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Fisher Effect in Post-Unification Germany - Insights for Firms, Central Banks and Governments

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Fisher Effect in Post-Unification Germany

Insights for Firms, Central Banks and Governments

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Abstract

Irving Fisher's (1930) hypothesis is a pillar in international economic theory used by Central banks and financial ministries to assess the impact of real and nominal variables that are essential for firm-level growth. This paper examines the validity of generalized Fisher's hypothesis for post-unification Germany for the time-period beginning January 1991 until March 2020 through a frequency-time domain framework using continuous wavelet analysis. We make two inferences from the empirical analysis; first, the generalized Fisher hypothesis holds perfectly well for the study period. Second, the relationship between real stock return and inflation exhibited in the post-financial crisis period is attributed to the indirect growth effects of the Germany's overall domestic product. The results provide valuable insights for firms, banks and governments.

Keywords: Fisher hypothesis, real stock return, inflation, wavelet analysis, post-unification. JEL Classification: E43, E44

1 Introduction

1.1 Fisher's theory in the context of firms, banks and government

Firm-level management focusing on areas of company strategy and investor outlook undertakes business decision-making drawing from the macroeconomic developments in the domestic and international markets. For these purposes, the essential macroeconomic indicators in use at the firm-level include the growth of gross domestic output; the level of change in the general price level in producer, consumer and savings or investment rents; the developments in the exchange rates; and, the performance of the stock markets. Irving Fisher's hypothesis builds on the value of using real economic variables as against nominal values that are construed in currencies that further depend on free-float or fixed-rate regimes that may introduce fallacious decision-making of various economic factors that may result in a decline in profitable or economic well-being.

Accordingly, his hypothesis combines the macroeconomic variables of real stock return that indicates shareholder behavior and mood of the stock markets with that of inflation to make statements on the

movement in domestic and international economic output that is the sum of agricultural, industrial and service sector production. Specifically, Fisher postulates a causal movement between the variables: real interest rate, nominal interest rate and expected inflation such that nominal interest rate influences changes in the inflation rate of a given market. Fisher's method is embedded knowhow used by listed companies and SMEs alike to get realistic insights on company growth besides operational planning of procurement, production and sales.

From the perspective of central banks and financial intermediaries, the Fisher hypothesis provides details on the correlation between inflation and interest rates so that production boosting or expansionary monetary policies can be planned by using open market operations that aims towards inflation targeting while providing consumer-friendly nominal interest rates. Central banks directly influence the flow of capital of wholesale and retail banks and together they have significant impacts on macroeconomic growth, which is steered by the government using fiscal expenditure policies. Fisher effect therefore demands a close working of monetary policies set by Central banks and macroeconomic policies implemented by federal governments to together create an environment that leads to high productivity, output and employment.

The Fisher effect is a well-researched field covering testing of fit primarily in the American markets. Overtime, the analyses has spread to different region to verify the validity and to identify the causes for non-congruent relations or gaps. In terms of methodology, there are considerable advances made especially in the univariate testing models often used in inflation-targeting under monetary policy initiatives. To name a few: the usage of the Augmented Dickey Fuller test (ADFL), the Kalman-Fitter Method and multiple versions of quantile cointegration (Asemota/Bala 2011; Atkins/Coe 2002; Bonham 1991) are predominantly in use both in long-run and short-run analyses of the Fisher theory. It needs to be stated that most studies address the veracity of the Fisher hypothesis and often in the context of monetary policy-making and currency-setting.

In the field of literature concentrating on Europe, Fisher studies are available on different sovereign governments or groupings of nations. Few studies address political events that have a massive impact on the economic-setting and result in a complete transformation of firm-level, banking and government incentive structures. Fisher studies on Germany are limited in literature; furthermore, there is none that cover the post-unification German nation, which is a historic event that affected all sectors of business and economic welfare. The next section discusses the ensuing of events that capture the impact of post-unification to help comprehend the importance and role of this phenomenon in the context of Fisher's theory.

1.2 Post-unification Germany: structural progress and viability for Fisher analysis

The economic and political union of East and West Germany was sealed in 1990 by creating market economy for free trade in goods and services and a free flow of resource mobility such as labor, capital and knowhow. Empirical evidence shows that despite a shaky start, market convergence lead to unprecedented structural changes that catalyzed increases in factor productivity and fueled trade integration, following surges in capital inflows and outmigration (Burda/Weder 2017). Although convergence or market integration did not represent a uniform distribution of profits or welfare, despite common legal frameworks, standardization, language and culture, neoclassical growth patterns could be verified in the overall growth of the output and the proliferation of businesses into the East (Burda/Weder 2017).

