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FREQUENCY DOMAIN ANALYSIS OF CONSUMER CONFIDENCE, INDUSTRIAL PRODUCTION AND RETAIL SALES FOR SELECTED EUROPEAN COUNTRIES

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Abstract. This paper examines the relationship between consumer confidence, economic growth and retail sales for selected countries employing frequency domain analysis. Our methodology includes the causality test developed by Breitung and Candelon (2006) which improves the methodology of Geweke (1982) and Hosoya (1991). We focus on the causality tests across frequency bands as well as the usual Granger causality tests. Especially for the emerging countries the causality goes from the economic growth to consumer confidence but not vice versa. This argument basically supports the findings of Güneş and Uzun (2010) as well as Balkytė and Tvaronavičienė (2010), which claim that in emerging countries consumers are not able to trigger the economic growth with their confidence due to their subsistence level of income. Besides, causality from consumer confidence to retail sales, which is a proxy for the consumer expenditures, is detected. As in Basdas and Çelik (2010), we also obtain significant differences whenever the frequency domain causality tests are employed instead of usual Granger causality tests in time domain.

Keywords: consumer confidence, causality analysis, frequency domain analysis, Breitung and Candelon test.

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1. Introduction

Consumer confidence / sentiment is commonly described as a leading economic indicator. In its simplest sense, such an indicator is defined as any economic statistic, which possesses information on the current and future path of an economy, Tvaronavičienė *et al*. (2009). According to the surveys of Tvaronavičienė and Grybaitė (2007), Tvaronavičius and Tvaronavičienė (2008), such statistics receive widespread attention from experts, investors and business and financial press as economic agents may amend consump-

tion / investment strategies depending on the pattern of leading indicators. Therefore, public and / or private institutions in many developed / emerging countries have constructed consumer confidence indices (CCI) to measure and disseminate the latest stance of consumer attitudes[1].

The analysis of consumer confidence advocates the positive relationship between consumer optimism and the future path of consumption expenditures. Among others, Carroll *et al.* (1994), Bram and Ludvigson (1998), Hüfner and Schröder (2002) and Kwan and Cotsomitis (2006) provide support for the link between changes in consumer attitudes and personal consumption expenditures. However, the bulk of the literature mainly focuses on developed countries and the expectations-consumption channel where consumer confidence is modeled as strictly exogenous[2]. Recently, Gomes (2007) emphasizes the inherent characteristics of endogenous growth models that rely on the optimization problem of a consumption utility maximizing representative agent. In such a theoretical setting, economic agents are expected to increase (decrease) their propensity to consume in expansionary (recessionary) periods. Hence, an increase in consumer confidence should lead to an increase in total retail sales and economic growth given that the survey responses are unbiased and there is no attrition problem.

The originality of this study is twofold: First, the research object of our study is to investigate the direct link between consumer confidence, economic growth and retail sales for the case of several countries, including both developing and developed countries. Second, as research methodology, we use spectrum analysis tools such as causality in frequency domain and spectral variance decompositions. We employ the consumer confidence indexes, industrial production (as a proxy for economic growth) and retail sales (as a proxy for the consumer expenditures) to provide insights into the transmission mechanism of changes in the consumer confidence, the response of domestic production and retail sales in selected countries. Our analysis would also shed light to the differences in this transmission mechanism between developed and developing countries.

The second section of this paper includes a brief literature survey on consumer confidence. Section three explains the data of our analysis. In section four, we introduce the methodology of empirical analysis, followed by section five, where we will present and explain the empirical findings. Section six will conclude with some remarks for further research.

2. Literature survey

There are two distinctive categories of literature on consumer confidence. The first could be termed as conventional with its focus on the predictive ability of consumer confidence while searching an answer to the well-known question: "Does consumer sentiment accurately forecast household spending?" Among others, Acemoglu and

[1] The first survey of consumer attitudes has been in the United States by the University of Michigan in the 1940s. Katona (1960) is cited as the seminal study for the concept and measurement of consumer confidence.

[2] Roos (2008) incorporates Katona's theory into a standard model of intertemporal utility maximization by allowing for a time-varying preference parameter which is exogenous to the consumer and determined by the social environment.

Scott (1994); Carroll *et al.* (1994); Fan and Wong (1998); Kwan and Cotsomitis (2004) constitute some of this orthodox approach. The second category includes studies that employ anything outside the orthodox realm (Among others, see Flavin 1991; Alessie, Lusardi 1997; Batchelor, Dua 1998; Souleles 2004).

