world' the 'daily deaths' series have already reached their maxima. This is where the model starts. It has a contrived simple number of 100 daily deaths from which the mortality rate – measured in daily deaths - falls with the passage of time. The 100 number affects nothing of substance. In the 'model' world all main trends happen in percentages or transformations of them: so as below we have a series of percentage rates of decline [or 'depreciation', now that will bring music to the ears of depreciation-calculating accountants.]

The alternative state with no assistance from any restrictions is set at 2% and the first performance goal is akin to how quickly the curves crash to the horizontal axis – like 25% a day instead of 5%. Try to imagine the area between any curve and the horizontal axis, as a proportion of the area from the 2% (alternative state). That's pretty-well the first goal deaths-destiny

behind the first-goal scores. So, countries differ much in the decline (d) rates. In model we take 5%: not bad but could be much better [like Australia?]



Now how 'fast' are counties approaching their destines. Look below. The first is a 'model society' getting its death rates down quickly – converting the burdens of restriction days into saving lives rapidly.





But the picture below is a sorrier story.



[There is much more than just the 'duration' of the restrictions involved here, but I won't anticipate the findings of the many anticipated Royal Commissions that will ultimately make findings on these matters, as we approach 2025.] Having now gone through all this we can assemble our first-goal scores. The scores are made to increase each day, in the model, but at a declining rate of improvement. This is both very realistic and is done to get a precise solution, for the 'optimal' number of days to let restrictions run.

When we come out of the model, we can place the whole thing on a normal date scale/calendar, use as much real-world input for what VEM tell us to get, giving real answers, for real countries, expressed in real dates.



Economists like to follow "total" curves like that above with "marginal' ones, below, which show how much the total rises each day – This is really just the slope [fancy name, first derivative] of the total. Because its marginal values ARE ALWAYS positive, the first-goal (TOTAL) score keeps rising – and we've only shown 300 days of the restrictions so far! Because the marginal is <u>falling</u> – the slope is decreasing – facilitating a solution.



Now to the second goal. This measures the not-nice percentage by which 'we' fall short of normal rates of economic activity. Again, we need to estimate where 'normal' would have gone, not just where it was: the 'alternative state or scenario' made prominent by Cambridge economists.

For fuller and gentler descriptions of G1 and G2 and how (or whether) they should be compared, please visit the mercifully-short essay on the Balanced society.

**High scores on the second goal are** Bad Thing for the model society: jobs, activity and profits lost, (tax) revenue forgone by the government, higher debts to be financed and, also, we incorporate social distress rising like the picture. Like the first goal scores the values rise with the duration, but at an increasing rate [upward banana bend: positive second derivative.]. As we journey along the 'n-path' of these restrictions, the second-goal score has percentages like 20 – 40% (of daily GDP), which can escalate: another way to get a solution. That's shown in the next picture – all the things it depends on the severity of restrictions cutting directly at economic activity,

Notice that while the first goal starts with a (10-day) lag, economic damage starts immediately and grows throughout the restriction period, unless and until the restrictions are lessened.

The next picture shows the general set-up for the Second Goal.







Notice that on the severity and 'gouging' numbers of the base case, only 30% of 'the economy' remains after 300 days of unchanged severe restrictions. [Got your attention?]

Before you are tempted to put the two curves on one diagram, weights are needed. The central feature of this [VE] model id there are always TWO GOALS and they must be combined with specific declared weights.

If we give 50% weight to each goal, the best ('optimal') length of the restrictions is where the vertical gap between the CURVES is greatest. We can make the life-saving goal anything, within the bounds of 0 and 100% but not the extremes because that wipes out one of the goals and breaks our cardinal rule.

The 50/50 – equal weight – case is shown above and below. Some variations on the theme then follow.



Can you spot where the difference between the goal functions is greatest? The daily change [marginal] curves show it better.



This "Marginal" figure shows the additional (positive) contribution of the First Goal to society, on the most recent day, as the restrictions reach duration-day, and the additional (negative) contribution of the Second Goal.

Now <u>the answer</u>: The ideal duration of the restrictions for this society is found where the marginal benefit from restrictions remaining an extra day (saving more lives) is just matched by the marginal detriment (more economic damage) in doing so. That's where the curves cross at 103 days, on the numbers used here.