Empirical analysis in the post-unification period is rare, since reliable national income and product was unavailable until Akerlof et al. obtained sensitive information from the former East (Akerlof 1991). According to their estimates, 80% of industrial output was uncompetitive when valued at world prices in 1990, while physical production had collapsed by more than 50% and unemployment was over 20%. Firstly, the pumping in of fresh capital via direct subsidies and social funds; secondly, the West German influence of entrepreneurial ideas that enabled technology transfers and institutions that created a strong market-orientation together accounted for 2 trillion Euros of investments in the East. These inevitably contributed to the boom in retail and wholesale trade, logistics, and business services such as restaurants, entertainment and other personal and professional services (Akerlof 1991; Sinn 1991, 1995, 2002).

Notwithstanding these positive outcomes, expenditures grew for example, from 1990 to 1997, the overall social security burden rose from just under 30% to 36.3% (Sinn, 1992). Till date, East-West income, opportunity and private investment disparities exist, however all 16 federal states have jointly enjoyed an increase in the per capital GDP. Using Solow-Swan growth models, Burda/Weder (2017) establish a clear relationship between investment activity an individual growth rates of federal states resulting from high capital accumulation, such that the new states grew the fastest. Economic convergence estimated by various studies ranged between 2 and 4%. While total factor productivity was the highest immediately after unification, this dipped after 1995 indicating labor market disparities that have slowed down market convergence (Burda/Severgnini 2015).

Studies conclude that the post-unification Germany represents tedious and expensive convergence or market integration efforts primarily driven by labor and capital migration, but all conclude that this historical event represents a success to the extent that real economic variables such as interest or growth rates are disparity-free. This fact serves as the central motivation for this paper: converged or integrated markets provide the perfect basis for the verification of the Fisher analysis. The following section discusses the objectives of this study.

2 Objectives of the study

Studies on post-unification Germany show that the economic unification or the East-West convergence of factor and output markets, despite uniform laws, institutional frameworks, and investment levels, represented an unqualified success (Burda/Weder 2017). Despite 30 years of market integration, factor and output price disparities prevail. Many of these are attributed to the gradual structural integration, but the social problems such as continued outmigration are explained due to political and cultural differences as compared to the older federal states. Moreover, significant differences in productivity and unemployment rates continue to sustain the East-West economic performance, even though per capita consumption has increased (Franz/Steiner 2000).

Figure 1 captures the results of economic and institutional integration by comparing macroeconomic indicators of per capita gross domestic product, unemployment rate and gross annual income between western and eastern Germany for the years 1991 and 2019. The illustration supports the arguments made in German economic literature that markets integrated sufficiently.

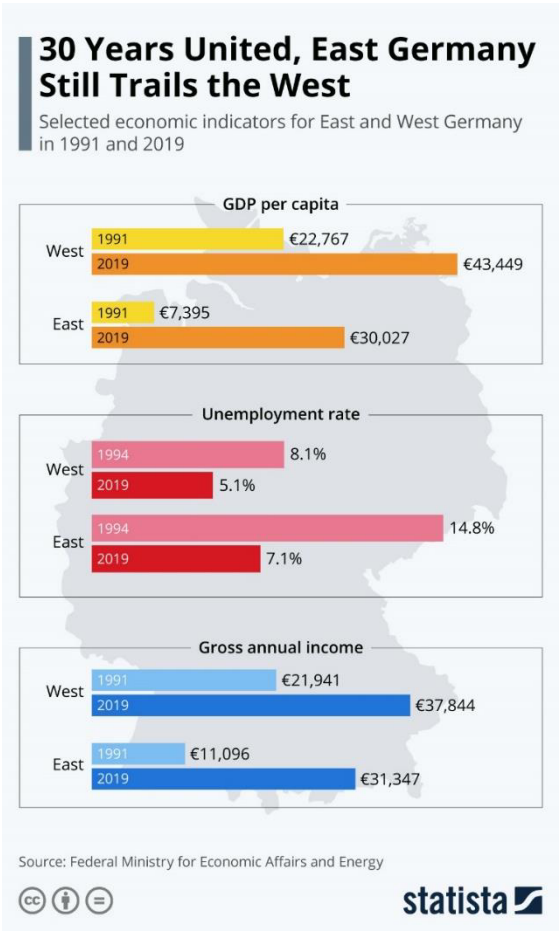


Figure 1: Selected economic indicators for East and West Germany
Source: Statista 2020

