METHODOLOGY OF CALCULATING INFLATION TARGETS

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WORKING PAPER

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FOREWORD

We are pleased to present Grzegorz Pytel's paper on inflation. Grzegorz Pytel, Sobieski Institute expert, argues that it is possible to scientifically model a correct inflation target for every monetary system. The Russian aggression on Ukraine has caused human tragedy for millions of people, mass destruction of Ukraine cities and economical and food crises for the whole world. Understanding how the best set inflation target will be very important after defeating barbarian Russia of Putin. It is why we believe this paper is very important.

On 7th November 2022 the Chief Economist of the Bank of England, Mr Huw Pill, said that:

"There is something arbitrary about 2% being the inflation target. Can I have, give you a really great economic argument why 2% is better than 1%, or 2% is better than 2.5%? I can try. But it wouldn't be super-convincing."

In this paper Pytel presents a model for calculating the inflation targets. We believe that this model is very convincing. It is up to the readers to decide if it is . By publishing this paper, we invite all experts to an open discussion on the inflation target

Pytel distinguished two different types of inflation:

- inflation caused by the invisible hand of economics, an intrinsic reaction to risk of doing economic activities, which is needed to balance the economy and may help maximise economic growth,

- inflation, which is an anthropogenic effect, oversupply of money and, according to Milton Friedman, a hidden tax the public will ever pay.

While there may be some practical limitations with respect to accuracy which Pytel mentioned in his paper, he argues that not getting inflation target correctly, and meeting it, has profound negative effects on the economic performance, either by overheating the economy (too high inflation) or contracting it (too low inflation). These effects are compounded and exacerbated if not meeting the correct inflation target is a long--term phenomenon. Grzegorz Pytel also argues that his inflation model allows quantifying those who are gaining and losing a competitive advantage in the Eurozone and on a global market.

The mission of Sobieski Institute is to create ideas for Poland. We believe that this time our expert has proposed a model (an idea) which could be used to calculate the inflation target for all currencies. Inflation and its effects are fundamental for economic management, and proper inflation management is in the public interest, we therefore invite all those who are interested in the subject to study the paper and share their reflections and critical comments.

Bartłomiej Michałowski
Executive Board Member
Sobieski Institute

Filip Seredyński
Executive Board Member
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Economics is a "right-wing" science
which may give "left-wing" answers.
(Prof Jon Gruber)

ABSTRACT

A key finding in this article is the role of rate-of-loss, ie. measure of risk, in economic system and how it links concepts of inflation, economic growth and equitable share of wealth. We show that inflation tends naturally to be equal to risk, ie. actual rate-of-loss in economic activities. This determines the value of inflation target. We propose how to measure such risk, rate-of-loss, and that it's also a condition for sustainable economic growth. We demonstrate that economic data supports this. We show that this determines what equitable share of wealth (economic output) is. We define and calculate "bubble" and "contraction" in economic system. Using a historical and ideological cliché, we demonstrate that for an economic system to be sustainable in a long-term equilibrium experiencing maximal growth rate, we need as much "Adam Smith" ("liberal") and "Karl Marx" ("socialist") thinking applied to economic policies. We show quantitatively where the balance between providers of capital and providers of labour in share of wealth is for a long-term sustainable economic development.

I. MONEY AND TIME

"Monetæ cudendæ ratio", a paper on coinage written by a Polish Scientist, Nicolaus Copernicus in 1526, proposed a principle: *"bad money drives out good"*. Around half a century later, it was also noted by Sir Thomas Gresham, a financier of Tudor dynasty in Britain, who founded the Royal Exchange. Two hundred years or so earlier, French philosopher, a counsellor of King Charles V, Nicolas d'Oresme, made the same observation.

Today, this is known as Gresham Law (or Copernicus-Gresham Law, unfairly forgetting the French philosopher). It was named by Sir Thomas Gresham in 1860 and popularised by Henry Dunning Macleod. From France, through Poland to Britain, the economic thinking captured by Gresham Law has been with us for at least half a millennium. Before we consider what level of inflation is in equilibrium for optimal economic growth, let's stop and consider some aspects of Gresham Law that would help us understand the nature of inflation and how it's linked to economic growth.

Does Gresham Law talk about fundamental human economic behaviour popularly referred to as *"greed is good"*, and more elaborately described by Adam Smith: *"It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own interest. We address ourselves, not to their humanity but to their self-love, and never talk to them of our own necessities but of their advantages."*? To limit Gresham Law to this would be to miss another key point of the law, which is the subject of this article. Gresham Law is also about inflation. Thus, those who argue like Milton Friedman did in 1969, that – for optimal economic growth if a long-term equilibrium is to be achieved – nominal interest rate should be zero and inflation should tend to be zero too, describe an economic utopia, because this would mean that Gresham Law may no longer apply. And – as we'll demonstrate further in this article – this would be a kind of utopia, which Milton Friedman would have described himself as a *"free lunch"*, that is getting an economic benefit without any costs attached to such gain. Thus, we will not only demonstrate – based on other aspects of an economic system – that Gresham Law is true, but also why it is true.

Gresham Law is trivial to understand in the monetary context of commodity money as it was originally observed by Nicolas d'Oresme, Nicolaus Copernicus and Sir Thomas Gresham. It's obvious to see how gold or silver coins lost some of their gold or silver, whether through deliberate theft of metal or because of their usage, wear and tear. In this case, the process of debasing would be widely distributed, risk of tracing theft or loss of value would be minimised. But why should Gresham Law still hold for representative or fiat money? In both cases – representative and fiat money – the value of money is guaranteed to hold by a trusted party, a bank, a state treasury, etc.

There is a fundamental difference between commodity money versus representative and fiat money. The former is a direct application of full reserve banking in economic activities in every exchange. In fact, it's a form of barter. The latter allows for trust to be stretched from trust in keeping money without decreasing it in its value, ie. full reserve banking, to trust in economic performance reflected in fractional reserve banking, and economically unsustainable process of depleting reserve banking (with its border form of no reserve banking).[1]

1 More details:
https://gregpytel.blogspot.com/2010/03/computational-complexity-analysis-of.html
https://publications.parliament.uk/pa/cm200809/cmselect/cmtreasy/144/144w254.htm
https://ethz.ch/content/dam/ethz/special-interest/mtec/chair-of-entrepreneurial-risks-dam/documents/dissertation/master%20thesis/MAS_Thesis_Marina_Stoop_2010_final.pdf

Leaving aside a form of banking by assuming full reserve banking approach in this article, any use of both commodity and representative money is a form of bartering. On the other side, fiat money, similarly to representative money, represents trust in the issuer. It's no longer linked to any commodity. Hence, fiat money can be deemed as an abstraction of representative money representing trust in value – not in an underlying commodity – in the economic value of the issuer. This may be deemed as a risk spreading mechanism: from value of a single commodity to the value of the entire economy in which such fiat money is a legal tender (hereafter called money).

The concept of legal tender is vacuous unless there is economic exchange, ie. deals which are settled using legal tender. John Sturt Mill, developed the ideas of David Hume, which Irving Fisher presented as a formula in 1911:

$$MV = PQ \text{ (Fisher's Equation)}$$

This equation captures for a given period:

- *M* is an average amount of money in economy,
- *V* which may be described as velocity of circulation of money, is frequency with which a unit of money is exchanged for goods or services,
- *P* is a price level, and
- *Q* is quantity of goods or services for which money is exchanged.

We may immediately observe two aspects of money, which are the key in our considerations. Firstly, money is a medium of exchange. As a medium of exchange, it creates intrinsic costs such as costs of printing banknotes, storing them, distributing them or of performing economic transactions. Whilst for the purpose of our considerations in the article we will ignore such costs, we can observe that such costs are a loss. Eg. there is very little value in having a physical paper as such, and even less value in storing a digital unit of money, unless it may be used. We note this as the fact that there are elements in economic exchange, which inevitably generate loss. Secondly, money especially when stored in a safe and inexpensive (to store) way, may be hoarded to preserve wealth.

At this point we may ask ourselves a question: how much money is needed for efficient economic exchange? We may say that it's easier said than done. The Fisher's Equation gives a static answer. Thus, in this sense, there is always the right quantity of money. Let's take a time factor into account. We still may expect inflation to be zero. If we assume that there is no economic growth, ie. the quantity of goods and services doesn't grow over time, then assume a fixed velocity of exchange (which typically monetarist do, and this argument doesn't limit the considerations in this article), the quantity of money may remain constant. However, if we assume that there is economic growth, ie. people produce increasingly more and/or new goods and services per money unit, and we also assume a fixed velocity of exchange, then the increase in money supply should reflect the increase of quantity of goods and services available for exchange. This leads us to a conclusion that economic growth with zero inflation, is not possible without supplying ("printing") new money for additional exchange. However, maybe it's possible to have economic growth without printing new money? If it is, Fisher's Equation tells us that economic growth with no new money would lead to deflation.

The above also leads us to key observations for our further considerations. If we don't use money as a part of economic exchange – we hoard it instead – we kill economic growth, as there is no money in circulation to pay for newly created goods and services. Or there would be deflation. Taking this argument to extreme, this would mean that economy would become a bartering economy, and – possibly – a new money would be introduced. And if we use less and less money in circulation to pay for more and more goods and services produced, we will have a deflationary effect. And there would be an economic incentive, for those who currently hold money not to spend them on goods and services, as money would keep appreciating just by the virtue of hoarding it. Doesn't it sound like a Friedman's "free lunch"? And there is also a natural phenomenon of loss and waste in economy, least of all costs of exchange like printing and using money, or electronic transactions. How are such costs covered in the process of economic exchange?

Noting this, we move to consider whether inflation is a natural phenomenon needed for economic growth, at what level of inflation the economy would be in a long-term equilibrium. Perhaps Gresham Law didn't only note the greed of human nature is necessary for economic activities, as rationalised by Adam Smith, but it might have a deeper meaning? Maybe it also has a meaning that inflation, a continued depreciation of a medium of economic exchange – money – is also a precondition for sustainable economic growth, balancing incentives of those who provide capital, with those who provide labour and making sure that all costs of production and economic exchange are reconciled in transactions/deals?

II. INFLATION

Milton Friedan once said: *"Inflation is the only form of taxation that can be levied without any legislation"*. Some called it more bluntly a *"theft"*[2]. This clearly goes back to the basic meaning of Gresham Law that money loses its value over time. Let's see who is a loser, how much is lost and why?

To analyse this, let's compare three simple scenarios in, say, one year period. The first one is a zero-inflation scenario. The second one, 10% inflation. The third one, 10% deflation.

In the first scenario nobody is worse off or better off. Those who have any disposable income may hoard money with no loss.

In the second scenario, if wages increase in line with inflation (eg. inflation is caused by growing wages, and there is no economic and productivity growth) those who have no disposable income are not worse off or better off. Those who have disposable income face 10% annual loss on their savings. They have incentive to invest money, to find a way to produce new goods or services, to earn extra money which is available due to inflation. Inflation may be indeed seen as taxation or theft. But it may also be described as a penalty for economic inactivity or unproductive use of money and decreasing risk aversion to invest.

In the third scenario, if wages decrease with deflation those who have no disposable income are no worse off or better off. Those who have disposable income are making 10% annually just by hoarding money. It sounds like a free lunch. No economic activity is needed to become richer. In any deflationary scenario – also when there is no wage decrease – free lunch is for everyone who has disposable income. Simply keeping money creates wealth.

By arguing for that and that economy can be in a long-term equilibrium having positive growth, or no growth, Milton Freedman argued that a "free lunch" was possible: keep your money, do nothing and you'll become richer anyway. There is no such a thing as a risk-free investment. It's also accepted that humans are risk averse. Thus, in all the situations inflation creates economic incentives to take a risk and invest. Inflation is a penalty for economic inactivity. Inflation reduces risk aversion to invest.

Let's focus on an aspect of inflation which promotes economic growth. When facing an investment decision, a provider of capital faces risk of losing all or part of invested capital. However, a provider of capital also faces risk of not investing. Inflation is such a risk, if not certainty, of not investing. On the balance, if a rate-of-loss, which measures risk, of not investing is greater than risk of investing, then a provider of capital will invest. If risk of investing is greater than of not investing, then a provider of capital won't invest. Existence of inflation is an incentive for providers of capital to invest without delay, as any delay generates loss. Time factor is critical. If there is inflation, any delay will decrease the value of their capital. It only makes economic sense to accept such decrease of value of capital if rate-of-loss of investing is greater than inflation.

2 https://fee.org/articles/inflation-is-theft/

Example 1 – rate-of-loss: incentive to invest:

Let's consider an investment in an economic system with 10% annual inflation rate. For a provider of a capital, rate of loss on capital keeps reducing 10% every year, since by not investing the loss on hoarded capital is 10% every year anyway. If annual inflation is 5% then such rate of loss halves to 5% every year.

Inflation is also an automatic debt reduction mechanism in the economy. It applies to individual debt. More importantly, it keeps writing off debt in the entire economic system.

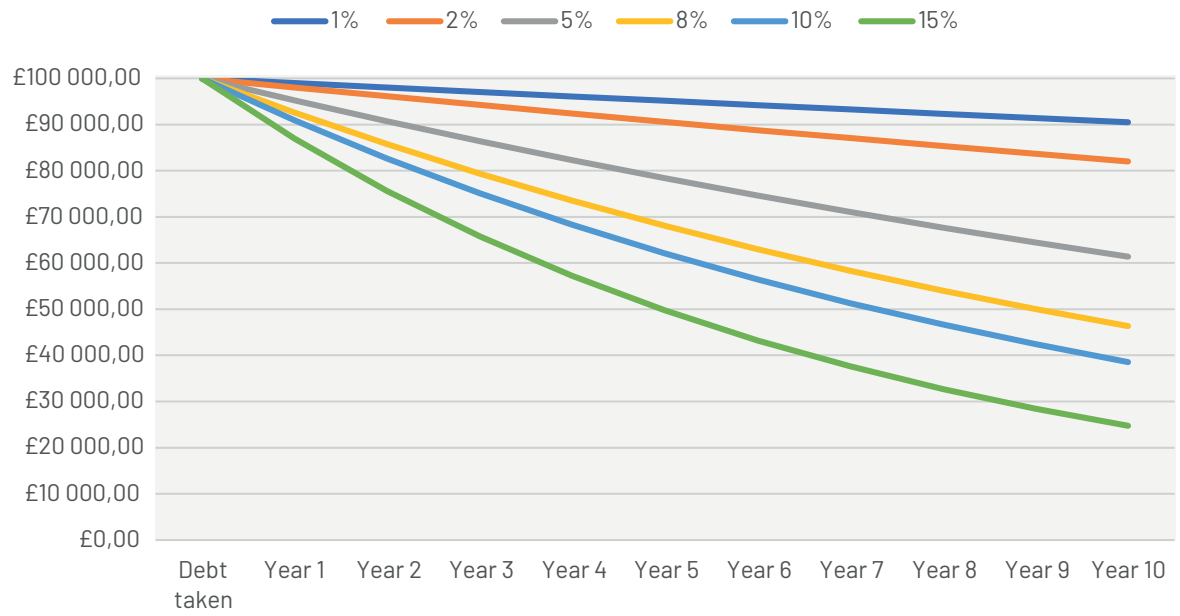
Example 2 – rate of debt reduction: incentive to borrow:

For a user of capital (a borrower), if annual inflation is 10%, any debt is being reduced by 10% every year. Thus, in just over 7 years, half of the debt is written off by inflation. With annual inflation rate of 5%, it would take around 15 years to halve the debt.

Not only does "higher" inflation write off systemic debt over time faster than "lower" inflation, "higher" inflation also limits the systemic indebtedness, and limits individuals getting into high(er) debt in the first place. The quantity of money one can borrow is linked to the ability to service the debt: creditworthiness.

The chart below shows how inflation repays debt:

CHART 1 **DEBT REPAYMENT – EFFECT OF INFLATION – DEBT £100,000**



Example 3 – debt servicing, limitation of individual and systemic debt level:

With inflation of 10%, and interest rate linked to inflation, a borrower can borrow around half the amount as when inflation is running at 5%. Eg. let's assume that an individual has £10,000 disposable income. At maximum, with inflation of 10%, such individual can borrow £100,000 and be able to service the debt. (Servicing the debt means paying a provider of capital, debt, at least the quantity of money which covers the loss due to inflation.) With inflation of 5%, such individual can borrow £200,000 and service the debt. With inflation of 1% such individual can borrow £1,000,000 and service the debt. With inflation of 0%, in theory, there is no limit to indebtedness, and all could live their lives at the top standard doing nothing, by simply borrowing money. With deflation, they could use borrowed money to keep repaying the borrowed capital. Zero inflation, and especially deflation, sounds like Milton Friedman's ultimate "free lunch".

This leads us to consider a combined time effect of debt reduction over time and limitation to getting into debt at any one time.

Example 4 – spreading borrowing risk over time:

After just 7 years, with 10% inflation, half of the debt is repaid by inflation. This opens a possibility of taking new debt with ability to service it after some time. It would take twice as long with inflation at 5% to take the same quantity of debt, as with inflation of 10%.

Such a structure, in a natural way, limits indebtedness and promotes spreading it – going into debt – over time, whilst inflation "takes care of" some of the debt. Thus, a combined debt reduction and limitation of indebtedness effect is a systemic mechanism which automatically builds risk portfolios for all actors in economic system: providers of capital and capital users alike.

Furthermore, because of limiting of the indebtedness, higher inflation creates incentives for providers of capital to be equity investors rather than debt providers. This promotes their direct involvement in economic management, becoming directly economically active.

Higher inflation also helps with economic management for those who pay for labour. In real world, wage reductions and redundancies, are significant frictions for efficient management. Clearly, the higher the inflation the more scope for the dynamic management of economic incentives when paying for labour. Those who perform less economically demanded roles, or are less productive in general, get wage increases below inflation rate. So, in reality, it's a wage reduction. Those who perform highly economically demanded roles get wage increases at or above inflation rate, reflecting economic value of their roles. The real increase is that part of increase which is above the inflation rate. This facilitates dynamic self-regulation of supply of labour in different economic roles on a supply side, rather than taking actions by employers on a demand side (wage reductions, redundancies). This helps avoiding conflicts with labour providers, not a minor issue in managing businesses.

There is also a key risk spreading and portfolio building mechanism built into inflationary processes. For both providers of capital, as well as those who borrow, inflation allows them to optimise their risk portfolio not only over time, but also across different economic activities, and manage it.

Example 5 – building investment portfolio underwritten by inflation:

Let's consider investing in 10 businesses with the same risk and business profiles, with 10% rate-of-loss, during the investment cycle period. If during this period inflation is greater than 10% – and 1 business out of 10 will fail and 9 out of 10 will stay viable – then this is a profitable investment portfolio. The debt write-off due to inflation on 10 businesses will cover the failure of 1 business, which failed. The debt of the entire portfolio will stay unchanged, and 9 will be viable businesses. A loss in such a portfolio, on average, will be covered by inflation, so there will no loss for an investor. With 5% inflation half of the debt would have been covered in the same period. Or it would have taken twice the period to cover the debt. This is a segue to the next chapter of this article by observing, that if the failure rate in this example was half (1 in 20), then 5% inflation would have had the same effect. Thus, it's economic risk, rate-of-loss, which is the key in our analysis in our aim to calculate the inflation target. Ie. it's a role of inflation to pay for rate-of-loss, risk resulting failure, in economic system. This will be at the centre of our analysis in deriving inflation target equation in the next chapter.

We can consider every economic system as a wide ongoing investment portfolio of all economic actors. Inflation discourages hoarding money, encourages investment and economic activity, penalises economic inactivity, rewards those who are innovative and productive and penalises those who are not. Inflation is also an automatic mechanism to build a risk portfolio, spreading the risk in time and across different economic activities amongst all economic actors. Deflation is a "free lunch": economic inactivity like hoarding money is rewarded.

It should be clear that inflation is conducive to economic growth. A naïve approach would suggest that the higher the inflation the better it is for economic growth. Is there no limit? Clearly, intuitively and, in reality, this can't possibly be true.

Policy makers around the world agreed that inflation of around 2% is good for promoting economic growth. Despite theories which were promoting zero inflation, or even deflation, as good for economic growth, it's been widely accepted that some inflation is good. However, there is no consistent theory, or a model, which justifies inflation targets.[3] It looks like a naïve approach to keep inflation as low as possible, without getting into a deflation. In the next chapter, we will consider how we can calculate the long-term inflation targets. They will be different for different economic systems and may be changing over time. And they have justification within economic systems: as there are risks which are realised in economic activities, such as failures, losses, market frictions, etc. inflation is a price paid for such losses. Inflation is the other side of equation of risk, ie. rate-of-loss, in economic system.

Further considerations, which are beyond the scope of this article, can lead us to demonstrate why low inflation and low interest rate create a false perception as if borrowing money is cheaper than when inflation and interest rates are high. It's also worth economic incentive analysis to figure out why providers of capital don't like high(er) inflation. In a nutshell, it exposes them to higher rate of loss (by hoarding money), limits their market as there is more money on the market due to inflation. Inflation directly competes with providers of capital and, if they refuse to compete, decreases their capital. However, additional money which causes inflation is not free money. It's not a "free lunch". We will explain this in the next chapter of this article too.

3 https://www.bankofengland.co.uk/-/media/boe/files/ccbs/resources/state-of-the-art-inflation-targeting.pdf?la=en&hash=313130B91A-7F12BD730BCA3D553E0FF9C440DB4A page 8

III. INFLATION TARGET EQUATION

We consider economic system as a one-step production system whereby an economic output at t_1 is the outcome of economic processes applied to input at the start of the period at t_0.

Let's assume that economic system operates in a one-step cycle between t_1 and t_0. Ie. we look at economic system as discrete production steps between input and output, taking into account inflation between the time of input, t_0, and the time of output, t_1. We also use a representative firm model to approximate whole economic system assuming that the firms are the same in terms of their preferences, risk appetite, productivity, efficiencies, etc.[4]

In such an economic system, production process starts at t_0 when a capital provider provides capital for a production process. The production process ends at t_1 when a provider of labour gets paid for provision of labour by the provider of capital. We note that at t_0 a provider of labour has an opportunity to provide capital and be a provider of capital if it's more beneficial than being a provider of labour being paid at t_1. Similarly, if it was more beneficial for a capital provider to become a provider of labour, the capital provider would become a labour provider.

In economic system with perfect competition market structure, there are no barriers of entry and no barriers of exit, and all economic actors have perfect information. Therefore, any economic actor can choose instantly whether to be a provider of capital or a provider of labour, depending which choice is more profitable. At the equilibrium both roles are equally profitable. A capital provider expects any losses to be covered (such losses are described as "rate-of-loss measure of risk") and get a (net) share of growth, ie. a share of wealth created by the production process. A provider of labour expects to get a (net) share of growth adjusted for inflation. Therefore, under perfect competition market structure, all providers of capital and labour get the same share of growth, of added value in economic activities. Otherwise, they would switch their roles.

Let's V denote the value of input into or output from economic system. After a period, when the output is produced, the value of the input is:

$$V\,(\,1 + c\,)$$

where c covers all costs of input. For example, an interest rate during the production, expressed as a proportion of the value of input as c. (1 is a normalising constant, if we express c in percentage.) This is what a provider of capital will get as an economic actor in money terms, with return calculated as: $V\,(\,1 + c\,) - V$. c may be broken down as follows: $c = l + gr_1$, where l is a rate-of-loss, ie. measure of risk, and gr_1 is a net return, ie. the real growth adjusted for inflation. The equation: $V\,(\,1 + c\,) - V$, represents *Return on Capital* in economic system.

4 https://www.jstor.org/stable/2553302

At the time of output, the value of output is:

$$V(1+r)$$

where r is the return on the input, a production output, that is the sum of inflation and net growth, net profit expressed as money: $r = i + gr_2$. The equation: $V(1+r) - V$ represents *Return on Labour* in economic system.

We use a representative firm model to approximate the whole economy. In a perfectly competitive economy, in a long-term, at equilibrium, $gr_1 = gr_2$.[5] $gr_1 = gr_2 = gr$, where gr is the average growth in the economic system, which is the same for all economic actors. It should be noted that return of providers of capital is not limited to growth of economic system, gr. They also "benefit" from l. But under perfect competition market structure, l covers only the loss resulting from risks realised in economic system. Otherwise, it would be a part of gr.

Combining the value of the input after a period – between input and output time – the value of the output, we get:

Input = $V(1+l+gr)$, accounting also for costs of capital, generates after a "period of time" on producer's side: Output = $V(1+i+gr)$ expressed in money terms, that is:

$$V(1+l+gr) \rightarrow^{inflation(\Delta t)} V(1+i+gr) \text{ where } \Delta t \text{ is a period between } t_0 \text{ and } t_1$$

this is an input – output transition: a production process. As providers of capital must have the same value of gain as providers of labour at equilibrium (otherwise, they would switch between the roles):

$$V(1+l+gr) = V(1+i+gr)$$

$$1+l+gr = 1+i+gr$$

which we can simplify and rearrange to:

Inflation Target Equation:

$$\boldsymbol{i = l}$$

Inflation in economic system = Rate-of-loss measure of risk in economic system

ie. given market structure of perfect competition, without any external intervention, inflation in economic system offsets loss on the input in the production process, and all economic actors benefit equally from economic growth.[6] The Inflation Target Equation sets out what an *invisible hand* of perfectly competitive market would have done.

5 This is implied directly by free entry and exit conditions and access to perfect information under perfect competition market structure to all economic actors.

6 Perfect competition implies that *Return on Capital* is equal *Return on Labour*. Without costs of entry and exit economic actors would switch to activity with the highest return. Zero profit, under perfect competition, doesn't imply zero growth. It implies equitable share of growth, an issue dealt with further in the article.

Thus, bearing in mind consideration in the previous chapter (ie. inflation prevents from capital hoarding, spreads risks in time and amongst economic actors, etc), we can conclude that inflation provides money into economic system, which reconciles economic frictions, inefficiencies and losses. *"There ain't no such thing as a free lunch."* Exactly. Any loss, costs of market frictions and inefficiencies in the system must be covered. And inflation pays for them. Thus, an inflation target in any economic system (eg. a country such as the United States) must be set to equal a risk, ie. rate-of-loss, rate of failure, in the economy. This was indicated by Example 5 in the previous chapter. We suggest revisiting this example.

There is a practical consideration related to the above statement. In the same way, as there is no perfect method to calculate inflation – what to include and in what proportion in a "basket" of goods and services, and how frequently "basket" must be re-calibrated to be representative – calculating rate-of-loss, as a measure of risk, in any economy is equally challenging. But, for practical reasons, it doesn't have to be ideal. It must be representative in the same way as calculating of inflation must be representative. The next chapter indicates that, in the US, data showing reliable rate-of-loss, as a measure of risk, in the economy already exists and is readily available.

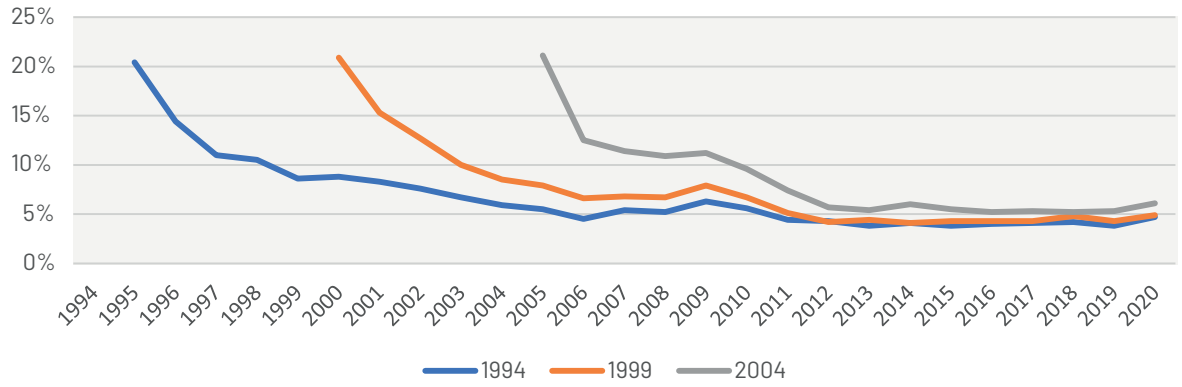
IV. CALCULATING INFLATION TARGET – DATA ANALYSIS

Below is the first shot of reliably calculating rate-of-loss as a measure of risk in the United States economy. We acknowledge that such method of calculations requires further research. Nevertheless, the method developed below appears to be credible and likely to be closely representative of risk, rate-of-loss, in the US.

