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"SYSTEMIC ECONOMIC CRISIS: CURRENT ISSUES AND PERSPECTIVES"

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# LONG WAVE OR BUSINESS CYCLE?
# EASTERN AND SOUTH EASTERN EUROPE SPECIFICITIES

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***Abstract***

*The financial crisis of 2008 led to one of the longest and most persistent Post War recessions of global economic activity. Neoclassical economists consider this crisis as the stochastic downturn of a common business cycle due to overoptimistic, risk-lover financial investors, which led to credit over-expansion. On the other hand, long wave theorists assert that deep recessions, such as the present one, are the result of the amplified long-lasting downturn, reoccurring every 40-60 years over the history of capitalism's development. According to these estimations, the last downturn of the fourth long wave started in early 70s. However, a debate exists on whether we are still facing the same downturn extended and re-enhanced due to neoliberal practices and any accompanying exogenous effects, or we are dealing with another long recession that followed the upward movement of a shortened fifth long wave that begun during the 80's. We provide a theoretical discussion and empirical evidence in order to answer two subsequent questions: Should this crisis be considered as a business cycle recession or a systemic downturn? If the second argument is true, are we facing the downturn of a fifth long wave after a relative shorter period of economic "prosperity", or on the contrary, we deal with the prolonged downturn of the fourth long wave? Our empirical comparisons check the significance of various structural specificities of different regions. In order to conclude on the importance of regional specific characteristics, we examine whether significant cross-country differences exist with respect to the evolution of this downturn in Eastern and South-Eastern Europe.*

**Key words:** *business cycles, systemic crisis, long waves, Eastern and South-Eastern Europe.*

**JEL**: C22, E32

## 1. INTRODUCTION

The financial crisis of 2008 led to one of the longest and most persistent Post War recessions of global economic activity. Similarly to comparable periods in economic history, it generated already vigorous debates. Neoclassical growth theory considers this crisis as the stochastic downturn of a common business cycle. On the other hand, the persistent current phase of negative growth triggers the awakening of theories that belong to a different section of economic literature. Traditionally, the theories of long waves come in the foreground with the occurrence of persistent long-lasting economic recessions. The long wave tradition asserts that deep recessions, such as the present one or similarly the ones that occurred in 1930's and 1970's, are the result of an amplified long-lasting downturn, reoccurring every 40-60 years over the history of capitalism's development.

The initial empirical evidences for long-lasting cyclical economic development lead us back to the first contributions at the end of 19th century by Jevons (1884), Parvus (1901), Van Gelderen (1913), De Wolff (1924) and the following, statistically more advanced, analysis of Kondratieff (1935; 1928; 1928/1984)[1] Aside to the familiar business cycles, they emphasized the continuing long waves lasting approximately half a century. Since that time, interesting questions have been raised such as:

- Are these long lasting cycles a true economic phenomenon?
- How can these long lasting cyclical movements of economic activity be explained?

Literature on theoretical justification of long waves is quite extensive. Contributions can be divided in three different schools: Marxists (Mandel 1981, 1975 1980) interpret long waves by the falling course of the rate of profit, which is indisputably a driving force of the system. At the same time, they incorporate various exogenous factors – wars, geographical / sectoral market expansion and technological progress – which avert the systemic downward and move the economy back to a new phase of expansion.

Closely to the Marxian approach, the Social Structure of Accumulation (SSA) School provides an additional argument, offering a framework of continual cyclical movements: social institutional arrangements such as labour relations, banking system, the political environment etc, when they are propitious for the continuity of capital accumulation, reassure the transition to the next upswing. (Gordon 1980, 1991; Gordon et al. 1994; Gordon et al. 1983)

Different than the above, the Schumpeterian/Innovation School focuses on a similar cyclical movement of technological progress. Based on appropriate micro-oriented arguments like entrepreneurial motivations for adapting new ideas, theorists consider the fluctuations of economic activity as the result of innovation-clusters (Kleinknecht 1987, 1986; Mensch 1975; Schumpeter 1939)[2].

Despite the different significance given to the parameter of technological progress, its influence on economy's long term evolution is undoubtedly accepted. Long fluctuations of economic activity were empirically and timely closely related to

[1] Although, the literature uses the term "Kondratieff cycles", there are many authors who believe that the credits should be given to earlier works: "*It would, in fact be more appropriate to speak about van Gelderen – De Wolff long waves* " (Kleinknecht, A, 1992, p1).