The orthodox approach argues that improvements in consumer sentiment stimulate consumption growth in the short run. Therefore, the starting point for these studies is to obtain the goodness-of-fit values from regressions of the growth of various measures of household spending on lagged values of consumer confidence using the following equation:

$$\Delta \log\left(C_t\right) = \alpha_0 + \sum_{i=1}^{n} \beta_i S_{t-i} + \varepsilon_t, \tag{1}$$

where C_t denotes consumption at time t, and S_t shows the CCI at time t[3]. Next they test the predictive ability of the sentiment while adding a vector of so-called control variables to the right-hand side[4]. Hence, the model becomes:

$$\Delta \log\left(C_t\right) = \alpha_0 + \sum_{i=1}^{n} \beta_i S_{t-i} + \gamma Z_{t-1} + \varepsilon_t, \tag{2}$$

where Z_{t-1} denotes a vector of other variables at time (t–1). This approach builds on the canonical permanent income (or life-cycle) hypothesis which postulates that consumers' decisions depend on their expectations of their future incomes. Thus, if consumer confidence is high, then consumer expenditures should be high simultaneously and in the near future.

On the other hand, an unconventional study by Batchelor and Dua (1998) tests the rationality of the economic forecasters' predictions through the proposed stable relationship between the Blue Chip economic indicators and the CCI. They show that consumer confidence is successful in predicting the 1991 recession but would not have performed as well in other times. Moreover, Souleles (2004) employs household-level data that from the Michigan Survey of Consumer Attitudes and Behavior. His results show that households' expectations are biased as forecast errors by individuals do not average out even over a sample period of 20 years.

There is no consensus on the usefulness of consumer confidence as a leading economic variable, either. Garner (1991); Roberts and Simon (2001) and Desroches and Gosselin (2002) conclude that the link between aggregate consumer expectation index and changes in future consumer sales activity is rather weak. Others like Throop (1992); Huth *et al.* (1994); Otoo (1999); Nahuis (2000); Eppright *et al.* (2003) and Jansen and Nahuis (2003) support consumer confidence in predicting changes in total consumer expenditures and demonstrate the link between confidence and financial market variables. Recently, there have been some skeptical studies like Dominitz and Manski (2004) which question the methods used in the preparation of consumer confidence indices and Van Oest and Franses (2008) which cautions on the interpretation of movements in consumer confidence.

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[3] Consumption variable used is the total real personal consumption expenditures. It is usually partitioned into categories as durables, non-durables and services.

[4] As Carroll *et al.* (1994) state, "...the choice of which other variables to include in the equation is inherently somewhat arbitrary".

The previous literature on the relationship between consumer confidence, domestic demand, and different variables of interest has not been conclusive. Consumer confidence can be considered as a quick and relatively inexpensive measure that operates as a proxy for consumer spending. Tvaronavičienė and Kalašinskaitė (2010) in their surveys agree, that in emerging markets there is hardly any data for personal consumer expenditures except GDP whereas economic growth is well measured by industrial production,. We believe that households incorporate the signals from the production figures (which are released earlier than personal consumption expenditures) into their decision making process. Hence, we propose that the link between consumer confidence and economic growth should provide valuable information for policy makers, market participants and households.

Theoretically, we follow Matsusaka and Sbordone (1995) which finds a significant relationship between the Michigan Index of Consumer Sentiment and GDP growth. They conclude that consumer confidence indices are able to forecast the evolution of economic activity when their coincident nature is taken into account and that a number of data-coherent parameter restrictions are imposed. Methodologically, we enhance Gelper *et al.* (2007), the first study in the consumer confidence literature to decompose Granger causality in the time domain, by performing a spectral density analysis in the frequency domain.

3. Data

Our data includes monthly industrial production index (IP), CCI and retail sales (RS) of various countries in order to test the relationship between the growth, consumer confidence and consumer expenditures. All series are obtained from countries' national statistical institutes, and seasonally adjusted IP and RS series are gathered. For all series, both log transformed and year-on-year changes are considered. The variables and descriptions are given in Table 1.

Table 1. The variables and their descriptions

Variable Name	Description
IP	Logarithm of seasonally adjusted industrial production index
IP_Y-O-Y	Year-to-year growth rate of seasonally adjusted industrial production index
RS	Logarithm of seasonally adjusted retail sales
RS_ Y-O-Y	Year-to-year growth rate of seasonally adjusted retail sales
CCI	Logarithm of consumer confidence index
CCI_ Y-O-Y	Year-to-year growth rate of consumer confidence index

Table 1 shows all the variables and its descriptions that are used for our research.

