Hien, M.D.A. van (357756)

by M.D.A. van Hien

Erasmus School of Economics

Erasmus University Rottedam

The Fiscal Gold Standard

Author:
M.D.A. van Hien

Supervisors:
Prof. dr. C.G. de Vries (ESE)
M. de Kok (Pensioenfonds ING)

December 2016

Abstract

The Fiscal Gold Standard scenario is a scenario based on high economic growth and low inflation. Despite the fact that we are currently not on a monetary gold standard, it is not unlikely that such a scenario occurs in future times. Low inflation can be caused by structural low energy prices, further budgetary discipline in the EU and stricter financial legislation. All these factors do not limit economic growth opportunities through technological innovations. This study describes the economic environment for a pension fund in a Fiscal Gold Standard scenario and provides tools to foresee the start of this scenario timely. The main findings of this study are that, at this time, a technological revolution is not to be expected in the near future. However, it is shown that internet of things technology and nanotechnology have great potential to result in significant economic growth on the long-term. Lastly, the Fiscal Gold Standard can serve as an alternative view for the secular stagnation hypothesis.

Keywords: Gold standard, asset and liability management, Google Trends, Kondratieff cycles

JEL classification: N10, G23, E32

"Innovation is the central issue in economic prosperity"

— Michael Porter

"Just as energy is the basis of life itself, and ideas the source of innovation, so is innovation the vital spark of all human change, improvement and progress"

— Ted Levitt

Acknowledgements

The completion of this thesis marks the end of an very important chapter in my life. At the same time, it allows me to start the next chapter of life with full joy and excitement. Therefore, I would like to offer my sincere thanks to those who have contributed to this success.

I thank prof. Casper de Vries for his insightful and critical comments and suggestions. His door was always open whenever I had a question about my research or writing. He allowed me do my own research, but guided me to the right direction when he thought I needed it.

Special thanks to Maarten de Kok from Pensioenfonds ING for offering me the opportunity to do this internship. His never-ending enthusiasm and expertise was very inspiring and valuable. I also greatly appreciate Pensioenfonds ING for the warm welcome they gave me and for allowing me to use their facilities.

Moreover, I want to thank Hens Steehouwer from Ortec Finance for letting me use his data.

Finally, I want to express my profound gratitude to my parents and brother for unconditionally supporting me during my studies. For receiving that support, I am forever grateful.

Contents

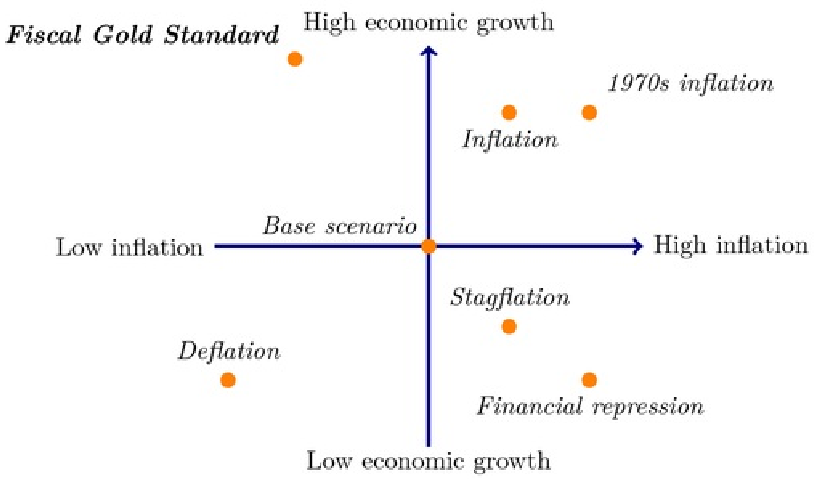
1 Introduction

This study gives a description of the development of a new alternative Asset Liability Management (ALM) scenario, the Fiscal Gold Standard (FGS). I worked on this study during an internship at Pensioenfonds ING as part of my master thesis. It is the purpose of this study to give an accurate view on the state of both the economy and the pension fund in the Fiscal Gold Standard scenario, a scenario of high economic growth and low inflation.

The main goal of an ALM study is to create a strategic policy framework. This strategic policy framework is used as a mechanism to address risks of a financial institution due to a mismatch between assets and liabilities. Since this scenario is developed for a pension fund, the mismatch occurs from the fact that a pension fund has long-term liabilities to its participants while it has short-term investment income streams. In practice, this implies that effects on inflation, (total) equity returns and interest rates are of major interest.

As an ALM study can be seen an iterative process, it is important to have a complete view on all possible states of the economy. This way, the pension fund is always aware of how assets and liabilities behave and it can adjust its investment and risk policy timely if necessary. By developing this new stress scenario, all quadrants in the scenario matrix in figure 1 below are filled by at least one scenario. As all quadrants are filled, this complete view on market movements gives the ability to create a solid strategic asset allocation policy. This prevents the pension fund from experiencing unexpected outcomes.

Figure 1: Schematic overview of scenario matrix



The Fiscal Gold Standard scenario serves not only the strategic asset allocation policy of the pension fund, but this high growth/low inflation scenario is also macro economically speaking very relevant. There is an universal belief that low or zero inflation is an important requisite for sustainable economic growth. Given that a new Kondratieff cycle might start soon (see chapter 6.2 for more details) and given that, based on break even inflation rates, inflation will stay low for the coming years, it is not unlikely that such a scenario occurs in future times. Also, economic history shows that the combination of high economic growth and low inflation are not a strange couple. During the Classical Gold Standard (1870 - 1913), inflation rates remained low and stable on the long term, while economic growth flourished. This is where the analogy to the gold standard comes from.

Despite the fact that there is no gold standard nowadays, there are multiple factors that can replicate this setting in the current economy. For example, low inflation can be reached as a result of structural low energy prices, while welfare gains can lead to economic growth. Also, due to further budgetary discipline in the European Union and stricter financial legislation, inflationary pressure is not expected from this side. This is where the term "fiscal" refers to. All these factors lower inflation rates without limiting economic growth opportunities through technological innovations.

104

Using a panel consisting of the Netherlands, United States, United Kingdom and Germany, the scenario of high growth and low inflation is estimated based on data from the Classical Gold Standard (1870 - 1913). As a technological revolution is the most likely driver of high economic in a setting of low inflation, a framework to timely foresee this revolution is also developed.

This study continues as follows. Chapter 2 gives an economic description of the historical context and the main differences to present economic times. Chapter 3 analyses the data for this study. Next, chapter 4 describes the methodology used for the forecasting results in 5. Also, chapter 4 develops a framework to timely foresee technological innovations using Google Trends. Results of these foreseeings and other factors that can trigger the Fiscal Gold Scenario are discussed in chapter 6.

2 Historical context

This chapter gives a short description of the economic situation in the late 19^{th} century. Finally, differences with the present economic world are presented.

The period 1870 - 1913 is characterised by a myriad of economic events. Technological changes occur rapidly after each other and earlier innovations are implemented at the production level. This results in significant efficiency improvements. Helped by low inflation levels (or even deflation), the economy experiences a steady growth. Both efficiency improvements as well as low inflation levels contribute to substantial wealth increasements. The stable price level is a consequence of the gold standard.

The gold standard is a monetary system where the value of a currency is based on fixed amount of gold, determined by the monetary authority. During the gold standard, the price level is a result of demand and supply of gold. Since every economy under the gold standard has a fixed exchange rate, the domestic price level is mainly determined by global (exogenous) factors. Among others, examples of global exogenous factors are periods of war (as economies temporarily abandoned the gold standard to finance their wars) or failed harvests causing food prices to rise.

Since the Great Depression of the 1930s, deflation is associated with economic depression. However, the sub-period of interest in the gold standard (1870 - 1913) shows that this is not by definition true. One has to distinguish between so called *good* and *bad* deflation. Good deflation occurs when aggregate supply increases more rapidly than aggregate demand (Bordo, Lane, and Redish 2004). This good deflation has various possible sources: 1. Positive technology shocks, 2. Reallocation of resources from sectors with declining returns to scale to sectors with increasing returns to scale, 3. Price decreases due to abolishment of trade barriers (Saxonhouse 2005). On the other side, bad deflation occurs in the contrary situation, hence when aggregate demand declines faster than aggregate supply rises. Generally speaking, deflation during the gold standard can be classified as good deflation.

By adhering to the gold standard, an economy profits from various advantages. The gold standard functions as a catalyst for capital mobility and further integration of international commodity markets (Zanden and Riel 2000).

A second advantage is that gold standard economies are, by the market, perceived as more trustworthier than other economies. This results in lower interest rates for government debt. Consequently, these economies have lower fiscal deficits and inflation levels (Rockoff and Bordo 1996). The gold standard causes the money supply to vary automatically with the balance of payments. The fixed price of gold (in terms of a specified amount of gold) serves as a credible mechanism to prevent governments of creating surprise fiduciary money issues in order to capture seignorage revenue. This avoids problems of high inflation and stagflation (Bordo and Kydland 1995).

In making a comparison between economies of the late 19^{th} century and the current situation, several issues need to be noted.

Firstly, during the classical gold standard, all economies are linked via a common adherence to the convertibility rule and are thereby all facing the same money shock. One can see similarities to the eurozone because of the fixed exchange rate in the eurozone. This is not the case outside the eurozone, so exchange rates do affect the economy.

Secondly, economic shocks the gold standard economy faced between 1870 and 1913 mainly consists of supply side shocks. This is in contradiction of the findings in deflationary periods in the 20^{th} century as a result of monetary contraction. However, the contemporary economy in Europe and the US is closer to the classical gold standard than to early 20^{th} century (Bordo, Lane, and Redish 2004).

Third, during the classical gold standard, the zero nominal bound is not perceived as a problem, as central banks did not use monetary policy to stimulate the economy. However, central do so nowadays.

Theoretically speaking, there are no restrictions for nominal interest rates to turn negative. In case the central bank supplies the banking system with enough reserves (such that the interbank rate becomes zero) and charges banks a per period fee for storing their money at the central bank, the nominal interest rates turns negative. Yet it is not very likely that central banks inject extra reserves into the economy in a Fiscal Gold Standard scenario, at which this study focuses on. This is usually done to stimulate the economy, but not an obvious policy when economic growth is already high (as is the case in the Fiscal Gold Standard scenario).

All in all, the economy as it is nowadays shows more similarities to the period of the Classical Gold Standard than one may think at first glance. This makes this period very suitable for this study.

3 Data

This section analyses the data for the scenario analysis graphically and numerically. This offers a simple way to get a feeling of the behaviour of the data and acquire useful characteristics for the more advanced analysis.

The underlying period for this scenario (1870 - 1913) is a subperiod of the gold standard. This era is chosen for its economic characteristics of high economic growth and low inflation. All data for the Netherlands, the United States and the United Kingdom come from Steehouwer (2005), unless stated otherwise. Data for Germany originates from various sources, which are mentioned in the specific sections.

3.1 Economic growth

Economic growth is measured by changes in national product (GNP) per capita. Data about the German GNP comes from Maddison (2013). Figure 2 gives a graphical presentation of real changes in GNP per capita of the four countries considered. Table 1 gives a statistical summary of the GNP data. The GNP data are measured in real terms which means that these are corrected for price changes.

From the figure, it is can be seen that all countries experience periods of both economic growth and decline and that all countries experience on average a positive growth. The Dutch economic growth fluctuates the most, as the maximum growth is 12.9%, while the largest decline is -10.4%. These heavy fluctuations occur primarily in the first half of the sample; in the second half is the economic growth more stable. The opposite applies to the United States (US) economy as the biggest spikes in GNP per capita changes occur in the second half of the sample. GNP per capita growth of the United Kingdom (UK) and German economy is more evenly spread around their averages, with less outliers.

In general, the development in GNP growth of the four countries follows more or less the same path, yet with varying magnitudes and possibly some lag. This is possibly due to the economies reacting to main events affecting all economies or the economies being linked to each other due to trade activities. As table 2 shows the link between economies at the time was not as strong as it is today. In the late 19th century, mainly the Netherlands and the UK show a strong correlation. This due to both economies having a powerful merchant navy. This also explains the (relatively) strong link of both economies with the US. Nowadays, the GNP growth is even more correlated due to various trade treaties and further globalisation.

Although every variable is influenced by population developments, only economic growth is corrected for this by using per capita growth. The reason behind this is that population growth can have both upwards and downwards effects, however, since it is unsure which variable is affected by what extend, it is chosen to take a neutral position. On average, all effects will cancel out against each other.

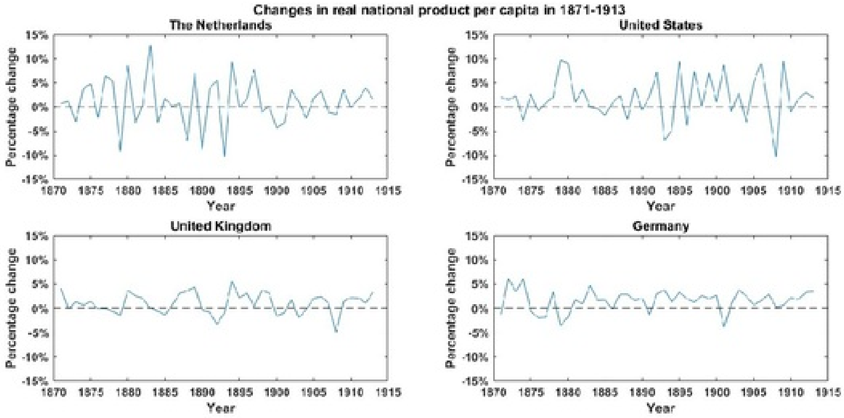


Figure 2: Changes in real national product per capita from 1871-1913

Table 1: Statistical characteristics of real GNP per capita growth

	The Netherlands	United States	United Kingdom	Germany
Average growwth	0.9%	1.8%	1.0%	1.6%
Standard deviation	4.9%	4.5%	2.2%	2.2%
Maximum	12.9%	9.7%	5.6%	6.1%
Minimum	-10.4%	-10.5%	-5.0%	-3.9%
Average during upturn	3.8%	4.2%	2.3%	2.5%
Average during downturn	-3.9%	-2.7%	1.2%	-1.8%

Table 2: Comparison between correlation coefficients of growth in real GNP per capita from 1870 - 1913 and 1985 - 2015.

Period: 1870 - 1913

	NL	US	UK	GER
NL	1.00			
US	0.20	1.00		
UK	0.23	0.15	1.00	
GER	0.07	-0.29	0.03	1.00

Period: 1985 - 2015

	NL	US	UK	GER
NL	1.00			
US	0.64	1.00		
UK	0.55	0.85	1.00	
GER	0.67	0.37	0.31	1.00

3.2 Production

To explain the economic growth, it is useful to look at the evolution of production. Since not only industrial production, but also agriculture production is a significant part of the GDP at the time, I distinguish between the two.

All economic production data are composed by Smits, Woltjer, and Ma (2009) of the Groningen Growth and Development Centre and are all value added volume indices.

Agriculture production
In 1870, the agriculture sector in the Netherlands has a share of approximately 30% of the GDP, slowly decreasing to 19% (Horlings and Smits 1997; Brouwer 2005). For the US, agriculture has an even larger share in GDP: in 1870, 38% of the GDP originates from agriculture activities, decreasing to 22% in 1913 (Alston et al. 2009). Agriculture in the United Kingdom accounted for 15% of the GDP in 1870, which decreases to only 6% in 1907 (Solomou and Wu 1999). This relatively low share in GDP is due to the United Kingdom being a pioneer in the process of industrialisation. Hence, the transition from an agriculture driven economy to an industrial economy was in an advanced stadium during the period of interest of this study. This also explains the declining growth in British agriculture production.
As a reference, agriculture production in 2014 has a share in the Dutch GDP of 2%, 1.3% in the US and 0.7% in the UK. Agriculture activities also include forestry and fishery.

All indices are re-standardised to 1870 to make relative comparison easy. Data for the US starts in 1889, however, there is a data point available for 1870 so all US data can be based on their relative level in 1870. Figure 3 below shows a clear increasing development in agriculture production for all countries, except for the UK. The US has the largest increase in agriculture production; its agriculture production almost three-doubled. The main reason for the increasing agriculture production is the invention of fertilisers (Zanden 1985).