The new difference between the goal scores can also be plotted. This shows the vertical differences between the two curves in the penultimate diagram. Remembering that these curves are not raw but 'weighted' we can add (in this case, difference) them and observe the peak ('optimal') point directly.

Using computer-based numerical solutions the peak is found exactly, but the picture, below, has far greater visual appeal when explaining any of this to non-technicians.



A great advantage of VEM is we can argue with everything in it, change it, and we still get precise answers.

Our first variation for a different set-up, within VEM changes the 'weights' with which the two main goals are combined.

Let's move from 50/50, as above, and put 75% weight on saving lives and 25% on the economic damage, then 25%/75%. We get new diagrams:



Remember the 75/25 case gives THREE TIMES the relative importance to Saving Lives (as against economic etc. damage) than it did in the 25/75 case.

Again, the revised solution is seen more easily with the marginal curves. This run of the model shows the restrictions should be left on longer, with increasing 'weight' being given to the death-saving benefits, which keep accumulating with larger restriction durations, and with less concern being given to the also-accumulating economic damage. The optimal length is computed as well over 300 days. Predictably, 25% weight to the first goal makes the case for shorter durations, with greater impatience and concern about the economic damage given greater importance by this model 'society'.

# **Further Variations on the One-shot Model**

In the Plain Words version, a series of 'runs' are reported to demonstrate the capacity of the model to handle further changes. Let the following pictures speak for themselves.











The next one (below) shows how the switch in mix brings an immediate end to the restrictions, firm the date (60 days) when the re-appraisal takes place. [I liken this to a sudden change in Government with the imposition of a new set of values. After all, is not that what the weights really do – they're all philosophy.]



Finally, a graph to show the various restriction-ending scenarios that we contemplated in the numerical analysis reported in the Plain-Words paper.



Now you have the wall-hangings. [Anyone care for the maths?]

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# Agonising Decisions, Shurka and Public Policy to Confront CoVid-19

'Difficult **decisions**' are choices made by decision-makers, among alternatives, which can kill, infect, damage or bankrupt persons, economies or parties affected by them.

'Rational decisions' are goal-consistent. Most realistic decisions have to meet two or more goals, not just one.

Decisions made with 'imperfect knowledge' are almost universal in business and politics, despite the arrogance of most economics teaching representing it otherwise.

Most major decisions are made to achieve 'multiple goals'.

For decades I taught third-year [see the appendix on why the year level matter so much] **Business Economics** starting with rational decisions for firms with market power to select (i) products/ranges/mixes to sell; (ii) prices; (iii) promotional media and intensity; and (iv) partnerships/alliances. I always began by asking the biggest decisions the students/ their families ever took. I got floods of agonising migration-decision testimonials as they/their parents moved, or fled, from Europe and Asia especially. I told them how "Value of Life" economics suggested saving the young and letting older folk die, if that was the choice, as in healthpromotion policy such as anti-smoking campaigns.

The pointed 'agony' in these decisions commanded enough attention for me to emphasise the criticality of decisions in the rest of the course: see the crisp appendix hereto.

**Shurka Ovlikzky** and her family based their life-threatening (mostly wrong) decisions on whether and when to leave Poland for Israel, enter and escape from ghettos, hide and return from the forest, all to escape the Nazi hunt for Polish Jews on informational premises that (i) Nazis would not kill academics and other professionals; (ii) non-Jewish Poles would remain friendly to them as they had in The Great War, and (iii) horror stories about family camps being death camps were untrue. Each information set was not just 'imperfect' but deadly wrong. After many narrow escapes with decisions that were risky or just dangerously-wrong, Shurka in 1941 had to decide, in seconds, to (a) stop her 3-months-old son crying, or (b) let him cry and alert the Nazi hunters to 200 fellow Polish Jews hiding in the Parczew Forest. Shurka decided to save the 200 hidden people and sacrifice her son. [Adiva Geffen, *Surviving the War*, Random House, London, 2019.]

**Decisions by Governments in 2020 to confront CoVid-19** are like Shurka's choice: deadly or damaging consequences either way: lockdown length and severity, bans, bail-outs and enforcement. I devoted April and May, 2020 to capturing the agony of choice facing them in a combined epidemiological-economic model with 2 goals – life saving and mitigating economic damage – with new tools and concepts to analyse choice and make much better predictions than any pre-existing models could do. My diverse suite of VEM-papers attests to this endeavour.