Depending on the availability of data the time period ranges from 1980 to 2010. Selected countries and corresponding time periods are summarized in Table 2. The data is obtained from OECD Statistics Database[5]

[5] We do not include Austria, Belgium, Poland and other smaller economies due to improper and / or shorter data series.

Table 2. Selected countries and time periods

Country	Start	End	Number of Observations
Czech Republic	Jan-96	May-10	173
Denmark	Dec-80	May-10	354
France	Dec-80	May-10	354
Germany	Dec-80	May-10	354
Greece	Jan-85	May-10	305
Hungary	Feb-93	May-10	208
Italy	Jan-90	May-10	245
Netherlands	Dec-80	May-10	354
Portugal	Jan-90	May-10	245
Spain	Jan-95	May-10	185
Sweden	Oct-95	May-10	176
United Kingdom	Dec-80	May-10	354

Table 2 shows selected European countries that we analyze in our research. As it's seen from the data, some statistics start from year 1980 whereas for some of the data starting period is 1995. The reason is that some countries started to make CCI evaluations after 1995 and they do not have any statistical data before concerning this object.

4. Causality tests in time and frequency domain

The Granger causality tests indicate whether the past changes in $x(y)$ have an impact on current changes in $y(x)$ over a specified time period. Nevertheless, these test results can provide results on causality over all frequencies. On the other hand, Geweke's linear measure of feedback from one variable to another at a given frequency can provide detailed information about feedback relationships between growth and consumer confidence over different frequency bands. Even though frequency decompositions are generally investigated for neurophysiologic studies, it is important to address how the causality changes with frequency. This measure would enable us to quantify what fraction of total power at frequency ω of growth (consumer confidence index) is attributed to consumer confidence index (growth). Besides, studies such as Yıldırım and Taştan (2009) show that the significance and / or direction of the Granger causality can change after adopting the causality test in frequency domain.

By using a Fourier transformation to VAR (p) model for x and y series, the Geweke's measure of linear feedback from y to x at frequency ω is defined as[6]:

$$M_{y\to x}(\omega) = \log\left[\frac{2\pi f_x(\omega)}{\left|\psi_{11}(e^{-i\omega})\right|^2}\right] = \log\left|1 + \frac{\left|\psi_{12}(e^{-i\omega})\right|^2}{\left|\psi_{11}(e^{-i\omega})\right|^2}\right|. \quad (3)$$

[6] For details of the computation of the measure, see Geweke (1982) and Breitung and Candelon (2006).

If $\left|\psi_{12}(e^{-i\omega})\right|^2 = 0$, then the Geweke's measure will be zero, then y will not Granger cause x at frequency ω. Breitung and Candelon (2006) present this test by reformulating the relationship between x and y in VAR equation:

$$x_t = \alpha_1 x_{t-1} + ... + \alpha_p x_{t-p} + \beta_1 y_{t-1} + ... + \beta_p y_{t-p} + \varepsilon_{1t}. \quad (4)$$

The null hypothesis tested by Geweke, $M_{y\to x}(\omega) = 0$, corresponds to the null hypothesis of $H_0 : R(\omega)\beta = 0$ where β is the vector of the coefficients of y and

$$R(\omega) = \begin{bmatrix} \cos(\omega)\cos(2\omega).....\cos(p\omega) \\ \sin(\omega)\sin(2\omega).....\sin(p\omega) \end{bmatrix}.$$

Breitung and Candelon (2006) simplify the Geweke's null hypothesis so that a usual F-statistics can be used to test causality in frequency domain. Therefore, this study uses Breitung and Candelon (2006) version of Geweke (1982).

5. Empirical findings

5.1. Causality tests in time domain

Before conducting Granger causality tests in frequency domain, the causality tests are conducted in time domain. Table 3 summarizes the results for log-level and year-to-year growth rate specifications when CCI is considered vis-à-vis IP and RS. The lag orders are selected based on Akaike Information Criteria. We check both cases of a deterministic trend and no deterministic trend while employing the unconditional Granger causality analysis.

We have significance at 5% level for 57 cases out of 192 with almost no difference between trend and no trend cases. The group of Germany, France and Portugal has a total of 32 cases of causality whereas Czech Republic, Sweden and United Kingdom each have 2 and Italy has none. Hence, it is not possible to argue for the existence of causality depending on different levels of per capita income. On the other hand, Y-O-Y specification has a slight edge of 32 to 25, signaling a longer term perspective could better capture the dynamics of the relationships.