Appendix 1 contains a print-out of *"Survival of private sector establishments by opening year"* from the US Bureau of Labor Statistics[7]. A basic examination of data allows us to assume that after 12 years, or even less, business failures stabilise (failure rate defined as 100% minus survival rate). This allows us to assume that further failures aren't related to initial start-up phase of business but are becoming representative of rate-of-loss, as a measure of risk, in an economic system as such. The chart below shows a failure rate in the US of businesses started in 1994, 1999 and 2004:

There are many ways of conducting statistical analysis of the date of business failure rate. We try to keep it simple. Below, are first basic observations:

CHART 2 **BUSINESS FAILURE RATES IN THE US FOR BUSINESSES STARTED IN 1994, 1999 AND 2004**



Source: based on data in Appendix 1

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- The graphs indicate a nearly horizontal asymptotic stability of business failure risk after not more than 12 years since start-up.

- It looks that failure rates for business started in 1994 and 1999 converged in around 2012, whilst failure rate for businesses started in 2004 remained a bit higher. This may be a coincidence. But it may be indicative that the systemic risks started affecting businesses started in 2004 more than older businesses were affected. For example, this may be related to the types of funding and risks related to financing of companies in a long-term (for example, a shift from equity financing to debt financing?)

7 https://www.bls.gov/bdm/bdmage.htm (Table 7. Survival of private sector establishments by opening year)

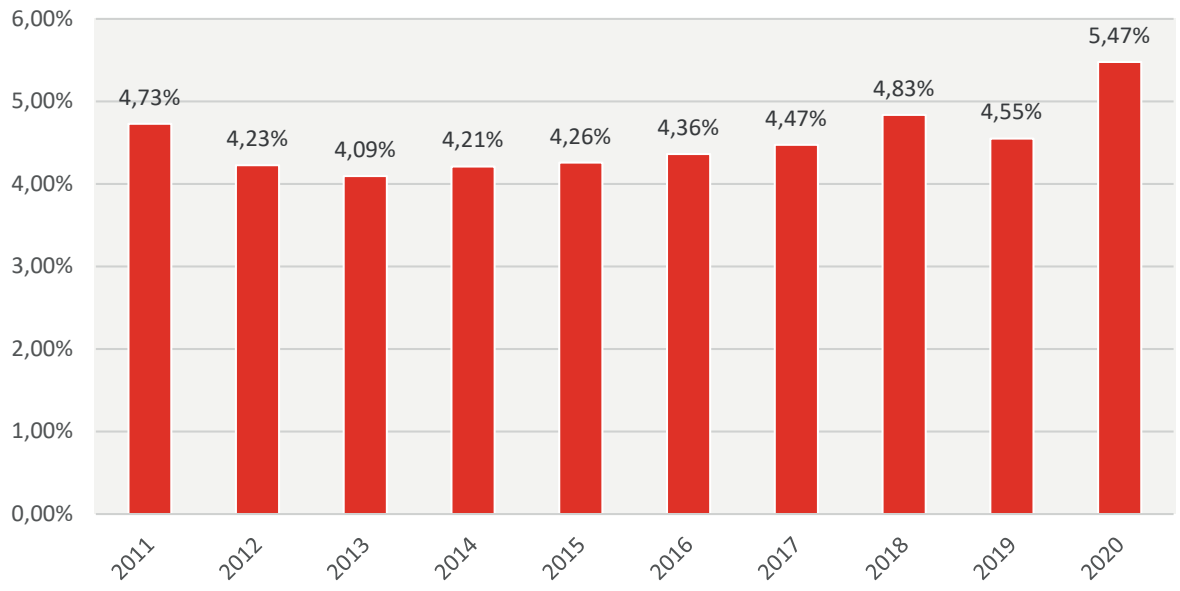
- It looks that since 2019 failure rates for businesses started in 1994, 1999 and 2004 all increased. This may be a blip. But the fact that it increased for all three groups suggests that it may be indicative of the increased systemic economic risk developed in the US economy.

To calculate a representative economic systemic rate-of-loss, a measure of risk, in the United States, we adopted the following methodology:

- For each year between 2011 – 2020, we calculate a geometric average of failure rates in each year for all business sets, grouped by the year of start-up, which are at least 12 years in operations (ie. as per our assumption that after 12 years, businesses achieved asymptotic stability with respect of their start-up phase, hence failure rate may be assumed to be representative of all businesses with respect to systemic and operational risks).

This analysis suggests that inflation target between 2011 and 2019 should behave been between 4% and 5% (4.4% on average) raising to above 5% in 2020.

CHART 3 **FAILURE: RATE-OF-LOSS MEASURE OF RISK BETWEEN 2011 AND 2020**



Source: based on data in Appendix 1

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We may reflect whether the above-mentioned risk, rate-of-loss, of the US businesses between 2011 and 2018 is consistent, if not (negatively) correlated, with decrease of the US GDP (whilst inflation was decreasing too). Ie. as the increased rate of failure wasn't balanced by increased inflation, GDP growth rate kept falling.

We may also consider using equity risk premia as representative of rate-of-loss measure of risk. Aswath Damodaran developed a methodology[8] and calculated such premia for a number of countries[9].

Such an approach has certain intrinsic weaknesses. In the past, credit rating agencies were not necessarily the best source of risks estimates. The same applies to accuracy of using CDS' as a measure of risk, especially that CDS' have a built-in economically perverse mechanism of allowing to insure a risk above its value (thereby creating an objective economic perverse incentive for such a risk to materialise, especially if there is a way of influencing this by those who insure such risk above its value). However, due to the global character of financial markets, with all their arbitrage mechanisms, this approach has its intrinsic consistency and is complete, underpinned by well-founded methodology. This is its strength.

The results of using Damodaran's approach give us the rate-of-loss measure of risk in the US at 4.24% for 2022. This compares to the average 4.41% for the years 2011 – 2020 calculated in this article using the previous method based on the rate of survival of private businesses in the US. Whilst the former reflects the markets perception *ex-ante*, the latter is its *ex-post* verification. It's encouraging to see such close results obtained using these two methods for close, albeit different, time periods.

Damodaran's approach also allows us to calculate the rate-of-loss measure of risk for different countries using country default spreads. This is in the column "Equity Risk Premium" of the table "Country Default Spreads and Risk Premiums" in Appendix 2. The data in this column passes a basic sense check. We would normally expect the rate-of-loss measure of risk between 5% – 10%. This means that inflation should match this to compensate for such rate of loss / risk. If the rate-of-loss measure of risk is above 10% clearly the economy is not healthy. Indeed, the table shows that this is the case with countries regarded as having less than healthy economies. And if the rate-of-loss measure of risk is above 15%, and more, such countries are in trouble. This makes our inflation – rate-of-loss measure of risk model look consistent.

The fact that, in real world, providers of capital assess their risk *ex-ante* is also an argument for accepting Equity Risk Premium as the measure of risk, rate-of-loss. And if in a long-term markets work, this measure will tend to be equal to *ex-post* measure such as one proposed above based on assessment of rate of business failures. We may conclude that it looks that central banks don't have to decide what their long-term inflation targets should be. These targets are set objectively for them by the markets expressed as prevailing Equity Risk Premia. It looks like yet another example of Smithian *"invisible hand"* of the market.

Does the recommendation that the inflation target for the US in the second decade of the 21st century of 4.2% – 4.5% surprise us? Does it sound outlandish? In 2010, although his key argument was different, Olivier Blanchard proposed inflation target in the US of 4%[10]. Using different methods than used in this article, Phuong V. Ngo proposed the US inflation target 3.5% to 5%.[11] Both appear to be consistent with and supported by the analysis presented in this article.

8 https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3825823
9 https://pages.stern.nyu.edu/~adamodar/New_Home_Page/datafile/ctryprem.html
10 https://voxeu.org/article/rethinking-macro-policy
11 https://academic.csuohio.edu/ngop/Ngo_OptimalInflation_Feb2016.pdf

The above also justifies a concept of inflating out of debt, ie. reducing debt by eroding it thanks to inflation. This would not only be by a way of debt reduction but also by readjusting response to rate-of-loss, ie. prevailing risk, in economy. However, as the next chapters will show, there is a limit to the extent inflating out of debt will lead to a long-term equilibrium, as it may lead to what's called popularly a "bubble". (We will define then what a "bubble" means in quantitative terms.) Thus, this will confirm further the assertions made in this article that the role of inflation is to balance rate-of-loss, ie. risk, in economic system. The policymakers should set an inflation target equal to rate-of-loss in economic system, so inflation may absorb the loss. From this angle, we may see the advantage of fiat money over commodity money or representative money. The latter two are real goods. Therefore, they can't absorb rate-of-loss, risk, as such, because they have intrinsic value. For this reason, we may think that what Copernicus or Gresham observed – debasing a currency – may have been driven by a more fundamental, and stronger, economic force than Smithian individuals' greed. That is by the need in economic system to balance rate-of-loss, ie. risk of economic activities.

V. FURTHER ANALYSIS OF INFLATION TARGETS

Appendix 3 contains graphs generated using GDP growth rate and inflation rate data for up to more than 50 years obtained from World Bank[12] for many countries in the world, for developed economies and several other countries. They show 5 year moving averages of GDP growth rate and inflation rate. (The choice of countries was random. The only bias was towards subjectively "better known" countries by their names and for having all major economies.)

After basic (visual) analysis, some conclusions appear to be inescapable:

- For the last 40 years or more, nearly all developed economies, and many other economies, have inflation rate decreasing and GDP growth rate decreasing too. At least for the last decade the inflation rate in the United States is below 4% – 5% rate, below what would reflect risk, rate-of-loss. (We assume that generally rate-of-loss in other developed economies shouldn't be lower, or much different than in the US.) Shouldn't inflation rate, hence inflation targets, in these countries be higher than the actual inflation targets?

- Poland and Ireland seem to be an exception from this trend. However, it's easy to identify exogenous developmental factors which would explain why these countries don't follow the general trend.

- Switzerland also appears to be an exception. However, considering the position of Swiss currency, and being a very low risk economy, it appears that data for Switzerland example may be considered to confirm the analysis.

- Turkey and Nigeria are a good example how high inflation may be associated with stable economic long-term growth. In fact, Turkey and Nigeria examples may be considered to confirm the analysis as they are assessed as high-risk countries for investors. And this high risk appears to be well reflected in high inflation rate. The data in Appendix 3 for Turkey and Nigeria appear to confirm this analysis, bearing in mind that this is an estimate at a point in time of January 2022.

- India and Pakistan are also interesting examples. In India, the inflation trend of around 8%, slightly downward, is associated with a steady growth rate. This may be explained, and there are arguments to justify it, that risk / loss rate in India keeps going down, whilst inflation is in territory, based on the US example, which reflects such risk / loss rate. On the other side, Pakistan average inflation rate (if we compare with Turkey) may still be too low for risk / loss rate there. Hence, there is a GDP growth downward trend in Pakistan. The data in Appendix 3 for India and Pakistan appear to confirm this analysis, bearing in mind that this is an estimate at a point in time of January 2022.

- We conducted the same analysis on different time windows for GDP growth rate and inflation rate data for these countries. It led to the same preliminary results.

12 Eg. https://www.macrotrends.net/countries/NOR/norway/inflation-rate-cpi

- This is a complex system with spill overs and feedbacks, like general equilibrium. For example, inflation rate volatility is likely to increase risk, rate-of-loss, in economic system. Thus, stabilising inflation at a certain level, leads to the inflation level being reduced, because lower volatility decreases risk, rate-of-loss and, therefore, needs to be balanced with reduced inflation rate.

- The overriding conclusion from analysing the graphs in Appendix 3 seems to confirm that to achieve stable economic growth, we should expect higher inflation rate in more risky economies than in lower risk economies. As it looks, we are unlikely to expect extraordinarily high levels of inflation targets. It looks we may expect a very low inflation target in exceptional cases like Switzerland, with inflation target c.4% – 6% for the US which can't be regarded as high inflation, similarly for the UK, with somewhat higher interest rates for developing and emerging economies, c.8% – 14%, again not historically unusually high. It doesn't look like a dramatic change. However, due to compounding effect of exponential processes, which we will deal with in the next chapter – "bubble" and "contraction" – it will make a huge difference for economic development over time. Each country, each economy, must be analysed taking her own circumstances into account. And let's not forget, the precise method for calculating rate-of-loss as a measure of risk – like calculating inflation rate – must be developed and empirically tested. The above analysis is indicative. But we can note that data for the US provided encouraging results.

The above is a very sketchy analysis. It alludes to various countries, and their economic circumstances, and different time periods, and a way how to calculate what inflation targets should be in different countries to facilitate economic growth. The outcome of the analysis in this article seems to be confirmed by the analysis in the Bank of England document prepared by Gill Hammond:

"[…] Balassa-Samuelson effects imply that optimal inflation in [developing and emerging] countries should be a little higher than in industrialised countries."13

13 https://www.bankofengland.co.uk/-/media/boe/files/ccbs/resources/state-of-the-art-inflation-targeting.pdf?la=en&hash=313130B91A-7F12BD730BCA3D553E0FF9C440DB4A page 8

VI. SUSTAINABLE GROWTH PRINCIPLE

Now we aim to show that arguments presented in the previous chapters let us analyse economic system and its stability from both growth mechanism and wealth distribution perspective.

It's commonly accepted by economists and policymakers that low inflation promotes economic growth. That's why – we can say – practically all economic policies try to promote low inflation. However – agreeing that what's commonly regarded as good economic growth must be associated with low inflation – this approach is not entirely correct and in fact it may be misleading in understanding the underlying phenomena. As we discussed in the previous chapter, low risk in economic system is consistent with low inflation. It's low risk which promotes economic growth by encouraging economic activities for the following reasons: the greater the risk the more diverse risk portfolio and capital needed to absorb any adverse events. Thus, the barrier of being economically active as a provider of capital keeps increasing as risk keeps increasing (and vice versa). Consequently, the higher the risk the lower the economic activities, and competition amongst economic actors. And this negatively affects growth.

There is also a feedback loop between risk in economic system and inflation itself. If risk is low economic actors are prepared to invest due to low risk. They don't need high(er) inflation to push them to invest. However, if risk is high(er) then increased inflation is needed to push economic actors to take such risk and invest because inflation is worse of the two evils. However, for a rational provider of capital, the greater the risk the more diverse risk portfolio is needed. Some economic actors with little capital to absorb any loss, won't invest, thereby lowering the growth. Thus, lowering the risk, which may manifest itself in lower inflation, will increase activities of economic actors leading to economic growth. However, using inflation control mechanism to promote economic growth, such as setting interest rate by central banks, is one element of risk control in economic system.

Thus, we conclude that risk should be lowered in economic system as it will lead to increased growth with lower inflation as a result. Such thinking typically leads to promoting more business-friendly policies, more favourable to providers of capital (than providers of labour). The sustainable growth equation let us understand quantitatively the limits of being business-friendly and identify the point when being too business-friendly starts backfiring.

Let's consider *Base* as the current value of economic system, the current output. We will also call it in the analysis later *Initial endowment*. From capital provider's perspective, we can calculate the present value of *Base* expected after time *n*:

$$Base(n) = Base\frac{1}{(1+r)^n}$$

For a capital provider a return rate *r* equals: *l*, rate-of-loss measure of risk, plus *gr*, expected growth. The future expected value is however affected by the output delivered by providers of labour, those who employ this capital and "make it work" to generate output, create wealth:

$$Base(n) = Base\frac{(1+r)^n}{(1+l+gr)^n}$$

For a provider of labour, a return rate *r* equals: *i*, that is inflation after period *n*, plus expected growth, value added by a labour provider:

$$Base(n) = Base\left(\frac{1+i+gr}{1+l+gr}\right)^n$$

Sustainable[14] Growth Principle:

for economic growth to be sustainable, far all *n* defined as number of time periods then *i = l* (Inflation = Rate-of-loss measure of risk) and:

$$\boldsymbol{Base(n) = Base}$$

If this condition isn't satisfied this means that for an endogenous perfectly circular economic system the net present value of the economic system in the future (after period *n*, with *n* going to infinity) would either race to infinity (which would be a "bubble" effect) or would race to zero (a "contraction" effect, economic activities keep dying, which is possible, but it's not sustainable either), in both cases at exponential pace.

This means that whilst there may be growth in economic system (growth in output generated from input), expressed as *gr*, the value of *Base* must remain unchanged. *Base* can also be considered as *Initial endowment*, gross domestic product in economic system (first input at the start of measuring the process), which can't change as a result of economic activities as it is fixed at a starting point. In our analysis, *Base* looks like "*Index = 100*" assumed as the starting value to measure inflation in base year.

The above model is based on the assumption of economic system being endogenous satisfying perfect competition market structure assumptions. Let's now extend this model to take exogenous effects into account. Referring to the *Base* period, let's call our starting value of the economy, initial *Base*, *Initial endowment*, gross domestic product, at year 0.

$$EV_0 = EV_0^+ = Initial\ endowment\ /\ Gross\ Domestic\ Product$$

The current value of economic system taking into account any subsequent periods – after a period number *n* – may be considered as a new endowment for the next period, say period *n*: EV_n. We don't assume that there is the same rate-of-loss measure of risk, growth or inflation rate in every period. EV_n can be calculated using the following recursive equation:

$$EV_n = (EV_{n-1} + EV_n^+)\left(\frac{1+i_n+gr_n}{1+l_n+gr_n}\right)$$

EV_{n-1} is endowment, gross domestic product, inherited, from the period preceding period *n*.

EV_n^+ is an additional endowment that was added into economic system during period *n*. This may be a result of, such things as:

- Innovation
- Productivity improvements
- New resources

14 The notion of "sustainable" in this article is a counterpart of a concept of "tractable" in complexity and computability theory.

The fact that $EV_k^+ < 0$ has the same effect on the current value of economic system as $\left(\frac{1+i_k+gr_k}{1+l_k+gr_k}\right) < 1$ shows us that negative additional endowment during a given period has the same effect as the share of output by providers of capital was greater than providers of labour. Ie. if providers of the capital have too big a share of the output, they are subtracting wealth from economic system. And if providers of labour were to have too big a share, this would be a bogus value: empty money added to the inflation rate.

General Sustainable Growth Principle:

extending Sustainable Growth Principle for economic system with exogenous effects:

$$\left(\frac{1+i_k+gr_k}{1+l_k+gr_k}\right) = 1$$

is a condition for optimal growth. If this condition isn't met, it has an exponential, compounding effect on the economic base – overinflating or contracting it – over time. The numerator in this equation expresses the share of the output by providers of labour and the denominator expresses the share of the output by providers of capital in period *k*. It should be noted that under perfect competition assumptions, with no barriers of entry or exit, perfect information, etc, every economic actor may freely choose to be a provider of labour or provider of capital.

The General Sustainable Growth Principle let us consider present value of economic system, after *n* periods, further:

$$EV_0 = EV_0^+ = Initial\ endowment$$

$$EV_n = (EV_{n-1} + EV_n^+)\left(\frac{1+i_n+gr_n}{1+l_n+gr_n}\right)$$

This recursive formula has the form of a non-deterministic, pseudo random (quasi) Fibonacci Sequence with EV_{n-1} known at the start of period *n*, and with other variables having pseudo random characteristics.

There is a catch in this formula, also for politicians and policy makers. It doesn't seem immediately obvious when $EV_n > EV_{n-1}$ whether this is a result of positive EV_n^+, ie. a genuine growth factor, or is a result of $\left(\frac{1+i_n+gr_n}{1+l_n+gr_n}\right) > 0$, ie. a "bubble" effect, or both. Similarly, when $EV_n < EV_{n-1}$, it's not immediately obvious either whether this is a result of negative EV_n^+, ie. a genuine negative impact factor or is a result of $\left(\frac{1+i_n+gr_n}{1+l_n+gr_n}\right) < 0$, ie. a "contraction" effect, or both. In the next chapter, we will see how to calculate both "bubble" / "contraction" effect for economic system, and how relates to measurable gross domestic product, GDP, growth (called MGr).

General Sustainable Growth Principle shows us that sustainability is about avoiding the present value – calculated in a form of pseudo random (quasi) Fibonacci Sequence – being exponentially divergent to infinity or exponentially convergent to 0 (zero) – ie. having runaway, exponential, compounding properties – and present value having a linear characteristic of the sum of all new endowment inputs into economic system in *n* periods:

$$EV_n = \sum_{k=0}^{n} EV_k^+$$

that is present value of *n* periods of economic system.

The General Sustainable Growth Principle extends the Inflation Target Equation:

$$i = I$$

Inflation in economic system = Rate-of-loss measure of risk in economic system

making it valid in economic systems with exogenous effects, as periods may be arbitrarily short or long, depending in what unit of time we want to measure economic processes. It also shows consistency between conditions for sustainable short-term economic growth and sustainable long-term economic growth.

Equitable share, fair share of economic output

If we assume that the intrinsic aim of economic system is to maximise its growth, Sustainable Growth Principle may be regarded as a definition, with justification, what fair share, or equitable share, must be in economic system between providers of labour and providers of capital.

VII. "BUBBLE" AND "CONTRACTION" OF ECONOMIC BASE

Now we define, by a way of equation, a concept of "overinflation", which is also called a "bubble", and show how to calculate it. When overinflation is below *0*, zero, we will refer to such overinflation as "contraction" (of the economic base).

When we empirically calculate economic growth, growth of gross domestic product, we do it based on the output which we can observe and measure. That is:

$$MGr = \frac{EV' - EV}{EV}$$

where:

- MGr is the measured economic growth rate, rate of increase of gross domestic product: GDP growth rate,
- EV' is the measured endowment value, it's a gross domestic product, GDP, or value of the economic base, at the end of the period (of growth measurement),
- EV is the measured endowment value, it's a gross domestic product, GDP, or value of the economic base, at the start of the period (of growth measurement).

We note that as can't be less than *0*, zero, then can't be less than *-1* (less than -100%). Ie. in any given period, the economic base may disappear, but it can't be negative. This will be important characteristic in our further analysis.

Next, we define:

$$EV' = EV^*(1 + gr)$$

EV^* is the adjusted initial economic base at the start of the period of growth measurement, compensated for a bubble or contraction effect when $\left(\frac{1+gr+i}{1+gr+l}\right) \neq 1$. gr is the economic growth resulting from applied production methods such use of new resources, use of new innovative tools, etc. New, or additional endowment, EV^+, is a new resource added. Economic growth gr measures how it is used, applied as a part of production process, and it also measures the effect of EV^+on growth, gr.

$$EV' = EV\left(\frac{1 + gr + i}{1 + gr + l}\right)(1 + gr)$$

Thus,

$$MGr = \frac{EV\left(\frac{1 + gr + i}{1 + gr + l}\right)(1 + gr) - EV}{EV}$$

$$MGr = \left(\frac{1 + gr + i}{1 + gr + l}\right)(1 + gr) - 1$$

We note that if $\left(\frac{1+gr+i}{1+gr+l}\right) = 1$ then $MGr = 1 \cdot (1 + gr) - 1$ that $MGr = gr$ is

Let's denote:

$$Gr = 1 + gr$$

$$MGr = \left(\frac{Gr + i}{Gr + l}\right) Gr - 1$$

$$MGr = \frac{(Gr + i)Gr - (Gr + l)}{(Gr + l)}$$

Thus, we can calculate Gr and as $gr = Gr - 1$

$$Gr^2 + (i - MGr - 1)Gr - l(MGr + 1) = 0$$

$$Gr = \frac{-(i - MGr - 1) \pm \sqrt{(i - MGr - 1)^2 + 4l(MGr + 1)}}{2}$$

$$gr = \frac{-(i - MGr - 1) \pm \sqrt{(i - MGr - 1)^2 + 4l(MGr + 1)}}{2} - 1$$

$4l(MGr + 1)$ is always greater than *0*, zero, then $-(i - MGr - 1) + \sqrt{(i - MGr - 1)^2 + 4l(MGr + 1)} > 0$. The only valid solution is:

$$gr = \frac{-(i - MGr - 1) + \sqrt{(i - MGr - 1)^2 + 4l(MGr + 1)}}{2} - 1$$

as otherwise EV' would have contracted by more than 100%, since $EV' = EV^* (1 + gr)$, which is not possible, ie. an economic system with negative *Initial endowment* value, gross domestic product, is not possible to exist.

A Bubble, overinflation greater than *0*, zero, ie. $MGr > gr$:

We may define and calculate a bubble in economic system as follows:

$$Bubble = MGr - gr = MGr - \left[\frac{-(i - MGr - 1) + \sqrt{(i - MGr - 1)^2 + 4l(MGr + 1)}}{2} - 1\right]$$

$$Value_{of_{Bubble}} = Bubble \cdot EV, \text{ ie. } Value_{of_{Bubble}} = Bubble \cdot GDP$$

A Contraction, or cooling, overinflation less than *0*, zero, ie. $MGr < gr$:

We may define a contraction, cooling off, of economic system as follows:

$$Contraction = gr - MGr = \left[\frac{-(i - MGr - 1) + \sqrt{(i - MGr - 1)^2 + 4l(MGr + 1)}}{2} - 1\right] - MGr$$

$$Value_{of_{Contraction}} = Contraction \cdot EV \text{ or } Value_{of_{Contraction}} = Contraction \cdot GDP$$[15]

15 GDP is gross domestic product, endowment value, ie. $GDP = EV$

We note that if $\left(\frac{1+gr+i}{1+gr+l}\right) = 1$, that is General Sustainable Growth Principle condition is met, then $MGr = gr$

and $Bubble = Contraction = 0$ and $Value_{of_{Bubble}} = Value_{of_{Contraction}} = 0$

Thus, as we can empirically measure:

- economic growth, gross domestic product growth, MGr,
- endowment value, ie. gross domestic product,
- inflation, *i*, and
- rate-of-loss measure of risk, *l*

we can also measure and monitor any bubble or contraction, and their values in the system.

A bubble is a fake value in economic system. It doesn't exist. But it's perceived to exist. Since it's growing with exponential characteristics, a bubble must burst. A contraction is a loss. It's an outcome of not maximally using the economic base: the endowment, the resources available to economic actors. Both phenomena are a result of suboptimal, inequitable, share of the economic output against by General Sustainable Growth Principle condition. Bubble and contraction are a measure of inequity in economic system.

Example:

Based on the data referred to in this article and available at the World Bank[16], the table below shows the value of contraction of economic base in the United States between 2011 and 2020, due to inequitable share of gross domestic product (GDP data for a preceding year).

TABLE 1:

Year	Risk, rate-of-loss (l)	Inflation (i)	GDP Growth Rate (MGr)	EV = GDP (in billions)	Bubble / Contraction (%)	Value of Bubble / Contraction (in billions)
2011	4.73%	3.16%	1.55%	$14,992.05	1.50%	$224.69
2012	4.23%	2.07%	2.25%	$15,542.58	2.07%	$321.91
2013	4.09%	1.46%	1.84%	$16,197.01	2.53%	$410.38
2014	4.21%	1.62%	2.53%	$16,784.85	2.49%	$417.90
2015	4.26%	0.12%	3.08%	$17,527.16	3.98%	$697.11
2016	4.36%	1.26%	1.71%	$18,238.30	2.98%	$542.59
2017	4.47%	2.13%	2.33%	$18,745.08	2.25%	$421.09
2018	4.83%	2.44%	3.00%	$19,542.98	2.29%	$447.40
2019	4.55%	1.81%	2.16%	$20,611.86	2.62%	$541.01
2020	5.47%	1.23%	-3.49%	$21,433.22	4.03%	$862.75

16 https://www.macrotrends.net/countries/USA/united-states/gdp-gross-domestic-product and Chapter IV of this article explains "rate-of-loss measure of risk". The descreption for the terms in the header of the Table 1 is on page 29.

The table below shows the actual GDP growth in the US between 2011 and 2020, and what would have been the maximum optimal growth – ie. without "bubble" / "contraction" effect – if, *ceteris paribus*, there was equitable share of wealth in economic system in the US in those years. This looks like a significant, but realistic, lost opportunity, systemic loss of wealth.

TABLE 2:

Year	Growth (MGr)	Inflation (i)	Risk, rate-of-loss (I) / optimal inflation (i) / equitable share of wealth	Optimal growth if there was equitable share of wealth
2011	1.55%	3.16%	4.73%	3.05%
2012	2.25%	2.07%	4.23%	4.32%
2013	1.84%	1.46%	4.09%	4.37%
2014	2.53%	1.62%	4.21%	5.02%
2015	3.08%	0.12%	4.26%	7.06%
2016	1.71%	1.26%	4.36%	4.69%
2017	2.33%	2.13%	4.47%	4.58%
2018	3.00%	2.44%	4.83%	5.29%
2019	2.16%	1.81%	4.55%	4.78%
2020	-3.49%	1.23%	5.47%	0.54%
Average	**1.70%**	**1.73%**	**4.52%**	**4.37%**

The optimal growth in the table above may look (to some) a bit too high. Thus, we may compare optimal growth results above to a different 10 years in the US economy.