[2] In the course of time, various theoretical contributions combined the arguments of the mentioned schools, in order to avoid a mono-causal interpretation of long waves. Kleincknecht (1992) encourages this mixture; neo-Schumpeterians include also SSA-arguments in their discussion (Clark et al. 1981; Freeman 1982; Perez 1985, 1983, 2010, 2002, 2004; Tylecote 1992), while other theorist combine the scarcity of natural resources with the emergence of new technologies (Rostow 1975; Volland 1987). Also Van Duijn (1977, 1983) incorporates Schumpeter's theory of innovation and the dynamic system of Forrester (1976) and Sterman (1985, 1986) in his product life cycle approach.

the occurrence of great technological revolutions. More specifically, the first long wave appears at the end of the 18th century with the beginning of the Industrial Revolution. The second started in the mid of the 19th century and was related to the mechanically produced steam engines that became the driving mechanism of production process in many industries and transportation (mechanization, first technological revolution). Direct outcome was the geographical expansion of capitalism. The opening of new markets for the mass produced industrial products occurred within the expanding period of the next, third long wave, which lasted until the end of the Second World War. Nevertheless, also this cycle was related to another (third) technological revolution: electrification that was accompanied by the expanded use of iron and heavy engineering. The fourth long wave starts after 1940 (in 1945 for Europe) relates to the revolution in natural sciences and known as the era of atomic energy, oil, automobiles and steel technologies connected with highly structured technology research. (Mandel 1981, 1975 1980; Zarotiadis 2012)

The end of the fourth long wave divides scholars' opinions. Some say that since the 1970 a fifth long wave began, associated with the revolution in electronics, telecommunications and informatics (Freeman and Lou 2001; Korotayev and Tsirel 2010; Perez 2010). Some believe that we are still in the longer-lasting downswing of the fourth long wave (Zarotiadis 2012; Wallerstein 1984), while others assume that now begins the sixth wave, associated with new developments in nano-bio technologies (Lynch 2004). Part of this disparity results not only from using different empirical techniques but also different theoretical arguments.

Truly, the existence of long waves and thus the answer to the first question (in as how much they are a true phenomenon) is primarily an empirical exercise. There are both: a number of empirical confirmations (Kleinknecht 1986; Kleinknecht and Bieshaar 1983; Korotayev and Tsirel 2010; Reijnders 1992, 2009; Van Duijn 1977, 1983; Metz 1992), as well as many contributions that question the existence of long waves (Garvy 1943; Van der Zwan 1980; Van Ewijk 1981, 1982; Solomou 1998, 1990). As Van Duijn (1983) pointed out "the longer a cycle, the harder it is to prove its existence". Yet, the confirmation of a long-wave, as well as the exact periodization, depends both on theoretical fixations and / or to the use of different empirical methodologies and data. This is what the present paper tries to do. Motivated by the current persistent crisis, it combines alternative methodologies in different countries in order to contribute in answering the following questions: should this crisis be considered as a business cycle recession or a systemic downturn? If the second is true, are we facing the downturn of a fifth long wave after a relative shorter period of economic "prosperity", or on the contrary, we deal with the prolonged downturn of the fourth long wave? How different could be the periodicity of economic development due to region-specific socioeconomic characteristics – for instance the socio-political specificities of Eastern and South-Eastern European economies.

## 2. METHODOLOGY & DATA

Spectral analysis is the most recent methodology in identifying the periodicities of time series. It estimates the level and also the significance of a period's importance in forming the cross-time development of a variable. There are two ways of presenting the derived estimations: first in the form of a table, where one shows the estimated importance (and the asymptotic standard errors) of periods of different duration, starting from the longest. (Note that the estimations can vary depending to the *window*-methodology used, namely Bartlett, Tukey or Parzen.) Second, in the form of a diagram that depicts the estimated importance of different periods, again, starting from those lasting longer.

Implementation of spectral analysis requires the transformation of time series to stationary processes. At this point, a debate exists with respect to the best trend elimination method. Difference stationarity method, which means to take 1st-differences and then apply spectral analysis, have been heavily criticized because there over- (under-) estimate the importance of shorter (longer) living periods. The opposite is being argued for trend stationarity method, where we apply spectral analysis on the residuals from the estimated linear trend: it is supposed to be biased towards longer lasting cycles. Middle ground could be created by the use of linear filters (Metz 2011).

In the present paper we proceed with two alternative de-trending techniques: trend elimination after OLS estimation and Hodrick Prescott (1997) filtering[3] (HP) following the proposal of Metz.