More important is the CCI-IP and CCI-RS pairings. We observe causality for 31 cases between CCI and IP compared to 26 between CCI and RS. CCI-RS pairing seems to work better under the Y-O-Y specification. Significant majority of the causality cases are unidirectional links between the pairings while we observe only 4 cases of bi-directional causality. These are CCI-IP for Germany and France in both log-level and Y-O-Y cases. 22 of the uni-directional cases are from CCI to IP/RS whereas 19 of them are from IP/RS to CCI. Overall, CCI causes IP in 14 cases and RS in 16 cases whereas IP causes CCI in 17 and RS causes CCI in 10 cases.

These results show that the consumers somewhat incorporate the past growth information as enhancing their expectations. Therefore, it is not possible to disregard that the agents in the economy are rational and use available growth prospect of the economy to form their expectations. Besides, the past changes in consumer confidence seem to slightly affect the growth of economy because the consumer confidence is a direct measure of their propensity to consume, wealth conditions and perceptions of the economic situation.

Table 3. Granger causality in time domain for all countries

Case →	Log-level								Y-O-Y							
Variables →	CCI → IP		IP → CCI		CCI → RS		RS → CCI		CCI → IP		IP → CCI		CCI → RS		RS → CCI	
Country	T	NT	T	NT	T	NT	T	NT	T	NT	T	NT	T	NT	T	NT
Czech Republic	0.536 (0.658)	0.441 (0.724)	**3.775 (0.012)**	**3.288 (0.022)**	0.376 (0.770)	0.098 (0.961)	0.799 (0.496)	0.484 (0.693)	0.469 (0.704)	0.471 (0.703)	2.597 (0.054)	2.648 (0.051)	0.604 (0.613)	0.603 (0.614)	1.151 (0.331)	1.108 (0.348)
Denmark	0.219 (0.883)	0.340 (0.796)	**2.745 (0.043)**	1.266 (0.286)	1.068 (0.363)	0.876 (0.454)	1.263 (0.287)	0.937 (0.423)	1.093 (0.352)	1.115 (0.343)	**3.023 (0.030)**	**2.808 (0.040)**	1.018 (0.385)	1.008 (0.389)	1.481 (0.220)	1.469 (0.223)
France	**3.732 (0.012)**	**3.700 (0.012)**	**6.001 (0.001)**	**5.960 (0.001)**	1.326 (0.266)	1.238 (0.296)	**4.150 (0.007)**	**4.252 (0.006)**	**4.914 (0.002)**	**5.007 (0.002)**	**7.002 (0.000)**	**7.113 (0.000)**	0.568 (0.637)	0.557 (0.644)	**10.950 (0.000)**	**11.087 (0.000)**