TABLE 3:

Year	Growth (MGr)	Inflation
1983	4.58%	3.21%
1984	7.24%	4.30%
1985	4.17%	3.55%
1986	3.46%	1.90%
1987	3.46%	3.66%
1988	4.18%	4.08%
1989	3.67%	4.83%
1990	1.89%	5.40%
1991	-0.11%	4.24%
1992	3.52%	3.03%
Average	***3.61%***	***3.82%***

Between 2011 and 2020, the average Growth was 1.7%, the average Inflation was 1.73% and, according to our model if inflation was equal rate-of-loss, ie. risk, Optimal average growth would have been 4.37%. Between 1983 and 1992 the average Growth was 3.61% and Inflation was 3.82%.

Optimal Growth results in Table 2 don't look unusual compared to Growth figures in Table 3. Whilst this is still to be verified, it's a plausible assumption that rate-of-loss as a measure of risk in the US between 1983 and 1992 was not much different than between 2011 and 2020. Inflation between 1983 and 1992 was higher than between 2011 and 2020, and closer to a level of inflation implicitly postulated by the model presented in this article. We invite the reader to compare Growth figures for two periods and Optimal growth for years between 2011 and 2020. We may suggest that according to our model and assuming that the rate-of-loss as a measure of risk in the US between 1983 and 1992 was the same as between 2011 and 2020 – ie. 4.4% on average – it appears there was still a small room for greater Optimal growth of around 0.5% between 1983 and 1992.

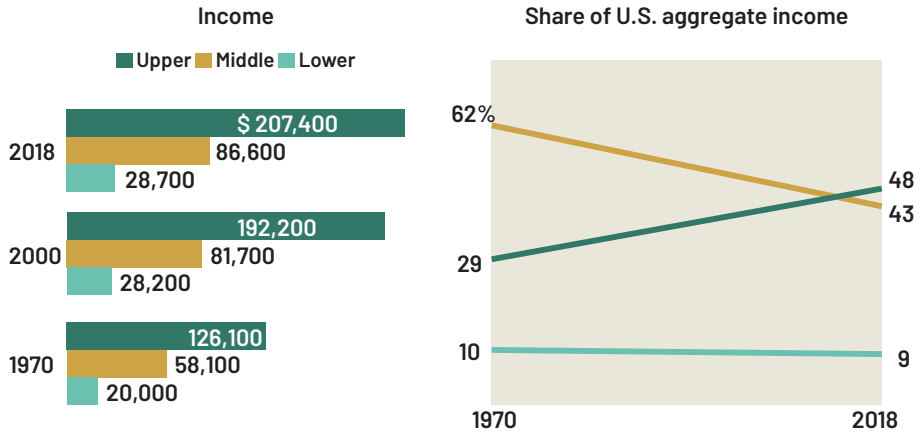
Between 1981 and 1990 average Growth was 3.34% and average Inflation was 4.74%. In this case, according to our model, inflation could have been too high by 0.3% – 0.7%. It looks there could have been a room for greater Optimal growth of between 0.5% – 1%. However, these 10 years require more detailed analysis due to unusually high inflation in 1981 of 10.33% followed by anti-inflationary measures, and negative growth of -1.8% in 1982.[17]

Whilst such analysis is beyond the scope of this article, we observe that continued contraction of economic base due to inequity as presented in the Table 1 above appears to be consistent with continued growth of inequality gap of income and wealth between richer and poorer households, which may also be regarded as a measure of inequity in economic system. Ie. providers of capital had too high a share of wealth than providers of labour. See the graph below. It looks the share of economic wealth between 1983 and 1992 was different than from 2011 onwards. Intuitively, we may regard share of wealth between 1983 and 1992 as more equitable.[18] We note the higher inflation between 1983 and 1992 than between 2011 and 2020.

GRAPH 1

The gaps In Income between upper-income and middle- and lower-income households are rising, and the share held by middle-income households is falling

Median household income, in 2018 dollars, and share of U.S. aggregate household income, by income tier



Note: Households ere assigned 10 Income tiers based on their size-adjusted income. Incomes ere scaled 10 reflect a three-person household. Revisions to the Current Population Survey affect the comparison of income data from 2014 onwards. See Methodology for details.
Source: Pew Research Center analysis of the Current Population Survey, Annual Social and Economic Supplements (IPUMS).
"Most Americans Say There Is Too Much Economic inequality In the U.S., but Fewer Than Hall Call it a Top Priority"

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17 We note that the accuracy of results of our analysis is limited by the quality of data about rate-of-loss measure of risk and also by the fact that our model assumes perfect competition market structure.

18 https://www.pewresearch.org/social-trends/2020/01/09/trends-in-income-and-wealth-inequality/

A key finding in this article is the role of rate-of-loss measure of risk in economic activities and how it links concepts of inflation, economic growth and equitable share of wealth. We also determined two aspects of inflation: one, which balances risk, rate-of-loss, and the other a monetary phenomenon.

The arguments above indicate consistency and completeness of the model presented in this article. We demonstrated in a form of measurable characteristics and equations a relationship between:

- Inflation,
- Rate-of-loss measure of risk,
- Economic growth,
- Equitable share of wealth.

We also concluded that if inflation matches the risk, rate-of-loss in the economic system, this assures an equitable share of wealth amongst economic actors and leads to optimal (ie. without a "bubble" of "contraction" effects) maximal growth in economic system. Thus, we postulate, in real economy inflation target be set as equal to rate-of-loss, ie. risk, in economic system. Chapter IV of this article presents two approaches – *ex-post and ex-ante* – on how to measure risk, rate-of-loss, in economic system.

We can use our model beyond its direct applications such as establishing long-term inflation targets for different countries or calculating the size of economic bubble or contraction. In Appendix 4 we show:

- Example 1: using the eurozone as an example, how we can use our model to calculate the impact on a country resulting from being in a single currency zone of countries with different risk profiles, and
- Example 2: that in the process of globalisation, with countries open to free trade, it's a natural process that wealth is transferred from more risky countries to less risky countries. In practice, it looks like that globalisation is a form of modern colonialism through free trade. Typically, more risky countries are poorer countries and less risky countries are richer countries. It follows that, *ceteris paribus*, countries should be open to free trade with riskier countries and be very careful about removing barriers of trade with less risky countries. Our model also demonstrates that the key to economic success is to be the least risky country.

VIII. HISTORICAL REFLECTION ON ECONOMICS AND ECONOMIC SYSTEMS DEVELOPMENTS

The Sustainable Growth Principle tells us how output of economic growth should be shared between providers of capital and providers of labour in economic system. Using historical and ideological cliché by calling providers of capital "Adam Smith" and providers of labour "Karl Marx", we can capture the sustainable economic growth principle as follows:

$\forall\, \boldsymbol{n}$:

$$\left(\frac{Karl\ Marx}{Adam\ Smith}\right)^{n} = 1$$

That is, in any sustainable economic system:

$$\text{“}Karl\ Marx\text{”} = \text{“}Adam\ Smith\text{”}$$

According to our model presented in this article, a share of wealth in economic system as equitable, ie. it makes the system sustainable, if the above condition "*Karl Marx*" = "*Adam Smith*" holds, and this means that: Inflation must equal risk / rate-of-loss.

Let's consider situations when "*Karl Marx*" > "*Adam Smith*". According to our analysis as:

$$\lim_{n\to\infty}\left(\frac{Karl\ Marx}{Adam\ Smith}\right)^{n} \to \infty$$

will be increasing with *n* to infinity at exponential rate, ie. there will be a strong compounding effect[19]. This clearly looks like what economists call a **"bubble"**. **In our analysis, a bubble looks like as if we tried to increase an initial *Base*, an endowment, which is not possible.** A bubble creates a perception of existence of value, wealth, which doesn't exist. That's why a bubble must burst. Thus, when "*Karl Marx*" > "*Adam Smith*" economic system is not stable in a long-term (or even in a much shorter-term). We may consider this analysis as an informal proof why the communist system was bound to fail.

Now let's consider situations when "*Karl Marx*" < "*Adam Smith*". According to our analysis as:

$$\lim_{n\to\infty}\left(\frac{Karl\ Marx}{Adam\ Smith}\right)^{n} \to 0$$

will be decreasing to 0 (zero) at exponential rate. There will be a strong compounding effect, with increasing *n*, this clearly look like a **"contracting"** of economic system[20]. In our analysis contracting of economic system is as if we don't use parts of initial *Base*, an endowment. And such a decrease is reducing the use of the initial *Base* to 0 (zero) at exponential rate, ie. with a compounding effect. This may be an accurate description of a mechanism of gradual reduction of growth of nearly all major western economies in the last 40 – 50 years, whilst at the same time, or because of that, inflation was going down too. This also seems to capture well a mechanism how the rich

19 To show this, either assume that "Karl Marx" to "Adam Smith" ratio is constant or take the infimum in the series of this ratio.

20 To show this, either assume that "Karl Marx" to "Adam Smith" ratio is constant or take the supremum in the series of this ratio.

(providers of capital) are becoming even richer, above the rate of economic growth, and why the economic growth has a decreasing trend at the same time. Ie. such an inequitable share of wealth when "*Karl Marx*" < "*Adam Smith*" results in contracting the *Base* in a long-term, ie. a lot of initial endowment is not used to generate output.

It appears that this analysis and model may be quite useful in general. For example, according to this analysis, stagflation is a result of, or a reaction to, a high risk, rate-of-loss. As explained earlier, after some time, high risk, rate-of-loss decreases economic activities. This leads to low growth rate. At the same time high risk ultimately leads to high inflation rate in economic system (needed to balance high risk, rate-of-loss, as presented earlier). Thus, in case of stagflation, the policy focus should be on identifying the sources of high risk, rate-of-loss and eliminating them, and as a result eliminating high risk, rate-of-loss. As a result, growth rate will start increasing and inflation rate will start going down. According to our analysis, stagflation is a natural phenomenon resulting from pushing inflation too much down below the level of rate-of-loss. The hard part is to determine how in different countries different risk, rate-of-loss may have different effects on growth rate. For example, it appears that the risk, rate-of-loss such as in Turkey or Nigeria will have different effects on growth rate there than it would be the case in Switzerland or the United States (see graphs in Appendix 3 and also refer to analysis in Chapter V of this article). We suggest such an exemplification how risk, rate-of-loss affects rate of growth to be subject of empirical research. There is an important human factor in perceiving risk and calculating it as a rate-of-loss, verified later by the empirical data,[21] and then reacting to this by changing, or not, a level of economic activities, which affects growth rate.

Concluding remark: *"The greatest shortcoming of the human race is our inability to understand the exponential function."* – Albert Bartlett.

21 Clearly an approach initiated by Gary Becker will be helpful: https://www.nobelprize.org/uploads/2018/06/becker-lecture.pdf

IX. (PRELIMINARY) CONCLUSIONS

The above is a theoretical model. In real life, there is no perfect competition, and no long-term stable equilibrium. However, whilst $i = I$ is also a model, it looks it may be practically applicable to manage the economy.

This analysis tells us that providers of capital and provider of labour are "frenemies", friends and enemies at the same time. Whilst they compete for wealth, output, in economic system, if this share is not equitable (as defined in this article), they will be acting against their own interest. For this reason, a balance between business/capital-friendly policies and labour-friendly policies is critical for sustainable growth. This paper indicates how this model can be verified: ie. by measuring risk, rate-of-loss and inflation in economic system, and how monetary policy (interest rate) must respond to it.

The aim of these policies should be focused on reducing risk, rate-of-loss (for example, as measured by the US Bureau of Labor, or using Damodaran's methodology) as used in the analysis in this article) and on ensuring using monetary policy (assuming that currencies are controlled by central banks) that inflation rate is as close as possible to be equal to rate-of-loss measure of risk

Similarly, in the same way how methodology to measure inflation was developed, a methodology to measure risk, rate-of-loss, must also be developed and tested and be consistent with inflation measuring methodology. The ones used in this article appears to be theoretically consistent and promising for practical purposes.

Setting up interest rate is a potent but quite crude mechanism of controlling inflation. This analysis and model show that inflation target should be set to reflect rate-of-loss measure of risk in economic system and setting up interest rate is a tool to achieve this.

It would be interesting to model events from economic history – like communism and its collapse, various crises in western economies in the last 100 years – using the model and approach presented in this article. Ie. that for any economic system to be stable, inflation must equal rate-of-loss measure of risk, in order to avoid "bubbles" growing, or "contracting" happening.

It also looks from our analysis that it's not a human, good old Smithian greed, which is behind human economic behaviour, but it's risk aversion, which seems to be driving people to become richer. Greed is an outside manifestation of a more primitive and instinctive avoidance of becoming destitute.

Making a far-fetched but quite explanatory statement, we may compare the relationship between inflation and rate-of-loss measure of risk in economy to relationship between energy and mass in physics. And that this equivalence appears to be quite fundamental. In perfectly competitive economy, higher inflation results in higher risk, rate-of-loss. Higher risk, rate-of-loss results in higher inflation needed to absorb the rate-of-loss, ie. risk in economic system.

APPENDIX 1

APPENDIX 1

Annual openings Year ended: March		Surviving Establishments	Total Employment of Survivors	Survival Rates Since Birth	Survival Rates of Previous Year's Survivors	Average Employment of Survivors		Business failure rate		
	1994						**1994**	**Graph in the Graphs Tab**		
March	**1994**	569,419	4,132,450	100.0	_	7.3	**1994**			
March	**1995**	453,134	4,140,239	79.6	79.6	9.1	**1995**	20.40%		
March	**1996**	387,868	4,012,051	68.1	85.6	10.3	**1996**	14.40%		
March	**1997**	345,155	3,947,376	60.6	89.0	11.4	**1997**	11.00%		
March	**1998**	309,084	3,862,645	54.3	89.5	12.5	**1998**	10.50%		
March	**1999**	282,484	3,721,580	49.6	91.4	13.2	**1999**	8.60%		
March	**2000**	257,488	3,655,305	45.2	91.2	14.2	**2000**	8.80%	20.90%	
March	**2001**	236,094	3,506,596	41.5	91.7	14.9	**2001**	8.30%	15.30%	
March	**2002**	218,171	3,276,821	38.3	92.4	15.0	**2002**	7.60%	12.70%	
March	**2003**	203,484	3,117,464	35.7	93.3	15.3	**2003**	6.70%	10.00%	
March	**2004**	191,428	3,025,551	33.6	94.1	15.8	**2004**	5.90%	8.50%	
March	**2005**	180,909	2,962,831	31.8	94.5	16.4	**2005**	5.50%	7.90%	21.10%
March	**2006**	172,805	2,914,145	30.3	95.5	16.9	**2006**	**4.50%**	6.60%	12.50%
March	**2007**	163,477	2,856,566	28.7	94.6	17.5	**2007**	**5.40%**	6.80%	11.40%
March	**2008**	154,939	2,772,210	27.2	94.8	17.9	**2008**	**5.20%**	6.70%	10.90%
March	**2009**	145,109	2,535,759	25.5	93.7	17.5	**2009**	**6.30%**	7.90%	11.20%
March	**2010**	136,978	2,421,364	24.1	94.4	17.7	**2010**	**5.60%**	6.70%	9.60%
March	**2011**	130,986	2,403,881	23.0	95.6	18.4	**2011**	**4.40%**	5.10%	7.40%
March	**2012**	125,354	2,399,386	22.0	95.7	19.1	**2012**	**4.30%**	4.20%	5.70%
March	**2013**	120,593	2,383,994	21.2	96.2	19.8	**2013**	**3.80%**	4.40%	5.40%
March	**2014**	115,619	2,372,009	20.3	95.9	20.5	**2014**	**4.10%**	4.10%	6.00%
March	**2015**	111,183	2,355,817	19.5	96.2	21.2	**2015**	**3.80%**	4.30%	5.50%
March	**2016**	106,785	2,339,019	18.8	96.0	21.9	**2016**	**4.00%**	4.30%	5.20%
March	**2017**	102,384	2,323,824	18.0	95.9	22.7	**2017**	**4.10%**	4.30%	5.30%
March	**2018**	98,046	2,299,788	17.2	95.8	23.5	**2018**	**4.20%**	4.80%	5.20%
March	**2019**	94,357	2,254,351	16.6	96.2	23.9	**2019**	**3.80%**	4.30%	5.30%
March	**2020**	89,876	2,195,534	15.8	95.3	24.4	**2020**	**4.70%**	4.90%	6.10%
Annual openings										
Year ended: March	**1995**						**1995**			
March	**1995**	604,415	4,372,481	100.0	_	7.2	**1995**			
March	**1996**	476,551	4,318,303	78.8	78.8	9.1	**1996**	21.20%		
March	**1997**	410,336	4,269,975	67.9	86.1	10.4	**1997**	13.90%		
March	**1998**	361,618	4,178,731	59.8	88.1	11.6	**1998**	11.90%		
March	**1999**	326,825	4,078,358	54.1	90.4	12.5	**1999**	9.60%		
March	**2000**	295,171	4,003,473	48.8	90.3	13.6	**2000**	9.70%		
March	**2001**	268,146	3,836,718	44.4	90.8	14.3	**2001**	9.20%		
March	**2002**	246,242	3,541,478	40.7	91.8	14.4	**2002**	8.20%		
March	**2003**	229,526	3,361,657	38.0	93.2	14.6	**2003**	6.80%		
March	**2004**	215,477	3,274,763	35.7	93.9	15.2	**2004**	6.10%		
March	**2005**	201,976	3,199,890	33.4	93.7	15.8	**2005**	6.30%		
March	**2006**	191,065	3,162,982	31.6	94.6	16.6	**2006**	5.40%		
March	**2007**	180,774	3,088,012	29.9	94.6	17.1	**2007**	5.40%		
March	**2008**	171,477	2,994,604	28.4	94.9	17.5	**2008**	5.10%		
March	**2009**	160,618	2,741,490	26.6	93.7	17.1	**2009**	6.30%		
March	**2010**	151,822	2,618,042	25.1	94.5	17.2	**2010**	5.50%		
March	**2011**	145,015	2,602,835	24.0	95.5	17.9	**2011**	4.50%		
March	**2012**	139,196	2,583,414	23.0	96.0	18.6	**2012**	4.00%		
March	**2013**	133,907	2,567,440	22.2	96.2	19.2	**2013**	3.80%		
March	**2014**	128,768	2,521,791	21.3	96.2	19.6	**2014**	3.80%		
March	**2015**	123,537	2,504,036	20.4	95.9	20.3	**2015**	4.10%		
March	**2016**	118,660	2,480,841	19.6	96.1	20.9	**2016**	3.90%		
March	**2017**	113,860	2,437,727	18.8	96.0	21.4	**2017**	4.00%		
March	**2018**	109,128	2,411,960	18.1	95.8	22.1	**2018**	4.20%		

March	**2019**	104,719	2,378,546	17.3	96.0	22.7	**2019**	4.00%
March	**2020**	99,930	2,308,447	16.5	95.4	23.1	**2020**	4.60%
Annual openings Year ended: March								
	1996						**1996**	
March	**1996**	609,638	4,376,545	100.0	_	7.2	**1996**	
March	**1997**	476,797	4,329,770	78.2	78.2	9.1	**1997**	21.80%
March	**1998**	408,018	4,248,705	66.9	85.6	10.4	**1998**	14.40%
March	**1999**	363,990	4,173,926	59.7	89.2	11.5	**1999**	10.80%
March	**2000**	325,701	4,115,688	53.4	89.5	12.6	**2000**	10.50%
March	**2001**	293,298	3,940,353	48.1	90.1	13.4	**2001**	9.90%
March	**2002**	267,339	3,635,089	43.9	91.1	13.6	**2002**	8.90%
March	**2003**	246,995	3,456,646	40.5	92.4	14.0	**2003**	7.60%
March	**2004**	230,620	3,363,765	37.8	93.4	14.6	**2004**	6.60%
March	**2005**	215,725	3,316,437	35.4	93.5	15.4	**2005**	6.50%
March	**2006**	203,390	3,283,078	33.4	94.3	16.1	**2006**	5.70%
March	**2007**	191,924	3,210,634	31.5	94.4	16.7	**2007**	5.60%
March	**2008**	181,330	3,106,853	29.7	94.5	17.1	**2008**	5.50%
March	**2009**	170,442	2,829,779	28.0	94.0	16.6	**2009**	6.00%
March	**2010**	160,473	2,710,277	26.3	94.2	16.9	**2010**	5.80%
March	**2011**	153,003	2,686,149	25.1	95.3	17.6	**2011**	4.70%
March	**2012**	146,723	2,676,883	24.1	95.9	18.2	**2012**	4.10%
March	**2013**	140,708	2,660,300	23.1	95.9	18.9	**2013**	4.10%
March	**2014**	135,496	2,631,076	22.2	96.3	19.4	**2014**	3.70%
March	**2015**	129,930	2,618,420	21.3	95.9	20.2	**2015**	4.10%
March	**2016**	124,433	2,597,697	20.4	95.8	20.9	**2016**	4.20%
March	**2017**	119,546	2,551,100	19.6	96.1	21.3	**2017**	3.90%
March	**2018**	114,335	2,521,416	18.8	95.6	22.1	**2018**	4.40%
March	**2019**	109,579	2,486,935	18.0	95.8	22.7	**2019**	4.20%
March	**2020**	104,407	2,432,392	17.1	95.3	23.3	**2020**	4.70%
Annual openings Year ended: March								
	1997						**1997**	
March	**1997**	639,114	4,653,407	100.0	_	7.3	**1997**	
March	**1998**	501,944	4,698,852	78.5	78.5	9.4	**1998**	21.50%
March	**1999**	436,505	4,610,718	68.3	87.0	10.6	**1999**	13.00%
March	**2000**	384,435	4,559,669	60.2	88.1	11.9	**2000**	11.90%
March	**2001**	338,998	4,333,345	53.0	88.2	12.8	**2001**	11.80%
March	**2002**	304,458	3,959,256	47.6	89.8	13.0	**2002**	10.20%
March	**2003**	279,205	3,709,345	43.7	91.7	13.3	**2003**	8.30%
March	**2004**	258,919	3,604,854	40.5	92.7	13.9	**2004**	7.30%
March	**2005**	240,821	3,536,477	37.7	93.0	14.7	**2005**	7.00%
March	**2006**	227,776	3,499,870	35.6	94.6	15.4	**2006**	5.40%
March	**2007**	213,968	3,426,520	33.5	93.9	16.0	**2007**	6.10%
March	**2008**	201,591	3,311,770	31.5	94.2	16.4	**2008**	5.80%
March	**2009**	187,304	3,004,789	29.3	92.9	16.0	**2009**	7.10%
March	**2010**	176,231	2,850,131	27.6	94.1	16.2	**2010**	5.90%
March	**2011**	167,587	2,827,369	26.2	95.1	16.9	**2011**	4.90%
March	**2012**	160,498	2,819,352	25.1	95.8	17.6	**2012**	4.20%
March	**2013**	154,081	2,806,671	24.1	96.0	18.2	**2013**	4.00%
March	**2014**	148,017	2,788,382	23.2	96.1	18.8	**2014**	3.90%
March	**2015**	141,865	2,761,084	22.2	95.8	19.5	**2015**	4.20%
March	**2016**	136,289	2,733,154	21.3	96.1	20.1	**2016**	3.90%
March	**2017**	130,158	2,689,393	20.4	95.5	20.7	**2017**	4.50%
March	**2018**	124,308	2,644,595	19.5	95.5	21.3	**2018**	4.50%
March	**2019**	119,317	2,593,849	18.7	96.0	21.7	**2019**	4.00%
March	**2020**	113,501	2,529,758	17.8	95.1	22.3	**2020**	4.90%
Annual openings Year ended: March								
	1998						**1998**	

March	**1998**	643,070	4,728,570	100.0	_	7.4	**1998**	
March	**1999**	515,330	4,722,697	80.1	80.1	9.2	**1999**	19.90%
March	**2000**	440,788	4,718,220	68.5	85.5	10.7	**2000**	14.50%
March	**2001**	383,515	4,513,905	59.6	87.0	11.8	**2001**	13.00%
March	**2002**	340,826	4,142,552	53.0	88.9	12.2	**2002**	11.10%
March	**2003**	309,183	3,904,056	48.1	90.7	12.6	**2003**	9.30%
March	**2004**	285,445	3,796,984	44.4	92.3	13.3	**2004**	7.70%
March	**2005**	264,980	3,737,229	41.2	92.8	14.1	**2005**	7.20%
March	**2006**	248,721	3,707,664	38.7	93.9	14.9	**2006**	6.10%
March	**2007**	233,012	3,640,698	36.2	93.7	15.6	**2007**	6.30%
March	**2008**	218,611	3,511,430	34.0	93.8	16.1	**2008**	6.20%
March	**2009**	202,644	3,231,210	31.5	92.7	15.9	**2009**	7.30%
March	**2010**	189,933	3,073,305	29.5	93.7	16.2	**2010**	6.30%
March	**2011**	180,855	3,053,866	28.1	95.2	16.9	**2011**	4.80%
March	**2012**	172,719	3,046,553	26.9	95.5	17.6	**2012**	4.50%
March	**2013**	165,417	3,037,780	25.7	95.8	18.4	**2013**	4.20%
March	**2014**	158,591	3,001,512	24.7	95.9	18.9	**2014**	4.10%
March	**2015**	151,953	2,991,023	23.6	95.8	19.7	**2015**	4.20%
March	**2016**	145,945	2,966,332	22.7	96.0	20.3	**2016**	4.00%
March	**2017**	140,253	2,932,637	21.8	96.1	20.9	**2017**	3.90%
March	**2018**	133,741	2,882,416	20.8	95.4	21.6	**2018**	4.60%
March	**2019**	128,151	2,836,963	19.9	95.8	22.1	**2019**	4.20%
March	**2020**	122,249	2,747,940	19.0	95.4	22.5	**2020**	4.60%
								10000.00%
Annual openings Year ended: March								
	1999						**1999**	
March	**1999**	650,730	4,736,499	100.0	_	7.3	**1999**	
March	**2000**	514,914	4,764,054	79.1	79.1	9.3	**2000**	20.90%
March	**2001**	436,181	4,578,837	67.0	84.7	10.5	**2001**	15.30%
March	**2002**	380,967	4,217,372	58.5	87.3	11.1	**2002**	12.70%
March	**2003**	342,763	3,982,345	52.7	90.0	11.6	**2003**	10.00%
March	**2004**	313,589	3,866,204	48.2	91.5	12.3	**2004**	8.50%
March	**2005**	288,762	3,778,972	44.4	92.1	13.1	**2005**	7.90%
March	**2006**	269,710	3,751,614	41.4	93.4	13.9	**2006**	6.60%
March	**2007**	251,399	3,670,789	38.6	93.2	14.6	**2007**	6.80%
March	**2008**	234,614	3,548,588	36.1	93.3	15.1	**2008**	6.70%
March	**2009**	216,177	3,254,444	33.2	92.1	15.1	**2009**	7.90%
March	**2010**	201,749	3,084,030	31.0	93.3	15.3	**2010**	6.70%
March	**2011**	191,474	3,062,699	29.4	94.9	16.0	**2011**	**5.10%**
March	**2012**	183,486	3,060,314	28.2	95.8	16.7	**2012**	**4.20%**
March	**2013**	175,427	3,033,792	27.0	95.6	17.3	**2013**	**4.40%**
March	**2014**	168,151	3,014,462	25.8	95.9	17.9	**2014**	**4.10%**
March	**2015**	160,952	2,995,664	24.7	95.7	18.6	**2015**	**4.30%**
March	**2016**	153,968	2,971,017	23.7	95.7	19.3	**2016**	**4.30%**
March	**2017**	147,397	2,942,087	22.7	95.7	20.0	**2017**	**4.30%**
March	**2018**	140,327	2,892,269	21.6	95.2	20.6	**2018**	**4.80%**
March	**2019**	134,279	2,835,599	20.6	95.7	21.1	**2019**	**4.30%**
March	**2020**	127,646	2,757,443	19.6	95.1	21.6	**2020**	**4.90%**
Annual openings Year ended: March								
	2000						**2000**	
March	**2000**	674,644	4,678,689	100.0	_	6.9	**2000**	
March	**2001**	528,894	4,656,268	78.4	78.4	8.8	**2001**	21.60%
March	**2002**	445,193	4,253,751	66.0	84.2	9.6	**2002**	15.80%
March	**2003**	392,621	4,065,722	58.2	88.2	10.4	**2003**	11.80%
March	**2004**	356,118	3,953,830	52.8	90.7	11.1	**2004**	9.30%
March	**2005**	325,423	3,871,332	48.2	91.4	11.9	**2005**	8.60%
March	**2006**	301,684	3,861,952	44.7	92.7	12.8	**2006**	7.30%
March	**2007**	280,436	3,791,627	41.6	93.0	13.5	**2007**	7.00%
March	**2008**	260,349	3,655,074	38.6	92.8	14.0	**2008**	7.20%