We use the most recent Maddison Project datasets[4]. We start with an analysis of GDP per capita annual series. In this case we apply the methodology first for a longer period, 1913-2010, for four countries (UK, Germany, Italy and Greece). Second, we use a shorter period, 1950-2010, in order to include in our comparison three additional Eastern European countries (Hungary, Poland and Bulgaria). Next, we proceed with an analysis of growth rates of the same variable, yet only for the shorter period, 1950-2010 and for the seven countries. In this manner, our empirical work contributes to relevant empirical literature, which due to availability of data, focused primarily on countries that early jointed capitalism and were traditionally related with long term cyclical economic performance.

## 3. EMPIRICAL ESTIMATIONS

In the following we discuss the main observances from the estimations, obtained from the above introduced methodology. For this reason we combine diagrams of all countries for each estimation in one picture, enabling thereby a comparative analysis. In the appendix you may find the relevant tables with the detailed results.

Starting with the discussion of the results, there is an obvious difference in the importance of periodicities results according to the de-trending technique we use: as expected, linear trend elimination favours the presence of longer economic cycles, while, on the contrary, de-trending by the use of HP technique does the opposite.[5] This gives us a great opportunity to repeat something that has been widely notified in the relevant literature: to confirm the existence and the duration of a long-wave depends to a great extent on the pre-existing theoretical fixations. Truly, if we take the residuals that remain after estimating a more sensitive, flexible trend – for instance by the use of HP – waves of more than 40 years disappear. Does this mean that they do not exist, or that the sensitive trend itself reproduces actually the deeper regularity of longer lasting periodicity?

In total, even if the spectral analysis based on HP-filter does reveal the importance of shorter-lasting periods, in our understanding, the existence of long-waves lasting around 40 years is an unquestionable conclusion. As we can see in the appendix, the standardized spectral density function of all countries' GDP per capita trend eliminated (stationary) series takes high values in low frequencies, which corresponds to longer cycle periods.

Altogether, besides confirming the existing of longer lasting waves, another rough observation is that during the 20$^{th}$ century their average duration declined at no more than 40 years. This speaks for the existence of more than two long cycles within the century. In other words, it seems to favour the hypotheses that we experience already the downtrend of the 5$^{th}$ wave.

The same procedure for the shorter sample with data after 1950, leads to more interesting information. The estimations are almost similar for Hungary, Poland, Bulgaria and Greece, where apart from long cycles of 32 years period, their GDP's per capita cyclical behaviour is also explained by cycles of 16 years period, especially for Greece. Interesting is also to notify that Greece and Italy, although they have similar historical and geopolitical characteristics, they follow quite different standards of

[3] Parameter $\lambda$ is chosen to be 100, as we use annual data and we wish to use a filter that is relatively less sensitive to periodical changes.

[4] Bolt, J. and J. L. van Zanden (2013). The First Update of the Maddison Project; Re-Estimating Growth Before 1820. Maddison Project Working Paper 4. http://www.ggdc.net/maddison/maddison-project/data.htm

[5] This is mostly the case in the analysis of level data (GDP per capita) then in the one of growth rates.

periodicity: the first seems to be more alike to the selected Eastern European countries, while the second is comparable to Germany and the United Kingdom.

Still, Italy provides also some interesting specificities. For instance, as we proceed with the estimation after using the HP filter, we find that the remaining shorter fluctuations are lasting more than 10 years in the UK, in Germany and even in Greece. This speaks for the appearance of relatively longer lasting business cycles, or in other words, our results support the presence of Juglars, Kuznets and Kitzin cycles in most of the countries. Oppositely, in case of Italy, significant periodicity appears also for 5-years cycles. In the analysis of the period of 1950-2010, using the same procedure, we found almost similar and more evident results, as we are able to compare also the estimations for the three south-eastern countries. Longer cycles seems to be present in United Kingdoms', Greece's and Bulgarian series, where the spectral density function reaches its maximum at 16 years duration. Again, Italy's graph is different from the others since three peaks occur on frequencies that correspond to cycles of 10, 5 and 4 years of duration. Partly similar is the picture we get for Germany, Poland and Hungary, where we see the existence of Juglar cycles of 10 years duration.

Finally, we estimate the spectral density functions for annual growth rates, using again the two alternative de-trending procedures. With the first method (linear trend elimination) we find long waves of 32 years duration in all series except from Italy. Interesting results are also presented in the series of Hungary and Bulgaria where we can see an important presence of very small cycles (2 years duration), probably because of the difficulties that they faced after the collapse of Stalinistic regimes (especially in case of Bulgaria). Greece's GDP per capita growth also depicts a long cyclical movement of 32 years, in this period. Again, as expected, with the second method (HO de-trending), business cycles are more evident in most of our series. However, long cyclical movements still appear to be significant, especially in the selected Eastern European countries, Poland, Hungary, and Bulgaria.