Table 3: Statistical characteristics of agriculture production

	The Netherlands	United States	United Kingdom	Germany
Average growth	0.6%	1.2%	-0.2%	1.6%
Standard deviation	4.9%	5.7%	6.1%	4.2%
Maximum	12.1%	16.8%	18.9%	13.2%
Minimum	-11.6%	-14.0%	-21.7%	-6.8%
Average during upturn	1.4%	0.9%	0.9%	2.6%
Average during downturn	-1.7%	2.5%	-6.0%	-3.5%

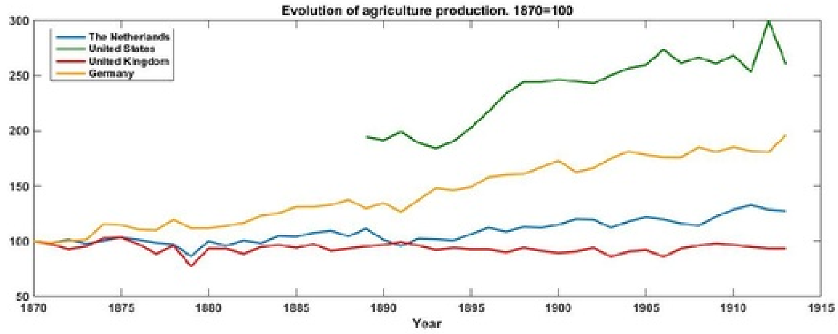


Figure 3: Agriculture production 1870-1913

Industrial production

While agriculture production became less important for GDP, industrial production took an increasing share of GDP over time. For the Netherlands, 24% of the 1870 GDP level originated from industrial production, while in 1913 this was equal to 31% (Horlings and Smits 1997). As a reference, 22% of the current Dutch GDP originates from industrial productivity, for the US this number is equal to 20%. Industrial production includes manufacturing, construction, utilities and mining.

As can be seen in figure 4, all countries experienced a large increase in industrial production. The US industrial production increased the most; almost 800% relative to the same in 1870. On average, the annual industrial production growth is higher than the average growth in GDP. An explanation for this is the increasing industrialisation of the production process.

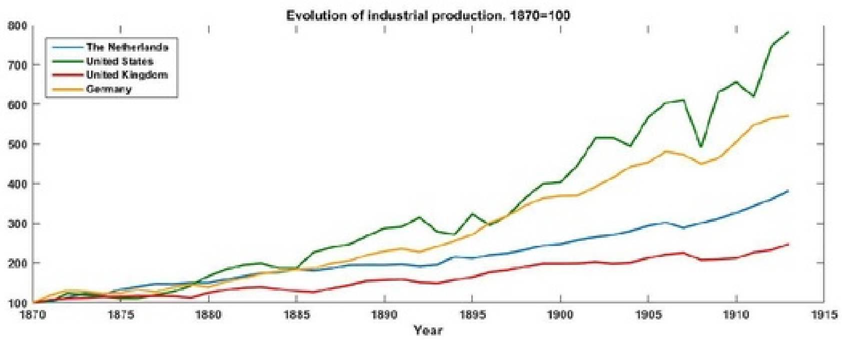


Figure 4: Industrial production 1870-1913

Table 4: Statistical characteristics of industrial production

	The Netherlands	United States	United Kingdom	Germany
Average growth	3.1%	4.8%	2.1%	4.1%
Standard deviation	3.4%	9.0%	3.8%	4.6%
Maximum	12.1%	25.0%	9.8%	17.3%
Minimum	-4.6%	-21.8%	-8.4%	-5.7%
Average during upturn	3.0%	7.1%	3.4%	4.2%
Average during downturn	3.5%	-7.1%	3.9%	3.2%

3.3 Inflation

Inflation is measured by changes in consumer price index (CPI). German data originates from the Alvaredo, Atkinson, Piketty and Saez wealth-income dataset (2015). Figure 5 gives a plot of changes in CPI over the period of interest. Based on this graph, it can be concluded that all four countries experience periods of negative inflation, i.e. deflation. Especially for the Netherlands, the United States and the United Kingdom, there are multiple periods of deflation or very low inflation. Periods with high inflation and (large) deflation alternate through time, which results in low average inflation numbers for all countries and is in line with the expectations during the gold standard. This implies that prices adjust rapidly to changes in business cycles. Table 5 describes this also numerically.

Figure 6 on page 13 gives a scatterplot with changes in GDP and inflation. This confirms the presence in all countries of periods with high economic growth and low or negative inflation, especially for the United States, United Kingdom and Germany. The large number of dots in the second quadrant of subfigure *(e)* shows that a scenario of high growth and low inflation is very relevant. These plots demonstrate the presumption that economic growth does not always have to go in hand with positive inflation levels.

Deflationary periods in the classical gold standard differs from deflation during the depression of the 1930s. As already mentioned in chapter 2, deflation in the gold standard can be classified as good deflation, while on the other hand deflation during the 1930s Depression is classified as bad deflation (Bordo, Lane, and Redish 2004). Bernanke and James (1991) offer two explanations why bad deflation is observed in the 1930s. These do not apply to deflationary periods in the gold standard.

First, since wages hold a certain degree of nominal rigidity, falling prices raises real wages and lowers labour demand. Assuming downward stickiness of wages, this also results in lower profitability and reduced investments. Yet this is somewhat questionable in the context of the 1930s. Taking in to account the high unemployment rate and falling costs of living, it is questionable why nominal wages remained at the same level (Bernanke and James 1991).

The second reason provided by Bernanke and James (1991) originates from deflationary effects on the financial system. Deflation weakens the financial position of borrowers since debt deflation squeezes their capital position. A weaker position of borrowers limits their investment possibilities and worsens agency problems in the borrower-lender relationship, impairing access to new credit. Hence, deflation during financial distress could cause a dead-weight loss on an economy.

Table 5: Statistical characteristics of inflation data

	The Netherlands	United States	United Kingdom	Germany
Average inflation	0.7%	0.3%	0.5%	1.1%
Standard deviation	5.2%	3.0%	4.3%	3.4%
Maximum	9.0%	7.0%	9.9%	9.5%
Minimum	-14.1%	-7.0%	-7.2%	-8.8%
Average during upturn	1.3%	0.4%	0.4%	0.8%
Average during downturn	-0.9%	-0.2%	0.1%	2.2%

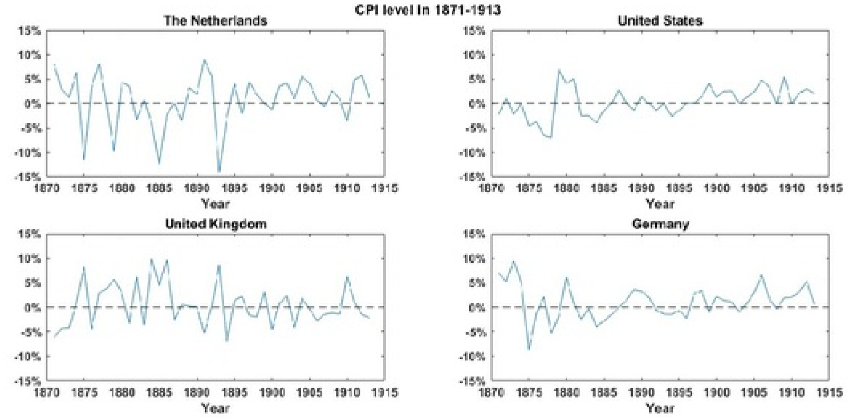


Figure 5: Inflation level in 1871-1913

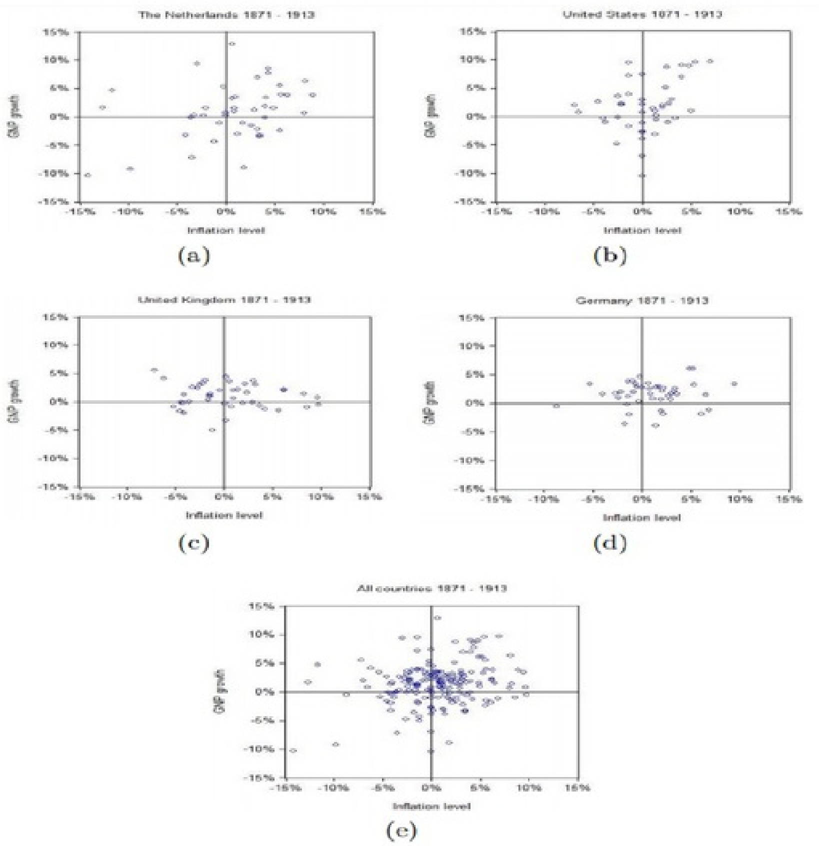


Figure 6: Scatterplots of growth in national product vs. inflation level

3.4 Money stock

During the gold standard, the money stock is determined by the amount of gold mined and, to a lesser extent, by an external money multiplier (e.g. in the form fractional reserve banking (Bordo 1990)). Here, the money stock is defined as M2, hence all financial assets held principally by households. Annual data for the Dutch money stock are approximated by percentages of GDP as given by Rousseau and Sylla (2001). Money stock data for the US and UK originate from Friedman and Schwartz (1963) and data for Germany are from Tilly (1973).

Figure 7 on page 14 shows the growth in money supply relative to the inflation level. From this figure, it can be seen that for all counties the expansion of money can partly explain the inflation level. This effect is more pronounced for the US, the UK and Germany. A statistical summary of money stock data is given in table 6. An important observation from this table is the large difference in money stock growth during periods of economic upturn and downturn. Since gold mining was relatively stable from 1870 to 1913, this difference supports the view that economic activity is influenced by the money stock. In times of economic upturn, the demand for money rises which can be supplied by fractional reserve banking. This is a widely observed in the late 19$^{\text{th}}$ century (Bordo 1990). This implies that, during the gold standard, not only gold mining but fractional reserve banking influences money supply as well.

Table 6: Statistical characteristics of money stock data

	The Netherlands	United States	United Kingdom	Germany
Average growth in money stock	3.8%	5.7%	1.9%	5.3%
Standard deviation	10.2%	5.3%	2.4%	6.1%
Maximum	62.6%	20.1%	10.0%	24.1%
Minimum	-9.5%	-4.3%	-3.8%	-11.0%
Average during upturn	4.9%	7.4%	2.4%	6.2%
Average during downturn	1.9%	2.5%	1.2%	1.7%

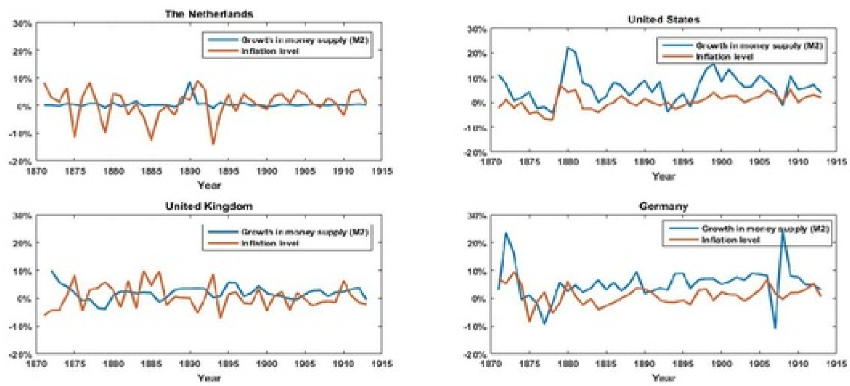


Figure 7: Growth in money supply (M2) vs. inflation level

3.5 Total equity return

Total equity returns are measured as logarithmic returns of real equity price indices. All returns are taken from local currencies, so there are no currency effects. Data of the German equity price index come from the Alvaredo, Atkinson, Piketty and Saez wealth-income dataset (2015). As displayed in figure 9, all countries have volatile equity returns. This volatility arises from the limited variety in stocks, mainly consisting of the railroad, banking and (coal) mining industry (Cowles 1939). Therefore, a shock to one of these industries has a large effect on the total equity returns. Figure 8 depicts this graphically.

On average, all countries have a return of approximately 1%, but all are also exposed to large swings in returns. Primarily around 1874, 1892 and 1902 returns were rather negative, possibly due to the respective financial crises in these years affecting all industrial nations. Table 7 gives a summary of statistical characteristics of the equity returns. This shows that total equity returns are significantly higher in periods of economic growth than in periods of economic downturn.

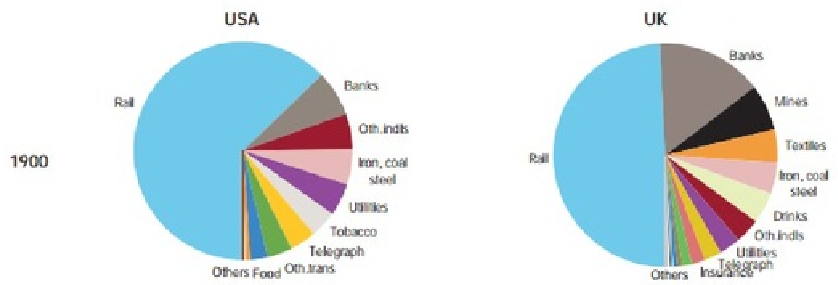


Figure 8: Industry weighting in equity markets. Source: Dimson, Marsh, and Staunton (2002). US based on total market, UK in Top 100 companies.

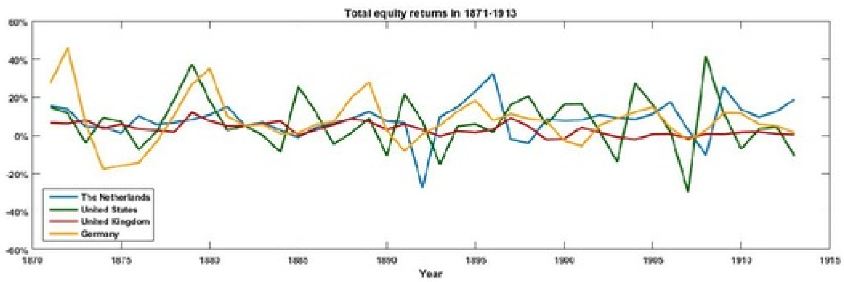


Figure 9: Equity returns in 1871-1913

3.6 Interest rates

Interest rates influence equity returns. Since short term interest rates and long term interest rates may have a different impact, I consider both. Further, it is important to analyse the behaviour of long term interest rates since it impacts the obligations of the pension funds. A higher long term interest rate results into lower long term obligations due to discounting.

Table 7: Statistical characteristics of total equity returns

	The Netherlands	United States	United Kingdom	Germany
Average equity returns	8.3%	6.8%	3.4%	7.6%
Standard deviation	9.3%	13.7%	3.3%	12.3%
Maximum	32.4%	41.7%	12.0%	46.1%
Minimum	-27.5%	-29.5%	-2.3%	-17.8%
Average during upturn	8.9%	6.1%	3.6%	7.4%
Average during downturn	6.8%	-10.2%	2.2%	8.3%

Both short term and long term interest rates for Germany are taken from Homer and Sylla (2005).

Short-term interest rates

In this analysis, the short term interest rate is equal to cash loan interest rate for the Netherlands, the open market discount rate for the UK and Germany and short term commercial paper interest rate for the US. Figure 10 gives a graphical presentation of the development of these interest rates. From this figure, it can be deduced that the short term interest rates remain fairly constant over time and that there exists an inverse relation to equity returns, i.e. when short term interest rates rise, equity returns decline. Further, one can see that the market perceives the US as the most risky country at that time.