March	**2009**	239,407	3,349,380	35.5	92.0	14.0	**2009**	8.00%
March	**2010**	221,708	3,194,876	32.9	92.6	14.4	**2010**	7.40%
March	**2011**	210,503	3,169,050	31.2	94.9	15.1	**2011**	5.10%
March	**2012**	200,746	3,153,890	29.8	95.4	15.7	**2012**	4.60%
March	**2013**	192,750	3,134,327	28.6	96.0	16.3	**2013**	4.00%
March	**2014**	184,355	3,124,582	27.3	95.6	16.9	**2014**	4.40%
March	**2015**	177,268	3,121,362	26.3	96.2	17.6	**2015**	3.80%
March	**2016**	169,451	3,092,747	25.1	95.6	18.3	**2016**	4.40%
March	**2017**	162,353	3,068,464	24.1	95.8	18.9	**2017**	4.20%
March	**2018**	154,461	3,027,407	22.9	95.1	19.6	**2018**	4.90%
March	**2019**	147,461	2,968,230	21.9	95.5	20.1	**2019**	4.50%
March	**2020**	140,302	2,896,963	20.8	95.1	20.6	**2020**	4.90%

Annual openings Year ended: March

	2001						**2001**	
March	**2001**	671,383	4,313,710	100.0	_	6.4	**2001**	
March	**2002**	508,376	4,001,028	75.7	75.7	7.9	**2002**	24.30%
March	**2003**	434,349	3,817,146	64.7	85.4	8.8	**2003**	14.60%
March	**2004**	386,793	3,751,867	57.6	89.1	9.7	**2004**	10.90%
March	**2005**	351,455	3,699,116	52.3	90.9	10.5	**2005**	9.10%
March	**2006**	322,909	3,664,248	48.1	91.9	11.3	**2006**	8.10%
March	**2007**	297,034	3,568,005	44.2	92.0	12.0	**2007**	8.00%
March	**2008**	274,484	3,420,089	40.9	92.4	12.5	**2008**	7.60%
March	**2009**	250,787	3,109,889	37.4	91.4	12.4	**2009**	8.60%
March	**2010**	231,551	2,950,829	34.5	92.3	12.7	**2010**	7.70%
March	**2011**	217,340	2,920,669	32.4	93.9	13.4	**2011**	6.10%
March	**2012**	207,292	2,901,611	30.9	95.4	14.0	**2012**	4.60%
March	**2013**	198,021	2,865,182	29.5	95.5	14.5	**2013**	4.50%
March	**2014**	188,498	2,840,720	28.1	95.2	15.1	**2014**	4.80%
March	**2015**	180,045	2,820,839	26.8	95.5	15.7	**2015**	4.50%
March	**2016**	171,356	2,794,360	25.5	95.2	16.3	**2016**	4.80%
March	**2017**	163,593	2,748,711	24.4	95.5	16.8	**2017**	4.50%
March	**2018**	155,100	2,696,859	23.1	94.8	17.4	**2018**	5.20%
March	**2019**	148,097	2,649,441	22.1	95.5	17.9	**2019**	4.50%
March	**2020**	139,974	2,567,788	20.8	94.5	18.3	**2020**	5.50%

Annual openings Year ended: March

	2002						**2002**	
March	**2002**	659,236	4,200,561	100.0	_	6.4	**2002**	
March	**2003**	516,525	3,978,225	78.4	78.4	7.7	**2003**	21.60%
March	**2004**	444,555	3,870,838	67.4	86.1	8.7	**2004**	13.90%
March	**2005**	395,685	3,831,940	60.0	89.0	9.7	**2005**	11.00%
March	**2006**	360,997	3,824,120	54.8	91.2	10.6	**2006**	8.80%
March	**2007**	330,348	3,725,942	50.1	91.5	11.3	**2007**	8.50%
March	**2008**	302,780	3,558,910	45.9	91.7	11.8	**2008**	8.30%
March	**2009**	275,267	3,261,835	41.8	90.9	11.8	**2009**	9.10%
March	**2010**	253,255	3,070,962	38.4	92.0	12.1	**2010**	8.00%
March	**2011**	237,710	3,041,589	36.1	93.9	12.8	**2011**	6.10%
March	**2012**	225,244	3,017,064	34.2	94.8	13.4	**2012**	5.20%
March	**2013**	214,273	2,982,077	32.5	95.1	13.9	**2013**	4.90%
March	**2014**	203,175	2,944,528	30.8	94.8	14.5	**2014**	5.20%
March	**2015**	193,637	2,929,857	29.4	95.3	15.1	**2015**	4.70%
March	**2016**	185,336	2,887,595	28.1	95.7	15.6	**2016**	4.30%
March	**2017**	176,097	2,832,518	26.7	95.0	16.1	**2017**	5.00%
March	**2018**	167,159	2,792,492	25.4	94.9	16.7	**2018**	5.10%
March	**2019**	160,204	2,743,154	24.3	95.8	17.1	**2019**	4.20%
March	**2020**	151,035	2,649,698	22.9	94.3	17.5	**2020**	5.70%

Annual openings Year ended: March

	2003						**2003**	

	March	**2003**	662,543	3,891,084	100.0	_	5.9	**2003**
	March	**2004**	525,244	3,804,733	79.3	79.3	7.2	**2004** 20.70%
	March	**2005**	453,130	3,752,400	68.4	86.3	8.3	**2005** 13.70%
	March	**2006**	406,991	3,718,365	61.4	89.8	9.1	**2006** 10.20%
	March	**2007**	366,143	3,644,988	55.3	90.0	10.0	**2007** 10.00%
	March	**2008**	330,963	3,491,112	50.0	90.4	10.5	**2008** 9.60%
	March	**2009**	296,904	3,174,969	44.8	89.7	10.7	**2009** 10.30%
	March	**2010**	271,042	2,997,006	40.9	91.3	11.1	**2010** 8.70%
	March	**2011**	252,322	2,964,296	38.1	93.1	11.7	**2011** 6.90%
	March	**2012**	238,688	2,949,752	36.0	94.6	12.4	**2012** 5.40%
	March	**2013**	226,559	2,920,974	34.2	94.9	12.9	**2013** 5.10%
	March	**2014**	214,060	2,899,140	32.3	94.5	13.5	**2014** 5.50%
	March	**2015**	203,464	2,878,763	30.7	95.0	14.1	**2015** 5.00%
	March	**2016**	192,827	2,854,938	29.1	94.8	14.8	**2016** 5.20%
	March	**2017**	183,224	2,816,408	27.7	95.0	15.4	**2017** 5.00%
	March	**2018**	173,983	2,773,581	26.3	95.0	15.9	**2018** 5.00%
	March	**2019**	165,872	2,728,907	25.0	95.3	16.5	**2019** 4.70%
	March	**2020**	156,307	2,657,641	23.6	94.2	17.0	**2020** 5.80%
Annual openings Year ended: March		**2004**						**2004**
	March	**2004**	653,887	3,639,709	100.0	_	5.6	**2004**
	March	**2005**	516,225	3,598,159	78.9	78.9	7.0	**2005** 21.10%
	March	**2006**	451,591	3,594,256	69.1	87.5	8.0	**2006** 12.50%
	March	**2007**	400,022	3,500,519	61.2	88.6	8.8	**2007** 11.40%
	March	**2008**	356,540	3,337,328	54.5	89.1	9.4	**2008** 10.90%
	March	**2009**	316,548	3,029,119	48.4	88.8	9.6	**2009** 11.20%
	March	**2010**	286,061	2,857,481	43.7	90.4	10.0	**2010** 9.60%
	March	**2011**	265,011	2,830,596	40.5	92.6	10.7	**2011** 7.40%
	March	**2012**	249,901	2,814,907	38.2	94.3	11.3	**2012** 5.70%
	March	**2013**	236,285	2,798,135	36.1	94.6	11.8	**2013** 5.40%
	March	**2014**	222,163	2,782,037	34.0	94.0	12.5	**2014** 6.00%
	March	**2015**	209,874	2,760,782	32.1	94.5	13.2	**2015** 5.50%
	March	**2016**	199,005	2,723,985	30.4	94.8	13.7	**2016** 5.20%
	March	**2017**	188,518	2,691,362	28.8	94.7	14.3	**2017** 5.30%
	March	**2018**	178,709	2,661,978	27.3	94.8	14.9	**2018** 5.20%
	March	**2019**	169,223	2,624,669	25.9	94.7	15.5	**2019** 5.30%
	March	**2020**	158,897	2,549,224	24.3	93.9	16.0	**2020** 6.10%
Annual openings Year ended: March		**2005**						**2005**
	March	**2005**	679,925	3,623,137	100.0	_	5.3	**2005**
	March	**2006**	544,317	3,658,558	80.1	80.1	6.7	**2006** 19.90%
	March	**2007**	467,307	3,575,214	68.7	85.9	7.7	**2007** 14.10%
	March	**2008**	409,023	3,414,579	60.2	87.5	8.3	**2008** 12.50%
	March	**2009**	357,373	3,068,818	52.6	87.4	8.6	**2009** 12.60%
	March	**2010**	318,534	2,898,237	46.8	89.1	9.1	**2010** 10.90%
	March	**2011**	293,767	2,877,515	43.2	92.2	9.8	**2011** 7.80%
	March	**2012**	275,621	2,872,790	40.5	93.8	10.4	**2012** 6.20%
	March	**2013**	259,986	2,847,458	38.2	94.3	11.0	**2013** 5.70%
	March	**2014**	243,856	2,833,151	35.9	93.8	11.6	**2014** 6.20%
	March	**2015**	229,707	2,817,773	33.8	94.2	12.3	**2015** 5.80%
	March	**2016**	216,894	2,799,606	31.9	94.4	12.9	**2016** 5.60%
	March	**2017**	205,301	2,762,321	30.2	94.7	13.5	**2017** 5.30%
	March	**2018**	194,313	2,749,606	28.6	94.6	14.2	**2018** 5.40%
	March	**2019**	183,944	2,701,963	27.1	94.7	14.7	**2019** 5.30%
	March	**2020**	172,383	2,623,794	25.4	93.7	15.2	**2020** 6.30%
Annual openings Year ended: March		**2006**						**2006**

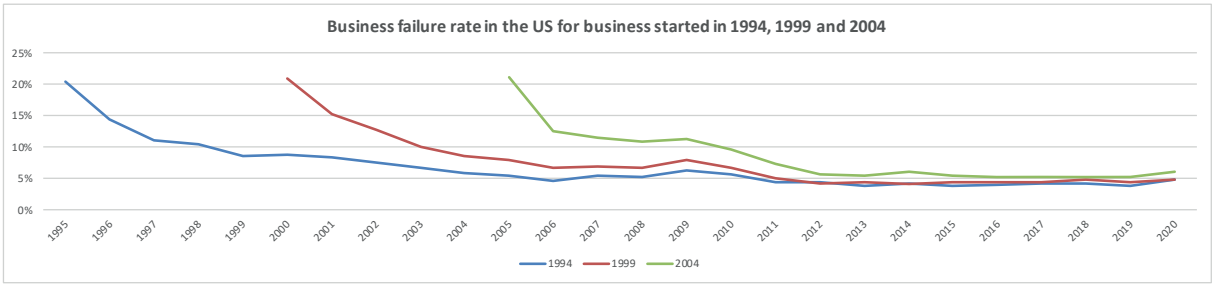
	March	**2006**	715,734	3,606,833	100.0	–	5.0	**2006**							
	March	**2007**	560,199	3,552,590	78.3	78.3	6.3	**2007**	21.70%						
	March	**2008**	474,184	3,375,430	66.3	84.6	7.1	**2008**	15.40%						
	March	**2009**	405,474	3,026,473	56.7	85.5	7.5	**2009**	14.50%						
	March	**2010**	356,437	2,840,541	49.8	87.9	8.0	**2010**	12.10%						
	March	**2011**	325,123	2,818,930	45.4	91.2	8.7	**2011**	8.80%						
	March	**2012**	302,968	2,818,584	42.3	93.2	9.3	**2012**	6.80%						
	March	**2013**	283,623	2,789,385	39.6	93.6	9.8	**2013**	6.40%						
	March	**2014**	265,596	2,779,157	37.1	93.6	10.5	**2014**	6.40%						
	March	**2015**	249,101	2,767,302	34.8	93.8	11.1	**2015**	6.20%						
	March	**2016**	234,472	2,747,561	32.8	94.1	11.7	**2016**	5.90%						
	March	**2017**	221,911	2,712,219	31.0	94.6	12.2	**2017**	5.40%						
	March	**2018**	209,397	2,687,395	29.3	94.4	12.8	**2018**	5.60%						
	March	**2019**	197,927	2,642,950	27.7	94.5	13.4	**2019**	5.50%						
	March	**2020**	185,109	2,583,044	25.9	93.5	14.0	**2020**	6.50%						
Annual openings Year ended: March		**2007**						**2007**							
	March	**2007**	703,834	3,507,309	100.0	–	5.0	**2007**							
	March	**2008**	544,014	3,382,980	77.3	77.3	6.2	**2008**	22.70%						
	March	**2009**	450,670	3,047,819	64.0	82.8	6.8	**2009**	17.20%						
	March	**2010**	390,550	2,873,967	55.5	86.7	7.4	**2010**	13.30%						
	March	**2011**	353,443	2,844,598	50.2	90.5	8.0	**2011**	9.50%						
	March	**2012**	326,364	2,832,460	46.4	92.3	8.7	**2012**	7.70%						
	March	**2013**	303,237	2,803,835	43.1	92.9	9.2	**2013**	7.10%						
	March	**2014**	282,373	2,797,607	40.1	93.1	9.9	**2014**	6.90%						
	March	**2015**	263,441	2,785,122	37.4	93.3	10.6	**2015**	6.70%						
	March	**2016**	247,023	2,762,326	35.1	93.8	11.2	**2016**	6.20%						
	March	**2017**	232,179	2,724,027	33.0	94.0	11.7	**2017**	6.00%						
	March	**2018**	218,228	2,693,302	31.0	94.0	12.3	**2018**	6.00%						
	March	**2019**	205,890	2,652,393	29.3	94.3	12.9	**2019**	5.70%						
	March	**2020**	191,824	2,580,888	27.3	93.2	13.5	**2020**	6.80%						
Annual openings Year ended: March		**2008**						**2008**							
	March	**2008**	678,095	3,333,421	100.0	–	4.9	**2008**							
	March	**2009**	510,240	2,991,800	75.2	75.2	5.9	**2009**	24.80%						
	March	**2010**	428,956	2,802,374	63.3	84.1	6.5	**2010**	15.90%						
	March	**2011**	382,843	2,782,400	56.5	89.2	7.3	**2011**	10.80%	**4.73%**					
	March	**2012**	350,653	2,801,721	51.7	91.6	8.0	**2012**	8.40%	**4.23%**					
	March	**2013**	324,092	2,782,441	47.8	92.4	8.6	**2013**	7.60%	**4.09%**					
	March	**2014**	299,467	2,759,736	44.2	92.4	9.2	**2014**	7.60%	**4.21%**					
	March	**2015**	277,982	2,745,721	41.0	92.8	9.9	**2015**	7.20%	**4.26%**					
	March	**2016**	259,619	2,726,494	38.3	93.4	10.5	**2016**	6.60%	**4.36%**					
	March	**2017**	243,531	2,688,888	35.9	93.8	11.0	**2017**	6.20%	**4.47%**					
	March	**2018**	227,991	2,659,209	33.6	93.6	11.7	**2018**	6.40%	**4.83%**					
	March	**2019**	214,969	2,614,028	31.7	94.3	12.2	**2019**	5.70%	**4.55%**					
	March	**2020**	199,857	2,526,280	29.5	93.0	12.6	**2020**	7.00%	**5.47%**					
Annual openings Year ended: March		**2009**						**2009**							
	March	**2009**	608,769	2,802,403	100.0	–	4.6	**2009**							
	March	**2010**	466,678	2,596,990	76.7	76.7	5.6	**2010**	23.30%						
	March	**2011**	404,363	2,592,091	66.4	86.6	6.4	**2011**	13.40%						
	March	**2012**	364,658	2,597,683	59.9	90.2	7.1	**2012**	9.80%						
	March	**2013**	333,536	2,569,653	54.8	91.5	7.7	**2013**	8.50%						
	March	**2014**	305,186	2,551,315	50.1	91.5	8.4	**2014**	8.50%						
	March	**2015**	280,858	2,538,948	46.1	92.0	9.0	**2015**	8.00%						
	March	**2016**	260,219	2,509,636	42.7	92.7	9.6	**2016**	7.30%						
	March	**2017**	241,940	2,484,040	39.7	93.0	10.3	**2017**	7.00%						

Graph in the Graphs Tab

Year	**Failure: risk / rate of loss**			
2011	4.73%	**4.73%**		
2012	4.23%	**4.23%**		
2013	4.09%	**4.09%**		
2014	4.21%	**4.21%**		
2015	4.26%	**4.26%**		
2016	4.36%	**4.36%**		
2017	4.47%	**4.47%**		
2018	4.83%	**4.83%**		
2019	4.55%	**4.55%**	4.41%	
2020	5.47%	**5.47%**	4.41%	

	March	**2018**	226,584	2,457,720	37.2	93.7	10.8	**2018** 6.30%
	March	**2019**	212,646	2,403,159	34.9	93.8	11.3	**2019** 6.20%
	March	**2020**	195,927	2,336,566	32.2	92.1	11.9	**2020** 7.90%
Annual openings Year ended: March		**2010**						**2010**
	March	**2010**	560,588	2,515,246	100.0	_	4.5	**2010**
	March	**2011**	440,431	2,483,787	78.6	78.6	5.6	**2011** 21.40%
	March	**2012**	384,642	2,491,052	68.6	87.3	6.5	**2012** 12.70%
	March	**2013**	345,504	2,474,299	61.6	89.8	7.2	**2013** 10.20%
	March	**2014**	313,915	2,461,884	56.0	90.9	7.8	**2014** 9.10%
	March	**2015**	286,201	2,438,705	51.1	91.2	8.5	**2015** 8.80%
	March	**2016**	263,309	2,415,456	47.0	92.0	9.2	**2016** 8.00%
	March	**2017**	240,948	2,385,147	43.0	91.5	9.9	**2017** 8.50%
	March	**2018**	226,812	2,352,910	40.5	94.1	10.4	**2018** 5.90%
	March	**2019**	212,624	2,314,880	37.9	93.7	10.9	**2019** 6.30%
	March	**2020**	192,239	2,235,414	34.3	90.4	11.6	**2020** 9.60%
Annual openings Year ended: March		**2011**						**2011**
	March	**2011**	582,569	2,570,850	100.0	_	4.4	**2011**
	March	**2012**	462,749	2,583,981	79.4	79.4	5.6	**2012**
	March	**2013**	403,725	2,568,705	69.3	87.2	6.4	**2013**
	March	**2014**	360,707	2,564,035	61.9	89.3	7.1	**2014**
	March	**2015**	326,173	2,557,506	56.0	90.4	7.8	**2015**
	March	**2016**	296,601	2,528,685	50.9	90.9	8.5	**2016**
	March	**2017**	271,166	2,503,450	46.5	91.4	9.2	**2017**
	March	**2018**	252,242	2,465,810	43.3	93.0	9.8	**2018**
	March	**2019**	235,407	2,428,603	40.4	93.3	10.3	**2019**
	March	**2020**	214,164	2,353,942	36.8	91.0	11.0	**2020**
Annual openings Year ended: March		**2012**						**2012**
	March	**2012**	631,817	2,793,113	100.0	_	4.4	**2012**
	March	**2013**	500,642	2,770,201	79.2	79.2	5.5	**2013**
	March	**2014**	433,844	2,776,679	68.7	86.7	6.4	**2014**
	March	**2015**	386,701	2,779,989	61.2	89.1	7.2	**2015**
	March	**2016**	349,688	2,764,396	55.3	90.4	7.9	**2016**
	March	**2017**	316,769	2,731,024	50.1	90.6	8.6	**2017**
	March	**2018**	292,852	2,695,619	46.4	92.4	9.2	**2018**
	March	**2019**	271,212	2,643,652	42.9	92.6	9.7	**2019**
	March	**2020**	246,618	2,566,695	39.0	90.9	10.4	**2020**
Annual openings Year ended: March		**2013**						**2013**
	March	**2013**	629,078	2,804,566	100.0	_	4.5	**2013**
	March	**2014**	500,620	2,833,786	79.6	79.6	5.7	**2014**
	March	**2015**	433,681	2,870,898	68.9	86.6	6.6	**2015**
	March	**2016**	386,033	2,858,300	61.4	89.0	7.4	**2016**
	March	**2017**	347,789	2,821,281	55.3	90.1	8.1	**2017**
	March	**2018**	318,384	2,798,409	50.6	91.5	8.8	**2018**
	March	**2019**	293,419	2,758,036	46.6	92.2	9.4	**2019**
	March	**2020**	265,834	2,695,059	42.3	90.6	10.1	**2020**
Annual openings Year ended: March		**2014**						**2014**
	March	**2014**	652,780	2,885,614	100.0	_	4.4	**2014**
	March	**2015**	520,294	2,919,878	79.7	79.7	5.6	**2015**
	March	**2016**	451,988	2,942,696	69.2	86.9	6.5	**2016**
	March	**2017**	403,418	2,918,394	61.8	89.3	7.2	**2017**

March	**2018**	364,335	2,895,590	55.8	90.3	7.9	**2018**
March	**2019**	331,393	2,866,621	50.8	91.0	8.7	**2019**
March	**2020**	302,651	2,787,134	46.4	91.3	9.2	**2020**
Annual openings Year ended: March	**2015**						**2015**
March	**2015**	678,135	3,018,287	100.0	_	4.5	**2015**
March	**2016**	539,885	3,080,396	79.6	79.6	5.7	**2016**
March	**2017**	468,409	3,087,836	69.1	86.8	6.6	**2017**
March	**2018**	416,505	3,079,853	61.4	88.9	7.4	**2018**
March	**2019**	375,875	3,045,501	55.4	90.2	8.1	**2019**
March	**2020**	339,136	2,992,643	50.0	90.2	8.8	**2020**
Annual openings Year ended: March	**2016**						**2016**
March	**2016**	733,085	3,135,574	100.0	_	4.3	**2016**
March	**2017**	583,804	3,180,955	79.6	79.6	5.4	**2017**
March	**2018**	504,459	3,183,508	68.8	86.4	6.3	**2018**
March	**2019**	448,782	3,157,327	61.2	89.0	7.0	**2019**
March	**2020**	398,366	3,081,653	54.3	88.8	7.7	**2020**
Annual openings Year ended: March	**2017**						**2017**
March	**2017**	733,490	3,117,255	100.0	_	4.2	**2017**
March	**2018**	580,180	3,155,073	79.1	79.1	5.4	**2018**
March	**2019**	502,898	3,150,418	68.6	86.7	6.3	**2019**
March	**2020**	442,252	3,096,339	60.3	87.9	7.0	**2020**
Annual openings Year ended: March	**2018**						**2018**
March	**2018**	733,825	3,092,530	100.0	_	4.2	**2018**
March	**2019**	582,882	3,148,631	79.4	79.4	5.4	**2019**
March	**2020**	500,325	3,107,968	68.2	85.8	6.2	**2020**
Annual openings Year ended: March	**2019**						**2019**
March	**2019**	770,609	3,120,486	100.0	_	4.0	**2019**
March	**2020**	601,739	3,103,992	78.1	78.1	5.2	**2020**
Annual openings Year ended: March	**2020**						**2020**
March	**2020**	804,398	3,114,111	100.0	_	3.9	**2020**


Business failure rate in the US for business started in 1994, 1999 and 2004
25%
20%
15%
10%
5%
0%
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
1994
1999
2004


Failure: risk / rate of loss between 2011 and 2020
6.00%
5.00%
4.00%
3.00%
2.00%
1.00%
0.00%
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
Failure: risk / rate of loss

APPENDIX 2

Country Default Spreads and Risk Premiums

Last updated: January 5, 2022

This table summarizes the latest bond ratings and appropriate default spreads for different countries. While you can use these numbers as rough estimates of country risk premiums, you may want to modify the premia to reflect the additonal risk of equity markets. To estimate the long term country equity risk premium, I start with a default spread, which I obtain in one of two ways:
(1) I use the local currency sovereign rating (from Moody's: www.moodys.com) and estimate the default spread for that rating (based upon traded country bonds) over a default free government bond rate. For countries without a Moody's rating but with an S&P rating, I use the Moody's equivalent of the S&P rating. To get the default spreads by sovereign rating, I use the CDS spreads and compute the average CDS spread by rating. Using that number as a basis, I extrapolate for those ratings for which I have no CDS spreads.
(2) I start with the CDS spread for the country, if one is available and subtract out the US CDS spread, since my mature market premium is derived from the US market. That difference becomes the country spread. For the few countries that have CDS spreads that are lower than the US, I will get a negative number.
You can add just this default spread to the mature market premium to arrive at the total equity risk premium. I add an additional step. In the short term especially, the equity country risk premium is likely to be greater than the country's default spread. You can estimate an adjusted country risk premium by multiplying the default spread by the relative equity market volatility for that market (Std dev in country equity market/Std dev in country bond). Sicnce government bonds are not available or traded in most countries, I approximate the relative equity market volatility by estimating the standard deviations in two indices, the S&P emerging market equity index (for equities) and the S&P emerging market government bond index (for government bonds), and using that ratio for all countries to estimate the additional country risk premium. Finally, I add that country risk premium to my estimate of a mature market equity risk premium, for which I use the implied equity ris premium of the S&P 500.

