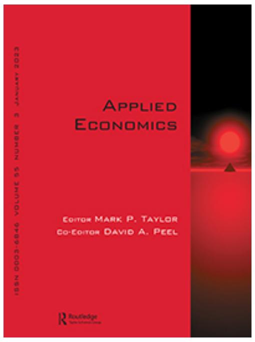

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Financial development and tourism: a century of evidence from Germany

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ABSTRACT

This article presents findings from the first study to examine the direct effects of financial development on tourism. Using a unique historical dataset for Germany covering 1870 to 2016, we apply an autoregressive distributional lag (ARDL) model with structural breaks. To identify the lead–lag relationship between financial development and tourism, we adopt the wavelet coherence method and the most recently developed Shi, Hurn, and Phillips (2020) time-varying causality test. The ARDL results suggest that, on average, financial development is associated with an increase in tourist arrivals. The wavelet coherence results unveil a significant positive correlation between financial development and tourism in both short- and medium-terms, and financial development leads to tourism growth in Germany. Moreover, the causality results indicate that the positive effect of financial development on tourism is most evident from 2009 onward. Our study provides important implications for policymakers.

KEYWORDS
ARDL; financial development; time-varying causality; tourist arrivals; wavelet coherence

JEL CLASSIFICATION
O40; Z32

I. Introduction

We seek to answer the question: what is the impact of financial development (financial development) on tourism? Empirically, much of what we know about the impact of financial factors on tourism revolve around the role of payment systems and financial crisis (see, e.g. Shahbaz et al. 2017; Tafel and Szolnoki 2020; Zenker et al. 2019). However, there are several reasons to expect financial development to influence tourism not the least is that well-developed financial systems can promote investments in the tourism sector, thus increasing tourism demand. Yet, empirically, the impact of financial development on tourist arrivals is not known.

Using historical dataset for Germany covering 1870 to 2016, we examine if the evolution of financial development has contributed to tourism. Globally, Europe has long been and remains a popular destination for tourism. Among the European countries, Germany makes for an important case study given that it is Europe's largest economy and one of the region's most competitive tourist destination (Dustmann et al. 2014; Vismara, Paleari, and Ritter 2012). Germany also has rich and numerous cultural and natural resources and is noted for its advanced infrastructure for leisure and business tourism, which evolved since the nineteenth century (Semmens 2005).

Notably, only a handful of recent studies have investigated the importance of finance on tourism, and they were predominantly based on pairwise Granger causality tests (see, e.g. Katircioğlu, Katircioğlu, and Altinay 2017; Shahbaz et al. 2019). Furthermore, existing studies in the context of a single country used a relatively short time series (24 to 40 observations). Apart from these, there are very few studies considered the issue of structural breaks in testing the stationarity of the tourism series.

Therefore, the present study aims to fill these gaps in the financial development–tourism nexus by bringing additional evidence for the largest economy in Europe, namely, Germany. Our contribution is three-fold. First, we present the first study that examines the direct effects of financial development on tourism, and we do so for an important country with deep roots in the tourism industry. Understanding financial development's effect on tourism is important given that it provides a unique perspective on factors that influence the

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tourism industry. Given that the core role of tourism lies in the global economy, it is important to understand the factors that influence tourism to appropriately strategize policy-wise.

Second, we use a unique historical data for Germany spanning almost 150 years from 1870 to 2016. The use of the long historical dataset has several advantages and allows us to follow the evolution of financial development and the tourism industry beginning from the periods of significant underdevelopment in both the tourism and financial sectors in the nineteenth century to what is now known as advanced in one of Europe's largest and strongest economy – Germany. We identify how these evolutions and transitions of financial development through time have influenced the German tourism sector.

Our third contribution is methodological. In addition to the autoregressive distributional lag (ARDL) model with structural breaks, we use the wavelet coherence technique to model the relationship between Germany's financial development and tourism. The wavelet approach is superior to other models such as correlation, autoregressive conditional heteroscedasticity (ARCH) and GARCH, and standard Granger causality or cointegration analysis as it can capture interconnection between the selected variables by combining information about both frequency and time domains. The wavelet analysis can also breakdown any ex-post variables on different frequencies to examine the subtleties of joint movements across different time horizons without information losses. The approach can also provide a better trade-off between detecting oscillations and peaks or discontinuities. Furthermore, to check the sensitivity of our wavelet coherence results, we also utilize a novel time-varying Granger causality test proposed by Shi, Hurn, and Phillips (2020). This method provides time-varying causal impacts by using a recursive evolving technique. Since the dataset used covers a long period, using the recursive evolving approach can better describe the changes in the causality running between financial development and tourist arrivals.

Our ARDL results suggest that, on average, financial development has a positive effect on tourism. The wavelet coherence results indicate that (i) there is a significant positive correlation between financial development and tourism in both short- and medium-terms; (ii) financial development leads to tourism growth in Germany. In addition, the causality results confirm that the relationship between financial development and tourism is time varying, and the causality running from financial development to tourist arrivals is most evident from 2009 onward.

The remainder of the article is structured as follows: Section II discusses the linkage between financial development and tourism. In section III, we describe the data set. Section IV presents the empirical approaches used in this study. Section V reports empirical findings. Section VI concludes.

II. The conceptual link between financial development and tourism

Conceptually, the relationship between financial development and tourism could be positive or negative depending on the mechanism through which financial development transmits to tourism. In this section, we discuss some of the key mechanisms to provide an overview of why we expect financial development to influence tourism.