Germany	**4.329 (0.005)**	**4.257 (0.006)**	**3.893 (0.009)**	**3.383 (0.018)**	**3.032 (0.029)**	**2.968 (0.032)**	0.611 (0.608)	0.678 (0.566)	**6.906 (0.000)**	**6.929 (0.000)**	**4.053 (0.007)**	**4.017 (0.008)**	**2.926 (0.034)**	**2.908 (0.035)**	0.698 (0.554)	0.668 (0.572)
Greece	0.233 (0.873)	0.737 (0.531)	1.205 (0.308)	0.941 (0.421)	**2.663 (0.048)**	**2.889 (0.036)**	1.387 (0.247)	1.411 (0.240)	1.298 (0.275)	1.253 (0.291)	1.252 (0.291)	1.268 (0.286)	**2.937 (0.034)**	**2.919 (0.034)**	0.892 (0.446)	0.894 (0.445)
Hungary	1.627 (0.184)	1.434 (0.234)	0.507 (0.678)	0.380 (0.768)	2.064 (0.106)	1.963 (0.121)	2.101 (0.101)	2.146 (0.096)	2.401 (0.069)	**2.752 (0.044)**	2.132 (0.098)	2.475 (0.063)	**5.600 (0.001)**	**5.507 (0.001)**	2.545 (0.058)	2.308 (0.078)
Italy	0.506 (0.678)	0.570 (0.635)	1.551 (0.201)	1.857 (0.137)	0.419 (0.740)	0.404 (0.750)	1.039 (0.376)	0.997 (0.395)	1.271 (0.284)	1.253 (0.291)	1.811 (0.145)	1.780 (0.151)	1.774 (0.153)	1.762 (0.155)	2.553 (0.056)	2.476 (0.062)
Netherlands	1.923 (0.125)	1.775 (0.152)	1.169 (0.321)	0.256 (0.857)	**5.746 (0.001)**	**5.763 (0.001)**	1.325 (0.266)	1.149 (0.329)	2.583 (0.053)	**2.637 (0.050)**	1.528 (0.207)	1.532 (0.206)	**6.788 (0.000)**	**6.788 (0.000)**	1.869 (0.135)	1.871 (0.134)
Portugal	0.226 (0.878)	0.267 (0.849)	**3.981 (0.008)**	**4.736 (0.003)**	0.820 (0.484)	0.861 (0.462)	**4.553 (0.004)**	**4.133 (0.007)**	0.197 (0.898)	0.309 (0.819)	**3.110 (0.027)**	**3.709 (0.012)**	1.191 (0.314)	1.165 (0.324)	**4.021 (0.008)**	**3.745 (0.012)**
Spain	**3.572 (0.015)**	**2.791 (0.041)**	1.792 (0.149)	1.537 (0.205)	0.773 (0.510)	0.850 (0.468)	0.485 (0.693)	0.501 (0.682)	**6.501 (0.000)**	**6.246 (0.000)**	1.890 (0.132)	1.744 (0.158)	0.929 (0.428)	0.831 (0.478)	0.312 (0.816)	0.311 (0.817)
Sweden	1.864 (0.138)	1.635 (0.183)	0.413 (0.744)	0.306 (0.821)	2.042 (0.110)	1.670 (0.175)	2.107 (0.101)	1.610 (0.189)	1.919 (0.129)	1.933 (0.127)	1.573 (0.198)	1.157 (0.328)	**2.779 (0.043)**	**2.815 (0.041)**	1.629 (0.185)	1.623 (0.186)
United Kingdom	1.121 (0.341)	1.121 (0.341)	1.110 (0.345)	1.103 (0.348)	0.399 (0.753)	0.341 (0.796)	1.713 (0.164)	1.877 (0.133)	1.097 (0.351)	0.910 (0.437)	2.030 (0.109)	1.606 (0.188)	1.072 (0.361)	1.071 (0.361)	**2.967 (0.032)**	**2.966 (0.032)**