Country	Moody's rating	*Adj. Default Spread*	*Country Risk Premium*	*Equity Risk Premium*	*Country Risk Premium*
Abu Dhabi	Aa2	0.42%	0.49%	4.73%	0.49%
Albania	B1	3.83%	4.45%	8.69%	4.45%
Algeria	NR	5.53%	6.43%	10.67%	6.43%
Andorra (Principality of)	Baa2	1.62%	1.88%	6.12%	1.88%
Angola	B3	5.53%	6.43%	10.67%	6.43%
Anguilla	NR	5.88%	6.83%	11.07%	6.83%
Antigua & Barbuda	NR	5.88%	6.83%	11.07%	6.83%
Argentina	Ca	10.21%	11.87%	16.11%	11.87%
Armenia	Ba3	3.06%	3.56%	7.80%	3.56%
Aruba	Baa2	1.62%	1.88%	6.12%	1.88%
Australia	Aaa	0.00%	0.00%	4.24%	0.00%
Austria	Aa1	0.34%	0.39%	4.63%	0.39%
Azerbaijan	Ba2	2.56%	2.97%	7.21%	2.97%
Bahamas	Ba3	3.06%	3.56%	7.80%	3.56%
Bahrain	B2	4.68%	5.44%	9.68%	5.44%
Bangladesh	Ba3	3.06%	3.56%	7.80%	3.56%
Barbados	Caa1	6.38%	7.41%	11.65%	7.41%
Belarus	B3	5.53%	6.43%	10.67%	6.43%
Belgium	Aa3	0.51%	0.60%	4.84%	0.60%
Belize	Caa3	8.51%	9.89%	14.13%	9.89%
Benin	B1	3.83%	4.45%	8.69%	4.45%
Bermuda	A2	0.72%	0.84%	5.08%	0.84%
Bolivia	B2	4.68%	5.44%	9.68%	5.44%
Bosnia and Herzegovina	B3	5.53%	6.43%	10.67%	6.43%
Botswana	A3	1.02%	1.19%	5.43%	1.19%
Brazil	Ba2	2.56%	2.97%	7.21%	2.97%
British Virgin Islands	NR	5.88%	6.83%	11.07%	6.83%
Brunei	NR	0.72%	0.84%	5.08%	0.84%
Bulgaria	Baa1	1.36%	1.58%	5.82%	1.58%
Burkina Faso	B2	4.68%	5.44%	9.68%	5.44%
Cambodia	B2	4.68%	5.44%	9.68%	5.44%
Cameroon	B2	4.68%	5.44%	9.68%	5.44%
Canada	Aaa	0.00%	0.00%	4.24%	0.00%
Cape Verde	B3	5.53%	6.43%	10.67%	6.43%
Cayman Islands	Aa3	0.51%	0.60%	4.84%	0.60%
Channel Islands	NR	0.72%	0.83%	5.07%	0.83%
Chile	A1	0.60%	0.70%	4.94%	0.70%
China	A1	0.60%	0.70%	4.94%	0.70%
Colombia	Baa2	1.62%	1.88%	6.12%	1.88%
Congo (Democratic Republic	Caa1	6.38%	7.41%	11.65%	7.41%
Congo (Republic of)	Caa2	7.66%	8.90%	13.14%	8.90%
Cook Islands	B1	3.83%	4.45%	8.69%	4.45%
Costa Rica	B2	4.68%	5.44%	9.68%	5.44%
Croatia	Ba1	2.13%	2.47%	6.71%	2.47%
Cuba	Ca	10.21%	11.87%	16.11%	11.87%
Curacao	Baa2	1.62%	1.88%	6.12%	1.88%
Cyprus	Ba1	2.13%	2.47%	6.71%	2.47%
Czech Republic	Aa3	0.51%	0.60%	4.84%	0.60%
Denmark	Aaa	0.00%	0.00%	4.24%	0.00%
Dominican Republic	Ba3	3.06%	3.56%	7.80%	3.56%
Ecuador	Caa3	8.51%	9.89%	14.13%	9.89%
Egypt	B2	4.68%	5.44%	9.68%	5.44%
El Salvador	Caa1	6.38%	7.41%	11.65%	7.41%

Estonia	A1	0.60%	0.70%	4.94%	0.70%
Ethiopia	Caa2	7.66%	8.90%	13.14%	8.90%
Falkland Islands	NR	5.88%	6.83%	11.07%	6.83%
Fiji	B1	3.83%	4.45%	8.69%	4.45%
Finland	Aa1	0.34%	0.39%	4.63%	0.39%
France	Aa2	0.42%	0.49%	4.73%	0.49%
French Guiana	NR	3.26%	3.79%	8.03%	3.79%
Gabon	Caa1	6.38%	7.41%	11.65%	7.41%
Gambia	NR	4.68%	5.44%	9.68%	5.44%
Georgia	Ba2	2.56%	2.97%	7.21%	2.97%
Germany	Aaa	0.00%	0.00%	4.24%	0.00%
Ghana	B3	5.53%	6.43%	10.67%	6.43%
Gibraltar	NR	0.72%	0.83%	5.07%	0.83%
Greece	Ba3	3.06%	3.56%	7.80%	3.56%
Greenland	NR	0.72%	0.83%	5.07%	0.83%
Guatemala	Ba1	2.13%	2.47%	6.71%	2.47%
Guernsey	Aa3	0.51%	0.60%	4.84%	0.60%
Guinea	NR	7.66%	8.90%	13.14%	8.90%
Guinea-Bissau	NR	5.53%	6.43%	10.67%	6.43%
Guyana	NR	3.83%	4.45%	8.69%	4.45%
Haiti	NR	8.51%	9.89%	14.13%	9.89%
Honduras	B1	3.83%	4.45%	8.69%	4.45%
Hong Kong	Aa3	0.51%	0.60%	4.84%	0.60%
Hungary	Baa2	1.62%	1.88%	6.12%	1.88%
Iceland	A2	0.72%	0.84%	5.08%	0.84%
India	Baa3	1.87%	2.18%	6.42%	2.18%
Indonesia	Baa2	1.62%	1.88%	6.12%	1.88%
Iran	NR	5.53%	6.43%	10.67%	6.43%
Iraq	Caa1	6.38%	7.41%	11.65%	7.41%
Ireland	A2	0.72%	0.84%	5.08%	0.84%
Isle of Man	Aa3	0.51%	0.60%	4.84%	0.60%
Israel	A1	0.60%	0.70%	4.94%	0.70%
Italy	Baa3	1.87%	2.18%	6.42%	2.18%
Ivory Coast	Ba3	3.06%	3.56%	7.80%	3.56%
Jamaica	B2	4.68%	5.44%	9.68%	5.44%
Japan	A1	0.60%	0.70%	4.94%	0.70%
Jersey	Aaa	0.00%	0.00%	4.24%	0.00%
Jordan	B1	3.83%	4.45%	8.69%	4.45%
Kazakhstan	Baa2	1.62%	1.88%	6.12%	1.88%
Kenya	B2	4.68%	5.44%	9.68%	5.44%
Korea, D.P.R.	NR	10.21%	11.87%	16.11%	11.87%
Kuwait	A1	0.60%	0.70%	4.94%	0.70%
Kyrgyzstan	B2	4.68%	5.44%	9.68%	5.44%
Laos	Caa2	7.66%	8.90%	13.14%	8.90%
Latvia	A3	1.02%	1.19%	5.43%	1.19%
Lebanon	C	17.50%	20.34%	24.58%	20.34%
Liberia	NR	7.66%	8.90%	13.14%	8.90%
Libya	NR	3.83%	4.45%	8.69%	4.45%
Liechtenstein	Aaa	0.00%	0.00%	4.24%	0.00%
Lithuania	A2	0.72%	0.84%	5.08%	0.84%
Luxembourg	Aaa	0.00%	0.00%	4.24%	0.00%
Macao	Aa3	0.51%	0.60%	4.84%	0.60%
Macedonia	Ba3	3.06%	3.56%	7.80%	3.56%
Madagascar	NR	5.53%	6.43%	10.67%	6.43%
Malawi	NR	7.66%	8.90%	13.14%	8.90%
Malaysia	A3	1.02%	1.19%	5.43%	1.19%
Maldives	Caa1	6.38%	7.41%	11.65%	7.41%
Mali	Caa1	6.38%	7.41%	11.65%	7.41%
Malta	A2	0.72%	0.84%	5.08%	0.84%
Martinique	NR	3.26%	3.79%	8.03%	3.79%
Mauritius	Baa2	1.62%	1.88%	6.12%	1.88%
Mexico	Baa1	1.36%	1.58%	5.82%	1.58%
Moldova	B3	5.53%	6.43%	10.67%	6.43%
Mongolia	B3	5.53%	6.43%	10.67%	6.43%
Montenegro	B1	3.83%	4.45%	8.69%	4.45%
Montserrat	Baa3	1.87%	2.18%	6.42%	2.18%
Morocco	Ba1	2.13%	2.47%	6.71%	2.47%
Mozambique	Caa2	7.66%	8.90%	13.14%	8.90%
Myanmar	NR	10.21%	11.87%	16.11%	11.87%
Namibia	Ba3	3.06%	3.56%	7.80%	3.56%
Netherlands	Aaa	0.00%	0.00%	4.24%	0.00%
Netherlands Antilles	NR	5.88%	6.83%	11.07%	6.83%
New Zealand	Aaa	0.00%	0.00%	4.24%	0.00%

Nicaragua	B3	5.53%	6.43%	10.67%	6.43%
Niger	B3	5.53%	6.43%	10.67%	6.43%
Nigeria	B2	4.68%	5.44%	9.68%	5.44%
Norway	Aaa	0.00%	0.00%	4.24%	0.00%
Oman	Ba3	3.06%	3.56%	7.80%	3.56%
Pakistan	B3	5.53%	6.43%	10.67%	6.43%
Palestinian Authority	NR	1.38%	1.60%	5.84%	1.60%
Panama	Baa2	1.62%	1.88%	6.12%	1.88%
Papua New Guinea	B2	4.68%	5.44%	9.68%	5.44%
Paraguay	Ba1	2.13%	2.47%	6.71%	2.47%
Peru	Baa1	1.36%	1.58%	5.82%	1.58%
Philippines	Baa2	1.62%	1.88%	6.12%	1.88%
Poland	A2	0.72%	0.84%	5.08%	0.84%
Portugal	Baa2	1.62%	1.88%	6.12%	1.88%
Qatar	Aa3	0.51%	0.60%	4.84%	0.60%
Ras Al Khaimah (Emirate of)	A3	1.02%	1.19%	5.43%	1.19%
Reunion	NR	4.51%	5.25%	9.49%	5.25%
Romania	Baa3	1.87%	2.18%	6.42%	2.18%
Russia	Baa3	1.87%	2.18%	6.42%	2.18%
Rwanda	B2	4.68%	5.44%	9.68%	5.44%
Saint Lucia	NR	5.88%	6.83%	11.07%	6.83%
Saudi Arabia	A1	0.60%	0.70%	4.94%	0.70%
Senegal	Ba3	3.06%	3.56%	7.80%	3.56%
Serbia	Ba2	2.56%	2.97%	7.21%	2.97%
Sharjah	Baa3	1.87%	2.18%	6.42%	2.18%
Sierra Leone	NR	8.51%	9.89%	14.13%	9.89%
Singapore	Aaa	0.00%	0.00%	4.24%	0.00%
Slovakia	A2	0.72%	0.84%	5.08%	0.84%
Slovenia	A3	1.02%	1.19%	5.43%	1.19%
Solomon Islands	Caa1	6.38%	7.41%	11.65%	7.41%
Somalia	NR	10.21%	11.87%	16.11%	11.87%
South Africa	Ba2	2.56%	2.97%	7.21%	2.97%
South Korea	Aa2	0.42%	0.49%	4.73%	0.49%
Spain	Baa1	1.36%	1.58%	5.82%	1.58%
Sri Lanka	Caa2	7.66%	8.90%	13.14%	8.90%
St. Maarten	Ba2	2.56%	2.97%	7.21%	2.97%
St. Vincent & the Grenadines	B3	5.53%	6.43%	10.67%	6.43%
Sudan	NR	17.50%	20.34%	24.58%	20.34%
Suriname	Caa3	8.51%	9.89%	14.13%	9.89%
Swaziland	B3	5.53%	6.43%	10.67%	6.43%
Sweden	Aaa	0.00%	0.00%	4.24%	0.00%
Switzerland	Aaa	0.00%	0.00%	4.24%	0.00%
Syria	NR	17.50%	20.34%	24.58%	20.34%
Taiwan	Aa3	0.51%	0.60%	4.84%	0.60%
Tajikistan	B3	5.53%	6.43%	10.67%	6.43%
Tanzania	B2	4.68%	5.44%	9.68%	5.44%
Thailand	Baa1	1.36%	1.58%	5.82%	1.58%
Togo	B3	5.53%	6.43%	10.67%	6.43%
Trinidad and Tobago	Ba2	2.56%	2.97%	7.21%	2.97%
Tunisia	Caa1	6.38%	7.41%	11.65%	7.41%
Turkey	B2	4.68%	5.44%	9.68%	5.44%
Turks and Caicos Islands	Baa1	1.36%	1.58%	5.82%	1.58%
Uganda	B2	4.68%	5.44%	9.68%	5.44%
Ukraine	B3	5.53%	6.43%	10.67%	6.43%
United Arab Emirates	Aa2	0.42%	0.49%	4.73%	0.49%
United Kingdom	Aa3	0.51%	0.60%	4.84%	0.60%
United States	Aaa	0.00%	0.00%	4.24%	0.00%
Uruguay	Baa2	1.62%	1.88%	6.12%	1.88%
Uzbekistan	B1	3.83%	4.45%	8.69%	4.45%
Venezuela	C	17.50%	20.34%	24.58%	20.34%
Vietnam	Ba3	3.06%	3.56%	7.80%	3.56%
Yemen	NR	10.21%	11.87%	16.11%	11.87%
Zambia	Ca	10.21%	11.87%	16.11%	11.87%
Zimbabwe	NR	6.38%	7.41%	11.65%	7.41%

For more details, download the excel spreadsheet that contains this data on my website: https://www.stern.nyu.edu/~adamodar/pc/datasets/ctryprem.xlsx
If you are interested in my approach to computing the equity risk premium, download my magnum opus (just kidding):
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3825823

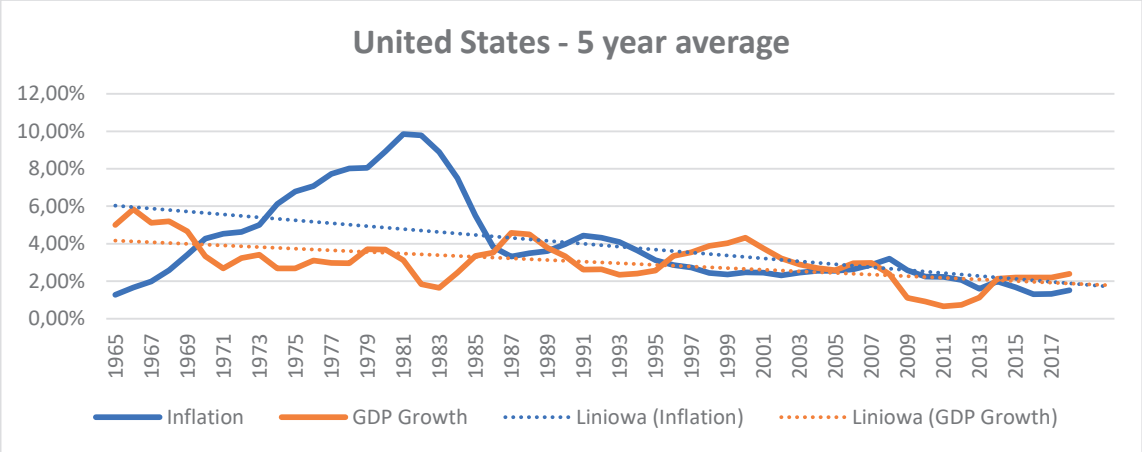
And my paper on measuring country risk
https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3879109

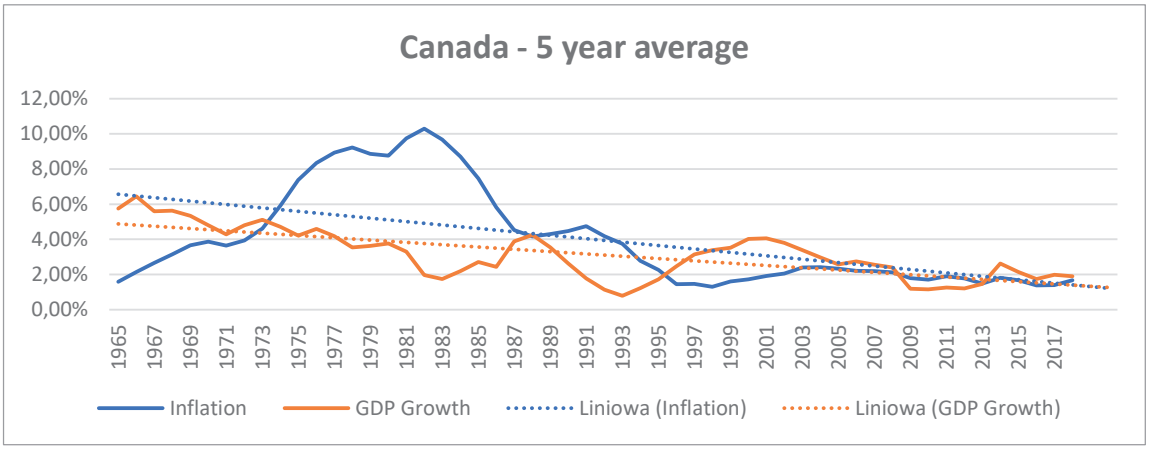
Last updated: January 2022

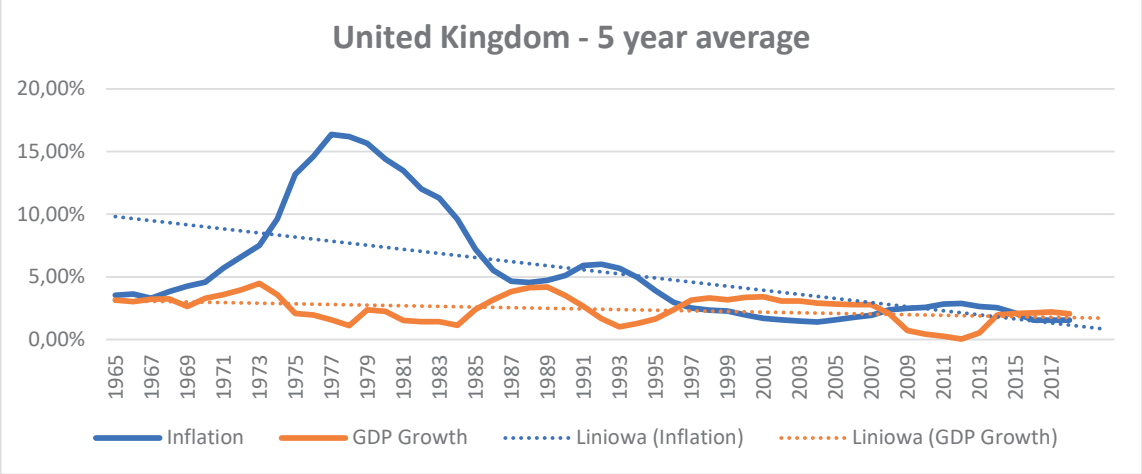
Aswath Damodaran

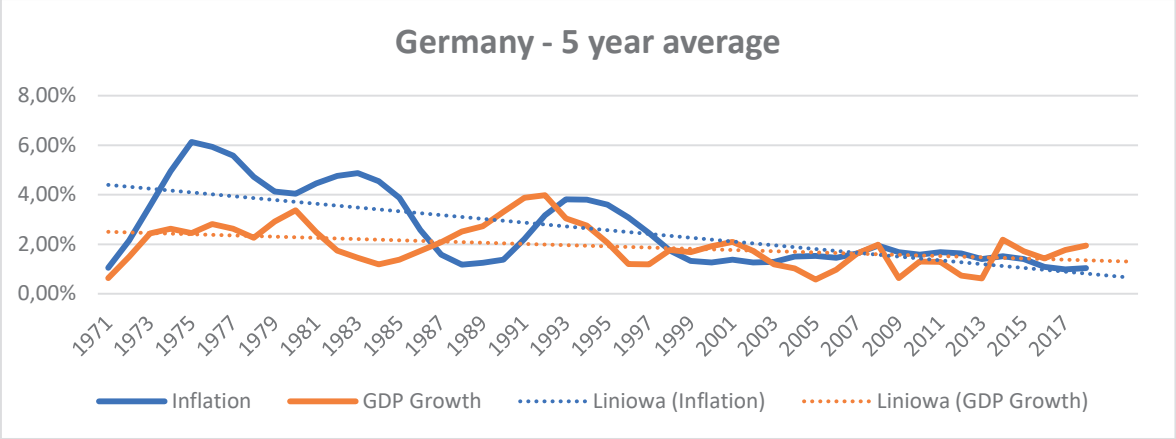
APPENDIX 3

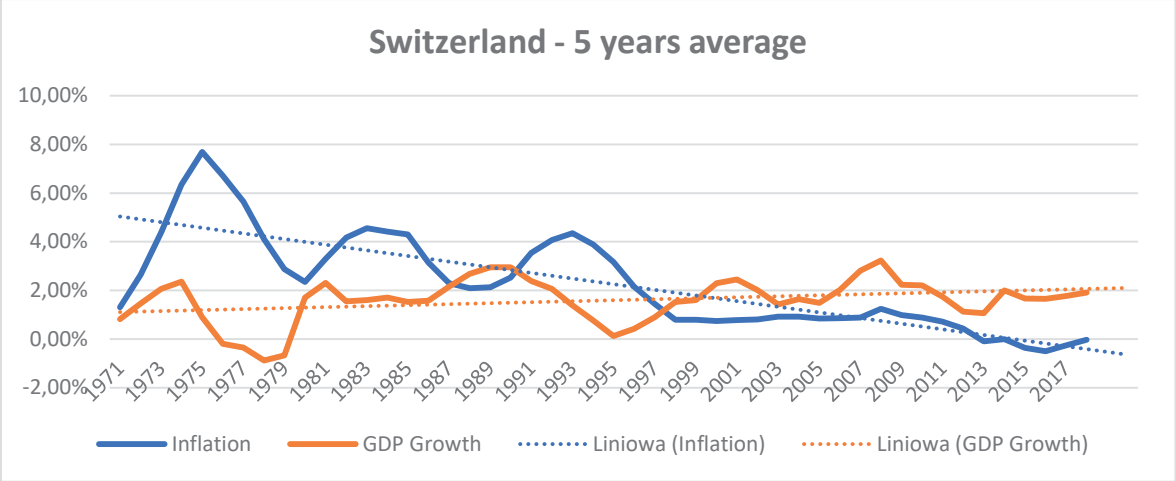
World Bank data: extracted from:
https://www.macrotrends.net/countries/NOR/norway/inflation-rate-cpi
5 year moving averages with linear trendlines. Here is the spreadsheet for the graphs below.

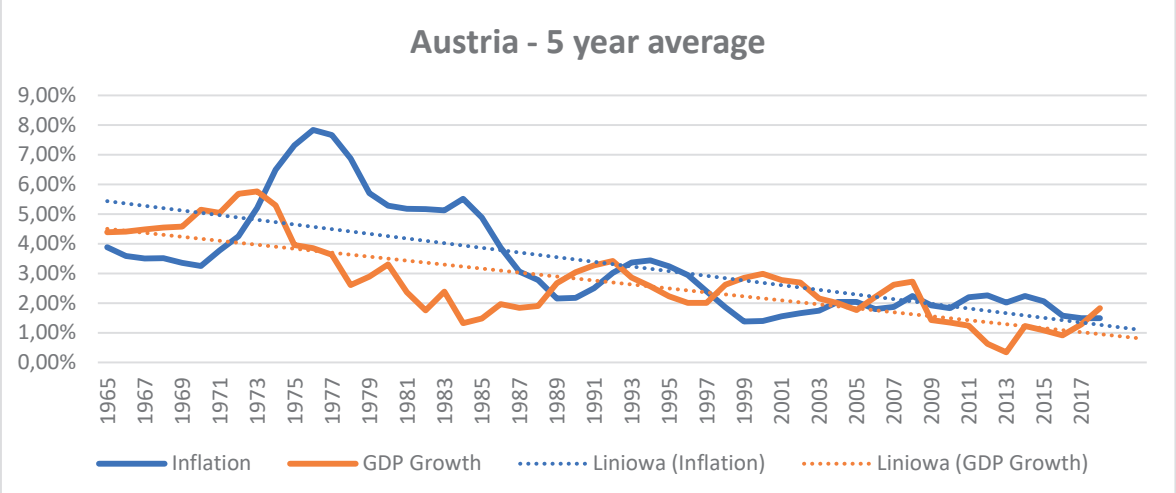


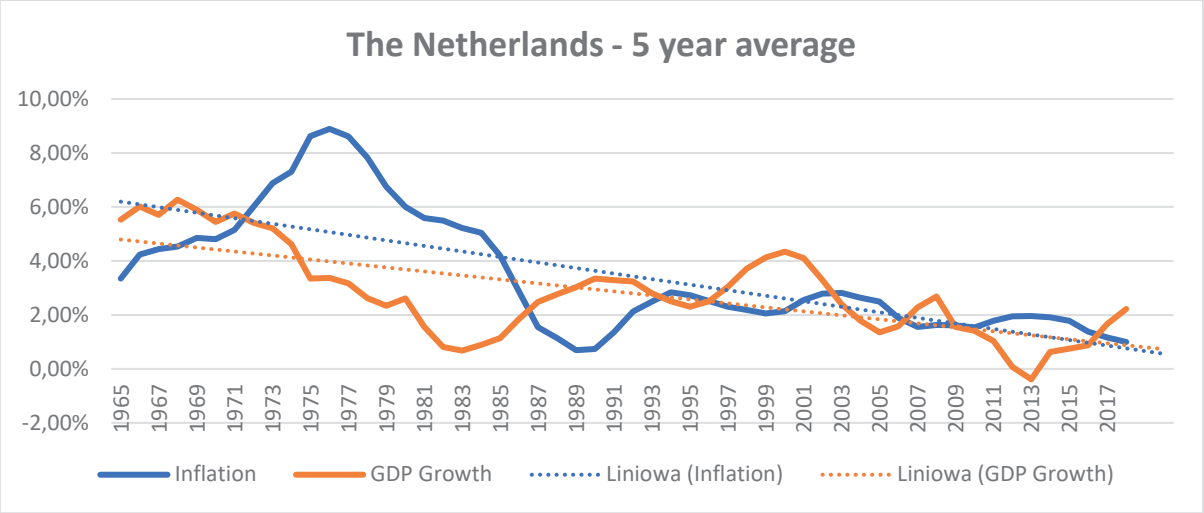


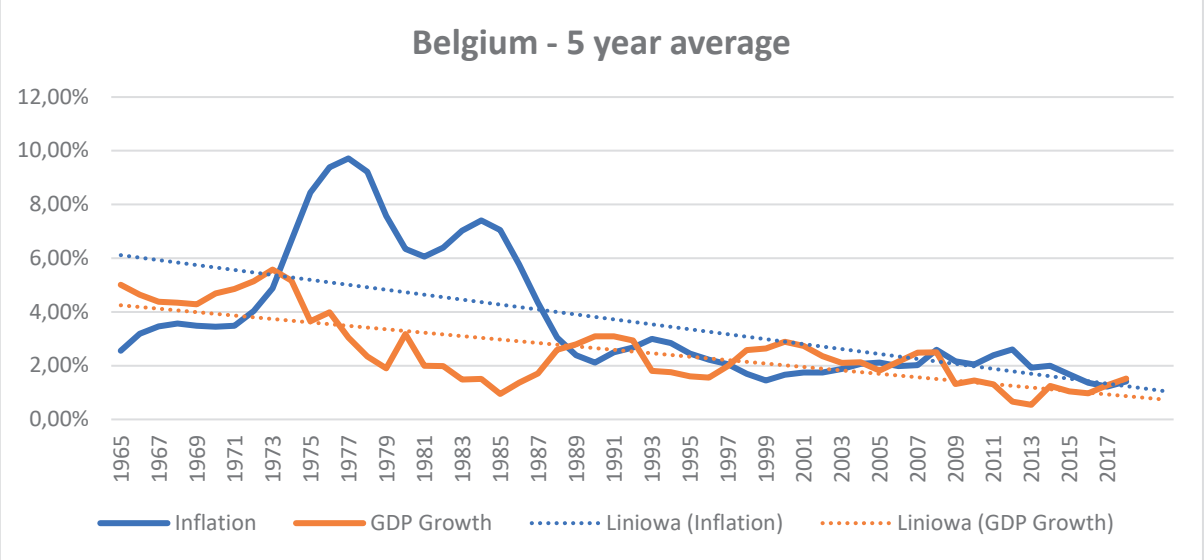


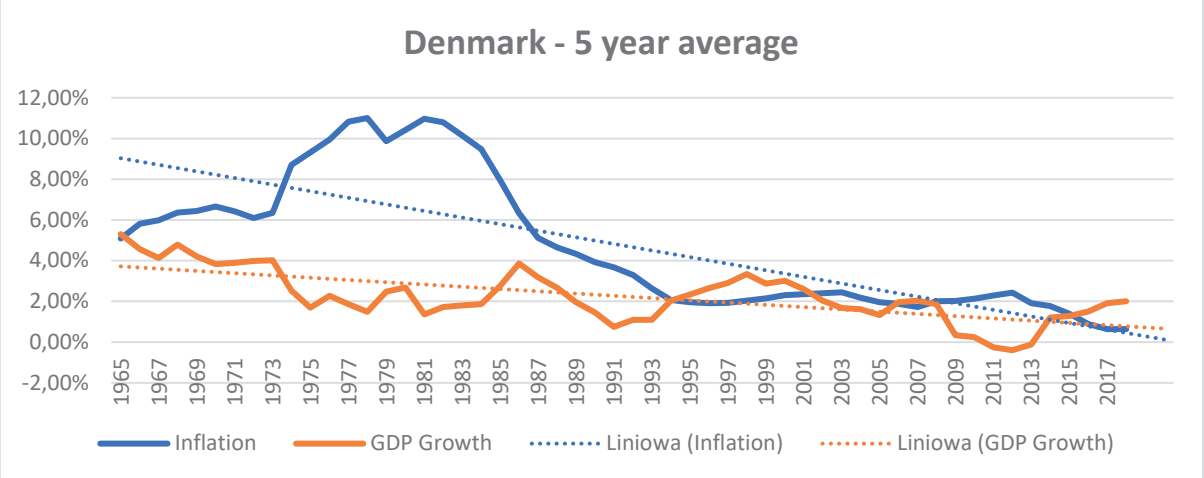

Germany - 5 year average
8,00%
6,00%
4,00%
2,00%
0,00%
1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