Economic growth is an important mechanism linking financial development to tourism. The relationship between financial development and economic growth is not new as a well-established literature has shown a positive relationship between financial development and economic growth (see, e.g. Arestis, Demetriades, and Luintel 2001; Calderón and Liu 2003; De Gregorio and Guidotti 1995; Hermes and Lensink 2003), while a related literature has demonstrated that the relationship is non-linear (see, e.g. Aydin and Malcioglu 2016; Christopoulos and Tsionas 2004). Economic growth has been linked to tourism growth (see, e.g. Aslan 2014; Tugcu 2014). In essence, financial development could be positively associated with tourism given that financial development tends to promote economic growth, which is an important contributor to tourism.

Financial development could also influence tourism via its effects on technology diffusion and infrastructure growth. Financial development is associated with innovation, the diffusion of new technologies and infrastructure growth (see, e.g. Hsu, Tian, and Xu 2014; Ilyina and Samaniego

2011; Xiao and Zhao 2012), which are relevant for tourism growth (Adeola and Evans 2019; Khadaroo and Seetanah 2007, 2008; Xiang 2018). The importance of innovation and technology as crucial elements of tourism growth has long been recognized in many countries, with evidence suggesting that technology strengthens the commercialization and promotion of local tourism offerings, thus increasing tourism demand (Adeola and Evans 2019). Similarly, infrastructure is an important factor in the development of the tourism sector, and for most tourists, infrastructure is an important component of destination features that influences the decision to travel (Khadaroo and Seetanah 2007). Financial development is also associated with an enabling environment that promotes savings and investments while offering a high degree of liquidity (Edwards 1996; Popov 2018). By promoting investments, financial development is likely to stimulate significant investments in the tourism sector, thus shaping the destination features, which tend to influence tourism demand.

Financial development can be linked with tourism via its effects on trade openness. The long-run relationship between financial development and trade openness is well-known (Baltagi, Demetriades, and Law 2009; Kim, Lin, and Suen 2010, 2011). In some contexts, financial development tends to promote trade openness (Kim, Lin, and Suen 2011), while in others, it hinders trade (Kim, Lin, and Suen 2010). Trade openness is linked to easier access to exports that can help develop and increase the appeal of local tourism. Further, by promoting cross-border trade activities, trade openness tends to facilitate international travel, and with it, a significant boost to the tourism sector (Turner and Witt 2001). Importantly, the competition induced by trade openness and the resulting lower domestic prices for goods and services, are important features of destination countries that attracted tourists (Turner and Witt 2001; Wong and Tang 2010). Trade openness is thus associated with tourism growth (Shahbaz et al. 2017; Wong and Tang 2010), and accordingly, is a potential channel through which financial development transmits to tourism.

Crime is another important mechanism. Crime is a well-known deterrent for tourism, and thus, tourism growth is lower in areas with higher crime rates (Alleyne and Boxill 2003; Altindag 2014; Mehmood, Ahmad, and Khan 2016; Michalko 2004; Theodore and Azmat 2000). The prevalence of cashless transactions associated with financial development is known to deter crime (Armey, Lipow, and Webb 2014). Thus, by deterring crime, financial development influences the characteristics of destinations, consequently promoting tourism. Put differently, tourists tend to feel safer without carrying large sums of money, and are thus generally more attracted to destinations that provide electronic financial transactions (Wulandari 2017).

The preceding discussions mainly suggest that financial development is likely to promote tourism via its effects on various tourism-enhancing outcomes. However, with the likelihood of hindering outcomes such as trade openness, financial development could also hinder tourism via other mechanisms. However, we expect the relationship between financial development and tourism to be positive, given that most of the channels tend to suggest a positive effect.

III. Data and sources

The historical dataset used is drawn from multiple sources and consists of annual observations for Germany for the years 1870 to 2016. We use the measure of financial development taken from Madsen and Ang (2016) and updated using data from the Global Financial Data database.[1] As Awaworyi Churchill et al. (2020, 7) note, financial development is expected to measure ``the depth, access, efficiency, and stability of financial institutions and markets in a country, and is also linked to financial liberalization and deregulation of markets". Thus, to capture these dimensions of the financial system and institutions, we use credit-to-GDP ratio. Credit-to-GDP ratio is constructed as the outstanding bank loans to the non-financial corporate sector and households (Awaworyi Churchill et al. 2020; Madsen and Ang 2016).[2] This measure of financial development has been widely used in the literature

[1]The Global Financial Data database is available at http://www.globalfinancialdata.com/.
[2]The bank loans include ``lending by various types of financial institutions such as commercial banks, savings banks, postal banks, credit unions, mortgage banks, insurance companies, and building societies" (Awaworyi Churchill et al. 2020, 7).

Table 1. Summary statistics.

Variables	Mean	Std.Dev	Min	Max
Tourist arrivals	6,100,410	8,539,199	2900	35,600,000
Credit-to-GDP ratio	0.57	0.32	0.05	1.19
Real GDP	41.35	33.13	10.84	117.65
Inflation	1.09	1.95	−2.32	17.41
Exchange rate	2.12	3.13	0.00	23.50

including the economic history literature that uses historical statistics to explain various outcomes (see, e.g. Awaworyi Churchill et al. 2018, 2019; Madsen and Ang 2016; Madsen, Islam, and Doucouliagos 2018; Schularick and Taylor 2012).

Consistent with a large body of literature, we measure tourism using information on tourist arrivals (see, e.g. Athanasopoulos and de Silva 2012; Fourie and Santana-Gallego 2011; Ivlevs 2017; Lim and McAleer 2001, 2005; Yang, Lin, and Han 2010). We construct a new historical dataset of tourism for Germany drawing on information from multiple sources. Specifically, we use data on tourist arrivals taken from Rahlf (2016) for the years 1870 to 1994, but with some missing information.[3] We update this information using tourist arrival data for the years 1995 to 2016 from the World Bank's Development Indicators database.