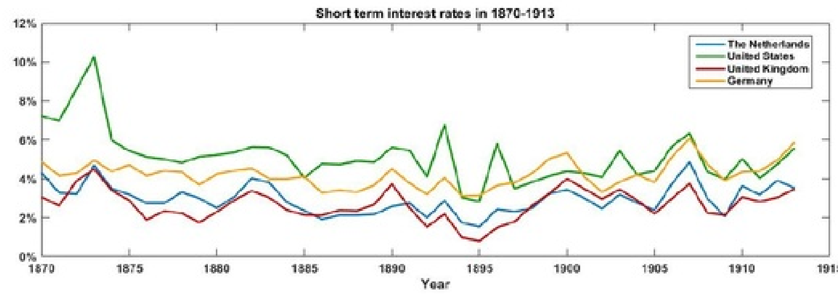


Figure 10: Short-interest rates in 1871-1913

Table 8: Statistical characteristics of short-term interest rates

	The Netherlands	United States	United Kingdom	Germany
Average short term interest rate	2.9%	5.1%	2.7%	4.2%
Standard deviation	0.7%	1.3%	0.8%	0.7%
Maximum	4.9%	10.3%	4.5%	6.1%
Minimum	1.5%	2.8%	0.8%	3.1%
Average during upturn	2.9%	5.1%	2.7%	4.2%
Average during downturn	3.0%	5.0%	2.5%	4.1%

Long-term interest rates

Government bonds with longest remaining time to maturity are used as a proxy for the long term interest rate for all countries. Figure 11 reports the development of these interest rates over time. It can be seen that these all decline until around 1898, and starting to rise thereafter. The volatility of the long term interest rates is on average roughly half of the volatility of the short term interest rates. Thus, long term interest rates are twice as stable as the short term interest rate, which is in line with expectations of long interest rates behaviour.

As table 8 and 9 indicate, there is an inverted yield curve in this sample for the US and Germany, and a marginal spread in interest rates for the UK. This is due to the fact that short-term interest rates mostly consists of loans to less creditworthy firms (and consequently a higher risk premium), while long-term interest rates are based on a safe government and bigger, more stable firms.

A second explanation for this phenomenon is that this period has a very stable price index on the long term (expected inflation is approximately equal to zero). As a result, the long-term interest rate has a relatively low inflation component in the yield of long-term nominal bonds (Geiger 2011).

A similar situation arises in more recent years. During the periods of 1970 - 1990 and the current 2010s, low expected economic growth and perceived threat of price deflation has two effects on interest rates. The first is that the inflation risk premium is very low. This compensates investors for potential losses in purchasing power. A second effect is that low interest rates are perceived as indicative for downgrading of long-term expected economic growth. This latter phenomenon was not present during the gold standard as economic growth was primarily (very) positive.

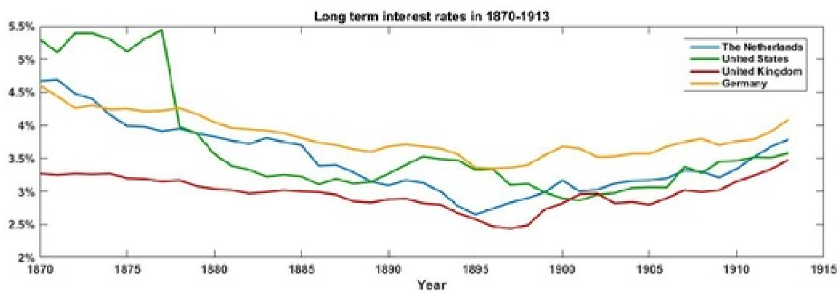


Figure 11: Long-term interest rates in 1871-1913

Table 9: Statistical characteristics of long-term interest rates

	The Netherlands	United States	United Kingdom	Germany
Average long-term interest rate	3.5%	3.6%	3.0%	3.8%
Standard deviation	0.5%	0.8%	0.2%	0.3%
Maximum	4.7%	5.4%	3.5%	4.6%
Minimum	2.7%	2.9%	2.8%	3.4%
Average during upturn	3.4%	3.6%	3.0%	3.8%
Average during downturn	3.5%	3.6%	2.9%	4.1%

3.7 Exchange rates

Figure 12 shows the exchange rate to the US dollar in indices of the respective countries. Data about the German exchange rate originates from Edvinson (2016).

The German mark appreciates by 16% from 1873 to 1881, to remain stable around this level afterwards. This appreciation is due to the effects of a 500 francs war indemnity (33% of the French GDP at the time) from the French - German war ending in 1871. As well as for the German mark, the Dutch guilder and British pound behave relatively volatile around 1873. It is most likely that this is a effect of the aforementioned French - German war, whose sea blockades frustrated Dutch and British maritime trade. All currencies tend to move in the same direction, but their fluctuations are relatively small.

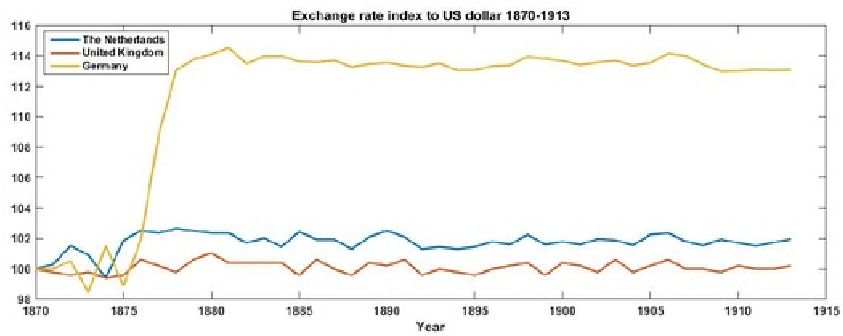


Figure 12: Exchange rate index to US dollar in 1870-1913

3.8 Unemployment

Figure 13 plots the unemployment rate over time. Unfortunately, there was no data available for Germany and for the US before 1890. Data for the Netherlands are available from Statistics Netherlands
Statistics Netherlands (2014). Note that these data are estimates for the unemployment rate and that no adjustments have been made for hidden

unemployment. The informal sector of the economy was of significant size during the underlying period.

Unemployment rate of the Netherlands remains very stable over the period of interest. There seems no link to connection to economic growth. This deviation from data of the US and UK is possibly due to different definitions of unemployment. Statistics Netherlands defines the unemployment rate as the percentage of the labour force who is willing to participate in the labour process for more than 12 hours a week, but is unable to do so. It is very likely that the Dutch definition of unemployment at that time differs from the definition Statistics Netherlands uses nowadays. Therefore, are critical note on this data needs to be made. As labour unions only started to organise their bargain power late 19th century and as GDP shows very large fluctuations, it is unlikely that this did not result in larger swings of Dutch unemployment. In further analyses of this study, Dutch unemployment rates are not taken into account.

Data for the US and UK are much more volatile and show a more clearer link to changes in national product. As expected, higher economic growth results in a lower unemployment rate.

High unemployment rates for the US from 1893 to 1898 are results of the Panic of 1893, caused by financial and political turmoil in Argentina in 1890.

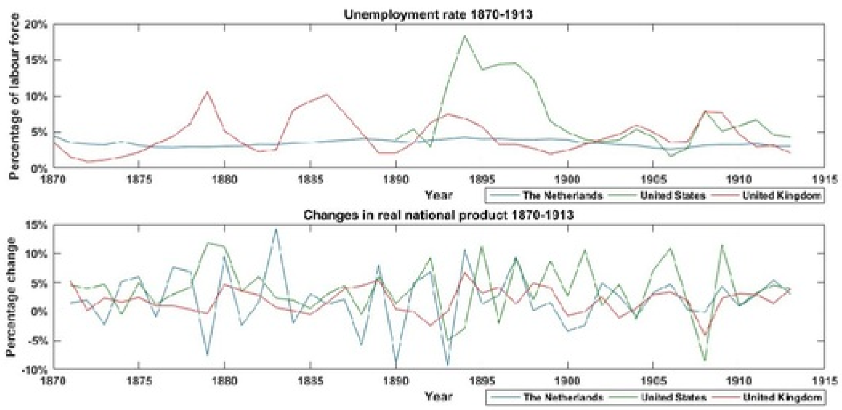


Figure 13: Unemployment rate in 1870-1913 (1890-1913 for US)

Table 10: Statistical characteristics of unemployment rates

	The Netherlands	United States (1800-1913)	United Kingdom
Average unemployment rate	3.5%	7.1%	4.5%
Standard deviation	0.4%	4.4%	2.4%
Maximum	4.3%	18.4%	10.7%
Minimum	2.7%	1.7%	0.9%
Average during upturn	3.4%	5.9%	4.0%
Average during downturn	3.5%	11.6%	6.9%

3.9 Energy prices

Since energy costs are a significant part in production costs, low energy prices can have a deflationary pressure and are therefore of great importance in this scenario analysis. As a proxy for these energy costs, coal is used since it was the dominant energy source for both producers and households in the late 19^{th} century. In 1870, 25% of the of the total US energy consumption was allocated to coal, rising to a 70% level in 1900 Schurr and Netschert (1960). US coal prices are from the United States Bureau of the Census (1975), Dutch coal prices originate from Horlings and Smits (1996).

Comparing the bituminous coal prices in figure 14 to the inflation levels in their respective countries, confirms the expectation that low coal prices have a deflationary effect. This is a more pronounced effect for the US. One explanation for this is that Dutch wages rose much quicker than wages in the US (Zanden and Riel 2000). The relative price of capital to labour rose by 70% for the Netherlands, while this was only 56% for the US. Since wages are one of the largest cost drivers in the production process, higher wages drive up inflation and partly cancel out the effect of low energy prices.

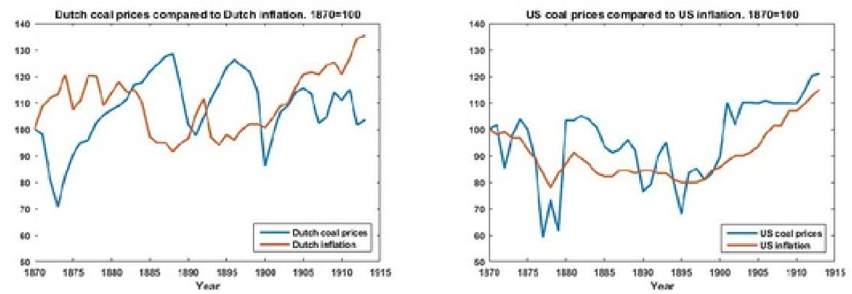


Figure 14: Development of Dutch and US coal prices compared to Dutch and US inflation

3.10 Real estate

As a proxy for real estate prices, the Herengracht price index by Eichholtz (1997) is used. This price adjusted index provides biennial data starting in 1628, so linear interpolation is used to come up with data for the intermediate periods. Further, the indices are re-standardised to 1870 to make relative comparisons easier.

This index shows a steady growth in real estate prices until 1882 whereupon it starts to drop until 1890. On average, the index growths by 0.5% a year, with a standard deviation of 4.1%. The biggest price drop is -9.6%, the highest price gain is 8.8%.

Figure 15: Herengracht price index

4 Methodology

This section describes the methodology used for determining the effects of the parameters in the "fiscal gold standard" scenario. These effects are estimated using a vector autoregressive model. Before estimating the model, the variables are tested on the presence of stationarity. Further, the lag length of the model is determined and a comparison between two types of panel models is made.

As technological innovations are the main growth drivers in this scenario, a framework is set up to foresee the introduction of these innovations. This is done by detecting trends in popularity of internet search terms. Section 4.2 elaborates on this.

4.1 Estimating the dynamics of the economy

Vector autoregressive models

Vector autoregressive (VAR) models are flexible models introduced by Sims (1980), used as an alternative for multivariate simultaneous equations models for macroeconometric analysis. A VAR model describes the dynamic evolution of the variables based on their common past (Verbeek 2012). The length of this past is determined by the number of lags in the model. Information criteria as Akaike's information criterion, Schwarz criterion or the Hannan-Quinn criterion give guidelines for this.

A simple VAR model, consisting of two variables, X_t and Y_t, and one lag is written as

$$\begin{bmatrix} X_t \\ Y_t \end{bmatrix} = \begin{bmatrix} \delta_1 \\ \delta_2 \end{bmatrix} + \begin{bmatrix} \theta_{11} & \theta_{12} \\ \theta_{21} & \theta_{22} \end{bmatrix} \begin{bmatrix} X_{t-1} \\ Y_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \end{bmatrix} \quad (1)$$

By assuming the values of theta being nonzero, it is clear that the past of X helps explaining Y. Since all equations have the same explanatory variables, simple ordinary least squares (OLS) can be used in estimating the coefficients equation by equation. This gives the same result as using a system estimator (Verbeek 2012).

In contrast to simultaneous structural models, a VAR model does not require the user to explicitly specify all variables as either exogenous or endogenous. In fact, it treats all variables as endogenous. Not having to specify the variables is an advantage since it is not always clear which variables should be treated as exogenous. Furthermore, a VAR model is a flexible model since the coefficients of the variables depend on both their own lag(s) as well as those of the other variables. Hence, a VAR model takes the dynamics of the economy into account in estimating the model.

Yet there are some drawbacks in using VAR models. One of these is that a big VAR model increases the danger of overfitting of the variables. As can be seen from equation 1, the case of a variables and b lags in each equation results in the total number of parameters to be estimated equal to $a + ba^2$. Especially in the case of limited availability of data, degrees of freedom are rapidly used up, leading to large standard errors in the estimated coefficients.

A second drawback is that VAR models may, from an economic perspective, show spurious results. This is due to the fact that VAR models capture little of the theoretical information in the relation between the variables (Brooks 2008). This latter issue can be solved by restricting the behaviour of variables by estimating a structural VAR model.

Model selection

In studying the effects of the fiscal gold standard scenario, two types of models are estimated. These are individual models for each of the four countries considered and a panel model where all countries are pooled in one model. The advantage of the latter model is that amount of available data increases, resulting in more accurate coefficient estimates. Both type of models are estimated using two sets of variables: the main ALM parameters and a secondary set of alternative parameters.

The set of main Asset Liability Management (ALM) parameters consists of economic growth, inflation, interest rates and total equity return. The alternative set of parameters is composed of agriculture and industrial production, unemployment, energy prices and real estate prices.

This first set of parameters are used to describe the economic environment in case of a fiscal gold standard. The state of the economy influences the assets and liabilities of the pension fund to great extend.
The second set of alternative parameters give a wider view of the economic situation. They are used to see whether changes in economic parameters can help to foresee the occurrence of a fiscal gold standard scenario.

Stationarity

Before estimating the model, it is important to test the data on stationary, i.e. they do not have a stochastic trend. This is economically relevant since it corresponds to economic stability which makes it easier to draw correct conclusions.

If non-stationarity in the time series is detected, one can check whether the variables are cointegrated. If cointegration applies, one can still run a VAR model in levels. Despite the stochastic trend, the estimates are super consistent and therefore very reliable. This is common practice in monetary economics.

The case differs if cointegration is not found. Then the levels regression may give spurious results. To correct for this, one can take first differences of the non-stationary series or alternatively by removing trends from the time series. Using the latter method, only fluctuations around the trends remain which makes the time series more suitable for economic analysis (Steehouwer 2005).

The use of the first differencing method can be demonstrated by a simple (general) example. A series is said to be stationary if the largest root α of the equation

$$z^p = \alpha_1 z^{p-1} + \alpha_2 z^{p-2} + ... + \alpha_{p-1} z + \alpha_p \quad (2)$$

is $|\alpha| < 1$. Now take the random walk $x_t = x_{t-1} + \varepsilon_t$, where ε_t is a white noise process. Clearly, this random walk is non-stationary, as it can be written as $x_t = \alpha x_{t-1} + \varepsilon_t$ with $\alpha = 1$. Taking first differences results in $\Delta x_t = x_t - x_{t-1} = \varepsilon_t$, which is stationary.

Testing for stationarity

For the sake of simplicity, in this study, stationary is tested by the Fisher type Adjusted Dickey-Fuller test. This is a unit root test for panel data, but also gives results of the unit root tests for the individual countries. The advantage of this specific test is that it allows the autoregressive coefficients to vary freely across cross-sections. This feature makes Fisher type unit root tests very flexible.

Output of these tests are reported in the appendix (tables 25 up to 29). From here one sees that all variables are stationary, except for the long-term interest rate (see table 29 on page 60). This is in contradiction to the expectation based on the graphical presentation of the data in figure 16 at the next page. However, the outputs of these tests are based on asymptotic results and since relatively few data is available for this study, the unit root test output for the long-term interest rate suffers from methodological issues. Hence, the power of this test is relatively low and based on the long term, it can be stated that the long-term interest rate can be treated as stationary and that no adjustments have to be made.

According to economic theory, as long as monetary policy is reliable, interest rates are mean reverting i.e. they revert to their long-term average as time goes by. This is plausible since central banks influence interest rates with their monetary policy to control inflation and economic growth. However, empirics show that long-term interest rates are actually not mean reverting and thereby close to a random walk (Stock and Watson 1988). This is due to the long memory of shocks in interest rates (End 2011).

All in all, one can conclude that test results for long-term interest rates are in line with empirics but based on economic expectations, one can still treat long-term interest rates as a stationary time series. This is a valid assumption for countries with a credible monetary policy regime.