## 4. CONCLUSIONS AND PROPOSALS FOR FURTHER RESEARCH

Our empirical estimations confirm long wave's significant contribution in GDP's cyclical evolution in both levels and growth GDP per capita series. The most interesting result of our research is that these long term cycles were also present to countries of Eastern Europe as Hungary, Bulgaria, Poland, despite the very different socioeconomic and political environment. Moreover, Greece seems to be very much alike with respect to cyclical patterns, although it has a quite different political development in the post-war period.

Another interesting result is that the estimated duration of long-waves during the $20^{th}$ century declined at no more than 40 years. This seems to favour the hypotheses that we experience already the downtrend of the $5^{th}$ wave. Nevertheless, it has to be further studied in order to come to more secure empirical conclusions for the different countries.

Finally, we find that for the selected European countries Juglars, Kuznets and Kitzin cycles of medium duration are by far more typical than the short business cycles, although with some exceptions. This is also an interesting finding that needs to be examined more carefully. In case it can be securely confirmed, it reveals a less volatile and/or less flexible character of European economies, signifying special characteristics that explain the additional difficulties faced in a period of systemic crisis like the present one.

**Figure 1**: Spectral density estimation of GDP p.c. time series subsequent to linear trend elimination (1950-2010)

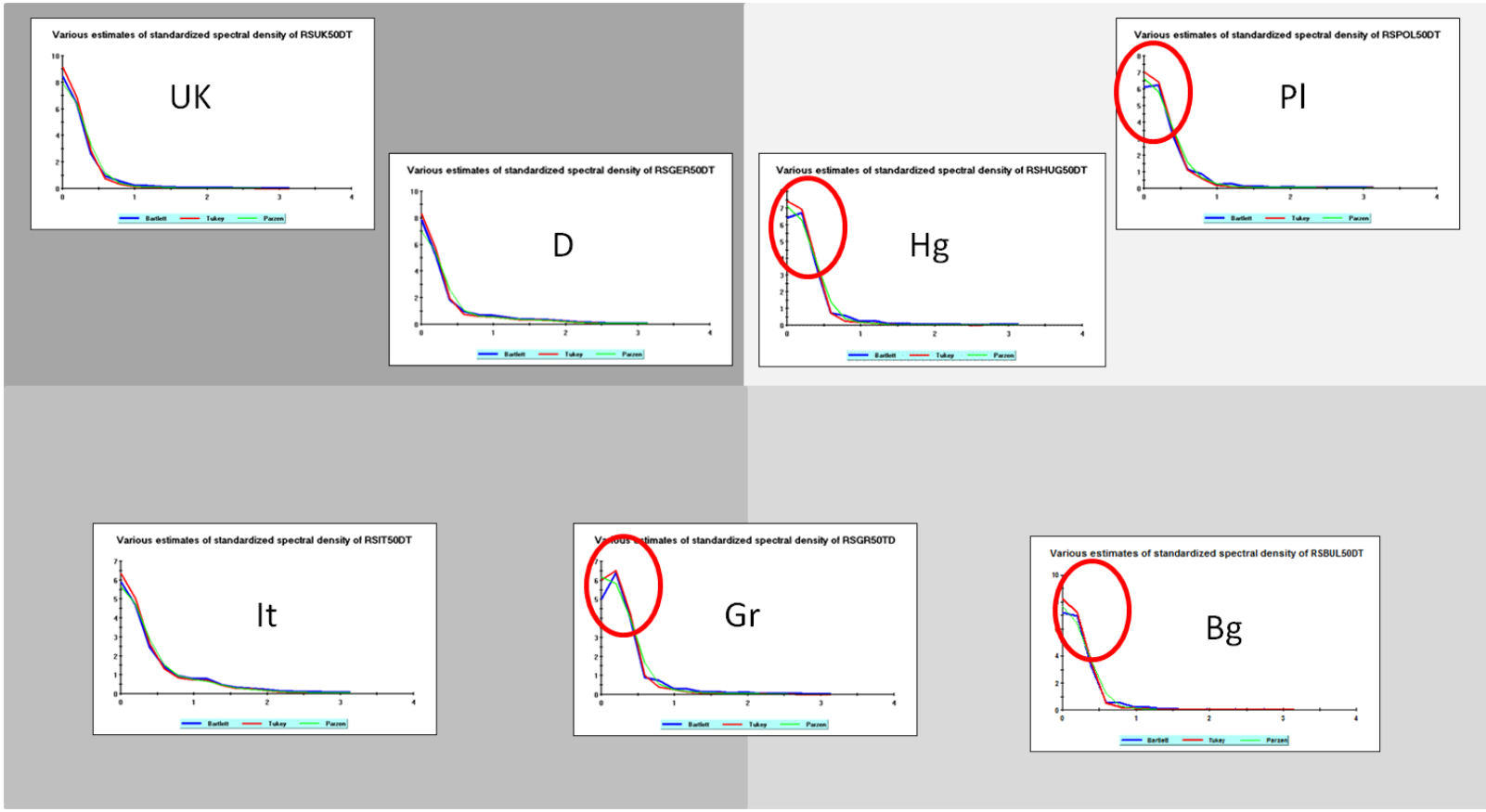


**Figure 2**: Spectral density estimation of GDP p.c. time series subsequent to Hodrick Prescott trend elimination (1950-2010)