We control for a standard set of covariates that are likely to influence tourist arrivals including real GDP, inflation, and exchange rate (see, e.g. Qiu and Zhang 1995; Seetaram 2010; Yang, Lin, and Han 2010). Data for these variables are taken from the Schularick-Taylor Macrohistory Database.[4] Table 1 presents the summary statistics of variables used in the analysis.

IV. Empirical methodology

Narayan, Liu, and Westerlund (2016) unit root test with two structural breaks

The traditional unit root tests tend to lack power in the presence of structural breaks (e.g. Great Depression, World Wars, etc.), which could lead to serious mis-specification biases and incorrect inferences (Perron 1989; Zivot and Andrews 2002) and a significant over-estimation of the volatility in the conditional heteroscedasticity models (Lamoureux and Lastrapes 1990). To avoid these pitfalls, we adopt generalized autoregressive conditional heteroscedasticity (GARCH)-based unit root test, which was recently proposed by Narayan, Liu, and Westerlund (2016) and developed to account for non-independent and identical errors and allows for two endogenous structural breaks consistent with a GARCH (1,1) process.[5]

Autoregressive distributional lag model (ARDL) with structural breaks

We use the ARDL model, in some contexts known as the bound test (Pesaran and Shin 1999; Pesaran, Shin, and Smith 2001), which allows us to estimate both long- and short-run dynamics. We specify the following ARDL model with structural breaks:

$$\begin{aligned} ln(TA_t) = \alpha_0 &+ \sum_{j=1}^{h} \alpha_{1j} ln(FD_{t-j}) + \sum_{j=1}^{k} ln(RGDP_{t-j}) \\ &+ \sum_{j=1}^{l} \alpha_{3j} DCPI_{t-j} + \sum_{j=1}^{m} \alpha_{4j} ln(FX_{t-j}) \\ &+ \alpha_{5j} B_{i,t-j} + \varepsilon_t \end{aligned} \tag{1}$$

where TA, FD, $RGDP$, $DCPI$ and FX stand for tourist arrivals, FD, real GDP index, inflation, and foreign exchange rate respectively; B_i $(i = 1, 2)$ is the break dummy consistent with the break points identified by the procedure of Narayan, Liu, and Westerlund (2016); h, k, l, m and n represent the number of lags of explanatory variables, which are determined using information criteria. We obtain the optimal lags by estimating $(p+1)^q$ regression equations, where p and q, respectively, denote the required optimal lags and number of regressors in the model.

After determining the optimal lags, we estimate an unrestricted error correction model (ECM) specified as

[3] Between 1941 and 1949, there are some missing observations, which we use linear interpolation techniques to interpolate the missing data. The data is freely available online at: https://figshare.com/articles/German_Time_Series_Dataset_1834_2012/1450809/1.

[4] The data is available at http://www.macrohistory.net/data/. Details how the variables are constructed can be found in Jordà, Schularick, and Taylor (2017) and Jordà et al. (2019). Inflation is calculated as the change in consumer price index (CPI).

[5] This is the only unit root test that takes into account heteroscedasticity in the data series.

$$\Delta \ln(TA_t) = \beta_0 + \sum_{j=1}^{n} \beta_{1j} \Delta \ln(TA_{t-j}) + \sum_{j=1}^{h} \beta_{2j} \Delta \ln(FD_{t-j}) + \sum_{j=1}^{k} \beta_{3j} \Delta \ln(RGDP_{t-j}) + \sum_{j=1}^{l} \beta_{4j} \Delta DCPI_{t-j} + \sum_{j=1}^{m} \beta_{5j} \Delta \ln(FX_{t-j}) + \beta_{6j} \Delta B_{i,t-j} + \mu_0 \ln(TA_{t-1}) + \mu_1 \ln(FD_{t-1}) + \mu_0 \ln(RGDP_{t-1}) + \mu_0 DCPI_{t-1} + \mu_0 \ln(FX_{t-1}) + \varepsilon_t \tag{2}$$

We then use the following ARDL model to investigate the short-run dynamics:

$$\Delta ln(TA_t) = \gamma_0 + \sum_{j=1}^{n} \gamma_{1j} \Delta ln(TA_{t-j}) + \sum_{j=1}^{k} \gamma_{2j} \Delta ln(FD_{t-j}) + \sum_{j=1}^{l} \gamma_{3j} \Delta ln(RGDP_{t-j}) + \sum_{j=1}^{m} \gamma_{4j} \Delta DCPI_{t-j} + \sum_{j=1}^{n} \gamma_{5j} \Delta ln(FX_{t-j}) + \gamma_{6j} \Delta B_{i,t-j} + v_t \tag{3}$$

Wavelet coherence approach

To properly examine the connectedness between financial development and tourist arrivals, we apply the bivariate concept called the wavelet coherence. The wavelet analysis enables us to compare the frequency contents of two time series and also draw conclusions on the synchronicity of the series at specific periods and across certain ranges of time. The squared wavelet coherence can be constructed using the equation below.

$$R^2(k,f) = \frac{|C(f^{-1} W_{pq}(k,f))|^2}{C(f^{-1} |W_p(k,f)|^2) C(f^{-1} |W_q(k,f)|^2)} \tag{4}$$

where C represents time and is a smoothing operator over time, the value of $R^2(k,f)$ ranges between 0 and 1. Closeness to zero indicates the non-existence of correlation, while closeness to unity stands for the presence of high correlation. Since the wavelet coherency is restricted to positive values, we use the phase differences, ϕ_{pq}, to determine the lead–lag relationship.

$$\phi_{pq}(k,f) = tan^{-1}\left(\frac{L\{C(f^{-1} W_{pq}(k,f))\}}{O\{C(f^{-1} W_{pq}(k,f))\}}\right) \tag{5}$$

where L and O represent the imaginary operator and the real part operator of the smoothed cross-wavelet power, respectively.