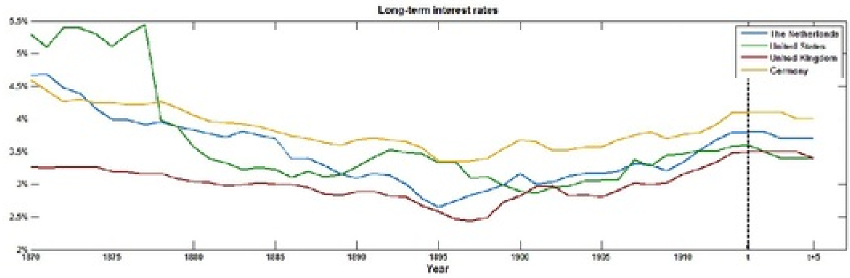


Figure 16: Long-term interest rates data in and out of sample. Out of sample data points are generated by forecasts. Chapter 5 expands on these results.

Lag length

As mentioned before, the number of lags is determined by the Akaike information criterion (AIC), the Schwarz-Bayesian criterion (BIC) and Hannan-Quinn criterion (HQ). Typically, models with lower values of information criteria are preferred. The main difference between AIC and BIC is that BIC penalizes models with more free parameters heavier and therefore gives preference to smaller models to prevent the model from overfitting. HQ usually prefers a model in between AIC and BIC (Lütkepohl 2011).

As table 30 up to 33 in the appendix show, AIC indicates that for all models a lag length of five should be selected. The more stricter BIC and HQ criteria advise a lag length of one, expect for Germany where HQ also suggests to use five lags in the model. However, all models are estimated using one lag. This is based on the relatively small amount of data available and to prevent the model of showing unexpected behaviour. The latter issue can arise when the degrees of freedom are used up rapidly. This occurs when little data is used in combination while lots of coefficients need to be estimated (i.e. a combination of many parameters and/or lags).

Model checking

Table 11 gives an overview of the expected coefficient signs of the estimated VAR models. Plus signs indicate a positive relation between previous periods value and current periods value, a negative signs indicate an inverse relation between the previous period and current period.

Before discussing the expected signs for each equation, a general note on the autoregressive element needs to be made. Statistically, there exists the danger of an explosive autoregressive process. Explosive behaviour in AR processes show a close link to non-stationarity and therefore limit the ability to draw correct conclusions. If a series is stationary, it will be in general non-explosive as well. Equation 3 below shows an example of an

Table 11: Overview of expected coefficient signs in estimated VAR models. Values in parentheses denote the order of lagged variables.

	ΔGNP	**Inflation rate**	**Equity return**	**Short interest**	**Long interest**
ΔGNP(-1)	+/-	-	+	+	+
Inflation rate(-1)	-	+/-	-	+	+/-
Equity return(-1)	+	+	+/-	+	+
Short interest(-1)	-	+	-	+	+
Long interest(-1)	-	+	-	+	+

iterative AR(1) process, starting at $x_t = \lambda x_{t-1} + \varepsilon_t$. This example clearly shows that in case $|\lambda| > 1$, an AR process shows explosive behaviour. So, statistically, the expected sign of the autoregressive element can be both positive or negative, as long as its absolute value is smaller or equal to one. However, the expected sign of autoregressive element can still be restricted to be either positive or negative based on economic expectations.

$$\begin{aligned}
x_t &= \lambda x_{t-1} + \varepsilon_t \\
&= \lambda(\lambda x_{t-1} + \varepsilon_{t-1}) + \varepsilon_t \\
&= \lambda^2 x_{t-2} + \lambda\varepsilon_{t-1} + \varepsilon_t \\
&\dots \\
&= \varepsilon_t + \lambda\varepsilon_{t-1} + \lambda^2\varepsilon_{t-2} + \ldots + \lambda^{t-1}\varepsilon_1 x_0 \\
&\Rightarrow E(x_t) = \lambda^t x_t
\end{aligned} \tag{3}$$

- **GNP:** As inflation increases, it tempers economic growth since aggregate demand decreases. Extra investments in equity results in higher economic growth as investors only invest if they have positive profit expectations. Positive profit expectations can imply higher production and therefore economic growth. If interest rates rise, borrowing money for consumption or investments gets more expensive. This has a negative effect on economic growth.

- **CPI:** Intuitively, higher economic growth causes demand to increase and therefore also prices. However, as the data shows, this is not always the case during the Classical Gold Standard. So, in a gold standard setting, it is expected that on average economic growth lowers inflation. On the other hand, higher equity returns causes a trade effect in inflation which increases the inflation rate. Again, if interest rates rise, borrowing gets more expensive which lowers demand and consequently also prices.

- **Equity return:** Higher economic growth signals extra production which makes it for investors more attractive to invest in equity. On the other hand, higher prices lower equity returns as profits are harmed because of higher production costs. For interest rates applies the same as for the two previous points; higher costs of capital make it less attractive to invest. So, equity returns are influenced negatively by this.

- **Interest rate:** Both interest rates have the same expected signs, which can be reduced to one argument. Higher economic growth, inflation, equity returns and demand for capital increases the demand for capital which results in rising prices of capital. As interest rates are the price of capital, these interest rates will rise.

The estimated coefficients are reported in table 34 up to 37 in the appendix. From these tables it is clear that, in most of the cases, the signs of the estimated parameters for the individual countries are the same, i.e. the models estimate that the effects of the parameters on the economy is for all countries the same. If it is the case that the signs do not match, this is mostly due to one of the coefficients not being significant. Hence, the results of the individual countries are consistent and can be compared with each other. Chapter 5 discusses the expected coefficient signs with the estimated ones for each economy in detail.

Instead of estimating a classic panel VAR model, a new so called "combined forecasts model" is constructed. The reasoning for this is that internal dynamics of the economies are of greater importance than dynamics between economies. As countries experience highs and lows at different moments in time, a classical panel averages this out. As a result, forecasts become overly smooth. Using panel VAR techniques could partially overcome this issue, however, using these models for forecasting does not give economic sensible results. Chapter 10 discusses the consideration between a classical panel VAR model and the combined forecast model.

Forecasting

Once estimated, the models described above are used to forecast the economies of the individual countries as well as the economy in the "combined forecasts model".

For the individual countries, forecasts are conducted using dynamic forecasting. This means that, starting from the last observation in the data, the forecasted values are produced by recursive exercisition. In matrix algebra, the forecasting process can be denoted as follows:

$$\begin{bmatrix} X_{t+1} \\ Y_{t+1} \end{bmatrix} = \begin{bmatrix} \widehat{\theta_{11}} & \widehat{\theta_{12}} \\ \widehat{\theta_{21}} & \widehat{\theta_{22}} \end{bmatrix} \begin{bmatrix} Y_t \\ X_t \end{bmatrix} \tag{4}$$

Hence, by filling in the last known data point of X_t and Y_t in equation 4, the estimated coefficients, $\widehat{\theta_{i,j}}$, create a new data point. This new data point is then used to create the next data point, until the desired number of forecast steps is reached.

Moreover, stochastic simulation is used to estimate standard deviations around these forecasted values. Innovations for this stochastic simulation are created by a bootstrap method, whose re-sampled residuals are drawn from the start of the data sample through one period before the period to be simulated. All models are simulated 1000 times.

The combined forecast model is used as the forecast model for all four countries considered in this study. This model is created by simply taking the average of the forecasts for the individual countries. Genre et al. (2012) argue that combining forecasts with advanced methods relatively to simple means does not always lead to a significant improvement of the forecast. This is strongly dependent on the context of the forecasts. To prevent falsely made assumptions, this study combines forecasts by taking simple averages.

Thus, in the combined forecast model, the forecasted values for the the variable of interest, Ω, in period t are computed as follows:

$$\overline{\overline{\Omega_t}} = \frac{1}{4}\left(\widehat{\Omega_{t,NL}} + \widehat{\Omega_{t,US}} + \widehat{\Omega_{t,UK}} + \widehat{\Omega_{t,GER}}\right) \tag{5}$$

Using the combined forecasts gets round the problem of plain outcomes due to the fact that the four individual economies experienced highs and lows at different times. Secondly, based on the results discussed in chapter 5, this also gives a realistic prediction of the economy since it is consistent with rational expectations. This applies to the forecasted equity returns, as well as for the fact that high equity returns occur before economic growth.

Hence, using the combined forecasts model does not harm the purpose of this study and gives an complete and accurate description of the scenario (see table 21 on page 43 for a discussion of these results).

4.2 Google Trends

As this study assumes that economic growth in the Fiscal Gold Standard scenario comes from a technology revolution, a framework is developed to timely foresee this revolution coming. This subsection describes this framework.

The basic idea behind this framework is that a technology revolution can take off once the great public is aware of these technologies. It is expected this takes place as soon as new technologies enters the production process (see chapter 6.2 for more details). Further, it is expected that the public searches at large for these technologies on the internet. As almost 90% of all online search queries are performed via Google, the Google Trend database is a reliable source of search popularity (Statista 2016). Google Trends provides data for a specific search term relative to the day with the highest number of queries. This day gets the value 100 and all other days are made relative to this. The use of Google Trends data is rising in popularity among economists to analyse economic subjects [1]. In order test on the presence of a statistical significant in Google Trends data, a Mann-Kendall trend test is performed.

Mann-Kendall trend test

The Mann-Kendall trend test is a non-parametric test for detecting a monotonous trend in non-normal distributed data (Mann 1945; Kendall 1975). The data is tested against the null-hypothesis that there is no monotonous trend in the data. This trend test is a derivative of the Kendall correlation rank test. In addition to the Kendall correlation rank test, accounts the Mann-Kendall test for correlation between correlation ranks over time. The Mann-Kendall tau test statistic is computed as follows:

$$\tau = \frac{S}{\frac{1}{2}n(n-1)} \tag{6}$$

where S equals:

$$S = \sum_{k=1}^{n-1} \sum_{j=k+1}^{n} sgn(X_j - X_k), with\ sgn(x) = \begin{cases} 1 & \text{if } x > 0 \\ 0 & \text{if } x = 0 \\ -1 & \text{if } x < 0 \end{cases} \tag{7}$$

This tau coefficient is the proportion of upwards movements in time over the proportion downwards movements over time. The interpretation is the same as that of a correlation coefficient. Thus, a positive tau coefficient indicates an upward trend, a negative coefficient a downward trend.

The significance of the tau coefficients is measured by means of the p-value. The Mann-Kendall trend test requires the data to be distributed independently, so no presence of auto-correlation. Since this is not the case for Google Trends data (hence, there is (positive) autocorrelation), the chances of the test falsely detecting a trend rises. This is because the variance of S is overestimated by the test. Yue et al. (2002) remove this autocorrelation from the series without losing the trend. They do this by first removing the trend slope from the original time series. Then they remove autocorrelation on this detrended series and lastly they superimpose the slope from the first step on the series without

[1] Among others Askitas and Zimmermann (2009), Choi and Varian (2012), Preis, Moat, and Stanley (2013) and Veldhuizen, Vogt, and Voogt (2016)

autocorrelation. According to Yue et al. (2002), this new, ”blended” series preserves the original trend without being influenced by significant autocorrelation. This procedure is also known as the trend-free pre-whitening method. In identifying significant monotonous trends in Google Trends data, this study also uses this correction method.

Benchmarks
As Google Trends provides only relative search popularity data, benchmarks are used to correct for shifting baselines in overall search volume. The popularity of technologies is transformed by dividing over the popularity of the benchmark. The resulting quotient is then used in the Mann-Kendall test.

The selected benchmarks for this study are:

- **Software, computer and currency** are chosen for their stable popularity over time. A positive trend relative to this benchmark indicates an increasing popularity of the technologies.

- **Vacancies** is an economic benchmark. During times of economic upturn increases the demand for labour, and hence the search frequency ”vacancies”. It is expected that a positive trend relative to this benchmark signals possible economic growth by these technologies.

5 Forecasting

This chapter describes and interprets the results of the simulated forecasts made by the model as characterised in the previous chapter.

To reproduce the cyclical behaviour of the data in the underlying period, all forecasted values are statistically simulated by the model. This is done through dynamic forecasting. Moreover, stochastic simulation estimates standard deviations around the forecasted values. All models are simulated 1000 times. See chapter 4.1 for more details.

In all figures, the blue line represents the actual values from 1871 to 1913 and the mean value of the simulation there after. The dashed lines indicate one standard deviation from the forecasted values. Hence, these forecasts simulate a counterfactual scenario: if the First World War had not happened, what would then be economic situation?

5.1 Individual countries

The Netherlands

Estimation results

As regards to coefficients for the Dutch economy (table 34 in the appendix), it is clear that GNP growth is strongly mean reverting. This is in accordance with the strong fluctuations in GNP from figure 2 on page 8. Also, Dutch equity returns show to be a good predictor of economic growth in the next period.
Equity returns, on their turn, have an inverse relation with previous periods short-term interest rate. Hence, when short-term interest rates lower, capital gets cheaper which makes investing in equity more attractive. As a result of more equity investing, inflation rises in the next period.

Finally, the positive coefficients of economic growth and inflation in the short-term interest rate equation (although not significant for economic growth) show that the Dutch economy adhered to the Taylor rule, as adjusted by Fagan, Lothian, and McNelis (2013). Note, however, that not all coefficients are significant. In the adjusted Taylor rule, interest rates are influenced by past interest rates, current GDP growth, current inflation and an exogenous policy shock. Without the adjustment of Fagan et al., the gold standard era does not follow the Taylor rule. This is because interest rates at the time were not influenced by decisions of a central bank, as central banks did not use monetary policy to stimulate the economy (or simply since the Fed started to operate not before 1914 in the case of the US). In the adjusted Taylor rule, interest rates, and therefore inflation as well, are the result of the interaction of demand and supply of money. This is a valid assumption as money demand is stable and money supply is mostly exogenous.

Since interest rates follow (an adjusted version of) the Taylor rule, the same conclusions based on the Taylor rule can be drawn as one does nowadays. Hence, interest rates during the gold standard were also an indicator of economic development.

Forecasting results

The forecasted results in all estimated models show a clear case of flatlining. Flatlining occurs when the model missforecasts the turning points in the forecasts. This gives the model the tendency to return to the steady state too fast. The flatlining of the models is due to the many turning points in the data. When there is a steady growth in the data, it is much easier for the models to forecast well (Wickens 2014).

Figure 17 depicts the simulated forecasts for the Dutch economy. Table 12 gives these forecasts and some of their characteristics numerically. The simulations show on average a positive real economic growth and zero or positive inflation for the upcoming five years. Compared to the underlying data, the forecasted total equity return is lower (6.9% vs 8.3%), but also less volatile (8.8% vs 9.3%). Further, as expected, both short-term and long-term interest rates remain very stable over the whole forecasting period.

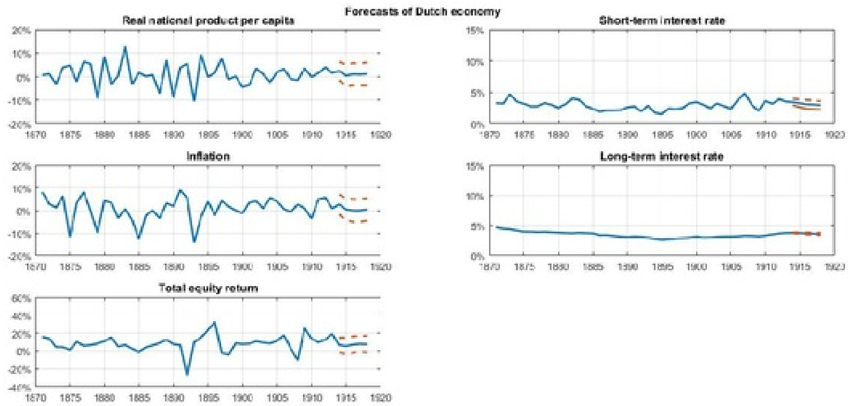


Figure 17: Forecasts for the Dutch economy

As this study is not only interested in an average gold standard situation, but also in a more extreme gold standard situation, a second panel model is simulated. This simulation is also used to see how a Fiscal Gold Standard scenario is affecting the current economy.

For this more extreme situation, economic growth is pre-specified to be 3.2% in year three up to five. This 3.2% growth is the point where the highest ten per cent growth rates of the dataset are in. This therefore

Table 12: Growth path of the Dutch economy

Year	Real GNP	Inflation	Total equity return	Short interest rate	Long interest rate
1	2.4%	2.7%	6.7%	3.5%	3.8%
2	0.5%	0.5%	5.6%	3.3%	3.8%
3	1.1%	0.0%	7.1%	3.1%	3.7%
4	0.9%	0.0%	8.0%	3.0%	3.7%
5	1.2%	0.4%	7.6%	2.9%	3.6%
Average	1.2%	0.7%	6.9% *	3.1%	3.7%
Standard deviation	4.5%	4.8%	8.8%	0.6%	0.2%

* Average of total equity return is a geometric average

represents the level of high economic growth. Year one and two interpolate linearly from the starting value to the specified growth model.