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### Appendix: How Standard Economics 'Represents" DECISIONS

The dominant approach to 'pricing' in school and early-tertiary teaching is that prices arise from "Supply and Demand" (SAD). The 'world' in which this fits has (i) perfect information for all buyers and sellers; (ii) no firms big enough to have any market power; (iii) no firm advertising or differentiating products, ever; and (iv) every decision-maker has just ONE goal: maximise profits or 'satisfaction/utility' firm purchasing. No entity, anywhere, is concerned about 'risk' (things going different to expectation), because it never occurs.

In terms of the 4 P's of Business Decision-making:

- (1) Each firm has one product -identical to everyone else in their market;
- (2) The price, unique for all at any one time, is made and adjusted in the SAD market, not by any one firm;
- (3) Advertising and promotional activities never exit; nor do
- (4) **Partnerships**, alliances, collusion, risk, on-line selling or anything prominent that we observe about business today.

Almost as SAD are 'imperfect competition' approaches with all the features above, except firms have a crude form of product differentiation, a minor role in price setting but still no prospect of making profits better than bank interest.

<u>My approach to business economics</u> has decision-makers who are always prone to making mistakes, riskconsciousness, explicit chronology, foreign competition, government presence, multi-national companies, ecommerce and global trading integral features of the world I described. Industry associations, persistent craving for better products and production technologies were integral at all times.

The tragedy is that 75-80% of students studying any economics do not progress to third-year levels, where SAD or perfect-information decision theory is replaced by real-risk-realistic economics of decision-making. [I made that the theme of my Economic Society of Australia Presidential Address, *Aust. Econ Papers*, 2007]

The platform I used to combine the twin goals of life-saving and limiting economic damage in my **Virus-Economic Model** match the risk laden deadly environment that all leaders face today with CoVid-19, not the so-SAD set-up from which (most of) my colleagues cannot wrench themselves.

My students and academic colleagues in Melbourne, Cambridge, Lynchburg Va, and Uni los Andes, Bogota (Colombia) gave me wonderful examples from their family business and personal experiences to match the risk-laden set-up I favour, which is so far from the SAD scene.

I was unaware of Shurka's agonising choice, until I read about it, in the UK Lock-down, in May 2020. I wish I had known about it when I tried to convince impressionable students, brain-washed with SAD-stuff, that risk-making with deadly consequences either side of the choice, was the world-relevant set-up to model, understand and forecast world-relevant decisions: like CoVid-19, and almost everything we have to choose in business, government, and life itself.

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#### The Economics Behind the Economic Damage in the Virus Economic Model

[This is note to describe a 'complete' economy that I have structured to show the economic damage when significant restrictions and bans take place, with follow-on effects due to the support packages designed to limit the damage. It seems that, increasingly, the focus of public debate is turning in this direction. I anticipated this in early March and started analysing and broadcasting prospective monster budget deficits, financing issues and the polarisation of dates about tax, financing and sharp divisions between 'religions' in Economics. You ain't-a seen nuttin' yet (Al Jolson)]

Our economy is a modern open network of transactions.

It is the **virus rules and restrictions** that do the economic (and psychological) damage, not directly the virus itself. However well justified, those 'rules' are made by governments who thus do the damage, to fight the virus. Plain enough?

The economic damage is inflicted upon economic activity, in the first instance, from which follow:

- (i) much higher unemployment,
- (ii) loss of profits,
- (iii) loss of tax revenue,
- (iv) vastly increased government spending (on 'support packages") then
- (v) bigger budget deficits, debts and financing challenges, and
- (vi) the psychological damage, with, and arguably in greater proportion to, the damage to economic activity.

Economists measure economic activity by the size of **Gross Domestic Product (GDP)** which just adds up all the spending, and thus production in our whole economy.

People buy two broad classes of product: A-products and B-products. [This is our first innovation to to track the virus-rules damage.]

The A-products are things and services that are going to be "Allowed" when the virus-rules strike home: most food, medications, appliances.

The B-products are the things and services that are going to be "Banned" (like international and much domestic travel, most sport and entertainment in pubs, clubs and theatres where people mass) or "Butchered" because, while not prohibited as such they don't happen much because of what it banned (so, shops at airports And rail stations, taxis, travel agents, caterers, performers and organisers of events, and much more indirect victims of the rules.)