Notwithstanding these, the overall development of the post-unification in Germany is argued in the literature (see section 1.2.) to represent an imperfect yet a clear success. Furthermore, the case can be made that every country has regions or states, which are more prosperous than others due to comparative resource advantages – therefore a normal distribution of income or productivity can be allowed for as in any country analysis. This aspect, along with the economic progress made so far allows for post-unification Germany to be a viable country for the verification of the Fisher effect. Additionally, the following characteristics of old and new German states, which are similar to Anglo-Saxon federal frameworks as in the USA or the UK, support the Fisher-verification for the post-unification period:

Firm-level activity: German firms of varying legal forms and sizes operate throughout Germany. Local firms face zero regulation that deter labour, capital or innovation movement

Central bank's monetary policy: all states are governed by the German Central bank, namely the Bundesbank, that implements one unitary monetary policy for all states in coordination with the supranational Central bank, the European Central Bank. Likewise, all financial institutions like the Frankfurter Wertpapierbörse, EUREX and private banks are sources of financing for all states without discrepancies.

Governance structures: old and new states fall under the aegis of the federal government and have the same taxing and expenditure relationships. New states benefitted from extra financing from the old states but this policy is expected to be reversed. This does not present any problems for conducting the Fisher analysis.

The objectives of this paper are to validate the generalized Fisher hypothesis, using a data set for the period between January 1991 to March 2020 on stock returns, output, and inflation for Germany. First, we use a simple correlation to analyze the Generalized Fisher Hypothesis. Following this, in the next step we use a novel tool known as the continuous wavelet transformation method to identify any coherence between the variables stock returns, output and inflation to understand whether the hypothesis holds for post-unified Germany. If the hypothesis holds in both methods, we can verify Fisher analysis as a positive or affirmative phenomenon in Germany. Affirmative results would validate a high-level of market convergence such that firms, the Bundesbank and government institutions are working in a coherent manner that allows for free flow of information, ease of firm-level decision-making and overall economic stability.

3 Literature review

Fisher analysis is one of the oldest theories of modern monetary economics as a result of which there is around ninety years of literature covered by economists from different fields for multiple countries. For this reason, we classify literature into three sub-sections beginning with an explanation of what

empirical behavior can the researcher expect, following a discussion of affirmative and country-based studies that have assessed Fisher's theory so far.

3.1 Empirics of Fisher's hypothesis

Economists have verified real stock returns' behavior over long horizons and its relationship to inflation and output. Fisher's (1930) seminal work purported that interest rates, especially the nominal rate, capture all information available in the market on future price increases. Consequently, the nominal interest rate and expected inflation having a one to one relationship, while real interest rate and expected inflation are mutually independent variables. Fisher's hypothesis is extended to other real asset returns, particularly to stock returns, and termed as Generalized Fisher hypothesis that is now a central topic in macroeconomics since it helps ascertain the efficiency of capital markets in relation to increases in purchasing power. The generalized Fisher hypothesis's central argument is that common investors are, on average, compensated for the value loss of purchasing power due to expected inflation. This is an important contribution to economic and business sciences since it explains the mandatory relationship in stakeholder behavior based on nominal price incentives.

3.2 Affirmative literature

Principal evidence as hypothesized by Fisher was provided by Nelson (1976) and Fama and Schwert (1977), where they show that an inverse relationship exists between real stock returns and inflation. Feldstein (1980) provides the explanation that taxation based on depreciation and capital gains can be impacted by prevalent inflation other studies inferred that the relationship remained unclear or invalid due to measurement errors or intrusion from other variables. Fama (1981, 1990) verified Fisher's theory to conclude that the inverse relationship resulted from the positive relationship between total economic activity and share price movement. Overall, Fama's argumentation and elucidation of Fisher has influenced most of the affirmative literature. For example, on these lines, Carmichael and Stabbing (1983) pointed out that the Fisher effect depends on the accurate measurement of inflationary expectations. It is to be noted that the original Fisher equation includes inflation expectation, henceforth it is appropriate to use a variable that adequately measures inflation expectation. Given the difficulty in obtaining accurate inflation expectation data, most empirical literature studies resort to using actual inflation data if the inflationary expectations are well anchored (Macdonald/Murphy, 1989; Gallagher/Taylor, 2002; Weidmann 2019).