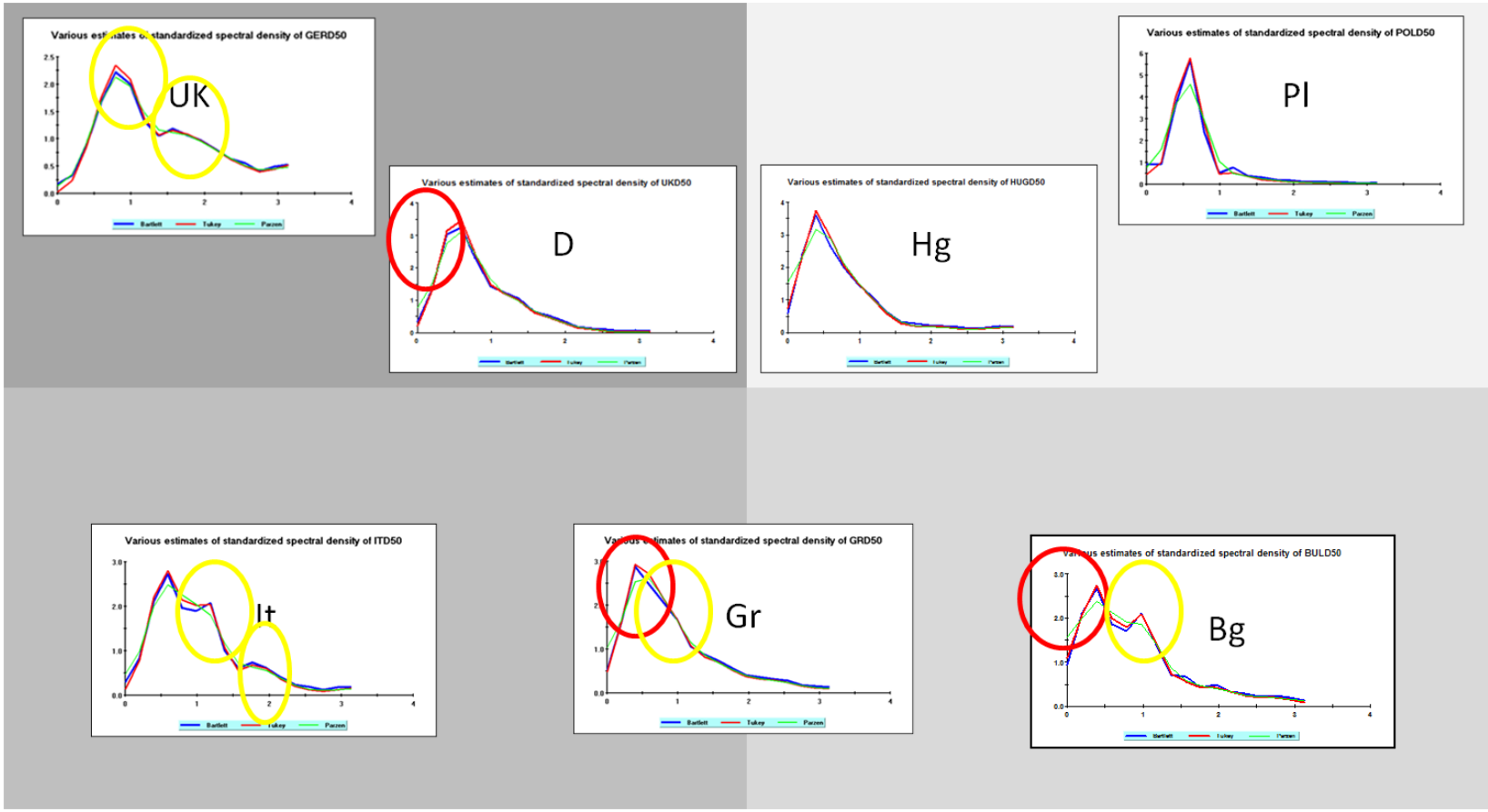


**Figure 3**: Spectral density estimation