Shi, Hurn, and Phillips (2020) time-varying causality test

To check the robustness of our wavelet coherency analysis results, we conduct the most recent causality method developed by Shi, Hurn, and Phillips (2020). The causality test has three time-varying algorithms, namely, forward-recursive causality, rolling causality and recursive evolving causality. We briefly describe the causality procedure as follows.

Let y_t be a k-vector time series that can be generated by the model below.

$$y_t = \alpha_0 + \alpha_1 t + u_t \tag{6}$$

where u_t follows a VAR(p) process.

$$u_t = \beta_1 u_{t-1} + \ldots + \beta_p u_{t-p} + \in_t \tag{7}$$

where $\in_t$ stands for the error term. Substituting $u_t = y_t - \alpha_0 - \alpha_1 t$ from Equation (6) into Equation (7), we can get:

$$y_t = \gamma_0 + \alpha\gamma_1 t + \beta_1 y_{t-1} + \ldots + \beta_p y_{t-p} + \in_t \tag{8}$$

where γ_i is a function of α_i and β_i with $i = 0, 1$ and $j = 1, \ldots, p$.

Dolado and Lütkepohl (1996) and Toda and Yamamoto (1995) suggest to use lag augmented VAR (LA-VAR) to perform Granger causality test for a possible integrated variable y_t and can be written as below.

$$Y = \tau\Gamma' + X\Theta' + B\Phi' + \in \tag{9}$$

where $Y = (y_1, \ldots, y_T)'_{T\times n}$, $\tau = (\tau_1, \ldots, \tau_T)'_{T\times 2}$, $\tau_t = (1, t)'_{2\times 1}$, $X = (x_1, \ldots, x_T)'_{T\times np} x_t = (y'_{t-1}, \ldots, y'_{t-p})'_{np\times 1}$, $\Theta = (\beta_1, \ldots, \beta_p)_{n\times np} B = (b_1, \ldots, b_T)'_{T\times nd}$, $b_t = (y'_{t-p-1}, \ldots, y'_{t-p-d})'_{nd\times 1}$, $\Phi = (\beta_{p+1}, \ldots, \beta_{p+d})_{n\times nd}$ and $\in = (\in_1, \ldots, \in_T)'_{T\times n}$; d represents the maximum integration order for y_t.

The Wald test statistic for testing the null hypothesis $H_0 : R\theta = 0$ is given by:

$$w = \left[R\theta\right]' \left[R\left(\widehat{\Omega} \otimes (X'QX)^{-1}\right)R')\right]^{-1} \left[R\hat{\theta}\right] \tag{10}$$

where $\hat{\theta} = vec(\hat{\Theta})$ denotes the row vectorization, $\hat{\Theta}$ represents the ordinary least squares (OLS) estimator $\hat{\Theta} = X'QX(X'QX)^{-1}$, $\hat{\Omega} = T^{-1}\hat{\epsilon}'\hat{\epsilon}$ and R is a $m \times n^2 p$ matrix where m refers to the number of restrictions. The Wald statistic is asymptotically χ^2_m distributed with the assumption of conditional homoscedasticity.

Based on the supremum (sup) Wald statistic sequences, Shi, Hurn and Phillips (2020) developed a real-time-varying causality test using a forward recursive (Thoma 1994), a rolling window (Swanson 1998) and a recursive evolving (Phillips, Shi, and Yu 2015) algorithms. In regard to the recursive evolving procedure, the Wald statistic over $[f_1, f_2]$ with a sample size fraction of $f_w = f_2 - f_1 \geq 0$ is denoted as $W_{f_2}(f_1)$ and the sup Wald statistic is as follows:

$$SW_f(f_0) = \frac{sup}{(f_1, f_2) \in \Lambda_0, f_2 = f}\left\{W_{f_2}(f_1)\right\} \tag{11}$$

where $\Lambda_0 = \{(f_1, f_2) : 0 < f_0 + f_1 \leq f_2 \leq 1, \text{ and } 0 \leq f_1 \leq 1 - f_0\}$ for some minimal sample size $f_0 \in (0, 1)$ in the regressions. The other two procedures are the special cases of the recursive evolving procedure.

In a simple switch case, the dating rules for the three procedures, respectively, are:

Forwarding

$$\hat{f}_e = \frac{inf}{f \in [f_0, 1]}\{f : W_f(0) > cv\} \text{ and } \hat{f}_f = \frac{inf}{f \in [f_e, 1]}\{f : W_f(0) < cv\} \tag{12}$$

Rolling

$$\hat{f}_e = \frac{inf}{f \in [f_0, 1]}\{f : W_f(f - f_0) > cv\} \text{ and } \hat{f}_f = \frac{inf}{f \in [f_e, 1]}\{f : W_f(f - f_0) < cv\} \tag{13}$$

Recursive evolving

$$\hat{f}_e = \frac{inf}{f \in [f_0, 1]}\{f : SW_f(f_0) > scv\} \text{ and } \hat{f}_f = \frac{inf}{f \in [f_e, 1]}\{f : SW_f(f_0) < scv\} \tag{14}$$

where $\hat{f}_e$ and $\hat{f}_f$ stand for the estimated first chronological observations, their test statistics either exceed or below the critical values for the starting and termination points in the causal relationship, cv and scv refer to the critical values of the W_f and SW_f, respectively. The starting and termination dates are computed similarly for multiple switches. Based on the simulation experiments conducted by Shi and Phillips (2020), the recursive evolving procedure produces the best results.