Other studies address the methodological consideration of which variables to include to filter out the existence of Fisher effect. Darby (1975) posited that unaccounted taxation might provide misleading results, while Mishkin (1992), Gilbert and Yeoward (1994) argue the relevance and usage of short-term versus long-term interest rates in the analysis of the Fisher hypothesis. From those studies that verified

Fisher, Fama (1981) provided the most accepted proxy hypothesis inference by positing that the negative and positive relationship of output with inflation and stock returns, respectively, leads to incoherence in the Fisher effect.

3.3 Country-based verification

Most Fisher effect studies focus on USA's inflation-targeting initiatives. Malliaropulos (2000) and Million (2004) evaluated Fisher effect for the USA to check trend stationarity using vector autoregressive (VAR) and cointegration tests and concluded that Fisher holds in the medium and long terms. Studies evaluating Fisher for the Asian region demonstrated that Fisher held in Hong Kong, China, Korea, Singapore, Thailand and the Philippines (Ahmad 2010). Granville and Mallick (2004) conducted a long-term study of the Fisher Theory for the UK using annual data for the period 1900 to 2000 adopting Johansen cointegration tests with the result of significant validation. Other similar methodical validations can be found for: the Turkish economy by Incekara et al. (2012); a combined study of USA, UK and Japan by Toyoshima & Hamori (2011); and, an examination of Fisher for OECD countries that also assessed the connection between current and expected inflation (Pelaez 1995).

There are segregated studies on the EU. In Germany's case, Weidman (1997) tested the Fisher hypothesis for the time-period 1957-1991 and found that the nominal interest rate and inflation moved with less than one coefficient, implying partial validity. Piccinino (2011) analyzed the Fisher effect for the Euro area for 1999-2001 using the European interbank offered rate as the interest rate, and German Federal Securities to measure expected inflation validated the hypothesis. They demonstrate a thorough validation of Fisher's theory for the entire data-set using the Box-Jenkins methodology. Jung et al. (2014) analyzed the Fisher relationship using autoregressive methods with the conclusion that the analysis was inconclusive for Germany and attributed the reason to the impact of German unification. Overall, few studies have covered Germany's post-unification period for verifying Fisher, which is the literature gap we seek to fill with this study.

In the vast empirical literature examining Fisher's effect, there are conflicting inferences on the negative relationship between real stock returns and inflation. This paper focusses on the country-studies that have relied on affirmative results of the hypothesis. Methodological validation of the literature discussed above verified Fisher causality for time-series and panel data using uni-directional and two-way cointegration techniques. Few studies used Box-Jenkins and Johansen methods. We pioneer the usage of the thus-far untested tool - continuous wavelet analysis -, that is gaining ground for enabling an accurate, timely and effective explanation of time-series data. In the next section, we discuss the details of the data and the method employed.

4 Data and Methodology

4.1 Data

We use monthly data beginning from January 1991 to March 2020 on the variables: Dax Performance Index, Consumer Price Inflation, and Output in the production sector. The data for these variables are collected to represent the items: stock return, inflation, and output, respectively. Historical data on Dax Performance Index is compiled from Yahoo Finance (finance.yahoo.com), while for the variables inflation and output, we collected corresponding data from Deutsche Bundesbank (www.bundesbank.de). We constructed two sets of variables for the analysis; first, the monthly change of these variables and second, the annualized change of these variables to derive stock return, inflation, and output growth. The real stock return calculated as the difference between the stock return and inflation. We provide a detailed discussion of the method in the following section.

4.2 Methodology

Following Aguiar-Conraria et al (2011), this study uses the Continuous Wavelet Transformation to understand the relationship between real stock return, inflation, and output growth. The Wavelet Coherency is used to find out the coherency between two variables for different frequencies over time. Furthermore, we apply partial Wavelet Coherency to determine the coherency between two variables conditional upon other variables for differing frequency over time. The wavelet coherence gives us a localized correlation coefficient in time and frequency space, and the statistical significance of it is verifiable using Monte Carlo Simulation methods. Information on positive and negative co-movement is identified using the lead-lag relationship in the wavelet phase. Based on the elaboration provided in Aguiar-Conraria and Soares (2011), we capture the methodical description below.