Note: p-values are given in the brackets. T stands for the case with a deterministic trend and NT for the case with no deterministic trend. Bold values indicate significance at 5% level

Journal of Business Economics and Management, 2011, 12(4): 589–602

Nonetheless, the simple Granger causality methodology leaves lots of questions unanswered as it fails to deliver results that should emphasize the link between CCI-IP and CCI-RS pairings in a strong manner.

Next, we check whether a numeraire CCI would enhance our results by employing German CCI (CCI_G) vis-à-vis other country's CCI (CCI_X), IP (IP_X) and RS (RS_X). The results are in Table 4.

We observe some support for the dominance of German consumer confidence especially in pairings with consumer sentiment and industrial production indices of other highly developed European countries like France, Italy and United Kingdom. Nonetheless, it is not possible to advocate German consumer confidence index as the main leading indicator of European household behavior with respect to the time domain Granger causality analysis.

Table 4. Granger causality in time domain for German CCI

Case →	**Log-level**						**Y-O-Y**					
Variables →	**$CCI_G \rightarrow CCI_X$**		**$CCI_G \rightarrow IP_X$**		**$CCI_G \rightarrow RS_X$**		**$CCI_G \rightarrow CCI_X$**		**$CCI_G \rightarrow IP_X$**		**$CCI_G \rightarrow RS_X$**	
Country	**T**	**NT**	**T**	**NT**	**T**	**NT**	**T**	**NT**	**T**	**NT**	**T**	**NT**
Czech Republic	0.385 (0.536)	0.494 (0.483)	2.090 (0.150)	3.373 (0.067)	0.003 (0.959)	0.001 (0.998)	3.352 (0.069)	3.347 (0.069)	2.211 (0.138)	2.263 (0.134)	0.022 (0.882)	0.042 (0.837)
Denmark	**4.341 (0.038)**	3.781 (0.053)	0.561 (0.455)	0.151 (0.697)	0.301 (0.584)	0.239 (0.625)	3.744 (0.054)	3.758 (0.053)	0.387 (0.534)	0.397 (0.529)	1.065 (0.303)	1.061 (0.304)
France	0.588 (0.444)	0.581 (0.446)	**6.235 (0.013)**	**6.822 (0.009)**	0.042 (0.837)	0.033 (0.855)	0.919 (0.338)	0.883 (0.348)	**5.308 (0.022)**	**5.346 (0.021)**	0.163 (0.687)	0.060 (0.807)
Greece	1.910 (0.168)	2.284 (0.131)	1.024 (0.312)	1.450 (0.229)	3.730 (0.054)	3.373 (0.067)	0.117 (0.733)	0.145 (0.704)	1.654 (0.199)	1.703 (0.193)	1.086 (0.298)	1.120 (0.291)
Hungary	1.109 (0.294)	1.116 (0.292)	**10.525 (0.001)**	**12.101 (0.001)**	0.667 (0.415)	0.604 (0.438)	0.772 (0.381)	0.802 (0.372)	**5.649 (0.018)**	**5.805 (0.017)**	2.432 (0.121)	2.463 (0.118)
Italy	**5.952 (0.015)**	**5.972 (0.015)**	**6.425 (0.012)**	**6.645 (0.010)**	1.568 (0.212)	1.317 (0.252)	**8.014 (0.005)**	**8.051 (0.005)**	**6.525 (0.011)**	**6.648 (0.010)**	0.434 (0.511)	0.463 (0.497)
Netherlands	2.389 (0.123)	2.425 (0.120)	0.641 (0.424)	3.107 (0.079)	0.001 (0.992)	0.077 (0.782)	0.715 (0.398)	0.705 (0.402)	1.380 (0.241)	1.366 (0.243)	0.003 (0.954)	0.003 (0.956)
Portugal	**4.958 (0.027)**	**4.685 (0.031)**	0.069 (0.792)	0.120 (0.729)	0.040 (0.842)	0.114 (0.735)	**6.709 (0.010)**	**6.836 (0.009)**	1.762 (0.185)	2.003 (0.158)	0.809 (0.369)	0.945 (0.332)
Spain	0.078 (0.780)	0.034 (0.854)	**5.075 (0.025)**	**5.091 (0.025)**	0.602 (0.439)	0.386 (0.535)	0.285 (0.594)	0.256 (0.613)	2.722 (0.100)	2.691 (0.102)	0.092 (0.762)	0.025 (0.875)
Sweden	1.673 (0.198)	1.692 (0.195)	**21.219 (0.000)**	**23.056 (0.000)**	1.415 (0.235)	1.416 (0.235)	0.875 (0.351)	0.875 (0.351)	**13.661 (0.000)**	**13.745 (0.000)**	0.001 (0.987)	0.011 (0.917)
United Kingdom	0.188 (0.665)	0.181 (0.671)	**10.859 (0.001)**	**10.480 (0.001)**	0.657 (0.418)	0.749 (0.387)	0.403 (0.526)	0.406 (0.524)	3.705 (0.055)	3.551 (0.060)	0.279 (0.597)	0.281 (0.596)

Note: p-values are given in the brackets. T stands for the case with a deterministic trend and NT for the case with no deterministic trend. Bold values indicate significance at 5% level

5.2. Causality test in frequency domain

Table 5 summarizes the Granger causality tests in frequency domain where 79 cases show the existence of causality out of 192[7]. This is simply an improvement of 38.6 per cent on time domain analysis. There is also a significant difference between low frequency (long-run) and seasonal frequency (short-run) cases as low frequency has 23 cases more than seasonal frequency.

When we consider CCI-IP and CCI-RS pairings, the superiority of frequency domain causality analysis becomes obvious. There are 42 cases between CCI and IP compared to 31 in time domain causality and 37 cases between CCI and RS compared to only 26 in time domain causality. There is a slight edge of 41 to 38 for log-level specification compared to Y-O-Y.