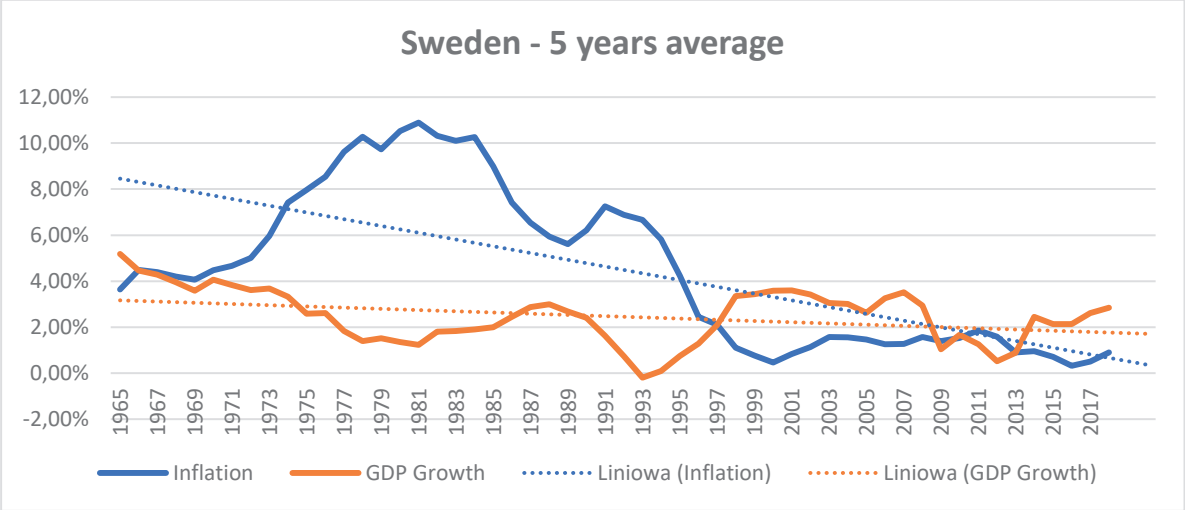

Switzerland - 5 years average
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
-2,00%
1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

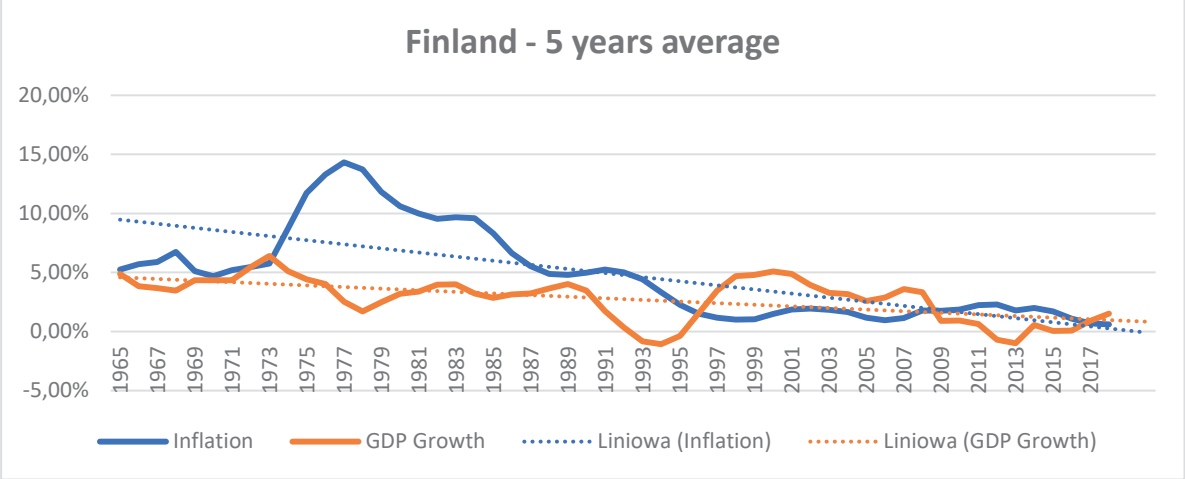

Austria - 5 year average
9,00%
8,00%
7,00%
6,00%
5,00%
4,00%
3,00%
2,00%
1,00%
0,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

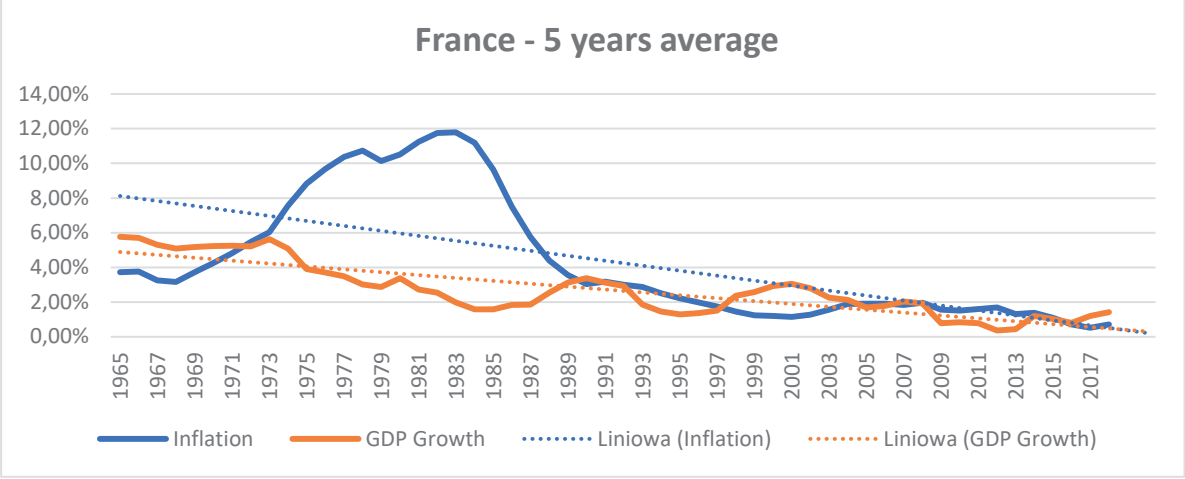

The Netherlands - 5 year average
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
-2,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

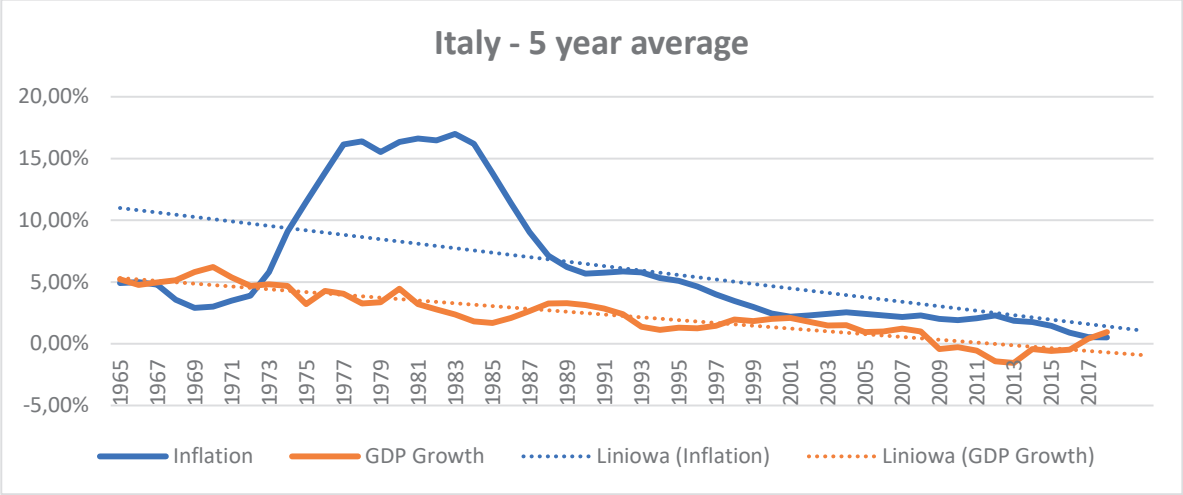

Belgium - 5 year average
12,00%
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

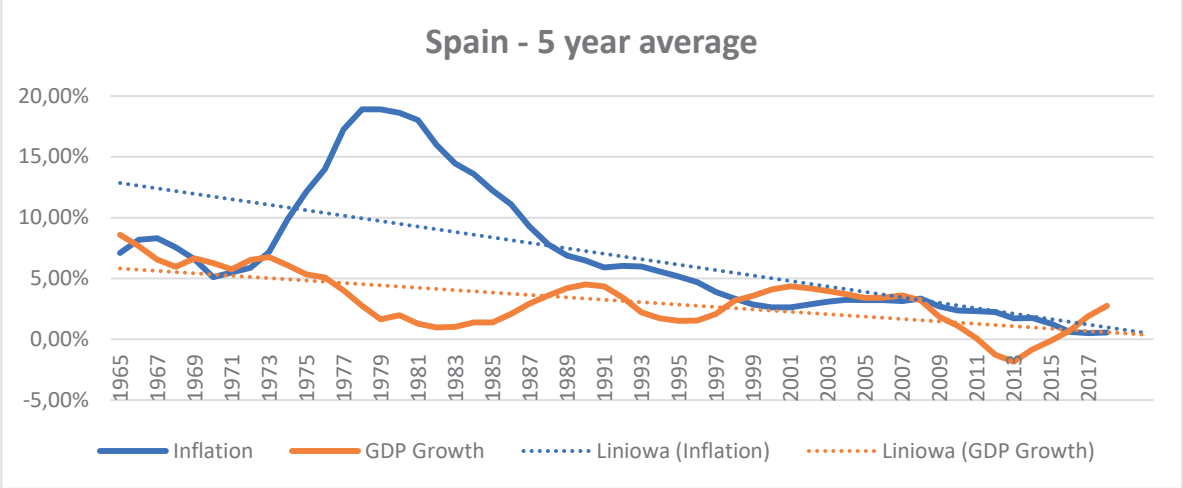

Denmark - 5 year average
12,00%
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
-2,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

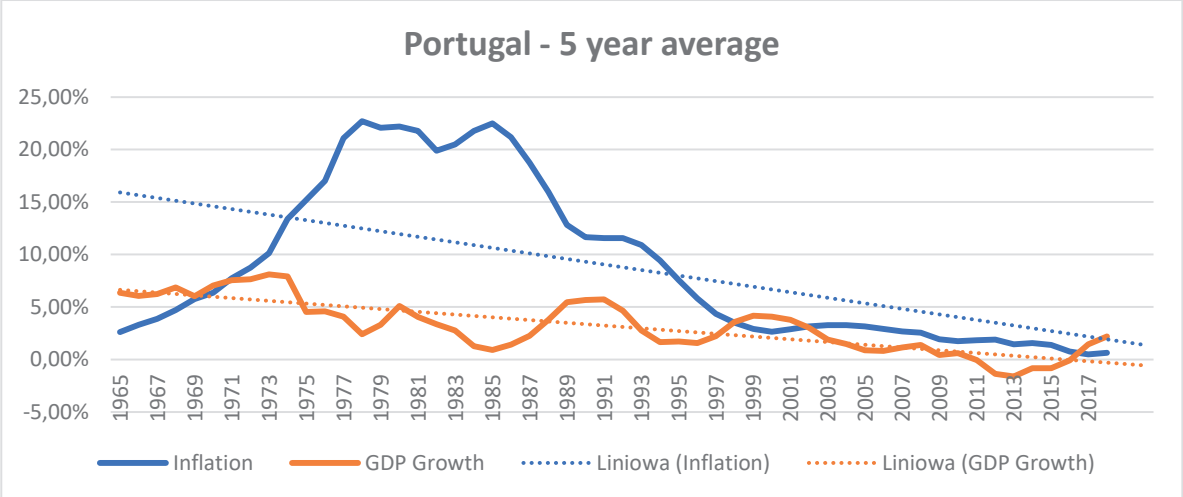

Sweden - 5 years average
12,00%
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
-2,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

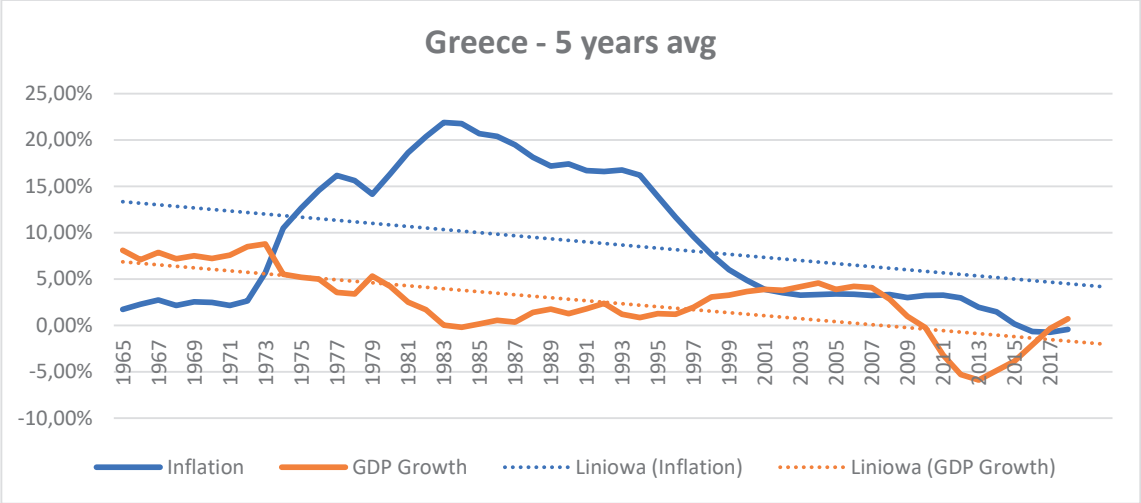

Finland - 5 years average
20,00%
15,00%
10,00%
5,00%
0,00%
-5,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

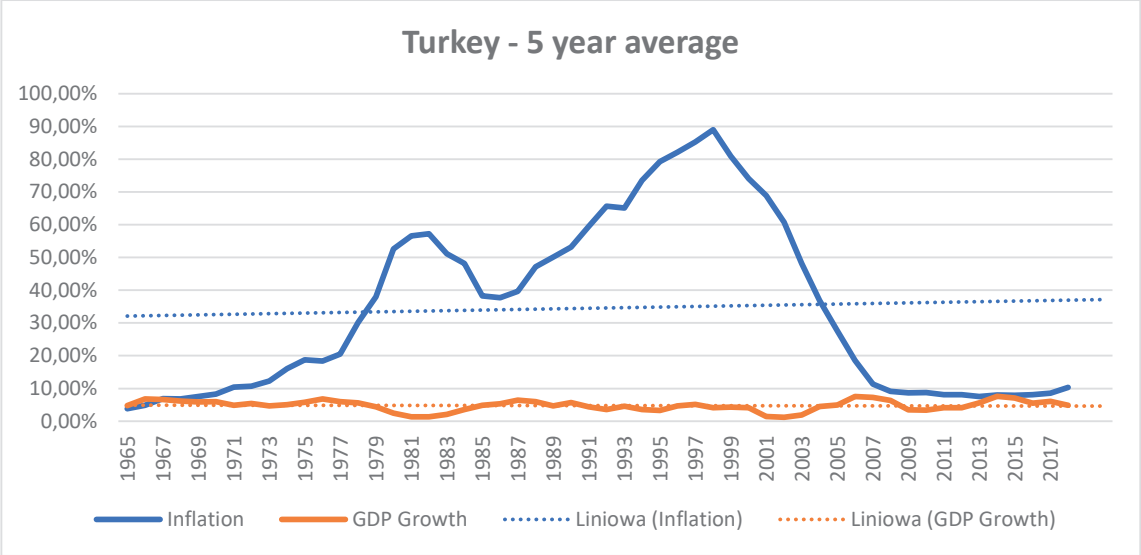

France - 5 years average
14,00%
12,00%
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

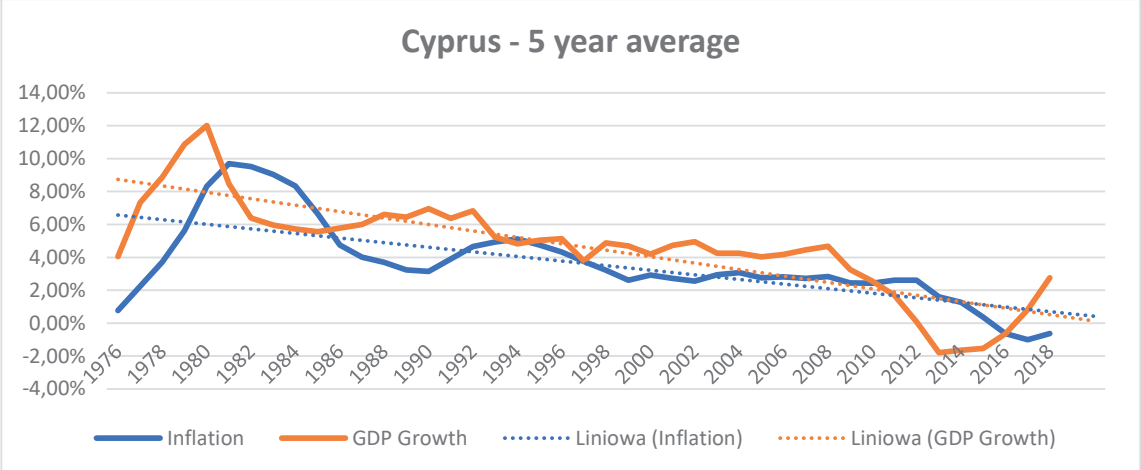

Italy - 5 year average
20,00%
15,00%
10,00%
5,00%
0,00%
-5,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

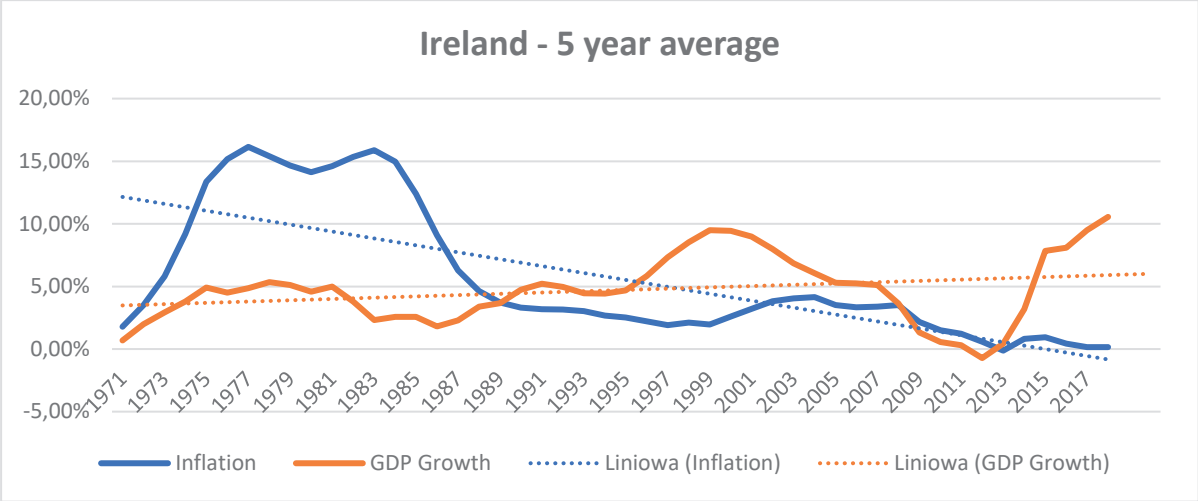

Spain - 5 year average
20,00%
15,00%
10,00%
5,00%
0,00%
-5,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

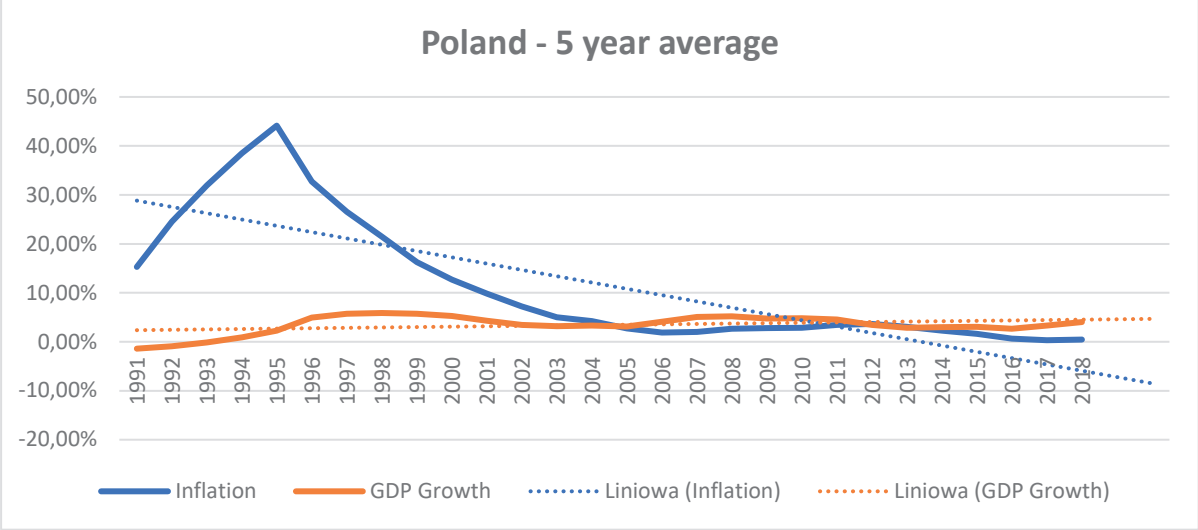

Portugal - 5 year average
25,00%
20,00%
15,00%
10,00%
5,00%
0,00%
-5,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

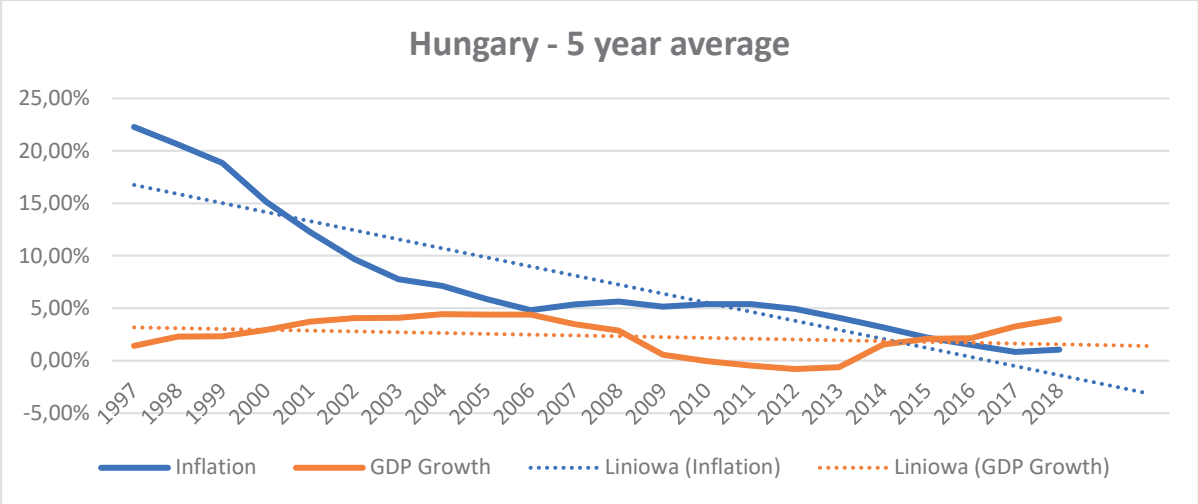

Greece - 5 years avg
25,00%
20,00%
15,00%
10,00%
5,00%
0,00%
-5,00%
-10,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

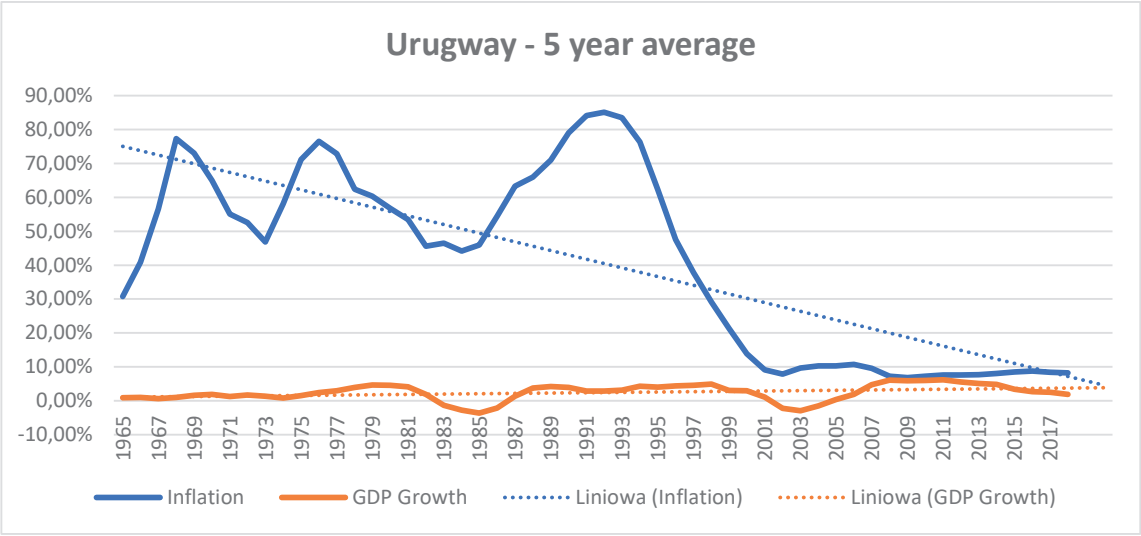

Turkey - 5 year average
100,00%
90,00%
80,00%
70,00%
60,00%
50,00%
40,00%
30,00%
20,00%
10,00%
0,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

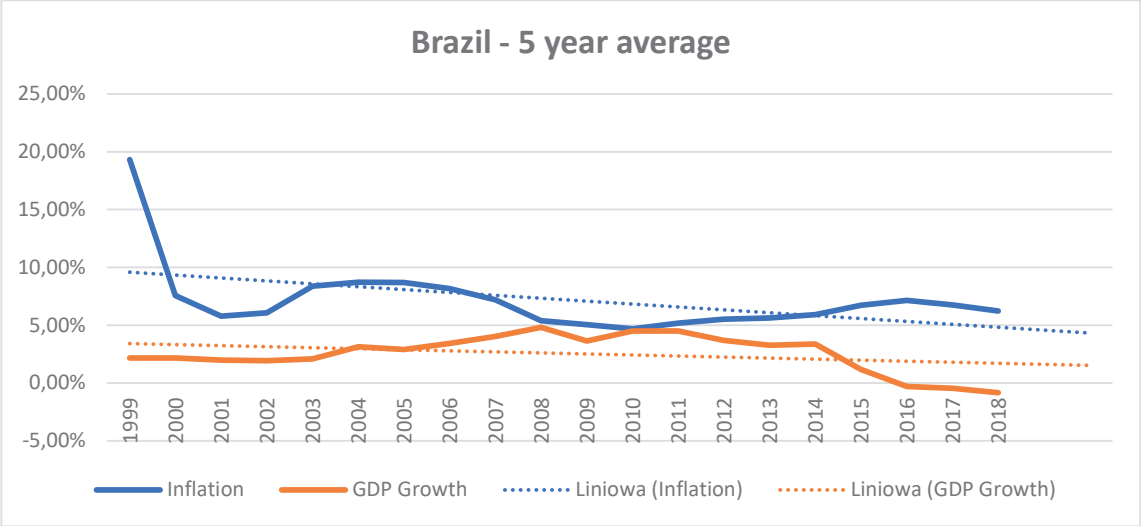

Cyprus - 5 year average
14,00%
12,00%
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
-2,00%
-4,00%
1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

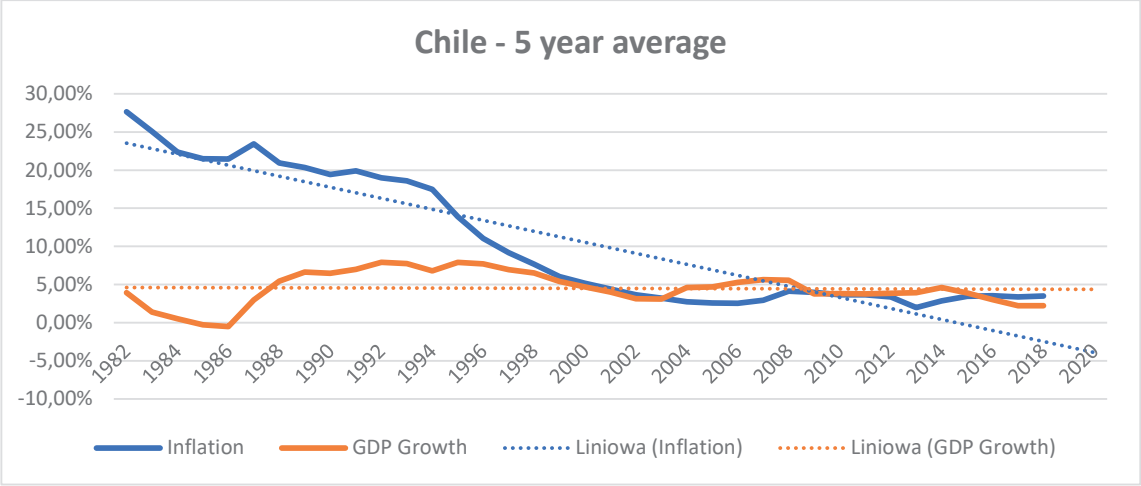

Ireland - 5 year average
20,00%
15,00%
10,00%
5,00%
0,00%
-5,00%
1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