Accordingly, starting values for other variables are pre-specified. These starting values are set as year zero. The model simulates the remaining values of year one up to five. Starting values for economic growth and inflation are acquired from Bloomberg and from the IMF for all other parameters (both consulted on 22 March 2016). All these values are the expected values for the eurozone in 2016. Table 13 gives an overview of the starting values used. The eurozone is chosen since three out of four countries are European countries and there exist great similarities between the countries. Furthermore, the euro interest rate is the benchmark. Note that although the same starting values for all countries are used, coefficients for forecasting are country specific estimates.

Table 13: Starting values for simulation with pre-specified growth. Real GNP and inflation are estimates by Bloomberg, short and long interest rates are estimates by IMF.

	Real GNP	Inflation	Total equity return	Short interest rate	Long interest rate
Starting value	2.2%	1.4%	N.A.	0.0%	1.0%

Table 14 reports the results for the Dutch economy. Remarkable are the very high total equity results, especially at the start of the forecasting period. This is in line with the expectation that equity returns occur before rising economic growths. The table also shows that inflation rises rapidly in the three two years and declines when economic growth stabilises. Compared to the interest rates movements in table 12, it is noteworthy that both short and long interest rates rise relatively fast. This due to the mean reversion element in interest rates, as interest rates in this forecast simulation are well below their long term average.

Table 14: Growth path of the Dutch economy with pre-specified economic growth

Year	Real GNP	Inflation	Total equity return	Short interest rate	Long interest rate
0*	2.2%	1.4%	N.A.	0.0%	1.0%
1	2.5%	0.2%	17.3%	1.1%	1.2%
2	2.9%	3.1%	13.7%	1.8%	1.4%
3	3.2%	3.1%	10.5%	2.1%	1.6%
4	3.2%	2.6%	8.7%	2.3%	1.9%
5	3.2%	2.1%	8.2%	2.4%	2.0%
Average	3.0%	2.2%	11.2%**	1.9%	1.6%
Standard deviation	0.3%	1.1%	3.4%	0.5%	0.3%

* Starting values are represented as year 0

** Average of total equity return is geometric average

United States

Estimation results

In analysing the coefficients of the US economy (table 35 in the appendix), the same reversal in economic growth and the anticipatory effect of equity returns on economic growth are visible as for the Dutch economy. This years US inflation rate is affected by last years equity return, the trade effect is also present. US inflation rate is influenced by both short and long-term interest rates as well.
As expected from table 11 on page 27, the short-term interest rates has a positive effect on inflation since increasing costs of capital increase production costs and therefore also consumer prices. Remarkably, last years long-term interest rate have a negative effect on current inflation. There is no clear economic explanation for this.
All coefficients for the short-term interest rate are in line with expectations. Higher equity returns result in more demand for capital (as other investors are attracted by high returns) and economic growth stimulates companies to to extend their production capacity to meet higher demand. Also, this short-term interest rate equation shows that the US economy followed the Taylor rule.

Forecasting results

As can be seen in table 15, the US economy shows the highest real economic growth of all countries. However, due to negative economic growth in the first forecasted period, its average growth is lower and thereby equal to the Dutch economic growth. Simulated inflation levels of the US economy are the lowest of all countries in the sample, including periods of deflation at the start of the forecast period. This situation of high economic growth and (very) low inflation creates a favourable environment for investors, which results in a relatively high total equity return. On the other hand, forecasted total equity returns for the US are the most volatile as well.

Also note that the short-term interest rate lies above the long-term interest rate. As mentioned before in the data section, one explanation for this phenomenon is that the short-term interest rate in the 19th century mainly consisted of loans to less creditworthy firms, while the long-term interest rate consisted of government debt and larger, safer firms. This results in a higher short-term interest rate. Since this is not longer a relevant issue for the current economy, the movements of the interest rates is of much more interest than actual levels. The simulations show that it is likely that both short-term and long-term interest rate will decline to their long term average.

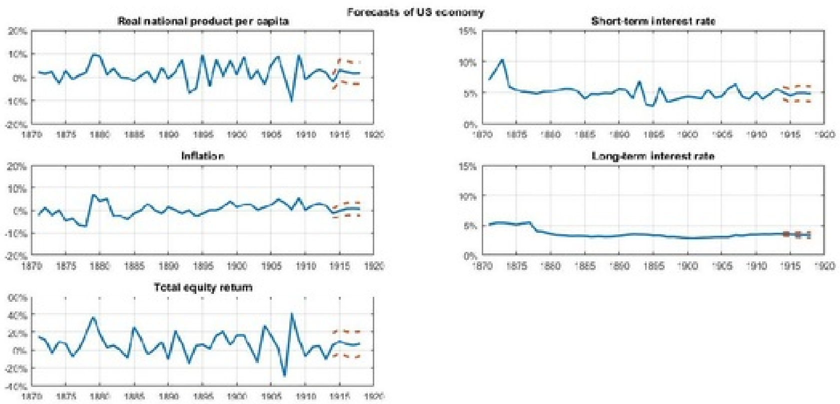


Figure 18: Forecasts for the US economy

Table 15: Growth path of the US economy

Year	Real GNP	Inflation	Total equity return	Short interest rate	Long interest rate
1	-2.1%	-1.3%	5.6%	5.0%	3.6%
2	2.8%	-0.3%	10.0%	4.5%	3.5%
3	2.1%	0.6%	6.5%	4.9%	3.4%
4	1.6%	0.7%	5.4%	4.9%	3.4%
5	1.7%	0.6%	6.9%	4.8%	3.4%
Average	1.2%	0.1%	6.7% *	4.8%	3.5%
Standard deviation	4.3%	2.6%	13.6%	1.1%	0.4%

* Average of total equity return is geometric average

Next, a second forecast simulation (using the starting values in table 13) is performed. Results are reported in table 16. Economic growth for the US is the highest of the sample. Despite this high growth number, inflation remains moderate at 1.7% on average. Due to the relatively stable economic growth and inflation numbers, total equity return does not fluctuate very much in this forecast. This is remarkable, as the standard deviation of total equity returns for all other economies is much higher. Total equity returns might suffer from some downward pressure due to quickly rising interest rates. Investors usually prefer the safe interest rates over the more risky equity returns.

Table 16: Growth path of the US economy with pre-specified economic growth

Year	Real GNP	Inflation	Total equity return	Short interest rate	Long interest rate
0*	2.2%	1.4%	N.A.	0.0%	1.0%
1	3.4%	1.6%	5.3%	2.1%	2.4%
2	4.0%	1.7%	4.9%	3.6%	2.9%
3	4.5%	1.8%	4.7%	4.9%	3.4%
4	4.5%	1.8%	4.3%	4.9%	3.4%
5	4.5%	1.8%	4.3%	4.9%	3.4%
Average	4.2%	1.7%	4.7%**	4.1%	3.1%
Standard deviation	0.4%	0.1%	0.4%	1.1%	0.4%

* Starting values are represented as year 0

** Average of total equity return is geometric average

United Kingdom

Estimation results

Coefficients for the UK economy are reported in table 36 (appendix). These coefficients show that current economic growth is only significantly influenced by previous year short-term interest rate. As expected, this is a negative relation. Hence, fluctuations in British economic growth are caused by fluctuations in the level of investments (which at their turn influence short-term interest rate). This is in line with the setting of the British economy at that time since the UK made its economic growth sprint before the analysed period of this study. Therefore, investments reached their steady state level which makes it for investors less attractive to invest in equity. Thus, investments are at a lower level and only originate from smaller investments which do not require large amounts of capital.

The British inflation equation shows that current inflation is influenced negatively by last years short-term interest rate. This implies that the British economy in the late 19th century adhered to the Taylor rule. Also, the equity trade effect in inflation is for the British economy not observed.

Forecasting results

The forecasted economic growth for the UK is the lowest of the sample, while inflation is the highest of all countries. This is shown graphically in figure 19 and numerically in table 17. The reason for this is that the UK was a pioneer in the process of industrialisation. Therefore, the UK already made their economics growth sprint before the scope of this study. Further, British total equity returns are low, but, according to the simulations, always positive for the coming five years. This is a unique feature in the whole sample.

The spread between British short-term and long-term interest rates is marginal. Continuing on the line of reasoning for the inverted yield curve in the US, this marginal spread in interest rates indicates that the UK economy is more developed than the other economies. Hence, the financial system is more advanced and the British firms are considered to be more creditworthy than firms in the other economies. This also explains the low interest rate levels for the British economy and is corresponding to the overall consensus that the British economy was among the more developed economies of the late 19th century.

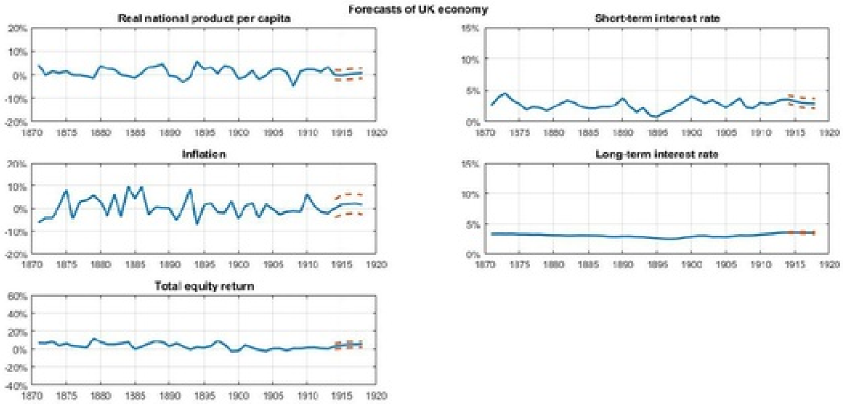


Figure 19: Forecasts for the British economy

Table 17: Growth path of the British economy

Year	Real GNP	Inflation	Total equity return	Short interest rate	Long interest rate
1	-0.1%	0.0%	2.9%	3.6%	3.5%
2	-0.3%	1.7%	3.9%	3.3%	3.5%
3	0.2%	1.9%	4.6%	3.0%	3.5%
4	0.4%	2.1%	5.0%	2.9%	3.5%
5	0.6%	1.6%	5.2%	2.9%	3.4%
Average	0.2%	1.4%	4.2% *	3.1%	3.5%
Standard deviation	2.1%	4.1%	3.2%	0.7%	0.1%

* Average of total equity return is geometric average

A second forecast simulation with a pre-specified growth path for economic growth is also conducted for the British economy. Table 18 shows the results numerically. Interestingly, while economic growth is much higher in this forecast than in the previous one, inflation has halved. Resulting from the low inflation expectations, total equity returns are low as well. An economic explanation for this is that consumers and firms postpone their consumption and investments respectively as they expect future prices to remain stable while total production grows. A second argument is that the spread between interest rates and total equity return is too wide. This causes investors to invest their money in the much more safer interest rates.

Table 18: Growth path of the British economy with pre-specified economic growth

Year	Real GNP	Inflation	Total equity return	Short interest rate	Long interest rate
0*	2.2%	1.4%	N.A.	0.0%	1.0%
1	2.3%	1.3%	1.6%	1.3%	2.2%
2	2.4%	0.9%	1.2%	2.2%	2.9%
3	2.5%	0.5%	2.3%	3.2%	3.5%
4	2.5%	0.5%	3.9%	3.2%	3.5%
5	2.5%	0.5%	4.6%	3.2%	3.5%
Average	2.4%	0.7%	2.4%**	2.6%	3.1%
Standard deviation	0.1%	0.3%	1.3%	0.8%	0.5%

* Starting values are represented as year 0

** Average of total equity return is geometric average

Germany

Estimation results

The estimated coefficients for the German economy are in table 37 (appendix). Against expectations, last years inflation has a significant positive effect on this years economic growth. However, a possible explanation is that, despite higher prices, production still increased due to foreign trade with economies that are not in the sample of this study. Further, the negative effect of higher a short-term interest rate is also present for the German economy.
Moving on to the inflation equation, one sees that higher economic growth lower next years inflation. This confirms expectations during the Classical Gold Standard, as aggregate supply tends to increase more rapidly than aggregate demand. This way, the economy grows while inflation declines. This equation also signals a strong equity trade effect in inflation, as stated in table 11.
Another striking result comes from the equity return equation. According to the estimated coefficients, a higher economic growth lowers equity returns next year. This is counterintuitive as equity returns tend to rise during periods of economic growth. Higher economic growth can signal a future extension of production capacity. The resulting increasing profit expectations makes it for investors attractive to invest.
Finally, the short-term interest rate equation shows that the German economy obeyed to the Taylor rule as well.

Forecasting results

Just like for the US and the UK, German economic growth rates are forecasted to be negative in the first period (see table 19). This results in a low average economic growth. Also, in line with expectations during the gold standard, inflation levels are low. German total equity returns are forecasted to be low on average and even less that both the short-term and long term interest rate. However, this number is somewhat distorted by the very negative return in year one. After year one, the returns profit from the rising economic growth, and thereby exceeding both interest rates. Just as for the US, the yield curve is expected to be inverted. The same line of reasoning as for the US inverted yield curve is applicable.

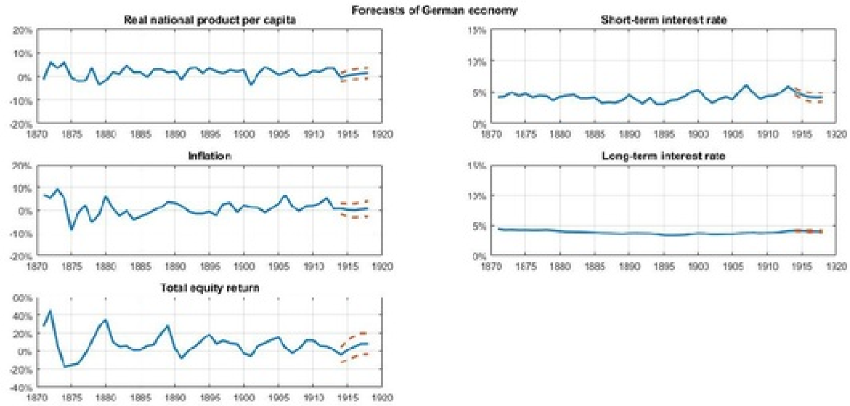


Figure 20: Forecasts for the German economy

Table 19: Growth path of the German economy

Year	Real GNP	Inflation	Total equity return	Short interest rate	Long interest rate
1	-0.5%	0.7%	-4.3%	5.1%	4.1%
2	0.3%	0.2%	0.9%	4.5%	4.1%
3	0.8%	0.0%	5.1%	4.2%	4.1%
4	1.2%	0.4%	7.9%	4.1%	4.0%
5	1.4%	0.7%	8.1%	4.2%	4.0%
Average	0.6%	0.4%	3.4% *	4.4%	4.1%
Standard deviation	2.0%	3.0%	10.8%	0.6%	0.1%

* Average of total equity return is geometric average

Simulation results for the German economy with pre-specified economic growth are shown in table 20. An outlier in these results is the deflationary number in the first year. There is no clear explanation for this. Afterwards, inflation rises quickly to 3.5% in year three. This causes total equity returns to be negative in the subsequent years. Average total equity returns seem very low, but this is mainly due to high equity returns at the start of the forecast, followed by two years of negative equity returns at the end of the forecast. They cancel out against each other, resulting in net low equity returns. Also noteworthy is the very wide spread between short in long term interest rates. Both rise, but, as expected due to their degree of mean reversion, this process is much slower for the long term interest rate.

Table 20: Growth path of the German economy with pre-specified economic growth

Year	Real GNP	Inflation	Total equity return	Short interest rate	Long interest rate
0*	2.2%	1.4%	N.A.	0.0%	1.0%
1	2.4%	-1.9%	7.3%	2.1%	1.2%
2	2.6%	2.0%	8.6%	3.1%	1.4%
3	2.8%	3.5%	2.6%	3.9%	1.6%
4	2.8%	3.1%	-4.7%	4.4%	1.9%
5	2.8%	2.0%	-9.5%	4.5%	2.1%
Average	2.7%	1.7%	0.9%	3.6%	1.6%
Standard deviation	0.2%	1.9%	7.0%	0.9%	0.3%

* Starting values are represented as year 0

Combined forecasts model

Results of the combined forecasts model are reported in table 21. There is no coefficient table available as these results are the average of the forecasts of the four individual economies. The outcomes of this model show that using the specified situation of high growth, the inflation remains relatively low as well. Total equity returns are higher than in all previous models, but decreasing despite rising real economic growth. The forecasts for interest rates show that there is an inverted yield curve. Again, since the composition of both the short-term and long-term interest rates nowadays is different from the late 19th century, its movements are more relevant. Since very low interest rates are observed now, it is likely in a fiscal gold standard setting that interest rates revert to their long-term averages.