of GDP growth series subsequent to linear trend elimination (1950-2010)

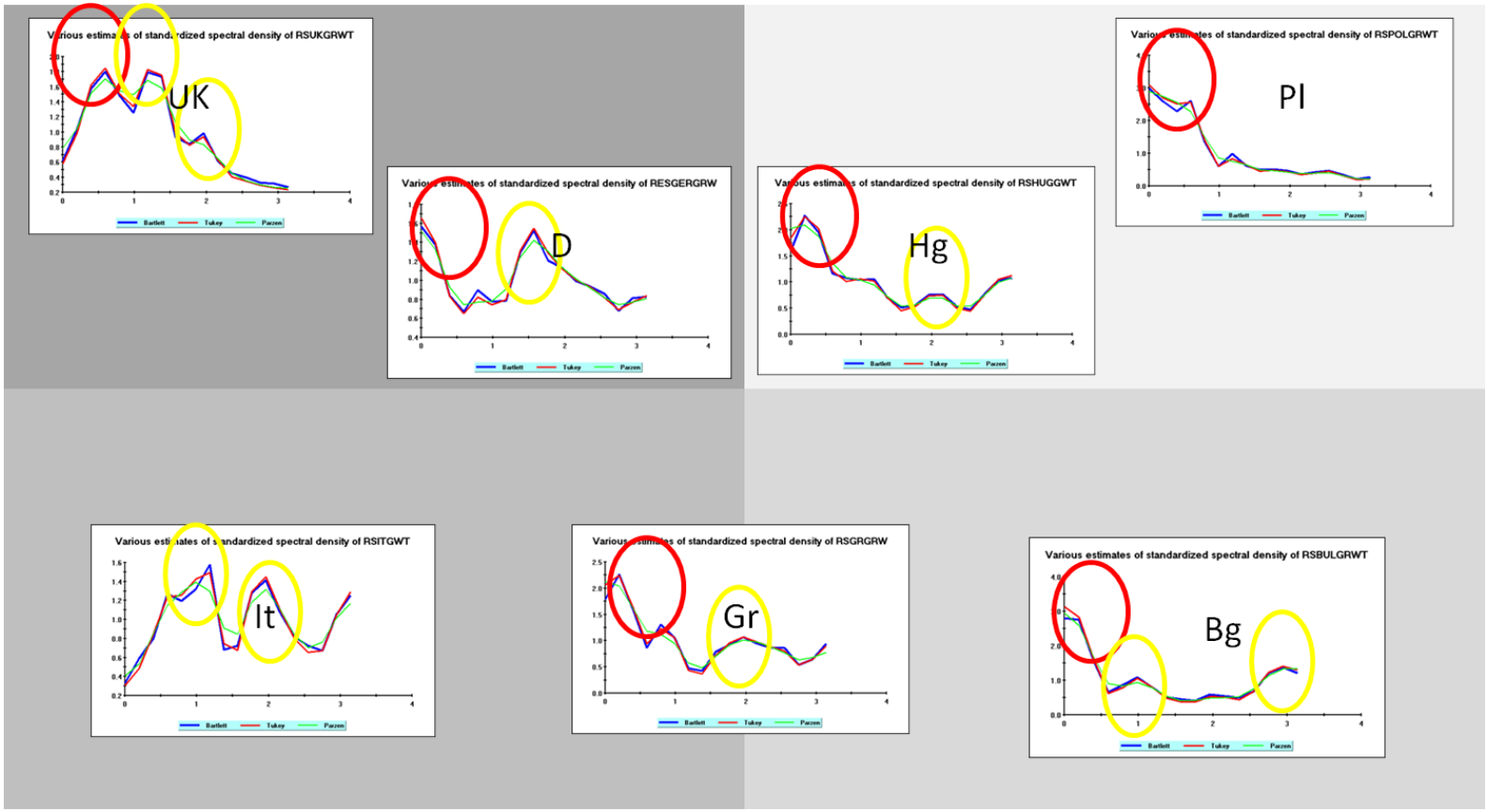
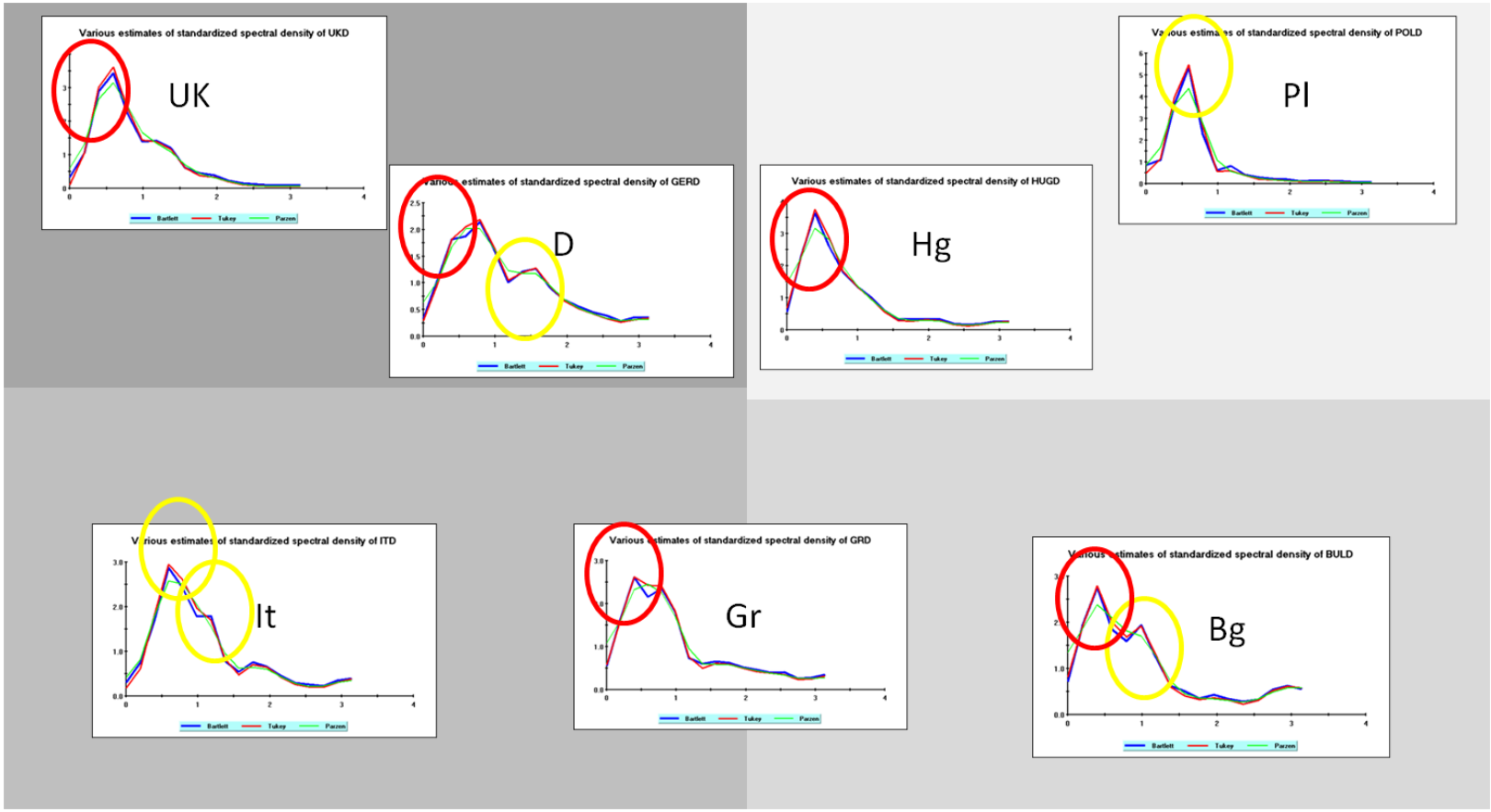