Firms in Our Economy make/provide and sell three types of product:

- A and B products as described above; and
- C-type products which means equipment (like bread ovens [always a classic example], so people buy bread not bread-making ovens.

While people want A and B products most of the time to live, firms who buy the C-products and get best technology when they replace or expands their production bases, when a crunch comes, they can make do with what they've got

for some time. [If you understand that you will now know the big difference between (i) A and B products, and (ii) C-things and be set up with a good economics start to understand much of virus economics.]

We've covered much of GDP so far. Just need to add the Government (Spending), mainly on welfare, health and support arrangements, which is significant in all modern economies and the links with other countries who whom we sell (called 'exports') and from whom we buy (called imports)

We take a period, like a year – say the full year just before the virus struck [like 2019] and we get the pre-virus GDP, as follows:

A(llowed) -products – 40 units B(anned or butchered) -products – 30 units C(apital-equipment) -products – 10 units Government Sending (G) – 20 units E(X)ports – 15 units, and I(M)ports – 15 units. Here it is!

GDP = A + B + C + G+ (X - M) = 40 + 30 + 10 + 20 + (15 - 15) = 100 units.

[This is all pre-cooked to give simple numbers, which can be scaled up to anything you want, and to simplify the trade side and make the Government purely political: Why not!]

A nice, easy shine how A and B work out and how the virus affects them.

A-products and B products are each composite of goods and services bought by our people

C-goods are capital equipment (machines) bought by our firms making A and B. They embody latest technology.

Government is active and prominent, making rules and providing welfare benefits, in our caring society.

Our economy sells "exports" (E) to other counties and buys/'imports' (M) from other counties.

We can measure the national production or expenditure as Gross Domestic Product (GDP) which in the year before the virus struck was exactly 100 units, made up and follows:

GDP = A + B + C + G + (X-M), which I is made up: 40 + 20 + 10 + 30 + (15-15) = 100.

Products A and B have prices in our advanced economy is mark-ups on their (Normal) unit costs of production. [Lest anyone think "supply and demand' (SAD hereafter) that approach has passed into history. The Norma/Markey up pricing system is affirmed in sorbet hand statistical evidence and fully explain in Coutts and Norman (Harcourt and Kreisler)

SO, we can write PA = (1+mA) \*UCA and PB = (1+mB) \*UCB, with ratio PA/PB = {(1+mA) \*UCA/ (1+mB) \*UCB}. Neither unit costs nor mark-ups move much as economic activity and industry demand shifts up and down – this doctrine being

know as rigid prices. IN this set up there is always substernal reserve of proactive capacity, and employment is Never full.

[Notice that the 'demand' limb of SAD (long-past economics) does not affect prices in mark-up pricing. As crude as it may look, mark-up forcing keeps perfuming best in earl-world studies on how prices are made. It will prove a great help in our following diagrams and we initiate the virus crisis. Grumble and groan from the SAD people!]

C-goods are producing only to make A and B goods.

Overall demand (spending) in the economy normally dominates how much so produced (thus GDP)

Our Economy's Supply Side and Supply Restraints

Three things limit the productive potential of Our Economy:

- 1. Availability and quality of labour, which grows with population and can be supplemented by migration and guess workers
- 2. Productive/ Technogym, which enables production to increase without augmenting the quanta of factors of productions, like about, and
- 3. Laws and rules that limit or prohibit certain production: even in pre-Oviyuts times unfair and defene-sensiti perodciton can be banned.

#### Measuring the Economic Damage Analysis in the Virus Economic Model

A part of the literature of economic analysis, which is hardly ever respected or taught these days, contains all the components to assemble our virus-relevant economic model, whose formal-structure is far easier to relate than the (now grossly-irresponsible) classical full-employment economics.

But beware. The dominant majority of active economists are very SAD, and can't stop being SAD. As almost every Government has adopted massive stimulus packages that these SAD economists utterly detest and believe them to be costly, ineffective or both, the 2025 Royal Commission into CoVid-19 will need to determine how so many governments stood against every core SAD principle [when all their advisers were inextricably SAD] and what happened to all the SAD economists when they got so thoroughly bypassed by the governments they were advising, in 2020.

VEM economics needs to have:

- (i) firms that ALWAYS work in an under-capacity setting, but none would ever have seen these 2020 conditions
- (ii) market power, even in 2020, when they are permitted to produce and sell
- (iii) a set-up that enables virus-rules to impact on economic activity, clearly and measurably.