V. Empirical findings

Preliminary analysis

We first perform some preliminary analysis including scatter plots and unit root properties of our data series. Figure 1 shows that financial development is positively correlated with tourist arrivals in Germany. We then implement unit root tests to examine the stationarity of the variables to ensure that the variables used are stable. Table 2 presents the results of Narayan, Liu, and Westerlund (2016) unit root test with two structural breaks. The results show that all series are stationary at the 5% significance level, except tourist arrivals. We find that the first break in the tourist arrival series occurred in 1900, and the second occurred in 1955. For the financial development variable, the first break was detected around 1900, and the second occurred from 1926 to 1964. The real economy of Germany had its first break in 1940, and the second break in 1966. Inflation in Germany experienced the first and second breaks in 1886 and 1911, respectively. The first break in the German foreign exchange rate series occurred in 1918, and the second break occurred in 1951.

Identified breaks are linked to various domestic or international shocks. For instance, the break data of 1900 for tourist arrivals coincides with a phenomenon that is referred to in the history literature as the rise of mass tourism in Germany and the decline of elite tourism in Reichenhall (Rosenbaum 2014). The break dates in financial development and GDP coincide with the decades of increasingly freer trade, where strong growth coupled with trade expansion resulted in the golden age of world trade (Awaworyi Churchill et al. 2019; Bhagwati 1994).

Our unit root test results provide a mixture of $I(0)$ and $I(1)$ series, and thus the conventional Engle and Granger (1987) and Johansen (1991)

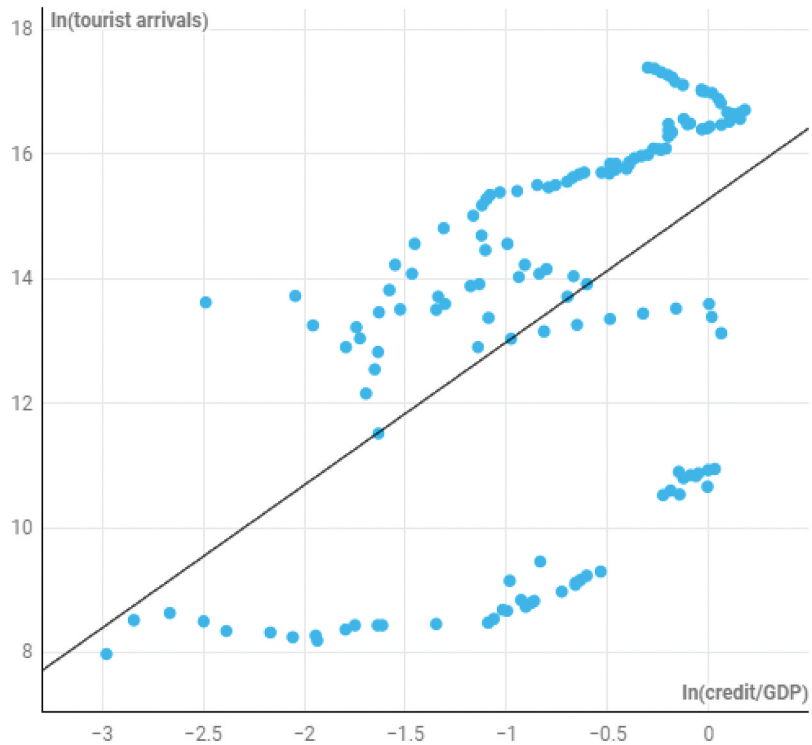

Figure 1. Association between tourism and financial development in Germany (1870–2016).

Table 2. Narayan, Liu, and Westerlund (2016) GARCH unit root test with two structural breaks.

Variables	Test statistic	TB1	TB2
ln(tourist arrivals)	−1.44	1900	1955
ln(credit/GDP)	−11.44*	1899	1926
ln(real GDP)	−4.24*	1940	1966
Inflation	−8.53*	1886	1911
ln(exchange rate)	−4.39*	1918	1951

TB1 and TB2 denote dates of structural breaks. The 5% critical value of the GARCH unit root test is −3.76, which are taken from Table 3 [N = 250 and GARCH parameters [α,β] chosen as [0.05, 0.90] in the paper by Narayan, Liu, and Westerlund (2016)]. Narayan, Liu, and Westerlund (2016) only provide critical values for 5% significance level. * Denotes statistical significance at 5% level.

Table 3. ARDL unrestricted error correction model.

Panel A: Breusch–Godfrey serial correlation LM test			
Test statistics		*p*-Value	
F-statistic	1.64	0.17	
Observed *R*-squared	6.87	0.14	
Panel B: Bounds test			
Test statistic		Lower bound	Upper bound
F-statistic	1.20	2.62	3.79

The lower bound and upper bound listed in Panel B of the table are critical value bounds at the 5% significance level.

cointegration tests are not appropriate in this context. We therefore use ARDL model, which is applicable to variables with different order of integration.[6]

ARDL results

We employ the Schwartz Bayesian Criterion (SBC) method to select the most appropriate ARDL model from a maximum of six lags for all data series. The ARDL(1,2,0,0,0,0) is selected as the baseline specification following which we test for serial correlation in the chosen model using the Breusch–Godfrey Lagrange Multiplier (LM) test. From Panel A of Table 3., we find that we cannot reject the null hypothesis of no serial correlation at the 5% significance level, which indicates that serial correlation is not a problem.[7] We then use the Cusum test to examine our model stability, which we confirm at the 5% significance level.[8]

Next, to examine the long-run equilibrium, we use the bounds test developed by Pesaran, Shin, and Smith (2001). The bound test is an F-test with the null hypothesis of $\mu_0 = \mu_1 = \mu_2 = \mu_3 = \mu_4 = 0$ in Equation (2). As Pesaran, Shin, and Smith (2001) note, the lower bound and upper bound are used when all series are $I(0)$ and $I(1)$, respectively. Reported F-statistic below the lower bound suggests that cointegration is unlikely, while

[6]The number of regressions estimated by ARDL model, in this article, is 12,500.
[7]Our results are robust from 1 lag to 10 lags.
[8]All the Cusum test results, in this article, are available upon request.