Table 5. Granger causality in frequency domain for all countries

Case →	**Log-level**								**Y-O-Y**							
Variables →	**CCI → IP**		**IP → CCI**		**CCI → RS**		**RS → CCI**		**CCI → IP**		**IP → CCI**		**CCI → RS**		**RS → CCI**	
Country	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**	**LF**	**SF**
Czech Republic	**Y**	**Y**	NF	NF	NF	NF	**Y**	NF	NF	**Y**	NF	NF	NF	NF	**Y**	NF
Denmark	NF	NF	**Y**	NF	NF	NF	**Y**	NF	NF	**Y**	**Y**	**Y**	NF	NF	**Y**	NF
France	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	NF	NF	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	**Y**	NF
Germany	**Y**	NF	**Y**	**Y**	NF	NF	**Y**	**Y**	NF	NF	**Y**	**Y**	NF	NF	**Y**	NF
Greece	NF	NF	**Y**	NF	NF	NF	**Y**	NF	NF	NF	**Y**	NF	NF	NF	**Y**	NF
Hungary	NF	NF	**Y**	NF	NF	**Y**	NF	**Y**	NF	NF	**Y**	NF	NF	**Y**	NF	**Y**
Italy	NF	NF	NF	NF	NF	NF	**Y**	NF	NF	NF	NF	NF	NF	NF	**Y**	NF
Netherlands	NF	NF	**Y**	NF	NF	NF	**Y**	**Y**	NF	NF	**Y**	NF	NF	NF	**Y**	**Y**
Portugal	**Y**	**Y**	NF	NF	**Y**	**Y**	**Y**	NF	**Y**	**Y**	NF	NF	**Y**	NF	**Y**	NF
Spain	**Y**	NF	**Y**	**Y**	NF	NF	**Y**	NF	**Y**	**Y**	**Y**	**Y**	NF	NF	NF	NF
Sweden	NF	NF	**Y**	NF	NF	NF	**Y**	**Y**	**Y**	NF	**Y**	NF	NF	NF	NF	NF
United Kingdom	NF	NF	**Y**	NF	**Y**	**Y**	**Y**	NF	NF	NF	**Y**	NF	**Y**	**Y**	NF	NF

Note: Y denotes significance at 5% level and NF stands for No feedback. LF denotes Low Frequency which is higher than 18 months with $0 < \omega < 0.35$ and SF stands for Seasonal Frequency which is for the period 2 months to 18 months with $0.35 < \omega < \pi$.

[7] No plots are given to save space. However, they are available from the corresponding author upon request.

Significant majority of the causality cases are unidirectional links between the pairings. Nonetheless, we observe 15 cases of bi-directional causality, another drastic improvement from time domain case. Overall, CCI causes IP in 17 cases and RS in 13 cases whereas IP causes CCI in 25 and RS causes CCI in 24 cases.

The frequency domain results with respect to countries groups also differ from the time domain case as only Greece and Italy have less than 5 cases of causality. Therefore, we strongly believe that this is a sign of coherence between European emerging and developed countries.

These results underline the rationality of consumers as they gather significant information from several resources about production and / or sales and use it while forming their expectations as well as understanding the current stance of the economy. Besides, the past changes in economic growth and retail sales seem to affect the consumer sentiment through wealth conditions and perceptions of the economic situation. Therefore, we argue that there is a strong causal link between CCI-IP and RS.

Next, we perform our numeraire CCI exercise by checking the causality from German CCI (CCI_G) to other country's CCI (CCI_X), IP (IP_X) and RS (RS_X). The results are in Table 6.

Using frequency domain analysis again improves our results with 53 cases of causality out of 132, an improvement on the case of only 29 cases in time domain results. We observe support for the dominance of German consumer confidence in CCI and IP pairings with no specific pattern for countries. Moreover, we have causality in CCI_G-RS_X pairings, an outcome which we failed to obtain employing the time domain technique. Hence, it is possible to advocate German consumer confidence index as the main leading indicator of European household behavior with respect to the frequency domain Granger causality analysis[8].

Last, we need to emphasize the improvement that Breitung and Candelon (2006) test offers with respect to the simple Granger causality in time domain. The main reason for such this superiority depends on the notion that Granger causality considers an average measure to test the causality whereas the Geweke's approach decomposes the causality at each frequency.

6. Conclusions

This study assesses the link between consumer confidence, economic growth and retail sales for a group of 12 European nations employing simple part of the spectral density analysis. Our contribution is three-fold. First, while most of the previous studies analyze the expectations-consumption channel, we examine the dynamic nature of expectations-production channel as well. It is possible to argue that emerging markets could experiment business cycles at shorter horizons with respect to an industrialized economy, a factor, which results in different links between sentiment, growth and sales.

[8] As our focus is not the sign between the variables, the co-spectrum analysis is not conducted. Here, our main interest is to quantify the causality between confidence and economic growth / retail sales, and, if available, to show how the frequency affects this causality.