For a set of two-time series $x(t)$ and $y(t)$, the derivation of Wavelet Coherency involves three steps: First, is to carry out the continuous wavelet transformation of these time series, which decomposes the series into a time–frequency space where oscillations can be observed from the wavelet power spectrum of a time series. The wavelet power spectrum can be interpreted as a measure of the local variance for a time series at each frequency. $W_x(\tau, s)$ and $W_y(\tau, s)$ are the wavelet transform of $x(t)$ and $y(t)$, while $|W_x(\tau, s)|^2$ and $|W_y(\tau, s)|^2$ are the wavelet power spectrums of these series, for time domain τ , and frequency domain s .

Second, the cross-wavelet transform of $x(t)$ and $y(t)$, is expressed as a product of the continuous wavelet transform of these series, which is similar to the covariance of these series in a time–frequency space where oscillations can be observed from the cross-wavelet power spectrum of these series. The cross-wavelet power spectrum depicts the local covariance of $x(t)$ and $y(t)$ at each time and frequency and denoted as $|W_{xy}(\tau, s)| = W_x(\tau, s) W_y(\tau, s)$.

Third, using the cross-wavelet and the wavelet power spectrum, the wavelet coherency, which is analogous with the correlation coefficient in the time and frequency domain, can be computed as presented below. In other words, for a set of two-time series $x(t)$ and $y(t)$, the Wavelet Coherency is denoted as follows.

$$R_{xy}(\tau, s) = \frac{|S(W_{xy}(\tau, s))|}{\sqrt{S(|W_x(\tau, s)|^2)S(|W_y(\tau, s)|^2)}} \text{ with } 0 \leq R_{xy}(\tau, s) \leq 1$$

Equation 1

The time-domain wavelet is given by, while the frequency domain is provided by s . W_x and W_y are the wavelet transform of x and y , respectively. S denotes a smoothing operator in both time and scale; without smoothing, coherency would be identical across all scales and times. On the same lines, the partial wavelet coherency, using an additional time series variable $z(t)$ as a control variable is derived as follows:

$$R_{xy/z}(\tau, S) = \frac{|R_{xy}(\tau, S) - R_{xz}(\tau, S)R_{yz}^*(\tau, S)|}{\sqrt{(1 - (R_{xz}(\tau, S))^2)(1 - (R_{yz}(\tau, S))^2)}}$$

Equation 2

Further, we also construct phase difference between two time series to illustrate positive or negative correlation and lead-lag relationship between these two time series. The value of the phase difference between $x(t)$ and $y(t)$ ranges from $-\pi$ to π . If $x(t)$ and $y(t)$ move together (in Phase) which is analogous to positive correlation at the specified time frequency if the phase difference is zero or it is between 0 and $\pi/2$. The reverse is true (out-Phase) when the phase difference lies between $-\pi/2$ and 0. The results from the estimated wavelet coherency are illustrated as graphs figures 2, 3, 4 and 5.

In the graphs, the thick black contour around the red color indicates the 5 percent significance level, estimated from Monte Carlo simulations using phase-randomized surrogate series. The colour code for coherency ranges from Blue (low, close to 0) to dark red (high, close to 1). Arrows are used to indicate the phase-difference between the two series. Furthermore, arrows pointing to the right or upwards indicate that the variables are in-phase. While arrows pointing to the left indicate that the variables are out of phase.

5 Discussion of Empirical Results

We start with a simple correlation to analyze the Generalized Fisher Hypothesis between the real stock return and inflation. The correlation coefficient between real stock return and inflation stands at 0.041 and -0.020 for monthly and annualized returns, respectively. Close to zero correlation indicating a near-exclusive nature of these two variables and supporting the Fisher hypothesis. The results from

the wavelet coherency help us to understand this relationship with much clarity. The wavelet coherency output is in graphs where the period in months measures the long-run and short-run coherency between the variables. The high coherency indicated by the red color, and the significance level identifies with the black and grey border.