Table 4. ARDL model with structural breaks.

Panel A: Breusch–Godfrey serial correlation LM test				
		p-Value		
F-statistic	1.06	0.38		
Observed *R*-squared	4.51	0.34		
Panel B: Short-run coefficients				
	Coefficient	Std. error	*t*-Statistic	*p*-Value
d(tourist arrivals(−1))	0.02	0.09	0.27	0.79
d(credit/GDP)	0.53	0.21	2.53**	0.01
d(credit/GDP(−1))	−0.15	0.20	−0.79	0.43
d(credit/GDP(−2))	0.19	0.20	0.96	0.34
d(real GDP)	0.31	0.61	0.50	0.62
d(inflation)	−0.02	0.02	−1.33	0.19
d(exchange rate)	−0.02	0.02	−0.99	0.32
d(break dummy)	0.01	0.08	0.13	0.90

d denotes the first difference operator, while the numbers in parentheses show the number of lags used.

above the upper bound suggests that cointegration exists. An *F*-statistic between the lower and upper bounds is inconclusive. Panel B of Table 3 shows that the *F*-statistic of 1.2 is smaller than 2.62, which is the lower bound indicating that there is no evidence of a long-run association between credit-to-GDP ratio and tourist arrivals in Germany. We proceed to the short-run dynamic analysis by estimating Equation (3). The results, which are reported in Table 4, show that the coefficient on financial development is positive and statistically significant at 5% level. Specifically, on average, a 1% increase in financial development is associated with an increase in tourist arrivals by 0.53%. Our findings lend support to the previous studies such as Khanna and Sharma (2021), thereby suggesting that financial development affects tourist arrivals positively. This is in line with the argument that financial development enhances ease of doing business and as a source of capital which is crucial for foreign direct investment (FDI) in the tourism industry, especailly for attracting international hotels and restaurant chains in the country (Zhang and Jensen 2007).

Wavelet coherence results

To examine the direction of the causal relationship between financial development and tourism in Germany, we employ a continuous wavelet coherence approach. The coherency is shown using contour plots because it involves three dimensions. In the graphical plot, the vertical and horizontal axes, respectively, represent frequency and time with frequency in yearly ranges from lower (4 years) to upper (32 years). The cone of influence showing the region of edge effects contains white contour lines which signify the region of 5% significance level simulated using Monte Carlo method of two white noise series with Bartlett window type. The vertical bar to the right of the plot stands for colour codes for local correlations ranging from red (high correlation) to blue (low correlation). Therefore, in our plot, a red colour inside the white contour at the bottom (top) of the plot indicates strong co-movement at high (low) frequencies, while red colour in the white contours at the left-hand (right-hand) side implies strong co-movement at the beginning (end) of the sample period. The phase difference between the two variables is captured by arrows. The name of the index shown first is the first series and the other being the second. Arrows pointed to the right (left) suggest that the two variables are in phase (out of phase). Left-up and right-down arrows indicate that the first variable is leading; otherwise, the first variable is lagging.

Figure 2 presents the results for the coherency and phase between financial development and tourist arrivals. We can see that most of the stronger and finest coherences stretching over longer periods are found at low-to-medium frequencies. Specifically, we observe a highly statistically significant co-movement between financial development and tourist arrivals in the 4–16 yearly frequency band for 1870 to 1960. The series are in phase with financial development leading to tourist arrivals. Similarly, the co-movement between the two data series is also very strong at the yearly frequency band of 4–8 from 2000 onward. Furthermore, we find arrows

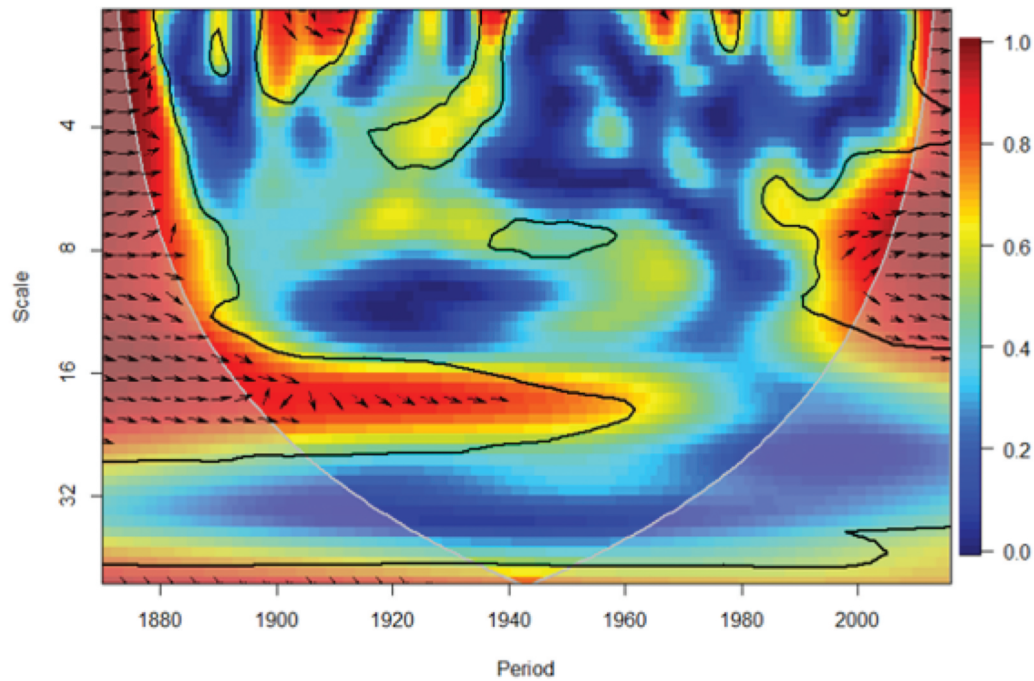

Figure 2. Wavelet coherence between financial development and tourist arrivals.