Table 6. Granger causality in frequency domain for German CCI

Case →	Log-level						Y-O-Y					
Variables →	$CCI_G \rightarrow CCI_X$		$CCI_G \rightarrow IP_X$		$CCI_G \rightarrow RS_X$		$CCI_G \rightarrow CCI_X$		$CCI_G \rightarrow IP_X$		$CCI_G \rightarrow RS_X$	
Country	LF	SF	LF	SF	LF	SF	LF	SF	LF	SF	LF	SF
Czech Republic	NF	NF	Y	Y	NF	NF	NF	NF	NF	NF	NF	NF
Denmark	Y	Y	NF	NF	NF	NF	Y	Y	NF	NF	Y	NF
France	Y	Y	NF	NF	NF	NF	Y	Y	Y	Y	NF	NF
Greece	NF	NF	NF	Y	NF	NF	NF	NF	NF	Y	NF	NF
Hungary	NF	NF	Y	Y	NF	NF	NF	NF	Y	Y	NF	NF
Italy	NF	Y	NF	Y	NF	NF	Y	Y	NF	Y	NF	NF
Netherlands	Y	Y	Y	Y	Y	NF	Y	Y	Y	Y	Y	NF
Portugal	NF	Y	NF	NF	Y	NF	Y	Y	NF	NF	NF	NF
Spain	Y	NF	NF	Y	NF	NF	Y	NF	NF	Y	NF	NF
Sweden	Y	NF	Y	Y	NF	NF	Y	NF	Y	Y	NF	NF
United Kingdom	NF	NF	Y	Y	NF	NF	Y	NF	Y	Y	NF	NF

Note: Y denotes significance at 5% level and NF stands for No feedback. LF denotes Low Frequency which is higher than 18 months with $0 < \omega < 0.35$ and SF stands for Seasonal Frequency which is for the period 2 months to 18 months with $0.35 < \omega < \pi$.

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Secondly, we calculate Granger causality tests in both time and frequency domain and measure the forecasting power of the CCI at different forecasting horizons. Our empirical findings show that variations in consumer confidence mainly concentrate over seasonal frequencies. Besides, we observe significant feedbacks from consumer confidence to economic growth over seasonal frequencies as well as low frequencies. Hence, we conclude that consumer sentiment remains a useful predictor of growth for both short and long time horizons.

Thirdly, German CCI stands as the leading economic indicator for European area as we observe its effect on economic growth and retail sales of other countries for both short and long time horizons.

Consequently this study presents an analysis of the link between consumer confidence, economic growth and retail sales by the breakdown of variance over main frequency bands and causality in the time and frequency domain analysis. The empirical methodology we employ yields new and interesting additional insights into the causal relationship. For further research, our methodology can be applied to test the forecasting performance of leading economic and financial indicators like Business Tendency Surveys, Consumption Index and Wholesale Confidence Index.

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VARTOTOJŲ PASITIKĖJIMO, PRAMONINĖS GAMYBOS IR MAŽMENINĖS PREKYBOS DAŽNIŲ ANALIZĖ PASIRINKTOSE EUROPOS ŠALYSE

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Santrauka

Straipsnyje nagrinėjamas ryšys tarp vartotojų pasitikėjimo, ekonomikos augimo ir mažmeninės prekybos pasirinktose dvylikoje Europos šalių, taikant dažnių analizės metodą. Vartotojų pasitikėjimo rodiklis traktuojamas kaip vienas pagrindinių ekonomikos rodiklių, padedančių priimti svarbius investicinius ir verslo sprendimus tiek trumpalaikėje, tiek ilgalaikėje perspektyvoje.

Tyrimo objektas susijęs su ryšio tarp vartotojų pasitikėjimo, ekonomikos augimo ir mažmeninės prekybos nustatymu tiek tarp išsivysčiusių, tiek mažiau ekonomiškai išsivysčiusių Europos šalių. Tyrimo metodologija apima Breitung ir Candelon (2006) priežastingumo testą, kuris patobulina ir papildo Geweke (1982) ir Hosoya (1991) siūlomus tyrimų metodus. Kylanti šalių ekonomika lemia vartotojų pasitikėjimą, o ne atvirkščiai. Šis argumentas iš esmės patvirtina Güneş ir Uzun (2010) bei Balkytės ir Tvaronavičienės (2010) ankstesnių tyrimų išvadas, kad augančios ekonomikos šalyse vartotojų pasitikėjimas dėl pajamų lygio neturi įtakos ekonomikos augimui. Atliekant tyrimą nustatytas priežastingumo ryšys tarp vartotojų pasitikėjimo ir mažmeninės prekybos kaip vieno iš pagrindinių vartojimą charakterizuojančių rodiklių.

Reikšminiai žodžiai: vartotojas, pasitikėjimas, ryšys, analizė, ekonomika.

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