A closer look at this economic environment yields the following effects for a pension fund. As interest rates rise and the inflation rate remains low and stable, investment returns outpace the increase in pension liabilities. Hence, the pension fund has a high(er) coverage rate. If expected inflation increases, it is beneficial to increase the inflation hedge as this results in a higher real coverage rate. This is not a real gain, as an inflation hedge only minimises the loss arising from a higher inflation rate.

To benefit from the increasing interest rates, it is intuitive to take a low interest rate hedge. This way, the pension fund does not cover itself against interest rate movements. As interest rates tend to rise in this scenario, the pension fund can benefit optimally in terms of a higher real coverage rate. Also, this increases the chance for pension indexation (i.e. inflation compensation).

Finally, one can conclude that the Fiscal Gold Standard scenario as defined here is a rosy scenario for an asset manager. Coverage rates are high which leads to high indexation possibilities as well. Consequently, purchasing power of its participants remains also high and stable in the near future.

Table 21: Growth path of combined forecast model with pre-specified economic growth

Year	Real GNP	Inflation	Total equity return	Short interest rate	Long interest rate
0*	2.2%	1.4%	-	0.0%	1.0%
1	2.5%	1.3%	10.1%	1.3%	1.9%
2	2.9%	1.1%	9.5%	2.6%	2.8%
3	3.2%	1.0%	8.4%	3.9%	3.7%
4	3.2%	1.0%	6.7%	3.9%	3.7%
5	3.2%	1.0%	6.3%	3.9%	3.7%
Average	2.9%	1.1%	8.1%**	2.6%	2.8%

* Starting values are represented as year 0

** Average of total equity return is geometric average

6 Foreseeing the Fiscal Gold Standard scenario

As already stated in the introduction, the Fiscal Gold Standard scenario is based on a situation of low inflation and high economic growth. To react timely, it is important to identify this scenario at an early stage. This chapter describes which factors can possibly cause low inflation combined with high economic growth.

6.1 Deflationary factors

Decreasing unemployment and rising wages
A result of a growing economy is a decreasing unemployment rate. It is expected that in the case of unemployment being close the the natural unemployment, the labour market tightens and wages rise. In a Fiscal Gold Standard scenario, however, this does not settle in rising production costs as productivity increases at the same rate, at minimum. Thus, rising inflation is mainly due to imported inflation.

Structural low energy prices
Since demand of energy is inelastic on the short-term, and since energy prices form a significant part of production costs, it is likely that a decrease in energy prices has deflationary influences. Figure 21 below shows the effects on economic growth, inflation and total equity returns if energy prices are shocked by one standard deviation. Note that impulse response figures are symmetric. Hence, a negative shock in energy prices (so, a price decline) results in positive economic growth, lower inflation and positive equity returns. These results are unfortunately not significant, but on average there is a pattern visible.

The most logical factor that can be identified as a cause of lower energy prices is the growing market share of alternative energy sources. This is also part of a technological revolution. The rise of alternative energy sources increases the number of players and opportunities on the market, resulting in price declines.

However, the supply of energy is elastic on the medium-term. Oil and shale gas producers will anticipate on declining prices. Oil producers are likely to downscale their production, driving prices up. Hence, the deflationary effect is only temporary.

Increasing velocity of money
Following the equation of exchange by Fisher, $MV \equiv PT$, an increase in the velocity of money (V) is expected. The Fiscal Gold Standard scenario is featured by a constant money supply (M), a constant, low price level (P) and a growing economy (T). Given the high economic growth in this scenario, the assumption of a constant money supply is a plausible one as

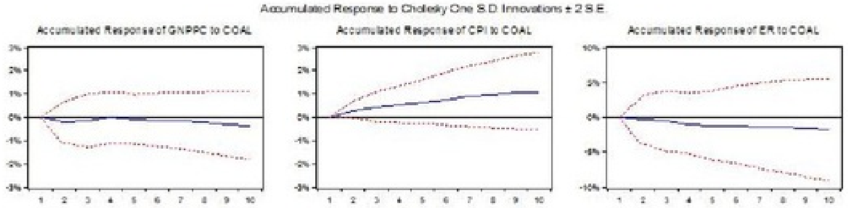


Figure 21: Impulse response shock to energy prices (coal) and its effect on gross national product per capita (GNPPC), inflation (CPI) and total equity return (ER).

it is not very likely that the central bank disturbs this by introducing an easy monetary policy. So, these factors lead inevitably in an increasing velocity of money.

Exogenous monetary and fiscal policy
A first order effect of easy monetary policy by central banks is an increased chance of inflation. However, interest rates are lowered as well. This stimulates paying off debts and investing in assets (mainly houses). This has a downward effect on inflation measured by CPI, since CPI does not account for wherewithal used for this actions. On the other side, asset inflation is likely to rise.

Fiscal policy influences the inflation level as well. Further budgetary discipline suppresses government consumption, such that inflationary pressure is not likely from this side of the economy. Secondly, increased capital requirements for financial institutions impede the supply of loans. This lowers consumption and investments and therefore inflation as well.

6.2 Economic growth

Kondratieff cycles
Technological innovations are important economic growth drivers in periods of low inflation. In foreseeing this growth timely, the so-called Kondratieff cycles are of great relevance. According to this theory, the economy cycles through waves of 40 to 60 years, which all start with technological innovations. To create a widespread effect, it is important that innovations improve the production process in the whole economy (Steehouwer 2005).

There is no general accepted explanation for the duration of the Kondratieff cycle. A first explanation is that in times of economic downturn, the striving for profits stimulates technological innovations. These innovations form an important starting point for a new Kondratieff cycle. A second explanation regards to social effects. Those who grow up in relative prosperity have a higher propensity to invest in innovations (resulting in higher economic growth), while those who grow up during economic downturn are more conservative in their investment decisions to not waste money on the more risky investment projects (as innovations usually are).

By this time, five Kondratieff waves have occurred in economic history since 1780. It is tough to determine when a Kondratieff wave exactly starts or ends, but it has all appearances that the ending of the 2008 financial crisis has started a sixth wave. Figure 22 gives an overview of all Kondratieff cycles through time.

According to the theory of Kondratieff, there are four main changes that can introduce a new Kondratieff wave. Those are:

1. Further exploitation of current innovations is no longer possible: ICT is already widespread implemented in the production process.

2. High levels of excess financial capital: one of the causes of the 2008 financial crisis.

3. Period of severe recession: a world wide economic crisis as a consequence of the financial crisis.

4. Institutional transformations: transformations in financial regulations, e.g. Basel III regulation demanding higher capital levels for financial institutions.

	Trough – Peak – Trough	*Basic Innovation*
1	1780 – 1810 – 1850	Steam transport
2	1850 – 1875 – 1890	Steel and electricity
3	1890 – 1915 – 1950	Cars and assembly lines
4	1950 – 1973 – 1990	Microelectronics and biotechnology
5	1990 – ? – ?	ICT ?

Figure 22: Overview of Kondratieff cycles through time. Source: Steehouwer (2005).

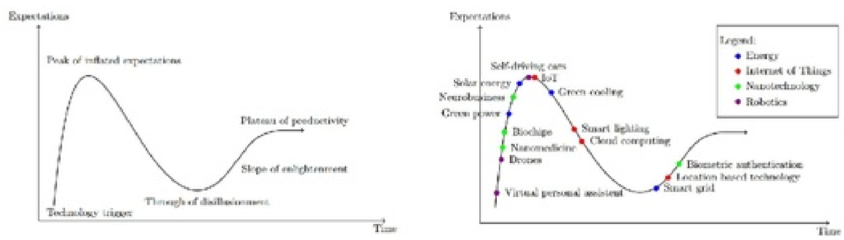
Now that the possible introduction of a sixth Kondratieff wave is classified, it is important to identify the innovations that can trigger new economic growth. Mathews (2003) mentions three requirements for a new technology to be successful. The first requirement is that costs of the new technology must be lower than costs of the current technology. Secondly, the costs of the new technology must be declining over time. Lastly, as mention before, the effects of the new technology must be widely introduced in the economy.

Foreseeing technological innovations
Technological innovations that are potential successful on the medium-term are energy, internet of things, nanotechnology and robotics (Allianz 2010). A Mann-Kendall trend test is used to test Google Trends data on the presence of a monotonous statistical trend. See chapter 4.2 for further details on this test and the procedures. Table 22 shows the selected search terms per technology. These search terms are chosen to give a reasonable view on important drivers of the aforementioned technologies.

Besides the Mann-Kendall test, the Gartner hype cycle is used to foresee the introduction of the selected technological innovations. Figure 23 shows the phases a new technology has to go through before it can lead to structural adoption in the economy. Further, this figure also shows the current positions of the selected technologies on the hype cycle. Once a new technology reaches the *slope of enlightment*, an eventual sustainable economic growth can be expected. Note that not all sub-technologies in a group have to reach the slope of enlightment for a group of technologies to be successful.

Table 22: Search terms per technology

Energy	**Internet of things**	**Nanotechnology**	**Robotics**
Solar energy	Cloud	Nanotechnology	Robotics
Renewable energy	Big data	Biotechnology	Artificial intelligence
Green technology	Smart lighting	Biofuels	Self-driving cars
Smart grid	Location based	Genomics	Drones
			Virtual assistent



(a) (b)

Figure 23: (a) Phases a technology has to go through in a hype cycle, (b) Hype cycle based on data from various Gartner hype cycles for 2015.

In this study, the Mann-Kendall trend test is conducted for two different periods. These are from 1 January 2011 up to 1 June 2016 and from 1 June 2015 up to 1 June 2016. This way, it is clearly visible how public interests in the technologies develops. Results are reported in table 23 and 24 respectively. These results can be interpreted as follows.

Table 23: Results of Mann-Kendall tau coefficient and two-sided p-values (in brackets). Sample period: 1 January 2011 up to 1 June 2016.

	Energy	Internet of things	Nanotechnology	Robotics
Computer	0,022 (0,058)	0,695 (0,000)	0,018 (0,064)	0,540 (0,000)
Software	0,233 (0,000)	0,808 (0,000)	0,365 (0,000)	0,555 (0,000)
Currency	-0,078 (0,005)	0,344 (0,000)	-0,219 (0,000)	0,495 (0,000)
Vacancies	-0,130 (0,001)	0,253 (0,000)	-0,315 (0,000)	0,368 (0,000)

Table 24: Results of Mann-Kendall tau coefficient and two-sided p-values (in brackets). Sample period: 1 June 2015 up to 1 June 2016.

	Energy	Internet of things	Nanotechnology	Robotics
Computer	0,243 (0,000)	0,465 (0,000)	0,415 (0,000)	0,107 (0,025)
Software	0,271 (0,000)	0,629 (0,000)	0,445 (0,000)	0,087 (0,035)
Currency	0,098 (0,001)	0,061 (0,051)	0,182 (0,005)	0,030 (0,075)
Vacancies	0,020 (0,084)	0,005 (0,097)	0,085 (0,036)	-0,015 (0,087)

Energy: Over the last five years, there is not significant trend for the benchmark computer. The remaining benchmarks give different results. With respect to the two stable benchmarks (computer and software), energy technology experiences a weak positive growth in popularity. Over the last year, only the benchmark vacancies is insignificant. All other benchmarks still indicate a weak positive trend. This can be explained by the strong cyclical behaviour of the search terms and the given that the sub-technologies are spread all over the hype cycle of figure 23. Based on this hype cycle, economic growth on the medium-term can be expected from smart grid technologies.

Internet of things: The data shows a significant strong positive trend with respect to the stable benchmarks. The economic benchmarks indicate a weak growth in popularity. Focusing on last year, both economic benchmarks become insignificant. Other benchmarks attenuate to a moderate positive trend. Thus, public interest in Internet of things is diminishing. This is in alignment with the hype cycle.

Nanotechnology: Except for the benchmark computer, all benchmarks report a significant trend over the last five years. Both economic benchmarks indicate a moderate decline in popularity. For last year, all benchmarks are significant and report a weak to moderate positive trend. So, one can conclude that nanotechnology is increasing in popularity over the recent past. Although the results are not very strong, this might signal economic growth in the long-term future.

Robotics: All benchmarks designate a moderate positive trend over the last five years. However, in the recent past only benchmarks computer and software are significant. The reported trend is downgraded to a weak positive trend. This implies strong movements in popularity over the last year. An explanation for this is that the popularity of self-driving cars receives above average attention by the media and that self-driving cars are at the top of expectations in the hype cycle. Technology of self-driving cars has to go through the phase of disillusionment before it can lead to significant economic effects.

However, as foreseeing which specific technology will flourish is not what this study is primarily aiming for, it is also of interesting to see how interest in technologies in general develops. This is displayed graphically in figure 24 below. An exponential acceleration in popularity of technology can point to the start of a technological revolution, given that the benchmark remains relatively constant. Based on figure 24, one can see a slight increase in popularity of technologies over recent years. Although this is far from exponential, it shows that the selected technologies have the potential of being part of a technological revolution.

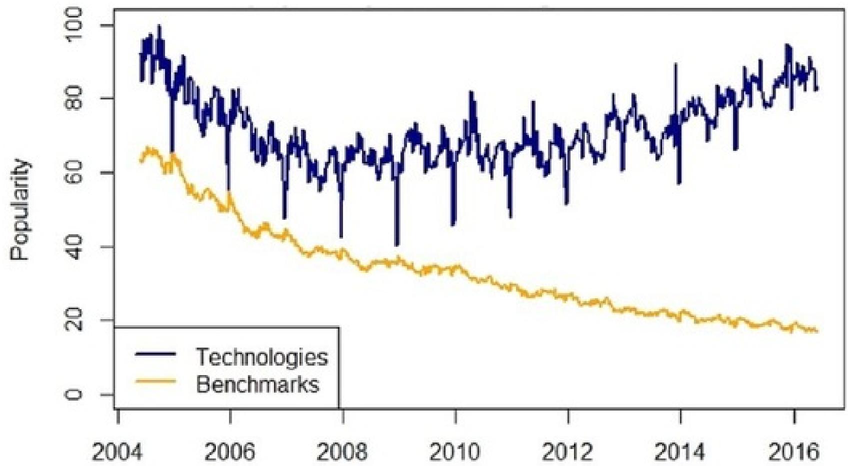


Figure 24: Relative popularity of technologies and benchmarks. Technologies and benchmarks are equally weighted composed of aforementioned technologies and benchmarks (software, computer, currency and vacancies), respectively. Chapter 4.2 gives more details on the selection of benchmarks.

Alternative view on the secular stagnation hypothesis?

All in all, it can be concluded that economic growth as a result of a technological revolution is not to be expected immediately. However, the results from the Mann-Kendall trend test combined with the Gartner hype cycle show that some technologies may take off in the medium term. Especially Internet of Things and robotics show a rapidly increase in popularity. Also, break even rates show that inflation rates tend to stay low for a while. As some of the requirements of the Fiscal Gold Standard are fulfilled, the chances of the scenario to become reality increases.

If the Fiscal Gold Standard scenario indeed becomes reality, this can be an alternative view on the secular stagnation hypothesis. A definition of secular stagnation is that the economy is in a condition where only negligible economic growth can be achieved in a market-based economy. Hence, negative real interest rates are needed to equate savings and investments with full employment (Teulings and Baldwin 2014). Yet negative real interest rates are hard to achieve with the presence of the zero lower bound on nominal interest rates and low (but still positive) inflation.

There are several factors that can lead to structural low economic growth. First, low population growth can result in diminishing demand for new products and labour. Secondly, increasing wealth inequality leads to lower aggregate demand as the wealthy spend only a relatively low share of their wealth. Lastly, decreasing technological development slows down productivity improvements of both labour and capital. This ultimately results in lower economic growth.

Aforementioned causes of secular stagnation should not be neglected, but there are arguments why things are not as bad as they are presented now. An alternative view on secular stagnation lies in technology. Technology improves productivity growth and is therefore an important factor in achieving rising GDP growth rates. As this study already showed, economic growth in the 19th century was mainly driven by technological advances. By understanding how old techniques worked, one was able to refine and adapt the technologies for new uses. This resulted in productivity improvements and increasing economic welfare. The same reasoning applies to the current economy. Debugging, improving and adapting technologies in nanotechnology or robotics leads to expected and unexpected breakthroughs which boost productivity. It is therefore unlikely to believe that technological innovations in the future will be more scare then they were in the past.