In G2 of VEM we DO have jobs (thus unemployment), taxes and budget balances [now deficits for many moons], financing options, for the huge government debts, and psychological effects (mainly damage), all tied pivotally to national income/production/expenditure, known as (real) GDP.

The national-income (GDP) components all had 2019 known (annual) values and/or plausible (pre-virus) forecasts for 2020 – the 'alternative state' that never was, or will be. Those 'target' values are shown in starred notation.

In the macro-economics of VEM, we have:

(i) GDP\* = A\* + B\* + C\* + G\* + (X\* - M\*) [e.g. for calendar-year 2019]

This is not even maths: it's a familiar-looking identity, with differences. So, we have, in VEM:

- A means consumer goods that remain 'allowed' under virus rules
- **B** means consumer goods that may be banned or butchered by virus rules
- **C** means capital goods, machines, bought only by firms, that embody latest technology and in a crunch such purchases can be (voluntarily) stopped or much reduced. [Economists call this 'Investment' a horribly confusing term that means other things to almost every non-economist, so in the coming Reformation let's eliminate endemic confusion, wherever possible.]
- **G** is government spending on welfare, health, education, defence, and notably now support packages to people and firms. It is totally controlled by the political process, which is why smart economists long ago realised we need theories of political economy.
- I'm trading simplicity for my long commitment to the open-economy economics by cooking eXports and iMports to be always equal.

The Economics of VEM paper provides numbers and diagrams to show the story. [Please read them.]

The Model (VEM) Economy goes through these stages:

Before the virus, VEM is undefined. We just need start values for GDP\* and its components. The set-up converts Bproduct purchases into A-equivalents using the price ratio (PB/PA). To screams of 'palpable rubbish' from SAD economists we make that ratio and its constituent prices 'sticky'/fixed. [To cut short a long debate and to show evidence, please see K J Coutts and N R Norman, in *The Oxford Handbook on Post-Keynesian Economics*, OUP, Oxford, 2013]. To show how this pricing set-up differs from SAD and works to integrate A and B products – we need special note 1., below

During the first stage of the virus restrictions, B goods are 'banned' (illegal) or 'butchered' (consequentially damaged) and A is hurt by falling purchasing power and uncertainty.

SAD economists would want any movement in economic activity modelled as optimising behaviour with free choice. That's just nonsense and will be for some time. [Because the choice set is dominated by the binding constraints of the rules and side-effects.] We have a simpler and more realistic framework: B-products are just stopped by law or flow-on effect, and spending on A (and supplies of it) will be bruised.

If B products were 'b\*' percent of GDP\* [b\*= B\*/GDP\*] before the virus, or in the 'alternative state', to be fancier, then that proportion of GDP\* is immediately 'gouged', by full-force restrictions (s=1), together with some fraction of A\* and undeniably part of the equipment purchasing C\*, in this environment. Government then comes to the rescue with the support packages [providing the SAD set of advisers are silenced], making G1 the flow-rate of government spending in the full-on restriction phase (stage 1) greater than G\* (pre-virus). Basically, despite any objections, government moves

to spend and support huge amounts in the virus-rules-affected economy. We get closer to understanding the degree of 'gouging' by studying the regulations and what effects they have, by using <u>anything but SAD economics</u>, which is whilst inapposite; will be for some time ahead, and demonstrably was for decades before the virus.

As the virus restrictions ease, B product sales re-start, in phase 2 and parts of A also recover, some of G can be relaxed (reduced) [to the relief and delight of the SAD group]. But the extent and shape of recovery is very dependent on experiences and physiological shocks manifested in the restriction phase.

We already have some data and industry-specific documentation on which to base this analysis. It will take time for sports, travel and entertainment facilities to be mobilised. The demand side may be limited by reticence and some firms will have disappeared. These analyses and case studies will replace maths and old-style formal forecasting (nothing extrapolated will make sense for months) for the path of GDP, unless and until the gouging recedes.

The degree of gouging, sensibly using basic accounting and hardly any fancy economic models, sets the scene for realistic economic forecasting in the months and year(s) after the virus struck, in the manner in which no conventional economic model can do, and certainly nothing associated with SAD.

#### **Economic Forecasting in the New Virus-Infected Economic Environment**

Leaving aside intuition and guesswork, which none of us can deny come in helpful at times, time-based forecasting means generating a series of predicted values Pit, for each variate i and time point or time interval t, based on actual data, Ait [Grateful thanks, Henri Theil.]