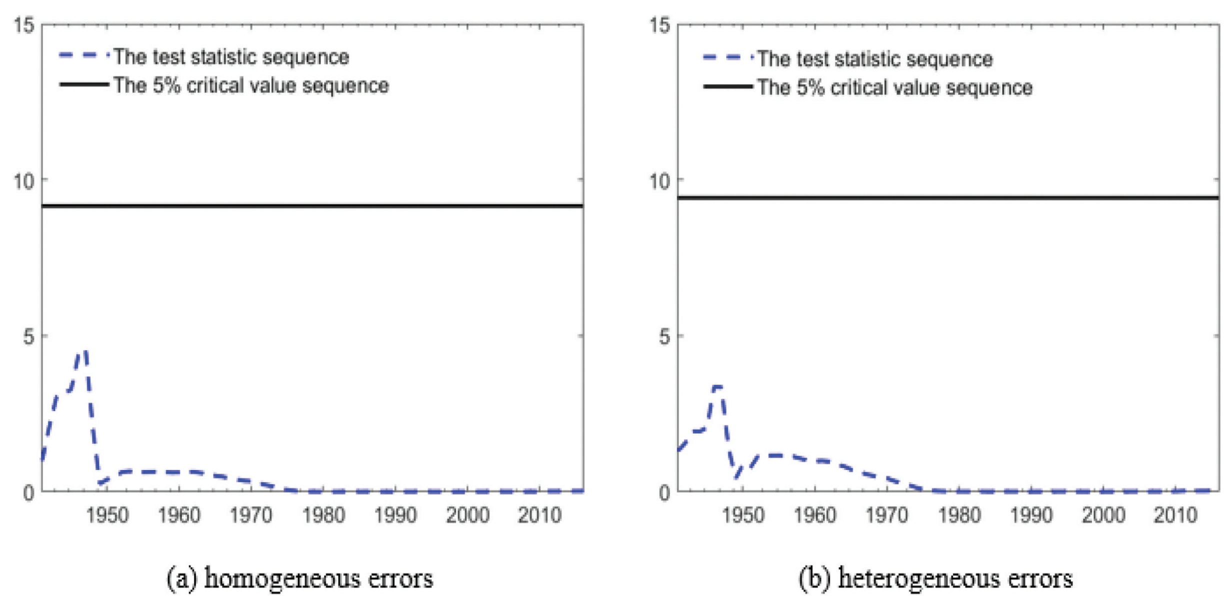

Figure 3. Forward expanding window causality running from FD to tourist arrivals.

in the red island predominantly point down-right and right, suggesting that financial development also leads tourism during this period. Overall, our wavelet coherence findings suggest that (i) there exists a significant positive correlation between financial development and tourism in Germany in both short- and medium-terms; (ii) changes in financial development can result in changes in tourist arrivals.

Time-varying causality test with different rolling-window strategies

To check the robustness of the wavelet coherence analysis outcomes, we implement the most recent time-varying Granger causality test developed by Shi, Hurn, and Phillips (2020) running from FD to tourist arrivals. We use three different rolling-window strategies: (i) forward expanding window

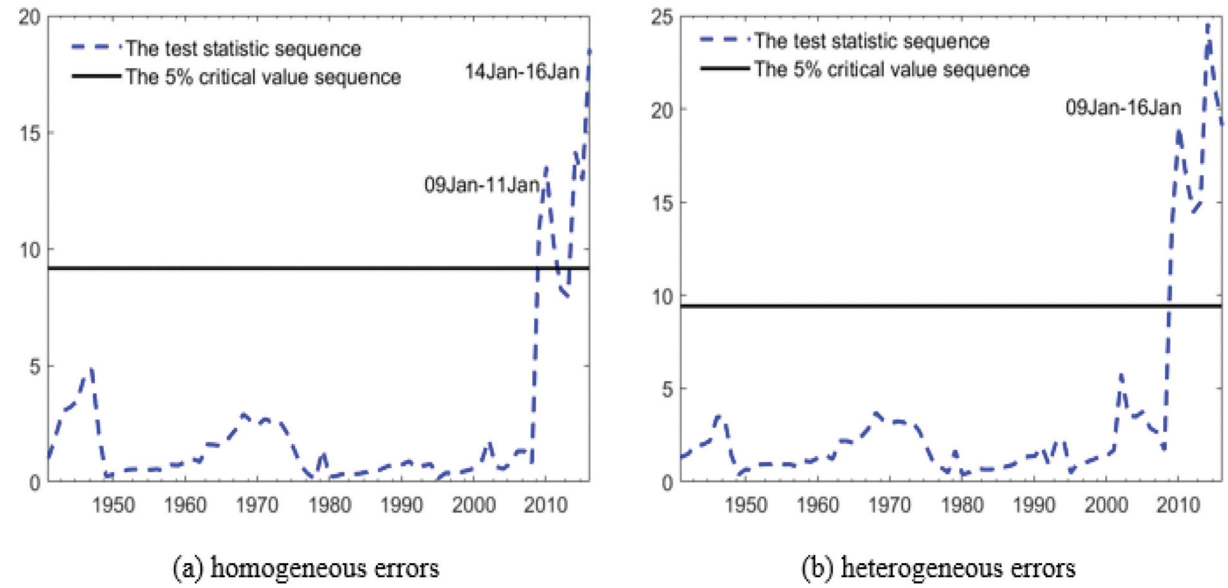

Figure 4. Rolling-window Granger causality running from FD to tourist arrivals.