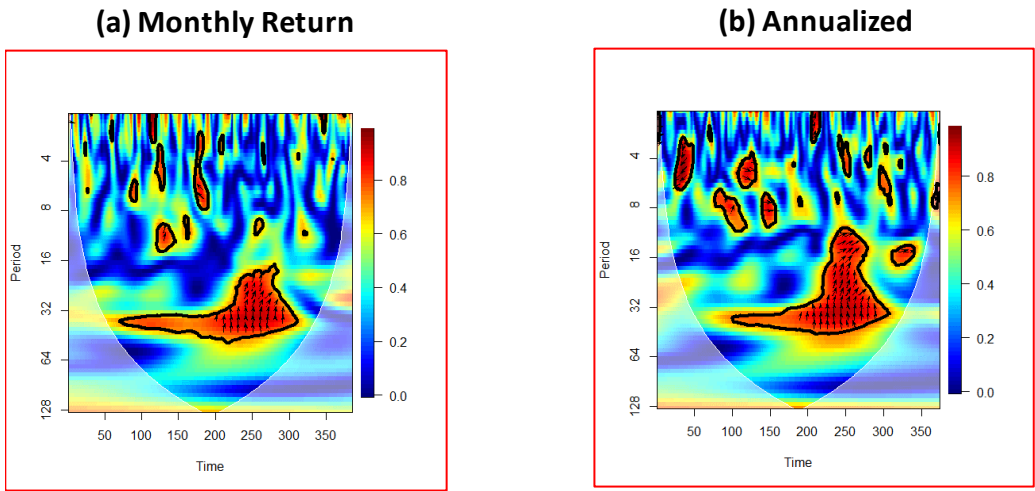


Figure 2: Wavelet Coherency between real stock return and inflation
Source: own illustration

Figure 2 provides the wavelet coherency between real stock return and inflation for both monthly and annualized returns, indicating that the coherency is more for the frequency period in the range of 16 to 64 months with a prominence during and after the global financial crisis period 2007-08. To examine the reason for this significant coherency between real stock return and inflation, we test Fama’s hypothesis. This hypothesis’s main idea is that the output acts as a proxy between real stock return and inflation towards establishing this relationship. In our case, since the correlation between real stock return and inflation is very low, and in the wavelet coherency, the effect is more prominent after the global financial crisis period, we are going to examine whether the output is acting as a proxy or not in this relationship.

Figures 3 and 4 plot the wavelet coherency between output growth with real stock return and inflation.

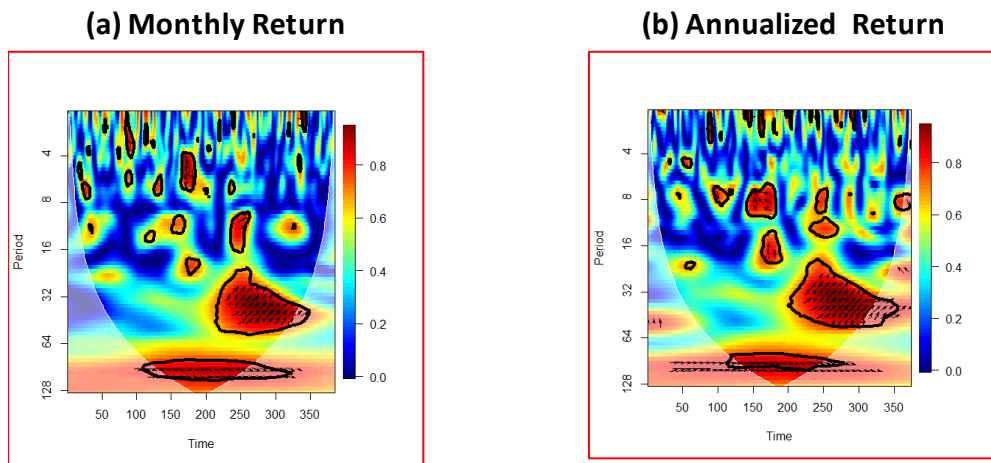


Figure 3: *Wavelet Coherency between real stock return and output growth*
Source: *own illustration*