The arising question is why many economist have a pessimistic view on the current economic situation. An important remark is made by Mokyr (2014). He argues that economists base their conclusions too much on aggregate statistics as GDP per capita and its derivatives. These aggregate statistics cannot accurately describe an economy where data and information are so well represented. Once new technologies work, they can be distributed at very low costs. This results in low impact on GDP according to aggregate statistics, while they contribute largely to consumer welfare. So, effects of technological innovations in the contemporary economy are therefore not always fully recognised.

Thus, the Fiscal Gold Standard scenario provides an alternative view on the secular stagnation hypothesis. Both deal with low inflation, but this study shows that low inflation is not necessarily harmful to economic growth. Economic history shows us the importance of technological innovations for economic prosperity and there seems to be little reason to assume that low economic growth numbers will be new standards.

7 Conclusion

The purpose of this study is to develop a new alternative ALM-scenario. This new scenario, called the Fiscal Gold Standard, is a scenario of high economic growth and low inflation. This is based on the Classical Gold Standard (1870 - 1913), which shows that high growth and low inflation are not a strange couple. Not only is this scenario very relevant to get a complete view of economic stress scenarios, but also in terms of macroeconomics. Given that a new Kondratieff cycle might start soon and given that break even inflation rates stay low for the coming years, this scenario might introduce itself in future times.

Economic history shows that the period of 1870 - 1913 is characterised by many technological changes occurring rapidly after each other. All these innovations resulted in efficiency improvements. This was possible since adhering to the gold standard resulted in a low and stable inflation rate. Low inflation is not a requirement to get innovations, but this makes the process more easy as it decreases the chance of failure due to rising costs. The gold standard is a monetary system where the value of the currency is linked to a fixed amount of gold. Therefore, inflation was only affected by global (exogenous) factors as wars or failed harvests.

Not only was inflation low (or negative) during the Classical Gold Standard, but it did also not result in a economic depression. Since the Great Depression of the 1930s, deflation is associated with economic depression. If deflation is caused by aggregate supply increasing more rapidly than aggregate demand, this does not harm the economy. This phenomenon is also known as good deflation.

Moreover, this study shows that the economy of the Classical Gold Standard is closer related to the current economy than one might think at first glance. A parallel can be made between the fixed exchange rates due to adherence to the gold standard and the eurozone. Further, economic shocks between 1870 and 1913 mainly consisted of supply side shocks. The contemporary economy in Europe and the US are closer to this than they are to the early 20^{th} century.

Despite the fact that there is no gold standard nowadays, there are multiple factors that can replicate this in the current economy. Low inflation can be reached by structural low energy prices (while welfare gains can lead to economic growth) or by further budgetary discipline in the European Union. Further, stricter financial legislation does extend deflationary pressure as it becomes more difficult for a financial institution to lend money. This is where "fiscal" in the Fiscal Gold Standard refers to. On the other hand, these factors do not limit economic growth opportunities as a result of technological innovations. Easy monetary policy by the central bank can theoretically counteract low inflation, but executing easy monetary policy is not very likely under the Fiscal Gold Standard as economic growth is already high.

Based on data from Google Trends, four groups of technologies are identified that can cause a technology revolution in the medium-term. Test results of the Mann-Kendall trend test and the Gartner hype cycle indicate that especially Internet of Things and robotics make take off on the medium term. Both groups show an acceleration in popularity among the great public.

Once the Fiscal Gold Standard becomes reality, it can be an alternative view on the secular stagnation hypothesis. This hypothesis states that the current market-based economy is in a condition where only negligible economic growth can be achieved. In order to achieve full employment, negative real interest rates are necessary to boost savings and investments. Both the secular stagnation hypothesis and the Fiscal Gold Standard scenario deal with low inflation, but this study shows that low inflation is not necessarily harmful to economic growth. Furthermore, there seems to be little reason to assume that low economic growth numbers will be new standards.

8 Literature

Abrigo, M. and I. Love (2015). "Estimation of panel vector autoregression in Stata: a package of programs". In: *University of Hawaii working paper*.

Allianz (2010). "The sixth Kondratieff - long waves of prosperity". In: *Allianz Global Investors*.

Alston, J., J. James, M. Andersen, and P. Pardey (2009). *A brief history of U.S. agriculture*. New York, NY: Springer New York.

Alvaredo, F., T. Atkinson, T. Piketty, E. Saez, and G. Zucman (2015). *The world wealth and income database*. URL: `http://www.wid.world/` (visited on 11/02/2016).

Askitas, N. and K. Zimmermann (2009). "Google econometrics and unemployment forecasting". In: *Applied Econometrics Quarterly* 55 (2): pp. 107–120.

Bernanke, B. and H. James (1991). "The Gold Standard, deflation, and financial crisis in the Great Depression: an international comparison". In: *Financial markets and financial crises*. University of Chicago Press, pp. 33–68.

Bordo, M. (1990). "The lender of last resort: alternative views and historical experience". In: *Federal Reserve Bank of Richmond Economic Review*.

Bordo, M. and F. Kydland (1995). "The Gold Standard as a rule: an essay in exploration". In: *Explorations in Economic History* 32 (4): pp. 423–464.

Bordo, M., L. Lane, and A. Redish (2004). "Good versus bad deflation: lessons from the gold standard era". In: *NBER Working Paper No. 10329*.

Brooks, C. (2008). *Introductory econometrics for finance*. Cambridge: Cambridge University Press.

Brouwer, A. (2005). *Old firms in the Netherlands, the long term spatial impact of firms' indentities and embeddedness*. Groningen: University of Groningen.

Canova, F. and M. Ciccarelli (2013). "Panel vector autoregressive models: a survey". In: *ECB Working Papers No. 1507*.

Choi, H. and H. Varian (2012). "Predicting the present with Google Trends". In: *Economic Record* 88: pp. 2–9.

Cowles, A. (1939). *Common-stock indices*. Bloomington, IN: Principa Press, Inc.

Dimson, E., P. Marsh, and M. Staunton (2002). *Triumph of the optimists: 101 years of global investment returns*. Princeton, NJ: Princeton University Press.

Edvinson, R. (2016). *Historical currency converter.* URL: `http://www.historicalstatistics.org/Currencyconverter.html/` (visited on 09/02/2016).

Eichholtz, P. (1997). "A long run house price index: The Herengracht Index, 1628-1973". In: *Real Estate Economics*: pp. 175–192.

End, JW van den (2011). "Statistical evidence on the mean reversion of interest rates". In: *DNB Working Paper No. 284*.

Fagan, G., J. Lothian, and P. McNelis (2013). "Was the gold standard realy destabilizing?" In: *Journal of Applied Econometrics* 28 (2): pp. 231–249.

Friedman, M. and A. Schwartz (1963). *Monetary trends in the United States and United Kingdom: their relation to income, prices, and interest rates, 1867-1975.* Chicago, IL: University of Chicago Press.

Geiger, F. (2011). *The yield curve and financial risk premia: implications for monetary policy.* Berlin: Springer-Verlag.

Genre, V., G. Kenny, Meyler A, and A. Timmermann (2012). "Combining expert forecasts: can anything beat the simple average?" In: *ECB Working Papers No. 1277.*

Homer, S. and R. Sylla (2005). *A history of interest rates.* Hoboken, NJ: John Wiley & Sons.

Horlings, E. and J. Smits (1996). "Private consumption expenditure in the Netherlands, 1800-1913". In: *Economic and Social History in the Netherlands*: pp. 15–40.

— (1997). "A comparison of the pattern of growth and structural change in the Netherlands and Belgium, 1800-1913". In: *Jahrbuch für Wirtschaftsgeschichte*.

Kendall, M. (1975). *Rank correlation methods, 4^{th} edition*. London: Charles Griffin.

Lütkepohl, H. (2011). "Vector Autoregressive Models". In: *EUI Working Papers*.

Maddison, A. (2013). *The Maddison-project.* URL: `http://www.ggdc.net/maddison/maddison-project/home.htm/` (visited on 09/02/2016).

Mann, H. (1945). "Non-parametric tests against trend". In: *Econometrica* 13 (3): pp. 245–259.

Mathews, J. (2003). "The renewable energies technology surge: a new techno-economic paradigm in the making?" In: *Futures* 46: pp. 10–22.

Mokyr, J. (2014). "Secular stagnation? Not in your life". In: *Secular stagnation: facts, causes and cures*. CEPR Press, pp. 83–89.

Nickell, S. (1981). "Biases in dynamic models with fixed effects". In: *Econometrica* 49 (6): pp. 1417–1426.

Preis, T., H. Moat, and H. Stanley (2013). "Quantifying trading behaviour in financial markets using Google Trends". In: *Scientific reports*.

Rockoff, H. and M. Bordo (1996). “The gold standard as a ‘good housekeeping seal of approval’ ”. In: *The Journal of Economic History* 56 (2): pp. 389–428.

Rousseau, P. and R. Sylla (2001). “Financial systems, economic growth and globalization”. In: *NBER Working Paper No. 8323*.

Saxonhouse, G. (2005). “Good deflation/bad deflation and Japanese economic recovery”. In: *International Economics and Economic Policy* 2: pp. 201–218.

Schurr, S. and B. Netschert (1960). *Energy in the American economy, 1850-1975*. Baltimore, MD: Jons Hopkins University Press.

Sims, C. (1980). “Macroeconomics and reality”. In: *Econometrica*: pp. 1–48.

Smits, J., P. Woltjer, and D. Ma (2009). *A dataset on comparative historical national accounts, ca. 1870-1950: a time-series perspective*. Groningen: Groningen Growth and Development Centre.

Solomou, S. and W. Wu (1999). “Weather effects on European agricultural output, 1850-1913”. In: *European Review of Economic History* 3 (3): pp. 351–373.

Statista (2016). *Worldwide desktop market share of leading search engines from January 2010 to July 2016*. URL: `https://www.statista.com/statistics/216573/worldwide-market-share-of-search-engines/` (visited on 22/09/2016).

Statistics Netherlands (2014). *Beroepsbevolking; vanaf 1800 (12-uursgrens)*. URL: `http://statline.cbs.nl/Statweb/selection/?DM=SLNL&PA=71882NED&VW=T/` (visited on 09/02/2016).

Steehouwer, H. (2005). *Macroeconomic scenarios and reality*. Amsterdam: Free University of Amsterdam.

Stock, J. and M. Watson (1988). “Testing for common trends”. In: *Journal of the American Statistical Association*.

Teulings, C. and R. Baldwin (2014). *Secular stagnation: facts, causes and cures*. London: CEPR Press.

Tilly, R. (1973). “Zeitreihen zum Geldlauf in Deutschland von 1870 bis 1913”. In: *Jahrbücher für Nationalökonomie und Statistik*.

United States Bureau of the Census (1975). *Historical statistics of the United States: colonial times to 1970*. St. Louis, MO: FRASER.

Veldhuizen, S., B. Vogt, and B. Voogt (2016). “Internet searches and transactions on the Dutch housing market”. In: *CPB Discussion Paper 325*.

Verbeek, M. (2012). *A guide to modern econometrics*. Hoboken, NJ: John Wiley & Sons.

Wickens, M. (2014). “How useful are DSGE macroeconomic models for forecasting?” In: *Open Economic Review*.

Yue, S., P. Pilon, B. Phinney, and G. Cavadias (2002). “The influence of autocorrelation on the ability to detect trend in hydrological series”. In: *Hydrological processes* 16 (9): pp. 1807–1829.

Zanden, J. van (1985). *De economische ontwikkeling van de Nederlandse landbouw in de negentiende eeuw, 1800-1914*. Wageningen: Agriculture University Wageningen.

Zanden, J. van and A. van Riel (2000). *Nederland 1780-1914: staat, instituties en economische ontwikkeling*. Amsterdam: Uitgeverij Balans.

9 Appendix I: Statistical output

9.1 Tables: unit root tests

For sake of simplicity, a Fisher type unit root test is performed. This has the advantage that test results for both the panel of countries as well as all individual countries are reported in one go.

Table 25: Unit root test on national product per capita

Panel		
Method	Statistic	P-value
ADF - Fisher Chi-square	122.629	0.000
Individual countries		
Country	Lag length	P-value
Netherlands	0	0.000
United States	0	0.000
United Kingdom	0	0.000
Germany	0	0.000

Table 26: Unit root test on inflation

Panel		
Method	Statistic	P-value
ADF - Fisher Chi-square	85.182	0.000
Individual countries		
Country	Lag length	P-value
Netherlands	0	0.000
United States	0	0.002
United Kingdom	0	0.000
Germany	0	0.000

Table 27: Unit root test on total equity return

Panel		
Method	Statistic	P-value
ADF - Fisher Chi-square	87.758	0.000
Individual countries		
Country	Lag length	P-value
Netherlands	0	0.000
United States	1	0.000
United Kingdom	0	0.007
Germany	1	0.000

Table 28: Unit root test on short-term interest rate

Panel		
Method	Statistic	P-value
ADF - Fisher Chi-square	38.920	0.000
Individual countries		
Country	Lag length	P-value
Netherlands	0	0.054
United States	0	0.003
United Kingdom	3	0.003
Germany	0	0.005

Table 29: Unit root test on long-term interest rate

Panel		
Method	Statistic	P-value
ADF - Fisher Chi-square	9.826	0.277
Individual countries		
Country	Lag length	P-value
Netherlands	1	0.280
United States	1	0.063
United Kingdom	1	0.665
Germany	2	0.630

9.2 Tables: lag length

Table 30: Lag length criteria for the Netherlands

Lag	AIC	BIC	HQ
0	-23.739	-23.523	-23.662
1	-26.825	-25.532*	-23.365*
2	-26.878	-24.446	-25.974
3	-26.593	-23.146	-25.367
4	-27.023	-22.498	-25.413
5	-27.206*	-21.604	-25.213

Note: * indicates lag order selected by the criterion
AIC: Akaike information criterion
BIC: Schwarz-Bayesian information criterion
HQ: Hannan-Quinn information criterion

Table 31: Lag length criteria for United States

Lag	AIC	BIC	HQ
0	-23.343	-23.128	-23.266
1	-25.459	-24.166*	-24.999*
2	-25.108	-22.738	-24.265
3	-25.348	-21.900	-24.121
4	-25.135	-20.610	-23.525
5	-26.699*	-21.096	-24.705

Note: * indicates lag order selected by the criterion
AIC: Akaike information criterion
BIC: Schwarz-Bayesian information criterion
HQ: Hannan-Quinn information criterion

Table 32: Lag length criteria for United Kingdom

Lag	AIC	BIC	HQ
0	-28.711	-28.496	-28.635
1	-31.354	-30.062*	-30.894*
2	-31.097	-28.727	-30.254
3	-31.113	-27.666	-29.887
4	-31.903	-27.378	-30.293
5	-32.644*	-27.042	-30.651

Note: * indicates lag order selected by the criterion
AIC: Akaike information criterion
BIC: Schwarz-Bayesian information criterion
HQ: Hannan-Quinn information criterion

Table 33: Lag length criteria for Germany

Lag	AIC	BIC	HQ
0	-28.162	-27.946	-28.085
1	-32.092	-30.800*	-31.632
2	-31.704	-29.334	-30.861
3	-32.493	-29.046	-31.267
4	-32.891	-28.366	-31.281
5	-34.638*	-29.035	-32.645*

Note: * indicates lag order selected by the criterion
AIC: Akaike information criterion
BIC: Schwarz-Bayesian information criterion
HQ: Hannan-Quinn information criterion

9.3 Tables: VAR coefficients estimates

In all forthcoming tables, the following abbreviations are used:

- ΔGNPPC: Real gross national product per capita growth rate
- CPI: Consumer price index (i.e. inflation)
- ER: Total equity return
- ST: Short-term interest rate
- LT: Long-term interest rate

Table 34: VAR(1) coefficient estimates for the Netherlands

Note: *, **, *** indicate significance at 10%, 5% and 1% respectively

	ΔGNPPC	CPI	ER	ST	LT
ΔGNPPC(-1)	-0.474838***	-0.252962	-0.167982	0.006338	0.002390
CPI(-1)	-0.000359	0.115545	-0.110186	0.044745**	0.005286*
ER(-1)	0.127359*	0.180628**	0.102276	0.017001*	0.003564**
ST(-1)	0.463096	1.311147	-4.417088*	0.408431***	0.045544*
LT(-1)	0.421272	-1.629320	1.348310	0.255793	0.866296***
C	-0.024610	0.010165	0.157779	0.006728	0.002721**
R-squared	0.301280	0.204966	0.120371	0.408686	0.957498
Adj. R-squared	0.204236	0.094544	-0.001799	0.326559	0.951595
F-statistic	3.104560	1.856212	0.985273	4.976280	162.2034
Determinant resid covariance (dof adj.)			9.57E-19		
Determinant resid covariance			4.43E-19		
Akaike information criterion			-26.64287		
Schwarz criterion			-25.40168		