Data before the present time are essential for extrapolation and econometric techniques, like VAR, which are just fancy extrapolations embodying complex combinations of past evolving databases.

A standard device for **forecast "accuracy" evaluation** and model-testing is to:

- (a) predict a series of Pit, predicted values for future time, t, of each chosen series to forecast, I; then
- (b) wait until real recorded "actual" data emerge, Ait; then
- (c) confront and difference them, generating Eit = {Pit-Ait}, called prediction errors; which are then
- (d) Used to compute forecasting-accuracy measures, like root-mean-squared errors and Theil tests.

[Notice that I call these 'accuracy' evaluations because the best-ever forecasts for the economy, business and government are those that predict shock outcomes, provoke decisions and actions that would not otherwise be taken, and which make the forecasts quite erroneous, highly inaccurate and this extremely valuable.]

Use any set of data collected in the period, say 2000-2019 to generate predictions for t>1.1.2020.

I defy anyone to generate anything by this method for prediction period 2020 that gets remotely close.

And for all the think-tanks that purport to use 'economic/econometric methods', what are they really using to get gouging effects on real GDP of 15-25% - e.g. the British Office of Budget 'Responsibility' (OBR) who made such forecasts, and purported to be open to criticism, invited comments [you can imagine mine! To which they never replied]. I say they used JAG: just a Guess.

We can do better, using "expiscation" (look it up) [my PhD examiners loved it]. -

#### My (New Nifty Neville) Rules for Economic Forecasting for 2020 and beyond

- 1. Keep forecasting, but with more scenarios and better and more honest revelations of method than before;
- 2. Ensure that the virus more specifically the virus rules that bludgeon economies are IN the process;
- 3. Scrap any data or model that do NOT embody the virus and virus restrictions, except for comparisons;
- 4. If the former models and data are useless that's not just a forecast but a dead certainty! then use accounting-style assessment of the proportions of industries, firms and economies banned or butchered by the virus restrictions, in full, eased or resumed (second wave) and build them into a 'gouging' measure; then
- 5. As new data arrive horribly belatedly that <u>do</u> embody the virus effects, improve the estimates and start exhuming former models, slowly; and/or
- 6. Try new models, because anything like SAD will be redundant [which is why I devised VEM];
- 7. Be prepared to find that "a child of nine" [see my VEM papers on that quip I've heard from a friend for over 5 decades] could forecast GDP for the 4 quarters of 2020 more accurately than any model used before 2020; and
- 8. Keep doing forecast evaluation, but don't be too hard on mathematical 'models' by 2025 we may have almost enough "past" data with the virus-effects in them to make pre-2020 economic models remotely useful.

#### Special Note 1

#### The ("Normal") Pricing Hypothesis Embodied in the VEM approach to Measuring Economic Damage

Readers of the 'Economics' paper using diagrams rather than any maths may have noticed a trick to convert the previrus rate of sales of B-products into A-product equivalents, so the two (A and B) can be added consistently as the household 'consumption' component of GDP and be compared. The trick is a straight line based on a fixed ratio of prices (PB/PA) which will again terrify the objecting SAD economists.

Even more extreme – 'crude', say the SAD people – is that both these prices – PA and PB – are fixed, at least 'sticky', being impervious to large cyclical swings in demand for these products, but shifted only when their unit costs of production change.

The "Normal", "Post- Keynesian" pricing hypothesis (NPH) can be written

(1.1) PA =  $(1+\mu A)$  UCA; PB =  $(1+\mu B)$  UCB, where UCA, UCB are unit production costs of (A, B); ( $\mu A$ ,  $\mu B$ ) constants.

Notice that, by differentiating (1.1):

(1.2) PA'(Demand) = PB' (demand) = 0 - there is no "demand (pressure)" term that exerts any influence on either of these prices whatever. [If you've been intrigued by my many references to SAD and you are not much of a codebreaker, you have a clue here on what the "D" stands for.]

(1.3) LnPA' (UCA) = LnPB'(UCB) = 1. Meaning that any (exogenous) change in unit costs is translated into an equiproportionate response in product prices, preserving the (percentage) mark-up factors.