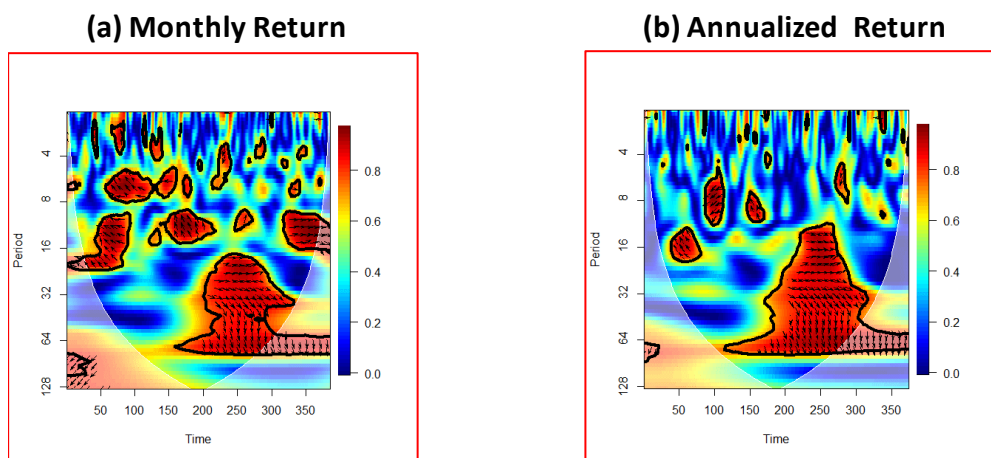


Figure 4: *Wavelet Coherency between inflation and output growth*
Source: *own illustration*

The graphs indicate that real stock return and output growth have a significant long-term relationship over the period; it also has a medium-term relationship during and post-global financial crisis period. Similarly, inflation and output growth have also shown a strong medium to a long-term relationship with a strong presence after the global financial crisis period. These analyses indicate the relationship highlighted by Fama in his proxy hypothesis. However, to obtain a complete and thorough overview, we ran a partial wavelet coherency to analyze the connection between real stock return and inflation. We explain the correlation between these variable as representative of the effect of the interaction of output growth on these variables, which is in line with Fisher's empirics. Figure 5 depicts the partial wavelet coherency, and it clearly shows that the real stock return and inflation are mutually exclusive variables as hypothesized by Fisher.

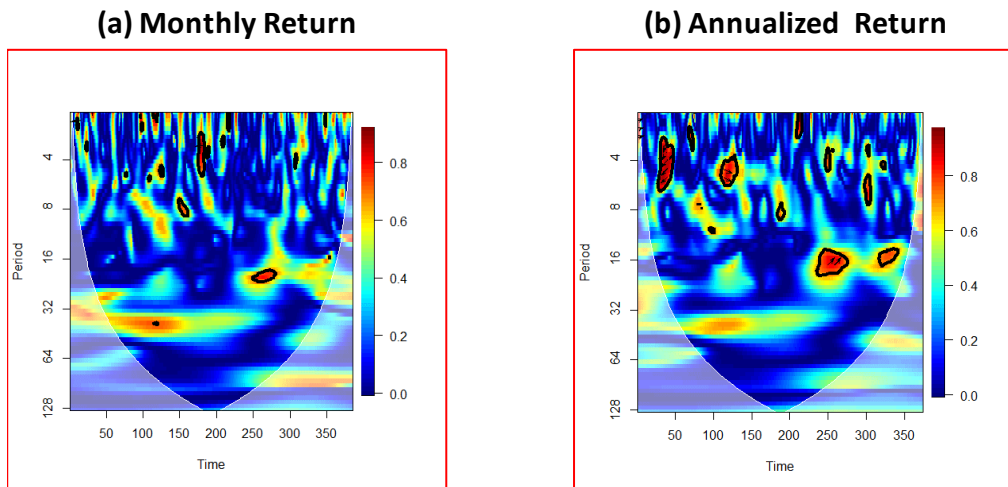


Figure 5: *Partial Wavelet Coherency between real stock return and inflation with output growth*
 Source: *own illustration*

6 Conclusion

Management and financial decision-making draws on the stability and growth of macroeconomic variables, notably output and stock returns. Time-tested macroeconomic theories such as Fisher's hypothesis help verify and establish the interrelation between these variables in tandem with the growth in price-levels. Our study contributes to this long-standing field of research in two ways: 1.) by using the novel method of wavelet analysis; and, 2.) by applying this method to post-unification Germany for the first time. We use monthly data from January 1991 to March 2020 to examine the Generalized Fisher Hypothesis.

Our results using simple correlation analysis to wavelet coherency as well as partial wavelet coherency indicate that the Fisher hypothesis holds in post-unification Germany. In the process of analysis, we observed a coherency exhibited by real stock return and inflation during and after the global financial crisis period. We used Fama's proxy hypothesis for verification and conclude that the coherency is mainly an outcome of an interaction of the variables return and inflation with output growth.

Our study aligns with regular practice in Fisher verification in using annualized returns as estimators. In the wake of Blume's (1974) contentment with the practice of using annualized returns because these estimators may not be unbiased, and may rather overestimate output performance, we used monthly returns data to compare the results. We can thus conclude that our results are robust. Future research using wavelet analysis could investigate the existence of such a bias to verify if a different pattern emerges.

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