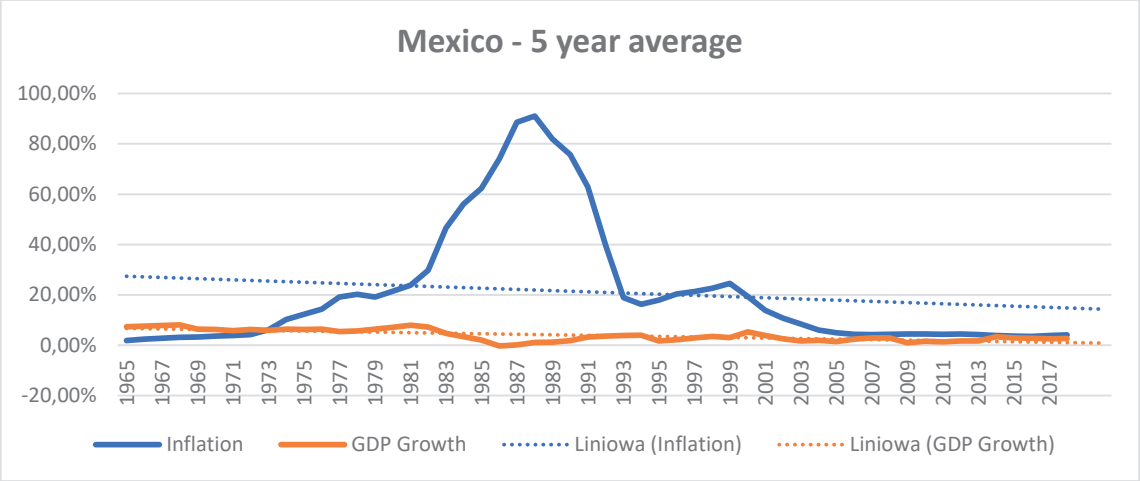

Poland - 5 year average
50,00%
40,00%
30,00%
20,00%
10,00%
0,00%
-10,00%
-20,00%
1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

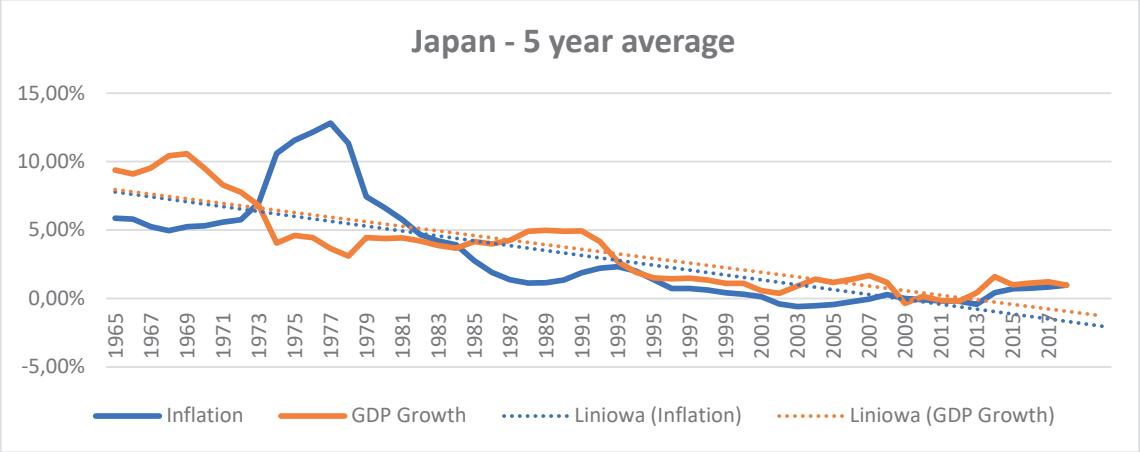

Hungary - 5 year average
25,00%
20,00%
15,00%
10,00%
5,00%
0,00%
-5,00%
1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

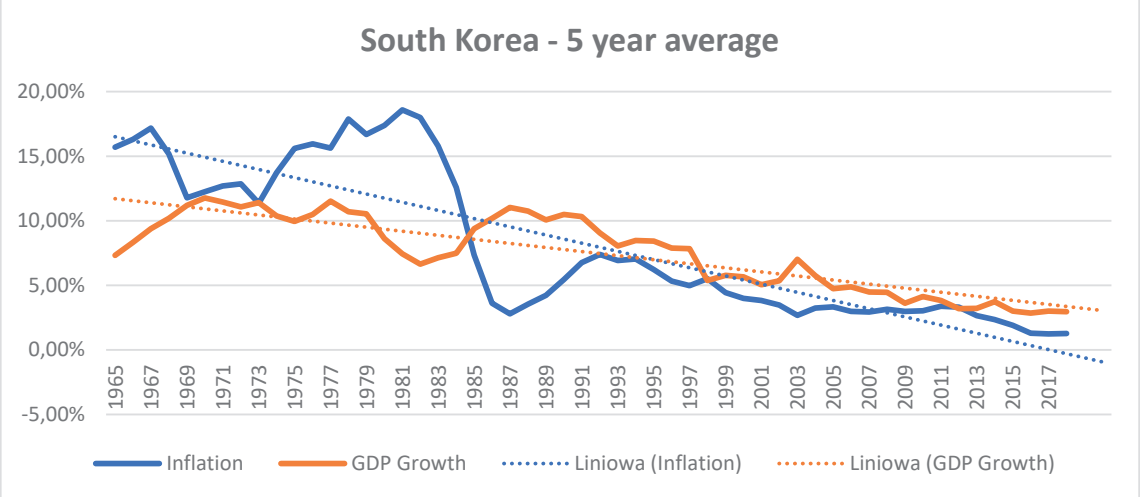

Urugway - 5 year average
90,00%
80,00%
70,00%
60,00%
50,00%
40,00%
30,00%
20,00%
10,00%
0,00%
-10,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

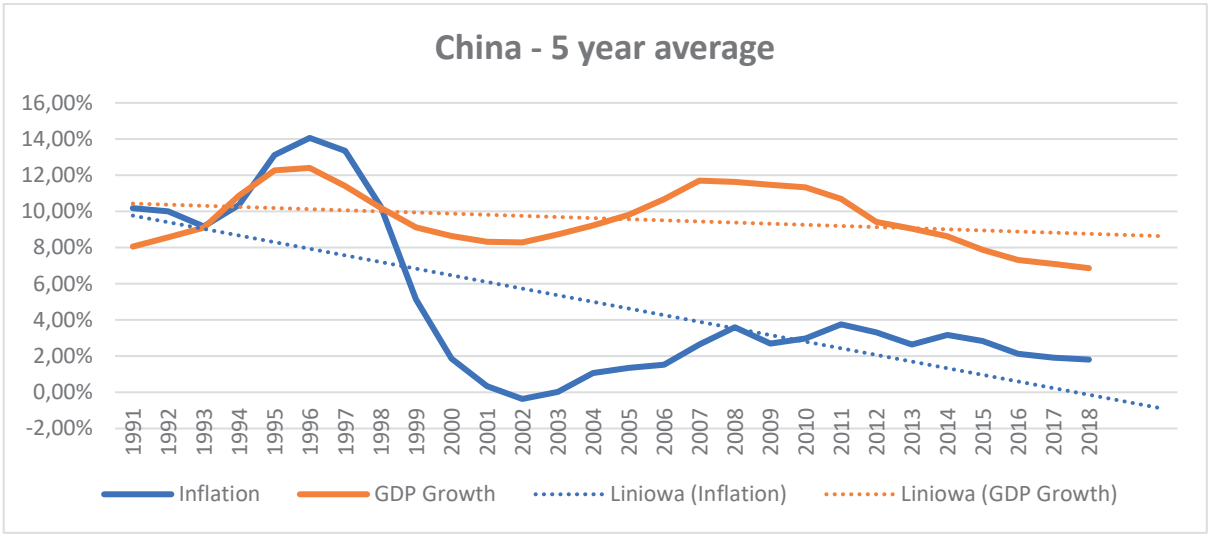

Brazil - 5 year average
25,00%
20,00%
15,00%
10,00%
5,00%
0,00%
-5,00%
1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

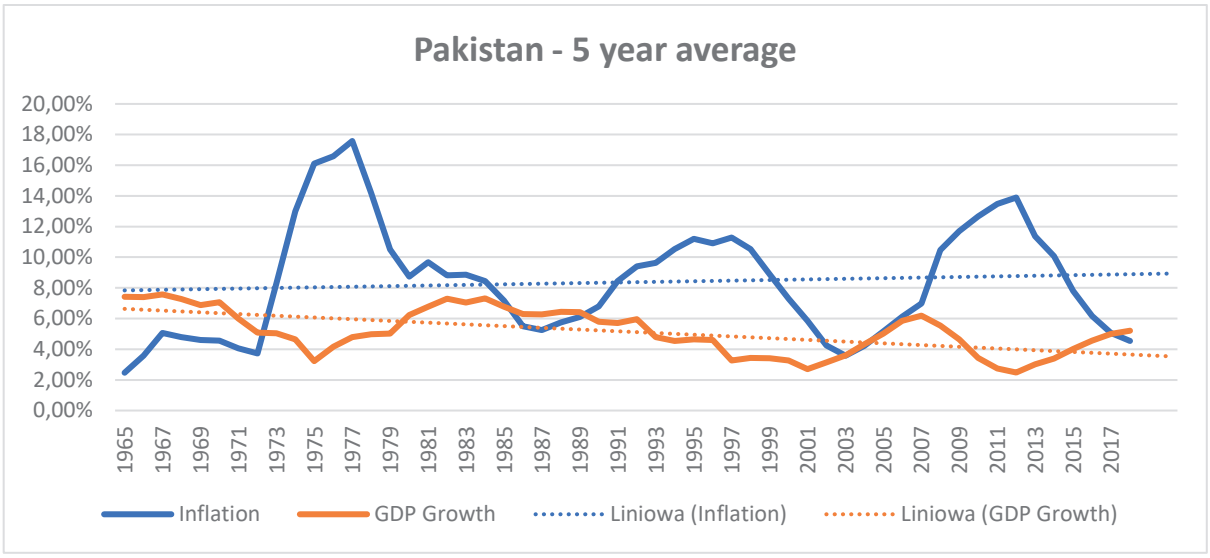

Chile - 5 year average
30,00%
25,00%
20,00%
15,00%
10,00%
5,00%
0,00%
-5,00%
-10,00%
1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

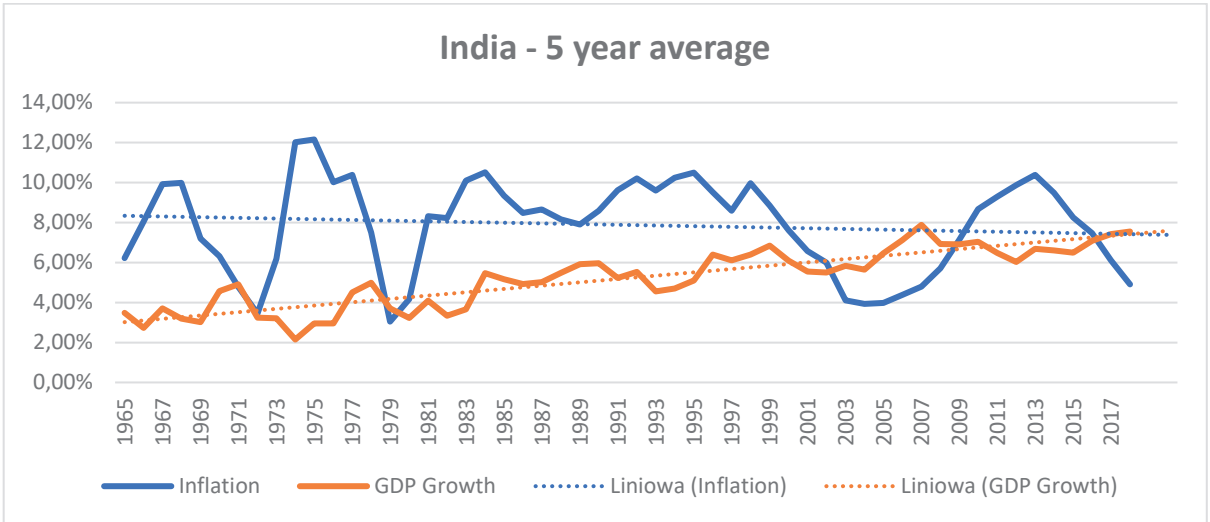

Mexico - 5 year average
100,00%
80,00%
60,00%
40,00%
20,00%
0,00%
-20,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

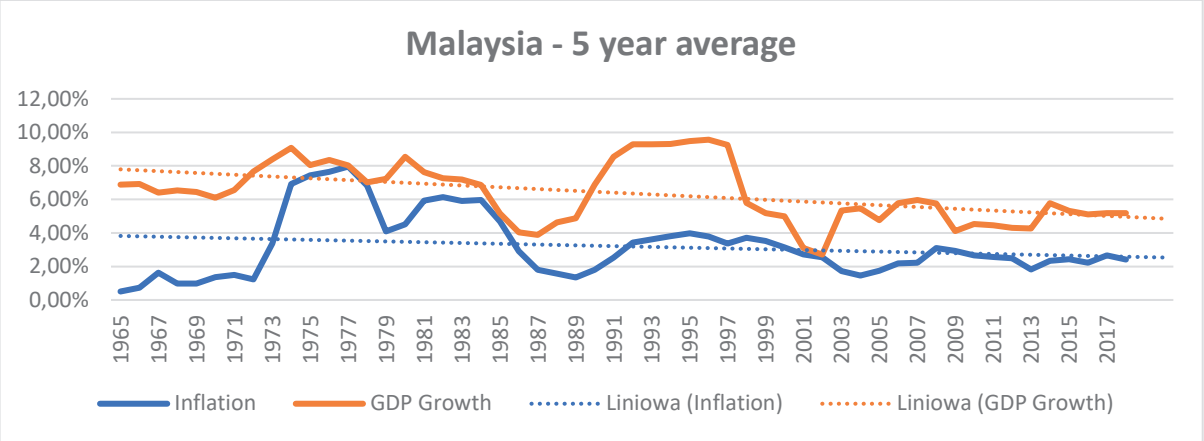

Japan - 5 year average
15,00%
10,00%
5,00%
0,00%
-5,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

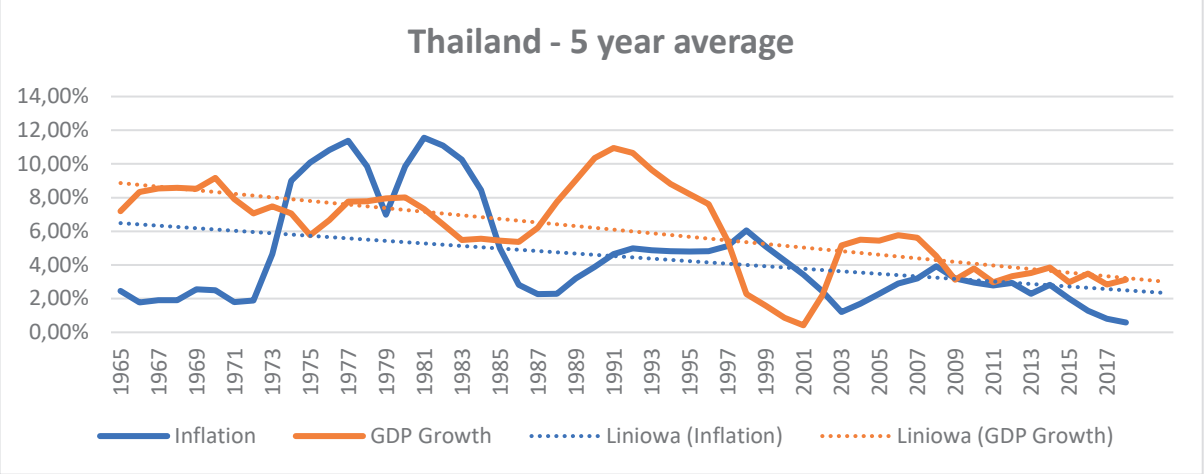

South Korea - 5 year average
20,00%
15,00%
10,00%
5,00%
0,00%
-5,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)


China - 5 year average
16,00%
14,00%
12,00%
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
-2,00%
1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

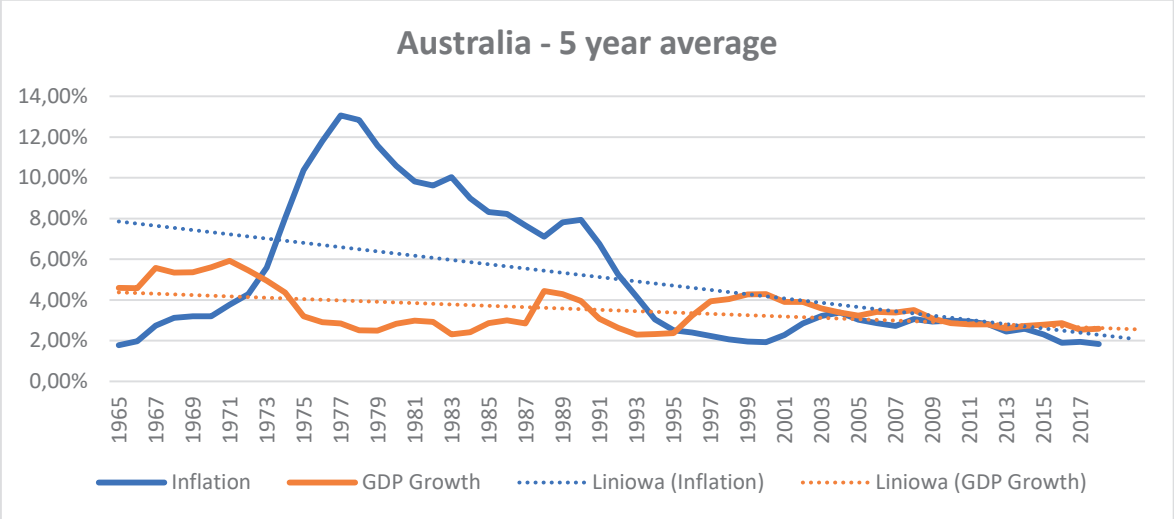

Pakistan - 5 year average
20,00%
18,00%
16,00%
14,00%
12,00%
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

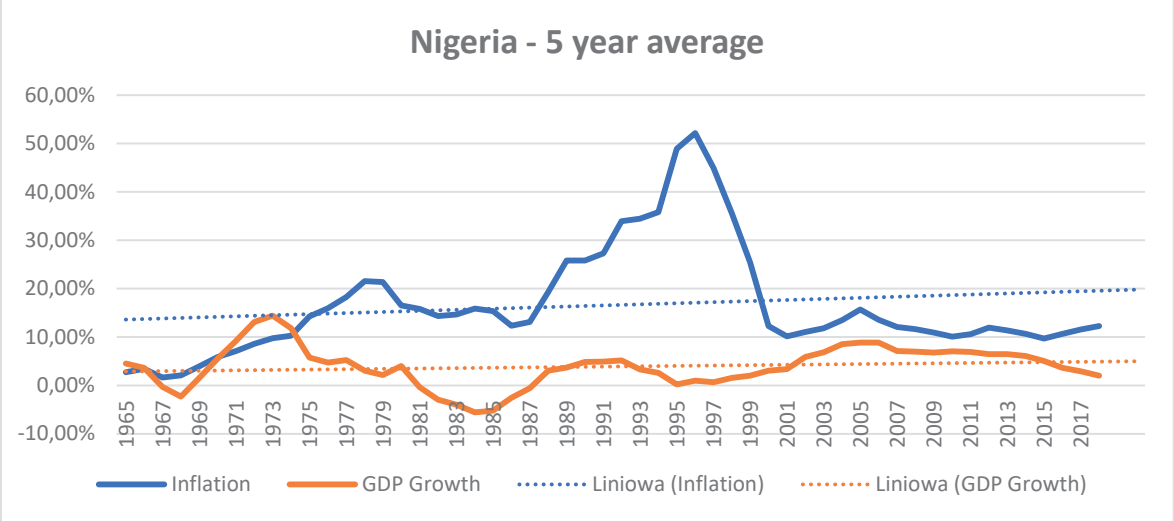

India - 5 year average
14,00%
12,00%
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

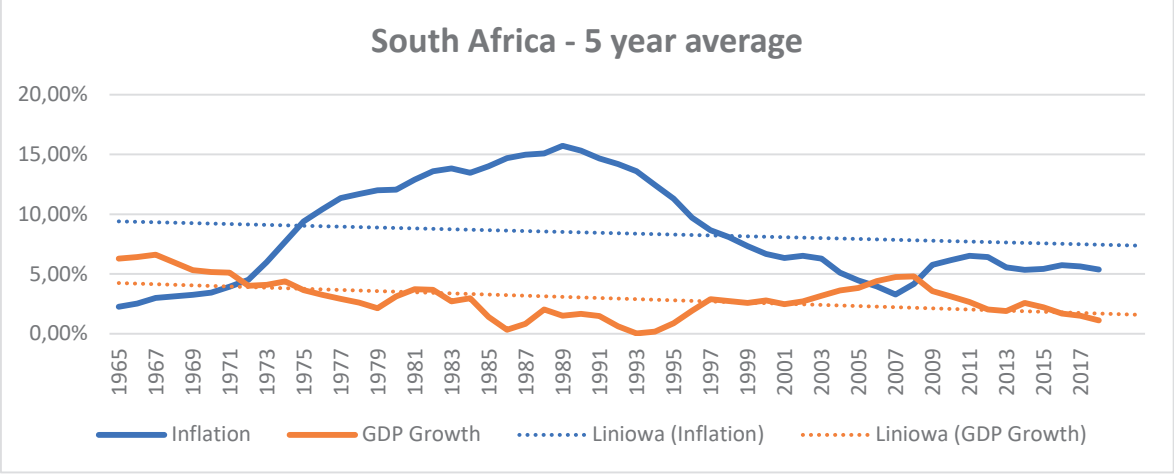

Malaysia - 5 year average
12,00%
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

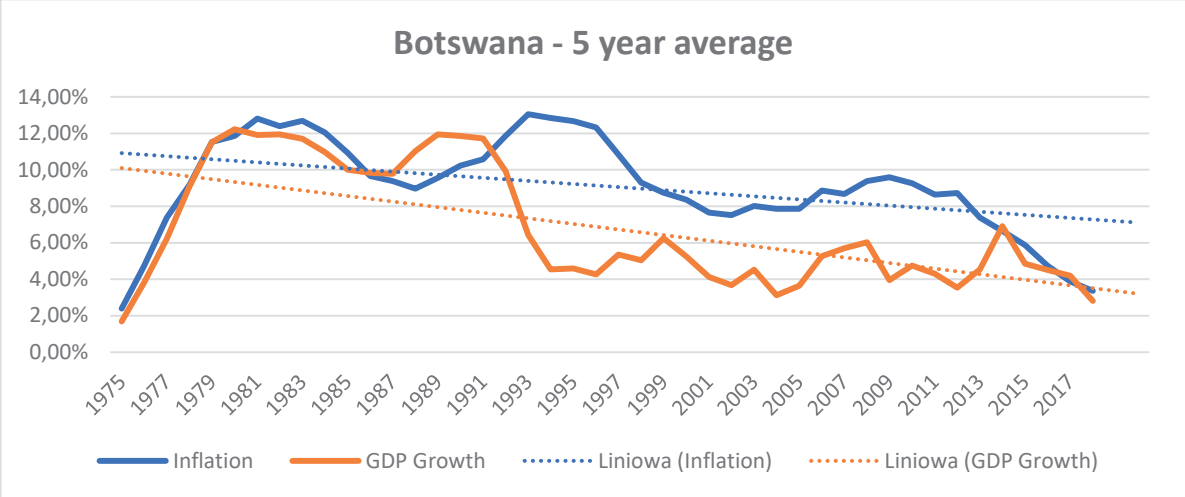

Thailand - 5 year average
14,00%
12,00%
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)


Indonesia - 5 year average
30,00%
25,00%
20,00%
15,00%
10,00%
5,00%
0,00%
1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)


Australia - 5 year average
14,00%
12,00%
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)


Nigeria - 5 year average
60,00%
50,00%
40,00%
30,00%
20,00%
10,00%
0,00%
-10,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)


South Africa - 5 year average
20,00%
15,00%
10,00%
5,00%
0,00%
1965 1967 1969 1971 1973 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015 2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)


Botswana - 5 year average
14,00%
12,00%
10,00%
8,00%
6,00%
4,00%
2,00%
0,00%
1975
1977
1979
1981
1983
1985
1987
1989
1991
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1997
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2001
2003
2005
2007
2009
2011
2013
2015
2017
Inflation
GDP Growth
Liniowa (Inflation)
Liniowa (GDP Growth)

APPENDIX 4

Example 1:

Analysis of competitiveness of countries with different risk profiles in a single currency zone, based on comparison between Greece and Germany in the eurozone. Such comparison between other countries may be performed using the Excel spreadsheet:

"Euro_winners_and_losers_ALL.xlsx"

Problem statement:

"For a country like Greece, where its debt is in an - effectively - foreign currency whose exchange rate with the 'domestic' one is permanently 1-for-1, an inflation rate that diverges from that of (Say) Germany means a permanent loss of competitiveness."

Thesis:
Our model - applied to 2021 data from eurozone countries - shows that the eurozone creates a competitiveness trap - the eurotrap - for countries with higher Equity Risk Premia, and, as it happens, maintains rich north - poor south divide.

Analysis:

1. Permanently different inflation rates in any two countries of a single currency area (like the eurozone) is unsustainable, as the country with a permanently higher inflation, as a trend, would price itself out of doing any business, and such a growing price gap would keep growing to infinity at exponential pace. Hence, whilst countries in the eurozone may have different inflation rates at any period, in the long term their inflation rates must, on average, converge, to avoid such price divergence to infinity.

2. Consequently, for all countries in the eurozone to maximise their growth potential and avoid internal shock of some countries being priced out of doing competitive business, the rate-of-risk measure of loss - which we measure as Damodaran's Equity Risk Premium - must average as a trend to be the same and must be equal to inflation.

3. We noted that 4.24% is the lowest Equity Risk Premium in all eurozone countries and that 2% is the eurozone inflation target. Therefore, by design, the eurozone is designed not to maximise growth potential of any of their members. By design in the eurozone providers of capital get a higher proportion of share of wealth created than providers of labour. And the higher the risk - Equity Risk Premium - the greater the share of wealth created by capital providers. So more risky countries in the eurozone, by design, have a greater wealth gap between capital providers and labour providers. If this is an indicator of internal social inequalities of countries, this explains well why we may expect richer and less risky eurozone countries - the rich north - to be more socially equal than riskier eurozone countries of the poor(er) south. This is what the eurozone delivers too.

4. **We created a spreadsheet tool with several Tables which allow us to analyse what happened in the eurozone in 2021. It allows us to compare competitiveness amongst the eurozone countries and establish who are winners and losers in the eurozone and by how**

much in terms of a proportion of their GDP and in absolute figures (in US dollars). Whether it's indicative of what's been happening in the eurozone since its inception is another matter. But it's not unreasonable to assume that it may well be the case. **As we're using holistic indicators: inflation and Equity Risk Premia, our analysis is not affected by different characteristics of tradable vs. non-tradable goods and services.**

a) TABLE A and TABLE B in the spreadsheet are connected. In TABLE A we can select a country (from the drop-down list) in the first row which we want to compare to the country selected (from the drop-down list) in the second row. TABLE A gives us results for both countries. The calculation of the Bubble /Contraction is a direct application of the formula which we derived in Chapter VII of the paper (page 24):

$$gr = \frac{-(i - MGr - 1) + \sqrt{(i - MGr - 1)^2 + 4l(MGr + 1)}}{2} - 1$$

b) In TABLE B we benchmark the country in the first row to the country in the second row of TABLE A. Ie. we subtract inflation and risk, respectively, of the country from the second row from inflation and risk, respectively, of a country from the first row of TABLE A (treat the second country as the benchmark for inflation and risk). Then we apply the aforementioned formula to these results and to growth data of the country from the first row of TABLE A. **The results in TABLE B tell us how much the country in the first row of TABLE A gained or lost of her GDP due to the fact that her inflation and Equity Risk Premium were different from the country in the second row of TABLE A. This tells us which countries benefited or lost in terms of their GDP compared to other countries in the eurozone.**

In the example below we show that Greece lost 5.97% of their GDP, ie. 12.64 billion US dollars, because her inflation and Equity Risk Premium was different from Germany's. Using the tool, we can compare any two eurozone countries.