**Potent Objections from the SADs**: This is mechanistic gibberish, by-passing the hallmark of stands economics – "Supply and Demand", omitting anything like rational decision making under SAD conditions. [Now you have it!]

**Response to SAD Objections:** The NPH arose from surveys in crisis times of how businesses ACTUALLY set and adjusted their prices; has been affirmed time and again in later survey and econometric work and DOES have a rigorous rationale: firms treat demand-pressure movement as unreliable and risky basis for changes prices but unit costs movement are reliably experience by any close competitors [whence implicit collusion and price movement follow.]

Moreover, SAD MUST presume no firms with ANY market power, arrogant ex ante- certain knowledge of all demand, cost and rival-firm reactions, no product differentiation, advertising or pure profits. The virus-infected world knocking SAD for six, but even before that, which world do you think fits reality best?

Amazing footnote: The "Normal" pricing hypothesis gets buried, disparaged and neglected by economists almost universally, until economic conditions become horribly "abnormal". Welcome to abnormality!

# Virology in the Virus Economic Model (VEM)

[This is a story of how the virus came to Our Land, got transmitted, the factors that determine the severity of the disease and, in brief, the core epidemiology behind our Virus Economic Model. We illustrate the story with pictures.]

There are many separately-governed lands, all connected in some way.

Residents of each land include visitors and migrants, collectively called 'movers.

A virus started in Faraway Land. Some movers from that land caught it, and spread it.

Movers include infected people who take the virus to other lands, and our land.

Each land differs in relation to border checks, other testing for the virus, mask-wearing, hygiene, health help, speeds of response, respect for the intelligence of fellow citizens by age and training, compliance with rules, hospital facilities and communications to their residents.

Twenty infected virus originators entered Our Land.

#### **Case 1**:

Faraway Land identifies the virus and tells the World immediately.

Our Land stridently makes comprehensive border checks, thus detects and isolates all 20 infected movers. One dies and 19 recover. Not one resident of Our Land gets the virus.

The upshot of case 1: Virus Cases (diagnosed virus infections) 20, of which Virus Deaths 1 and Recoveries 19.

The transmission rate is zero and no Virus restrictions of economy-support packages are needed.

[While this is the happiest of all outcomes, case 1 is NOT in our model which is entirely about virus restrictions.]

#### Case 2:

As for case 1, except...

Faraway Land fails to detect the virus or tell The World about it.

The pictures tell the story:



All 20 infected movers entered Our land and spread infections.

That creates new waves of cases, deaths and recoveries as each 'cohort' of infected 'cases' emerges from the initial infectors



We can label these chains of causation in the sequence - called links



The links are:

- 1. Deaths from the initial infected movers (mortality or death-to-case) rate 5%;
- 2. Infection to the next wave/cohort
- 3. Further infections/transmissions
- 4. Further recoveries
- 5. Further deaths
- 6. Next-round recoveries
- 7. Next-round deaths

Let's focus on 3,4 and 5:

The process is now quite active, and policy-makers invoke rules to limit lifestyles to limit the spread of the infection. But other factors also impinge on the strength and timing of all the links.



The following chart shows several 'other factors' that bear on the virus transmission process, apart from and for given 'doses' of the virus restrictions.



At various stages measurement can be taken of the cases (or deaths) that derive from the intial or an earlier cohort of infected cases. The ratio is a 'multiplier', which if less than one limnts to a lower value and the ultimate end of the process. Conversely, a ratio moe than one suggests an ever rising incidence of cases, or deaths. Epidemiologosts call this statistic R<sub>o</sub>

If VEM behind the G1 series, R<sub>o</sub> is taken to exceed 1 up to the point of maximum daily virus deaths, as in the exposition papers. Thereafter, different decay-decline rate of mortality and speeds of effectively of the conversion of restrictions into saving lives abound, but sub-unity R<sub>o</sub> is consistent with all of them.

This experience manifests in the 'q' factor which is specific to each country.

When the severity of restriction is altered, in the traverse out of the restrictions, both G1 and the ceiling are adjusted, but only if a 'second wave of infections occurs does the assumption of R<sub>o</sub> less than unity need to be changed.

We can thus see how explicit virology is built in to the derivation of the G1 function and the data for strategic choice by the policy makers.

We end the virology here – noting that it IS an integral part of VEM, which also adds in the economic/[psychological aspects almost universally omitted by virologists/epidemiologists.

NRN 28<sup>th</sup> May 2020.