Table 35: VAR(1) coefficient estimates for United States

Note: *, ** and *** indicate significance at 10%, 5% and 1% respectively

	ΔGNPPC	CPI	ER	ST	LT
ΔGNPPC(-1)	-0.381792***	0.105282	-0.559957	0.100460***	0.000890
CPI(-1)	0.120078	0.047138	-0.760653	0.029054	0.003757
ER(-1)	0.217426***	0.110363***	-0.025570	0.016098**	0.001493
ST(-1)	-0.383194	0.624012*	0.774299	0.367941	0.063496
LT(-1)	0.242722	-2.311040***	-2.071036	0.545504*	0.849171***
C	0.019427	0.045699**	0.115299	0.009078	0.001728
R-squared	0.540801	0.511949	0.082669	0.461665	0.901796
Adj. R-squared	0.477024	0.444164	-0.044738	0.386896	0.888157
F-statistic	8.479488	7.552555	0.648861	6.174577	66.11696
Determinant resid covariance (dof adj.)			4.69E-18		
Determinant resid covariance			2.17E-18		
Akaike information criterion			-25.05320		
Schwarz criterion			-23.81201		

Table 36: VAR(1) coefficient estimates for United Kingdom

Note: *, ** and *** indicate significance at 10%, 5% and 1% respectively

	ΔGNPPC	CPI	ER	ST	LT
ΔGNPPC(-1)	0.131773	-0.572482*	0.015489	0.098441**	0.004399
CPI(-1)	0.056737	-0.221142	0.013236	-0.027997	-0.002113
ER(-1)	0.102111	0.087042	0.451950***	0.017109	-0.002385
ST(-1)	-0.777945*	-1.699973*	-0.358434	0.597999***	0.035775**
LT(-1)	-0.468169	3.190195	2.371879	0.249623	0.939619***
C	0.038733	-0.039529	-0.043530	0.002097	0.000942
R-squared	0.182895	0.180057	0.252238	0.486192	0.897171
Adj. R-squared	0.069409	0.066176	0.148383	0.414830	0.882889
F-statistic	1.611601	1.581101	2.428738	6.813026	62.81896
Determinant resid covariance (dof adj.)			9.94E-21		
Determinant resid covariance			4.60E-21		
Akaike information criterion			-31.21072		
Schwarz criterion			-29.96953		

Table 37: VAR(1) coefficient estimates for Germany

Note: *, ** and *** indicate significance at 10%, 5% and 1% respectively

	ΔGNPPC	CPI	ER	ST	LT
ΔGNPPC(-1)	0.020340	-0.372397**	-1.300593*	0.016884	0.007235
CPI(-1)	0.335055***	0.105328	-0.771238	0.060396**	0.005558
ER(-1)	0.007060	0.170737***	0.564192***	0.008359	-0.000401
ST(-1)	-1.151833**	1.228731	-3.947359	0.549062***	0.043074**
LT(-1)	-0.159807	-1.640855	2.913945	-0.079954	0.882626***
C	0.066257	0.011836	0.109335	0.020692*	0.002448
R-squared	0.326621	0.459073	0.486846	0.441832	0.939926
Adj. R-squared	0.233096	0.383944	0.415575	0.364308	0.931582
F-statistic	3.492340	6.110477	6.830885	5.699333	112.6518
Determinant resid covariance (dof adj.)			1.34E-20		
Determinant resid covariance			6.19E-21		
Akaike information criterion			-30.91399		
Schwarz criterion			-29.67280		

10 Appendix II: Panel VAR model vs. combined forecast model

This appendix discusses the consideration between using a panel VAR model and the combined forecast model, as introduced in chapter 4.1. As already discussed, VAR models are very suitable for describing the dynamics of an economy. Panel VAR models exploit this advantage even more, as are able to capture static as well as dynamic interdepencies, incorporate time variations in the coefficients and account for cross-sectional dynamic heterogeneities (Canova and Ciccarelli 2013).

While coefficients for individual countries can be estimated using OLS techniques, this does not apply to the panel VAR model. As Nickell (1981) shows, dynamic panel models with fixed effects suffer from biased and inconsistent estimations if OLS estimation techniques are applied. This problem arises for a fixed number of cross-sectional dimensions and a large set of observations (even when N goes to infinity). One can correct for this by using instrumental variables in a GMM estimation framework. Since fixed effects are removed using Helmert transformation, a constant is omitted from the model (Abrigo and Love 2015).

The procedure described above results in the following coefficients table.

Table 38: VAR(1) coefficient estimates for panel model using GMM

Note: *, ** and *** indicate significance at 10%, 5% and 1% respectively

	ΔGNPPC	CPI	ER	ST	LT
ΔGNPPC(-1)	-0.337015***	-0.171404**	-0.421192**	0.056873***	0.001837
CPI(-1)	-0.004526	0.026022	-0.167899	-0.001043	-0.000772
ER(-1)	0.135586***	0.117114***	0.203807*	0.015379**	0.000579
ST(-1)	-0.357542	-0.158440	-0.358419	0.507448***	0.047153**
LT(-1)	-1.165688	-2.996533*	1.451894	-0.251143	0.729026***

Using these coefficients to forecast, the following growth path of the panel model economy can be constructed:

Table 39: Growth path of panel economy with pre-specified economic growth

Year	Real GNP	Inflation	Total equity return	Shot interest rate	Long interest rate
0*	2.2%	1.4%	N.A.	0.0%	1.0%
1	2.5%	-0.8%	1.6%	0.0%	0.8%
2	2.9%	-1.6%	2.2%	-0.3%	0.4%
3	3.2%	-0.5%	0.7%	-0.1%	0.2%
4	3.2%	-0.2%	0.2%	0.0%	0.0%
5	3.2%	0.0%	0.1%	0.0%	0.0%
6	3.2%	0.0%	0.0%	0.0%	0.0%
7	3.2%	0.0%	0.0%	0.0%	0.0%
Average	3.1%	-0.4%	0.2%	-0.1%	0.2%

* Starting values are represented as year 0

** Average of total equity return is geometric average

This table clearly shows that forecasts from the panel VAR model do not give economic sensible results as all variables converge to zero (except for economic growth, as this variable is pre-specified). The main indicator for this is total equity return. Despite an ideal economic environment for investors in the form of high real economic growth, low inflation and historically very low interest rates, total equity returns are expected to be very low or even non-existent. This is most likely due to the data of the four countries being smoothed out in the panel model. Consequently, upturns and downturns are compressed into a more flat time series.

As an alternative, the combined forecast model is used. This model combines the forecasts at time t of the economic variable of interest by averaging the forecasted values of that variable for the four economies at time t. This is legit as, in this study, the internal dynamics of the economies prevails over the dynamics between countries. Further, the estimated coefficients of the four economies do mostly have the same sign, especially when coefficients are significant. This leads to the conclusion that the VAR models of individual countries are consistent and can therefore be compared to each other. For the sake of completeness, table 40 gives the growth path of the combined forecast model. Note that this table is an exact copy of table 21 on page 43.

Table 40: Growth path of combined forecast model with pre-specified economic growth

Year	Real GNP	Inflation	Total equity return	Short interest rate	Long interest rate
0*	2.2%	1.4%	-	0.0%	1.0%
1	2.5%	1.3%	10.1%	1.3%	1.9%
2	2.9%	1.1%	9.5%	2.6%	2.8%
3	3.2%	1.0%	8.4%	3.9%	3.7%
4	3.2%	1.0%	6.7%	3.9%	3.7%
5	3.2%	1.0%	6.3%	3.9%	3.7%
Average	2.9%	1.1%	8.1%**	2.6%	2.8%

* Starting values are represented as year 0

** Average of total equity return is geometric average

Hien, M.D.A. van (357756)

ORIGINALITY REPORT

%10	%9	%6	%5
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.imf.org Internet Source	<%1
2	bura.brunel.ac.uk Internet Source	<%1
3	Submitted to King's College Student Paper	<%1
4	scholar.sun.ac.za Internet Source	<%1
5	arno.uvt.nl Internet Source	<%1
6	www.dnb.nl Internet Source	<%1
7	hkimr.org Internet Source	<%1
8	miha.ef.uni-lj.si Internet Source	<%1
9	www.eea-esem.com Internet Source	<%1
10	Michael D. Bordo. "The Gold Standard as a	<%1

“Good Housekeeping Seal of Approval”", The Journal of Economic History, 06/1996
Publication

11	www.dofin.ase.ro Internet Source	<%1
12	Submitted to Dublin City University Student Paper	<%1
13	www.hamanan.com Internet Source	<%1
14	eujournal.org Internet Source	<%1
15	www.aeaweb.org Internet Source	<%1
16	mpra.ub.uni-muenchen.de Internet Source	<%1
17	repub.eur.nl Internet Source	<%1
18	www.bis.org Internet Source	<%1
19	Submitted to Bournemouth University Student Paper	<%1
20	Submitted to University of Kent at Canterbury Student Paper	<%1
21	The New Palgrave Dictionary of Economics, 2008.	<%1

	Publication	
22	Submitted to University of Birmingham Student Paper	<%1
23	www.csbe-scgab.ca Internet Source	<%1
24	econstor.eu Internet Source	<%1
25	Aatola, Piia, Kimmo Ollikka, and Markku Ollikainen. "Informational efficiency of the EU ETS market – a study of price predictability and profitable trading", Journal of Environmental Economics and Policy, 2014. Publication	<%1
26	J.P. SMITS. "The determinants of productivity growth in Dutch manufacturing, 1815–1913", European Review of Economic History, 08/2000 Publication	<%1
27	Epstein, . "Bibliography", Routledge Explorations in Economic History, 2000. Publication	<%1
28	www.collective-action.info Internet Source	<%1
29	www.gamma.is Internet Source	<%1
30	www.global-labour-university.org Internet Source	<%1

31	Submitted to University of Warwick Student Paper	<%1
32	Submitted to University of Keele Student Paper	<%1
33	www.ecsdexpert.eu Internet Source	<%1
34	www.etsap.org Internet Source	<%1
35	Stephen C. Nelson. "Does compliance matter? Assessing the relationship between sovereign risk and compliance with international monetary law", The Review of International Organizations, 02/25/2010 Publication	<%1
36	Tiwari, Aviral K., Claudiu T. Albulescu, and Rangan Gupta. "Time–frequency relationship between US output with commodity and asset prices", Applied Economics, 2015. Publication	<%1
37	www.gla.ac.uk Internet Source	<%1
38	www.federalreserve.gov Internet Source	<%1
39	www.econ.ucdavis.edu Internet Source	<%1
40	duepublico.uni-duisburg-essen.de Internet Source	<%1

41	Wang, Xun, and Fotios Petropoulos. "To select or to combine? The inventory performance of model and expert forecasts", International Journal of Production Research, 2016. Publication	<%1
42	Submitted to University of Reading Student Paper	<%1
43	econ.geo.uu.nl Internet Source	<%1
44	ec.europa.eu Internet Source	<%1
45	archive.org Internet Source	<%1
46	www.ehs.org.uk Internet Source	<%1
47	macrofinance.nipfp.org.in Internet Source	<%1
48	Submitted to RMIT University Student Paper	<%1
49	www.voxeu.org Internet Source	<%1
50	www.ipart.nsw.gov.au Internet Source	<%1
51	Submitted to Erasmus University Rotterdam Student Paper	<%1

52	issuu.com Internet Source	<%1
53	Submitted to Curtin University of Technology Student Paper	<%1
54	jpmph.org Internet Source	<%1
55	digitalcommons.uri.edu Internet Source	<%1
56	nho.econ.muni.cz Internet Source	<%1
57	Submitted to University of Durham Student Paper	<%1
58	Kapsch, M.-L., M. Kunz, R. Vitolo, and T. Economou. "Long-term trends of hail-related weather types in an ensemble of regional climate models using a Bayesian approach", Journal of Geophysical Research, 2012. Publication	<%1
59	Submitted to Cardiff University Student Paper	<%1
60	Berge, Travis J. Cao, Guangye. "Global effects of U.S. monetary policy: is unconventional policy different?", Economic Review (Kansas City), Wntr 2014 Issue Publication	<%1
61	www.bportugal.pt Internet Source	<%1

62	dkuenzel.faculty.wesleyan.edu Internet Source	<%1
63	Submitted to University of Stellenbosch, South Africa Student Paper	<%1
64	R. K. Chowdhury. "Australian rainfall trends and their relation to the southern oscillation index", Hydrological Processes, 2009 Publication	<%1
65	geb.uni-giessen.de Internet Source	<%1
66	DWYER, GERALD P. JR. HAFER, R. W.. "Are Money Growth and Inflation Still Related? (Statistical Data Included)", Economic Review (Atlanta, Ga.), April 1999 Issue Publication	<%1
67	basepub.dauphine.fr Internet Source	<%1
68	mbfconference.luiss.it Internet Source	<%1
69	www.inderscience.com Internet Source	<%1
70	soilandwater.bee.cornell.edu Internet Source	<%1
71	M. Sulis. "Assessment of climate change impacts at the catchment scale with a	<%1

detailed hydrological model of surface-subsurface interactions and comparison with a land surface model", Water Resources Research, 01/28/2011
Publication

---

72 Ho, Tai-kuang. "Dilemma of the Silver Standard Economies: The Case of China", Southern Economic Journal, 2014.
Publication
<%1

---

73 Submitted to Middle East Technical University
Student Paper
<%1

---

74 www.cass.city.ac.uk
Internet Source
<%1

---

75 www.norges-bank.no
Internet Source
<%1

---

76 www.gctas.com
Internet Source
<%1

---

77 www.mcser.org
Internet Source
<%1

---

78 dl4a.org
Internet Source
<%1

---

79 www.etla.fi
Internet Source
<%1

---

80 nces.ed.gov
Internet Source
<%1

---

papers.ssrn.com

81 Internet Source <%1

82 mit.econ.au.dk
Internet Source <%1

83 lup.lub.lu.se
Internet Source <%1

84 www.docstoc.com
Internet Source <%1

85 Aalberg, Laura Andersson, Kjell Bertler,. "Stability of impurities in organic solvents. (Development of a Harmonised Method for the Profiling o", Forensic Science International, May 10 2005 Issue
Publication <%1

86 S. Fatichi. "Deterministic versus stochastic trends: Detection and challenges", Journal of Geophysical Research, 09/29/2009
Publication <%1

87 Financial and Monetary Policy Studies, 2016.
Publication <%1

88 capitalism.wfu.edu
Internet Source <%1

89 www.slideshare.net
Internet Source <%1

90 www.riksbank.se
Internet Source <%1

91	www.calfacts.org Internet Source	<%1
92	www.cb.is Internet Source	<%1
93	american.edu Internet Source	<%1
94	Kumar, S.. "Streamflow trends in Indiana: Effects of long term persistence, precipitation and subsurface drains", Journal of Hydrology, 20090730 Publication	<%1
95	aaltodoc.aalto.fi Internet Source	<%1
96	kluedo.ub.uni-kl.de Internet Source	<%1
97	Chen, Yu-Fu, Michael Funke, and Aaron Mehrotra. "What Drives Urban Consumption in Mainland China? The Role of Property Price Dynamics : House prices and consumption in China", Pacific Economic Review, 2016. Publication	<%1
98	euroframe.net Internet Source	<%1
99	www.coursehero.com Internet Source	<%1

100 Leung, M.T.. "Using investment portfolio return to combine forecasts: A multiobjective approach", European Journal of Operational Research, 20011001 <%1
Publication

---

101 theibfr.com <%1
Internet Source

---

102 www.fh-vie.ac.at <%1
Internet Source

---

103 www.nickcantone.com <%1
Internet Source

---

104 etheses.bham.ac.uk <%1
Internet Source

---

105 Donald H. Burn. "Estimates of changes in design rainfall values for Canada : ESTIMATES OF CHANGES IN DESIGN RAINFALL VALUES FOR CANADA", Hydrological Processes, 03/2012 <%1
Publication

---

106 Jorion, Philippe. "The long-term risks of global stock markets.", Financial Management, Winter 2003 Issue <%1
Publication

---

107 Gächter, Martin; Geiger, Martin; Glötzl, Florentin and Schuberth, Helene. "Sectoral Deleveraging in Europe and Its Economic Implications", Focus on European Economic <%1

Integration, 2015.
Publication

108 Campbell, John Y., and Robert J. Shiller. "Yield Spreads and Interest Rate Movements: A Bird's Eye View", The Review of Economic Studies, 1991. <%1
Publication

109 Hartmann, Heike, and Lisa Andresky. "Flooding in the Indus River basin — A spatiotemporal analysis of precipitation records", Global and Planetary Change, 2013. <%1
Publication

EXCLUDE QUOTES	OFF	EXCLUDE MATCHES	OFF
EXCLUDE BIBLIOGRAPHY	OFF		