TABLE A:

2021 comparison	***Risk / rate of loss (l) ie. Equity Risk Premium***	***Inflation (i)***	***GDP Growth (MGr)***	***GDP (in billions)***	***Bubble / Contraction (%)***	***Value of Bubble / Contraction (in billions)***	***Optimal growth if there was equitable share of wealth, ie. l = i***
Greece	7.80%	0.60%	8.30%	$211.65	-6.74%	$-14.27	15.04%
Germany	4.24%	3.20%	2.90%	$4,230.17	-1.00%	$-42.27	3.90%

TABLE B:

Value of relative gain/loss of competitiveness of Greece vs Germany in percentage terms of GDP and in US dollar, as a result of the single currency	*3.56%*	*-2.60%*	*8.30%*	*$211.65*	**-5.97%**	**$-12.64**	

c) **If we consider inflation and Equity Risk Premium as joint indicators of competitiveness - indicators which show whether investors are willing to make investment decisions - then the results in TABLE B allow us to calculate relative competitiveness of all countries in the eurozone.**

d) Whilst Estonia didn't maximise its growth considering its inflation and Equity Risk premium - actually we can check that it was quite close to it - it had the smallest contraction, 0.42%, thereby did the best in the eurozone. The table below (TABLE F) benchmarks all eurozone countries' performance to Estonia's. Ie. what Estonia's GDP gain was over other eurozone countries. It's NOT about how much wealth was transferred between two countries which are compared, but how much a country which is benchmarked gained or lost in all economic activities, in overall economic growth, because of the difference in inflation and Equity Risk Premium from the country it's benchmarked to.

It follows that a natural trading strategy for any country is to be open to free trade with higher risk countries, and be very careful with opening to free trade with lower risk countries (eg. opening to trade in areas where a riskier country has a competitive edge over a less risky country).

TABLE F:

Country	Competitiveness measure: benchmarked to the leader
Estonia	0.00%
Lithuania	0.04%
Luxembourg	0.30%
Germany	0.60%
Netherlands	0.99%
Belgium	1.20%
Austria	1.39%
Latvia	1.80%
Finland	2.08%
France	2.19%
Ireland	2.24%
Slovakia	2.34%
Spain	2.40%
Slovenia	3.00%
Malta	3.95%
Cyprus	4.04%
Italy	4.14%
Portugal	4.84%
Greece	6.96%

e) With exception for the Baltic States, Estonia, Lithuania and Latvia this is clearly in line with Equity Risk Premium data:

TABLE D:

Country	**Equity Risk Premium**
Germany	4.24%
Luxembourg	4.24%
Netherlands	4.24%
Austria	4.63%
Finland	4.63%
France	4.73%
Belgium	4.84%
Estonia	4.94%
Ireland	5.08%
Lithuania	5.08%
Malta	5.08%
Slovakia	5.08%
Latvia	5.43%
Slovenia	5.43%
Spain	5.82%
Portugal	6.12%
Italy	6.42%
Cyprus	6.71%
Greece	7.80%

This shows that the Baltic States compensated well for higher risk by having higher inflation. However, the Baltic States are still developing economies with some distance to match prices in countries such as Germany or the Netherlands.

The table (TABLE H) below shows the purchasing power parity in the eurozone in 2021 benchmarked to Germany.

TABLE H:

Country	PPP compared to Germany
Lithuania	0.62618084
Latvia	0.682861
Slovakia	0.72874494
Estonia	0.73819163
Greece	0.73954116
Slovenia	0.76383266
Portugal	0.77192982
Malta	0.79487179
Cyprus	0.82591093
Spain	0.84210526
Italy	0.88259109
France	0.97840756
Germany	1
Belgium	1.00269906
Netherlands	1.0391363
Austria	1.04048583
Ireland	1.06207827
Finland	1.12010796
Luxembourg	1.14844804

Furthermore, the Baltic States are very small economies surrounded by very supportive and rich Nordic countries. So, whilst the Baltic States performed well, to maintain such good performance, they have to achieve lower Equity Risk Premia in the future, since - as pointed in paragraph 1 above - a permanently higher inflation is not sustainable to keep compensating higher risk. And if they don't manage to lower Equity Risk Premia their growth will suffer. That is, in such a case the Baltic States may move down the list towards Slovakia, Slovenia, Portugal if not Greece. Or they have to achieve lower Equity Risk Premia to join the top performers, Luxembourg, Germany, the Netherlands.

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f) Our analysis shows the existence of a rich north - poor(er) south divide by design of the eurozone and the fact that the eurozone is managed for the benefit of the countries with the lowest Equity Risk Premia, rich north, to the detriment of the riskiest countries, poor south (because of inflation target is set below the lowest Equity Premium of any in the eurozone country). A solution would be for the eurozone countries with the highest Equity Risk Premia

to get them lowered by lowering their risks to the level of the lowest risk countries. However, this is much easier written than done, and doesn't really appear to be a realistic proposition.

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g) The above justifies quantitatively Oliver Hart's observation that the eurozone was a "mistake" because the countries weren't "homogeneous" enough (https://www.euractiv.com/section/euro-finance/news/economic-nobel-prize-winner-the-euro-was-a-mistake/) Our analysis boils down this lack of homogeneity to the issue of risk of doing business, measured as Equity Risk Premium, and measures this lack of homogeneity too.

5. Generally, our model shows that the eurozone as it is is a growth trap for countries with a higher risk of doing business. Permanently higher inflation to balance higher risk - in a single currency area - would price any country out of business: other countries would keep becoming (infinitely) cheaper. This would kill producing or doing anything that may be brought from a country with a lower inflation. Keeping inflation lower to stay competitive on prices in higher risk countries strangles these countries' economies by contracting their economic growth. Clearly the eurozone, with its very low inflation target of 2%, is designed to benefit the richest countries most (as it happens these are the countries with the lowest Equity Risk Premia) and, in practice, it keeps strangling economies of poorer countries in the eurozone (as it happens these are the countries with the highest Equity Risk Premia). The eurozone is a blueprint for a permanent rich north (lower risk) - poor south divide (higher risk).

Example 2:

Analysis of globalisation and its effects on countries with different risk profiles.

Problem statement:

"Globalisation amongst countries with different risk profiles leads to transfer of wealth from riskier countries to less risky countries. Globalisation makes rich countries richer, poor countries poorer, the divide between rich and poor is growing in societies as a result of globalisation."

Thesis:
Our model of risk-inflation-growth quantitative relationship shows that globalisation - ie. no trade borders between the countries - leads to transfer of wealth from more risky countries (typically poorer countries) to less risky countries (typically richer countries). And if in the richest countries inflation is below risk (of economic activities), this leads to transfer of wealth to the capital providers (typically the richest in the society), at a higher level than to labour providers (typically poorer in the society). This is not an ideological statement. This is a scientific fact, if our model is correct (and it's still a big "if"). And if we know data for risk (like Equity Risk Premia for countries), for inflation and for growth – using our model - we can calculate how much money (in a currency units) is transferred from poorer countries to richer countries, and then to capital providers in the richest countries. This is done by using the equation on page 24 of this article.

Analysis:
Let's think about how we can address various economic compensating mechanism - such as tradable vs. non-tradable goods and services effect on inflation, currencies exchange rates and trade barriers – using our model of economically sustainable growth, based on our theorem that, in order to achieve economically sustainable growth, inflation must be equal to the rate-of-loss (*ex-post*) or economic risk (ex-ante), which should be equal in the long term. We call it economic risk. We are taking a long-term view. Clearly, even looking at the last couple of years - effects of Covid pandemic and now war in Ukraine - short term scenarios present their own challenges which our model can't deal with.

Our *"growth to infinity"* argument - especially when such growth is exponential - is to show the unsustainability of certain arrangements if they were to remain permanent. It means that there must be a compensatory mechanism. If not, a correction will happen. In real life things can't diverge to infinity. And such a state of divergence is cut abruptly short, if the process is exponential.

Below is a skeleton of arguments of our reasoning - based on our model - applied to the real world (kind of a sense check of our model) which led to the conclusions above. **It all starts with analysis of tradable vs. non-tradable goods, followed by brief analysis of other correction mechanisms such as currencies' exchange rates and customs (trade barriers):**

1. Tradable vs. non-tradable goods

Let's assume there are two countries with different risk profiles: eg. Germany and Greece, with Greece having higher economic risk. According to our model (to achieve maximal sustainable growth) inflation in these two countries must be equal to economic risk in both countries. Ie.

inflation in Greece must be higher than in Germany. Clearly, when it comes to tradable goods and services - in a free trade, single currency zone - it wouldn't be sustainable to have higher inflation (as a permanent trend) in Greece than in Germany, as Greece would price itself out of trade: everything tradable (good & services) provided by Germany would be cheaper in Greece than sourced locally. Greece wouldn't produce anything which is tradable, and her trade exchange deficit with Germany would keep growing (to infinity due to difference in inflation as a permanent trend). Greece wouldn't be exporting anything to Germany. (This was also a point of our previous analysis: a single currency in two countries of different economic risks disadvantages the country in which the absolute value of the difference between inflation and economic risk is greater.)

Let's see now whether non-tradable goods can compensate for this phenomenon. Let's say Greece stays competitive, compared to Germany, in producing/providing tradable goods and services. In which, in order to make up for a higher economic risk, inflation of non-tradable goods is higher than inflation tradable goods. Inflation is an exponentially growing process of price increases. Thus, the price gap between tradable and non-tradable goods will keep growing exponentially to infinity. Such a trend is not sustainable. Eg. after some time, in Greece, the price of top of the range Mercedes will be less than the hourly wage of, say, a domestic cleaner; the price of the best jewellery from Germany will be less than the price of having a haircut in Greece. Clearly, this is not a sustainable situation.

To conclude, whilst non-tradable goods and services can reduce an inflation gap between Germany and Greece growing very big in the short term, in the long term - and it's not such a long term as the process is exponential - it cannot help. Or is it feasible that in Greece it will be possible to buy, say, ten top of the range Mercedes cars for the price of one visit to a barber?

It looks this shows that having different inflation rates in different countries - in a free trade, single currency area - is not an economically sustainable situation (according to our model). Compensating mechanisms, such as non-tradable goods and services, may only delay the effect.

2. The Dutch disease

The paragraph implicitly shows how our model deals with some possible effects of the Dutch disease. A country with significant internationally tradable - and valuable - resources, such as crude oil, may use proceeds from the sale of resources to compensate for the effects of higher inflation of the non-tradable goods and services. Ie. prices of local non-tradable goods and services can keep going sky high, whilst the prices of imported (tradable) goods and services stay very low, or in fact may be going down, effectively keeping overall inflation low for some time.

The Dutch disease happens when sale of such resources can't any longer compensate for high local inflation and the country prices itself out of producing and providing tradable goods and services.

Incidentally, we observed this above process first hand when it started happening in Norway in the 1980's continuing into the 1990's. Everything sourced locally was getting very expensive. Everything coming from abroad was becoming cheap(er). In 1990, the Norwegian government started stopping this process very quickly - which made many Norwegians very unhappy - by separating oil and gas revenues into a petroleum/pension fund, and only allowing very limited

amounts from this fund to enter into the Norwegian economy. The fund was focused on making foreign investments. This method was a part of a mechanism of making the Norwegian economy competitive on international markets.

3. Non-single currency and trading barriers

Coming back to the Greece vs. Germany example: with different economic risk, different inflation needed to maximise economic growth. Our model shows that being by both countries in a single currency is not sustainable (without single fiscal policy and mechanisms which make these two countries one country).

However, having different currencies - with freely floated exchange rates - would only help to a limited degree. This is similar to - actually it's a counterpart of - the non-tradable goods and services effect. Ie. to compensate for higher inflation (due to higher economic risk) the Greek currency would have to keep depreciating (exponentially) against the German currency to zero.

4. Trade barriers (eg. customs)

Similarly, trade barriers such as customs, which Greece would have to keep increasing to compensate for higher inflation compared to Germany would have to keep growing (exponentially) to infinity. (This is leaving aside any retaliatory moves by Germany, which would only accelerate this effect.) Keeping increasing trade barriers to compensate for the inflation gap, if reciprocated, leads to autarky. Ie. it will stop all trade between the countries. The mechanism of trade barriers is also a counterpart of both tradable vs. non-tradable goods and service effect and currencies exchange rates effect.

Altogether this is not such good news for Greece. Single currency is a killer for Greece (considering the difference in economic risk between Greece and other major eurozone economies). However, having its own currency, drachma, with free market established exchange rates presents its own challenges. But it gives Greece a degree freedom - not available when being in a single currency zone - to trade more efficiently with countries which have higher economic risk than Greece (ie. for Greece it's transfer wealth from them), to compensate for wealth transfer from Greece to countries with lower risk. Greek own currency would make Greece more competitive than it is at present. But it doesn't solve all the problems stemming from the fact that Greece is relatively a high-risk economy, compared to other European economies, like Germany or Luxembourg.

5. Globalisation

Our model leads to the following conclusions:

a) Mechanisms to balance competing economies with different risks

The mechanisms such as tradable vs. non-tradable goods, free currencies exchange rates, trade barriers such as customs, play a key role in balancing competing economies with different economic risk in the short-term. They don't work (in terms of balancing economies with different risks) - due to their own effects - if there is a permanent difference in economic risks in different economies.

b) Higher risk countries: choice between autarky and exploitation

It's not possible to compensate - unless we create a single system of wealth sharing, like in one country, coordinated fiscal policy, which would equalise economic risk profiles to some degree as if it was one country - for different economic risks in different countries. This is because countries with higher risk need higher inflation for sustainable economic growth than countries with lower risk. However, countries with higher inflation price themselves out of global trade. This pushes countries with higher risk to become autarkies or suffer economic crises and exploitation. Lowering inflation in higher risk countries - below their economic risk level - is not a solution, as it contracts higher risk countries' economies. Increasing inflation in lower risk countries, to match inflation in higher risk countries, creates (exponential) bubble in lower risk countries.

c) Middle-income trap of higher risk countries

Our model shows that: without equalising economic risk amongst all countries or having a single fiscal policy in all countries (as if it was one country), free trade is a wealth transfer mechanism from higher risk countries to lower risk countries, or higher risk countries have to keep contracting their economic base (this happens when inflation is below economic risk).

That is our model explains how and why the middle-income trap happens, and its mechanics: a higher risk country once it catches up with lower risk countries on prices, to stay competitive, it must keep inflation on the level of lower risk countries. This, in turn, keeps contracting economic growth (in higher risk countries).

d) Globalisation: wealth transferring mechanism to lower risk countries

According to our model, globalisation is in the interest of lower risk countries. Globalisation - ie. deregulated global free trade - is an economic mechanism which keeps transferring wealth from higher risk countries to lower risk countries. Empirical observations - ie. lower risk countries push for globalisation, and higher risk countries are not that keen to embrace it - appear to have been confirming this premise for many years. Our model shows the economic rationality of such behaviour.

Conclusions

a) Our model analytically explains why Scandinavian economies are so successful in the globalised world:

i) They are one of the lowest risk economies, and are perceived as such by capital providers.

ii) Their tax, fiscal and corporate systems are designed to spread economic risk amongst economic players (hence minimising need for local corrections/shocks).

iii) Inflation in Scandinavian economies is relatively close to economic risk (eg. as measured by Equity Risk Premia).

b) Our model presents a two-step process for any economy to belong to the richest economies:

i) Step 1: minimise economic risk - achieve a low-risk economy, perceived by capital providers as a low-risk economy. (It looks this is pretty much an intuitive and uncontroversial recommendation.) This will ensure maximal competitiveness with other economies, wealth transfer from higher risk economies if there is free trade. (This is what our model implies.)

ii) Step 2: ensure that inflation is as close to economic risk as possible to maximise economic growth and make it sustainable. If inflation is higher than economic risk, this will start developing a(n) (exponential) bubble. If inflation is lower than economic risk it will start (exponentially) contracting the economic base by transferring wealth to capital providers. In both cases economic growth will be reduced from what it would have been when inflation had been equal to economic risk.

iii) If other economies don't engage in free trade, this a recipe for economically efficient autarky.

c) Our model shows why it's rich, low risk countries, which push for free trade, globalisation, open deregulated markets, whilst poorer, higher risk countries aren't that keen. This is an economically rational behaviour maximising their profits in their situations. Without being emotive about it, globalisation looks like a modern form of colonialism. Maybe humans don't change that much. Humans only change tools to achieve their aim of increasing their wealth. This is what we can conclude from our model too.

d) Historical reflection: this analysis gives analytical and quantitative meaning to words: *"For to the one who has, more will be given, and he will have an abundance, but from the one who has not, even what he has will be taken away."* - Matthew 13:12.

Example 3:

The Bank of England dilemma: is 2% inflation target better, or not, than 1% or 2.5%?

On 7 November 2022 during an Outreach meeting of the Bank of England, the Chief Economist of the Bank, Mr Huw Pill stated that:

"There is something arbitrary about 2% being the inflation target. Can I have, give you a really great economic argument why 2% is better than 1%, or 2% is better than 2.5%? I can try. But it wouldn't be super-convincing."

Using the method in our article, we can do the calculations for the Chief Economist. We can calculate if, *ceteris paribus*, meeting consistently the inflation target of 1% or 2.5% is better, or not, than meeting consistently the inflation target of 2%, which is the current inflation target of the Bank of England.

This is done by using the formula for growth derived in Chapter VII of the paper (page 24):

$$gr = \frac{-(i - MGr - 1) + \sqrt{(i - MGr - 1)^2 + 4l(MGr + 1)}}{2} - 1$$

1. Firstly we take the data for UK for December 2021:

a) UK GDP growth was 7.4%

b) UK GDP value was £2,200 billion

c) UK inflation target was 2%

d) UK inflation was 2.2%

e) UK Equity Risk Premium was 4.84% (January 2021)

Please be careful when considering what is a gain or is a loss in the table.

2. Based on the above the results are as follows, if we assume as if the inflation target was 2.2% and calculate what GDP growth and value would have been for inflation of 1%, 2% and 2.5%.

Inflation Target (r)	*GDP Growth (MGr) at Inflation Target (r)*	*GDP (in billions) at Inflation Target (r)*	*Alternative Inflation Target (a)*	*GDP Gain / Loss (%) due to not meeting Alternative Inflation Target (a)*	*Value of GDP Gain / Loss (in billions) due to Alternative Inflation Target (a) not met*	*Growth that would have been if Alternative Inflation Target (a) was met*
2.20%	7.40%	£2,200.00	2.50%	-0.29%	£-6.45	7.69%
2.20%	7.40%	£2,200.00	2.00%	0.20%	£4.32	7.20%
2.20%	7.40%	£2,200.00	1.00%	1.19%	£26.15	6.21%

We assume the value of 2.2% as if it was the real inflation target:

a) If inflation had been 2.5%, the UK would have still gained additional 0.29% of GDP growth, or £6.45 billion.

b) if the Bank of England inflation target of 2% had been met, the UK would have lost 0.2% of GDP growth, or £4.32 billion.

c) if inflation had been 1%, the UK would have lost 1.19% of GDP growth, or £26.15 billion.

3. **Based on the second row of the table above, we can calculate what GDP growth and value would have been if the inflation target of 2% was met.** Now we can answer quantitatively a Huw Pill's dilemma, how better / or worse the Bank of England's inflation target of 2% is than if the inflation target was 1% or 2.5%, in the context of the UK's growth in 2021.

Inflation Target (r)	*GDP Growth (MGr) at Inflation Target (r)*	*GDP (in billions) at Inflation Target (r)*	*Alternative Inflation Target (a)*	*GDP Gain / Loss (%) due to not meeting Alternative Inflation Target (a)*	*Value of GDP Gain / Loss (in billions) due to Alternative Inflation Target (a) not met*	*Growth that would have been if Alternative Inflation Target (a) was met*
2.00%	7.20%	£2,195.79	1.00%	0.99%	£21.75	6.21%
2.00%	7.20%	£2,195.79	2.50%	-0.49%	£-10.73	7.69%

Assuming that Equity Risk Premium, ie. a measure of the country risk, risk of doing business in UK is 4.84% (ie. greater than inflation targets we consider in this example), and GDP is £2,195.79 billion (based on actual figure of £2,200 billion in 2021) and GDP growth is 7.2% (based on actual figure of 7.4% in 2021):

a) if the inflation target of 1% had consistently been met rather than if the inflation target of 2% had consistently been met, the UK would have been losing 0.99% of its GDP growth, or £21.75 billion.

b) if the inflation target of 2.5% had consistently been met rather than if the inflation target of 2% had consistently been met, the UK would have been gaining 0.49%, or £10.73 billion.

Thus, the cumulative effect of having a too low inflation target (ie. below the risk of doing business) is close to 1% of lost growth for every 1% of too low inflation. This is a reasonably good estimate, as this relationship is not linear.

If generally we consider 4% growth as very healthy (a figure of 7.4% is distorted in this respect by the recovery from the Covid pandemic lockdown of the economy), losing 1% - or a quarter, 25%, of the growth – is significant. And if we consider a cumulative effect of this phenomenon over the years, this shows how important it is to set the inflation target correctly and meet it for healthy running of the economy. Critically, this phenomenon doesn't appear to have been appreciated by central banks at all.

Example 4:

Problem statements:

How to manage productivity and economic performance, and how to calibrate regulations of different economy industries and sectors using inflation targeting?

1. Inflation equals to risk increases productivity and promotes innovation:

a) Let's assume, as it was typical for major developed economies in the last few decades – and it's implied by current low inflation targets - that risk (eg. as measured by Equity Risk Premia) was greater than inflation. For the simplicity of arguments, let's assume for now that all industries and sectors have the same risk profiles (as if it was all one system with uniform risk):

b) Then there will be:
i) providers of capital whose return beat the risk,
ii) providers of capital whose return didn't beat the risk, but beat the inflation, and
iii) providers of capital whose return didn't beat the inflation.

c) Providers of capital whose return didn't beat the inflation are making losses. In the middle or long term, they will be out of business.

d) Providers of capital whose return didn't beat the risk, but beat the inflation, can stay in business as they are making profit. According to our model developed in this article, such profits come at the cost of providers of labour and constitute an inequitable share of created wealth. They may be called, what Marxists call, but were never quantitatively precise about it, exploitation. Followers of Adam Smith should call it a subsidy from providers of labour.

e) Providers of capital whose return beat the risk can stay in business as they are making profit. According to our model developed in this article, such profits consist partly of gains resulting from beating the risk, which is equitable in terms of sharing of wealth created, ie. by being more productive than competitors, and partly of gains resulting from a margin between beating the inflation and the (average) risk, as if it wasn't beaten. And this latter part comes as the cost of providers of labour. (As stated above, it's the effect of inequitable share of created wealth. It may be called, what Marxists call, but were never quantitatively precise about it, exploitation. Followers of Adam Smith should call it a subsidy from providers of labour.)

d) Thus, keeping the inflation below the (average) risk keeps in business those less productive whose return is below the risk, but is above the inflation. Those whose return equals the risk make zero profit (as indeed it would be an outcome of perfectly competitive markets).

e) **When inflation meets the (average) risk, those providers of capital whose return is less than risk (and inflation), will be out of business. In such a scenario, those who are most productive, eg. inventors who believe they can beat the market, the risk, will start and stay in business. Their gain is possible because their individual risk is lower than the risk, ie. the average of risk of all economic actors.**

f) Ultimately, in such a dynamic equilibrium the risk in the economy is driven down by competition by those whose individual risk is equal or less than (average) risk. This, in turn, allows to lower the inflation, as the inflation target should be equal to the risk in such a model.

2. Inflation equals to risk helps calibrate regulations for different industries and sectors with inflation targeting.

a) In our analysis above, we assumed that all industries and economy sectors have the same risk profiles. Ie. from an economic perspective as if the economy consisted of one uniform industry or sector, which is never the case.

b) Let's assume that there are many different industries and sectors in the economic system which may have different risk profiles. The management of the economy by the state is based on the fact that the state can change risk profiles of different industries and sectors by changing laws and regulations, or by making investments in infrastructure, or by other market or legislative interventions.

c) If average risk of any individual industry or sector is higher than inflation such industry or sector will ultimately disappear. Therefore, if the state wants to keep such industry or sector alive, it must change laws and regulations, or act in some way, to bring the (average) risk of this industry or sector in line with the inflation. This is a counterpart of the situation whereby when wage increases for providers of labour in a certain profession stay below the inflation, in the middle or long term such a profession will cease to exist (as ultimately the wage will keep going exponentially to zero).

d) However, care must be taken not to over-intervene. Some industries or sectors may have to go due to, for example, technological innovation: new production methods, new substitutes, etc. It may not even be clear where to draw the borders between different industries and sectors.

e) **In this approach according to our model, maximisation of economic growth - across all industries and sectors - can be achieved by ensuring that inflation equals (average) risk. And, in turn, the management of individual industries and sectors can be done by managing their individual (average) risks, eg. allowing them to be above inflation, hence letting such industries or sectors disappear, or changing laws and regulations to bring average risk of individual industries or sectors to be equal to (average) risk (which is used as the inflation target) and letting them continue to exist.**

f) Our model seems to suggest that ensuring that all industries and sectors deemed by the state as vital for the economy have the same risk profiles defines the boundary of state intervention. This, however, doesn't mean that individuals within each industry or sector have the same risk profiles: these individuals have to compete to stay in business by ensuring that their return is no less than inflation. The former seems to be a counterpart of Marxists', or socialist, concepts of state intervention. The latter seems to be a counterpart of Smithian, or capitalist, concepts of *"the invisible hand of the market"*.

Conclusions:

Our model implies that economically productive behaviour by providers of capital is not when return is greater than or equal to inflation (which is a practical intuitive measure of being profitable), but when return is greater than or equal to risk. This implies that if inflation is greater than risk even some of those providers of capital who are productive, ie. those whose

return is greater than risk and less than inflation, will be out of business. This shows the damage to economy done when inflation is too high, ie. when it is greater than risk.

If inflation is less than risk, then providers of capital gain a higher share of wealth created than providers of labour. If inflation is greater than risk then providers of labour gain a higher share of wealth than providers of capital. In both cases, the growth is less than if inflation is equal to risk. Our model allows us to quantify these differences for specific instances.

If inflation is less than risk, the difference between risk and inflation, is a measure of loss of productivity in the economic system as it keeps those who are not productive in business, and its value is the measure of exploitation of providers of labour by providers of capital.

By symmetric analysis, if inflation is greater than risk, this difference between inflation and risk is a measure of loss of economic output as it puts out of business even some of those who are productive. This difference between inflation and risk is the measure of loss by providers of capital, putting all economic actors on an inflationary treadmill. Such a system is not sustainable as it would lead to cessation of economic output in the long term as it would be more beneficial to be a provider of labour than a provider of capital.

Practical challenges:

It's a practical challenge for the management of the economy to keep inflation equal to risk as closely as possible. Starting form accurately measuring both and then making sure than they are as close to each other as possible.

It's impossible in practice to have a static equilibrium when inflation equals risk. Such an equilibrium can only be achieved dynamically. That is that over time in the medium to long term average inflation will be equal to average risk. But this still may not prevent economic cycles, and crises in the short term. Whenever there is a difference between inflation and risk, its effects on economic growth still exist and have a compounding, exponential characteristic of contracting the economic base - when inflation is less than risk - or creating a bubble – when inflation is greater than risk.

Our model seems to explain why seemingly contradictory theories and approaches exist and are accepted within the economy: from laissez-faire to socialist economics. Our model shows that all of them are valid to a smaller or greater degree depending on the difference between inflation and risk. If risk is greater than inflation then our model argues for applying more of socialist economics than laissez-faire approach, and the other way round if inflation is greater than risk. If inflation equals risk, we need a balance. This conclusion leads to a policy challenge on how to achieve this.

APPENDIX 1, APPENDIX 3, APPENDIX 4

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