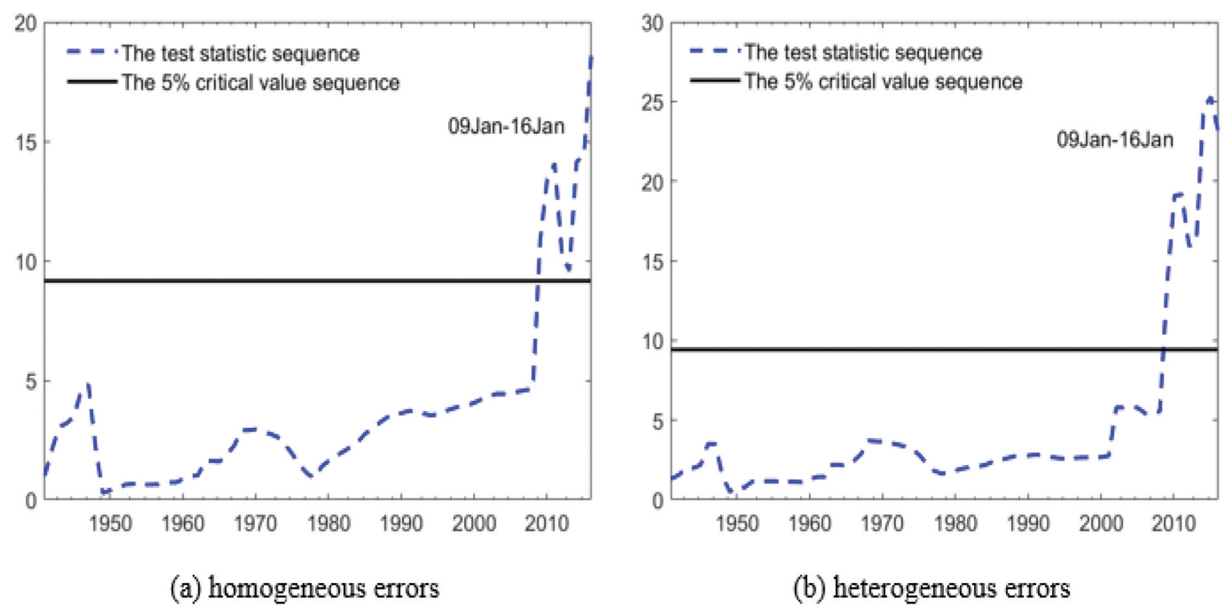

Figure 5. Recursive evolving window Granger causality running from FD to tourist arrivals.

method, (ii) rolling window method, and (iii) recursive evolving window method. The maximum lags are determined to be 6 for each estimation for every sub-sample. The baseline specification of the LA-VAR model includes five variables, which are tourist arrivals, financial development, real GDP, inflation, and exchange rate. Following Shi, Hurn, and Phillips (2020), we set the window size to be 72.

Figure 3 plots the results of forward expanding window Granger causality running from financial development to tourist arrivals. Here, we find no evidence of causality running from financial development to tourist arrivals over time given that the Wald statistics are well below the critical values at 95% significance level. Figure 4 presents rolling window Granger causality results. Panel (a) plots the results that take into account homogeneous errors. The non-Granger causality hypothesis is rejected over the periods 2009 to 2011 and 2014 to 2016. Turning to the results of heterogeneous errors in panel (b), the null hypothesis is rejected from 2009 to 2016. Figure 5 shows the results when a recursive evolving window technique is employed. Likewise, panel (a) presents the results of homogeneous errors, where we find uni-causality running from financial development to tourist arrivals over the period 2009 to 2016. In panel (b) which reveals the results of heterogeneous errors, we observe that the null hypothesis is rejected over the period 2009 to 2016. Our results differ from Fauzel and Seetanah (2021) and Shahbaz et al. (2019), who found the presence of bidirectional causality between financial development and tourism development. This is mainly due to the fact that they use the standard Granger causality approach that does not consider the time-varying factors.

The results in Figures 4 and 5 suggest a time-varying relationship between financial development and tourism, such that the positive effect of financial development on tourism, which is observed in the ARDL model and wavelet coherence is most evident for the period 2009 to 2016. Viewed together, these results confirm the major findings of wavelet coherence analysis.

VI. Conclusion

We examined the relationship between financial development and tourist arrivals in Germany using a unique historical dataset that covers the period 1870 to 2016. In doing so, we open a new avenue of research in tourism which differs from the literature that has examined the determinants of tourism demand. Specifically, the literature on the impact of financial factors on tourism has mostly focused on the role of payment systems and financial crisis, and by examining the impact of financial development, our study is an important first step that addresses a major gap in the literature.

The ARDL results indicate that, on average, financial development is positively associated with tourist arrivals over the sample period. Our wavelet coherence results suggest that financial development is positively correlated with tourism in both short- and medium-terms, and financial development leads to tourism growth in Germany. Moreover, the causality results imply that the relationship between financial development and tourist arrivals is time varying. In particular, financial development causes variations in tourist arrivals from 2009 onward. These findings suggest that financial development could be an avenue worth pursuing if policymakers aim to expand the tourism sector. Thus, policies aimed at promoting the financial sector can have significant implications for tourism.

While this study provides clear insights into the relationship between financial development and tourist arrivals, it is based on time-series analysis. Future studies can go further to examine the dynamics of financial development and tourism in a panel of countries. This is important given the general lack of studies on this relationship and the relevant insights that might emerge from different contexts. Furthermore, while this study provides detailed discussions on the mechanisms through which financial development can influence tourist arrivals, none of these mechanisms are empirically tested as it is beyond the scope of the current study. Empirically understanding the mechanisms through which financial development transmits to tourism is important, and thus future studies can shed light on the validity of these mediators.

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