**Figure 4**: Spectral density estimation of GDP growth series subsequent to Hodrick Prescott trend elimination (1950-2010)



# APPENDIX

## A.1: Spectral density estimation of GDP p.c. time series subsequent to linear trend elimination (1950-2010)

**UK**

Standardized spectral density functions of RSUK50DT, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 8.4443 | 9.1565 | 7.9732 |
| | | ( 4.9938) | ( 5.7434) | ( 4.2401) |
| .19635 | 32.0000 | 6.4018 | 6.9007 | 6.4018 |
| | | ( 2.6770) | ( 3.0607) | ( 2.4073) |
| .39270 | 16.0000 | 2.6141 | 2.8283 | 3.3127 |
| | | ( 1.0931) | ( 1.2544) | ( 1.2457) |
| .58905 | 10.6667 | .94313 | .75763 | 1.1894 |
| | | ( .39439) | ( .33604) | ( .44726) |
| .78540 | 8.0000 | .55760 | .33369 | .41517 |
| | | ( .23317) | ( .14800) | ( .15612) |
| .98175 | 6.4000 | .24836 | .13677 | .19239 |
| | | ( .10386) | ( .060662) | ( .072344) |
| 1.1781 | 5.3333 | .23591 | .11362 | .12767 |
| | | ( .098651) | ( .050394) | ( .048007) |
| 1.3744 | 4.5714 | .15950 | .092848 | .095798 |
| | | ( .066696) | ( .041181) | ( .036023) |
| 1.5708 | 4.0000 | .12131 | .051438 | .062486 |
| | | ( .050728) | ( .022814) | ( .023497) |
| 1.7671 | 3.5556 | .091224 | .045570 | .049608 |
| | | ( .038147) | ( .020212) | ( .018654) |
| 1.9635 | 3.2000 | .10106 | .047315 | .044646 |
| | | ( .042259) | ( .020986) | ( .016788) |
| 2.1598 | 2.9091 | .062889 | .030468 | .033984 |
| | | ( .026298) | ( .013514) | ( .012779) |
| 2.3562 | 2.6667 | .067331 | .023643 | .025766 |
| | | ( .028155) | ( .010486) | ( .0096890) |
| 2.5525 | 2.4615 | .052171 | .022872 | .022715 |
| | | ( .021816) | ( .010145) | ( .0085416) |
| 2.7489 | 2.2857 | .056959 | .018795 | .018983 |
| | | ( .023818) | ( .0083361) | ( .0071382) |
| 2.9452 | 2.1333 | .040975 | .013105 | .014294 |
| | | ( .017134) | ( .0058124) | ( .0053752) |
| 3.1416 | 2.0000 | .047164 | .0099194 | .011905 |
| | | ( .027892) | ( .0062220) | ( .0063308) |

**ITALLY**

Standardized spectral density functions of RSIT50DT, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 5.9112 | 6.3615 | 5.6622 |
| | | ( 3.4958) | ( 3.9903) | ( 3.0111) |
| .19635 | 32.0000 | 4.7015 | 5.0292 | 4.7352 |
| | | ( 1.9660) | ( 2.2306) | ( 1.7806) |
| .39270 | 16.0000 | 2.4706 | 2.6387 | 2.8930 |
| | | ( 1.0331) | ( 1.1703) | ( 1.0879) |
| .58905 | 10.6667 | 1.4199 | 1.3129 | 1.5397 |
| | | ( .59375) | ( .58231) | ( .57896) |
| .78540 | 8.0000 | .94286 | .84434 | .94517 |
| | | ( .39427) | ( .37449) | ( .35541) |
| .98175 | 6.4000 | .78601 | .73094 | .75995 |
| | | ( .32868) | ( .32420) | ( .28577) |
| 1.1781 | 5.3333 | .78766 | .70715 | .65861 |
| | | ( .32937) | ( .31364) | ( .24766) |
| 1.3744 | 4.5714 | .47256 | .45177 | .47935 |
| | | ( .19761) | ( .20037) | ( .18025) |
| 1.5708 | 4.0000 | .35483 | .29415 | .32626 |
| | | ( .14838) | ( .13047) | ( .12268) |
| 1.7671 | 3.5556 | .29891 | .25505 | .25016 |
| | | ( .12499) | ( .11312) | ( .094067) |
| 1.9635 | 3.2000 | .22960 | .18270 | .18496 |
| | | ( .096012) | ( .081034) | ( .069551) |
| 2.1598 | 2.9091 | .14912 | .11336 | .12427 |
| | | ( .062358) | ( .050279) | ( .046729) |
| 2.3562 | 2.6667 | .12751 | .080842 | .086306 |
| | | ( .053322) | ( .035856) | ( .032454) |
| 2.5525 | 2.4615 | .096339 | .063354 | .066377 |
| | | ( .040286) | ( .028099) | ( .024960) |
| 2.7489 | 2.2857 | .094282 | .053631 | .054468 |
| | | ( .039426) | ( .023787) | ( .020482) |
| 2.9452 | 2.1333 | .075635 | .043380 | .044985 |
| | | ( .031628) | ( .019240) | ( .016916) |
| 3.1416 | 2.0000 | .074025 | .035452 | .040189 |
| | | ( .043776) | ( .022237) | ( .021372) |

**GREECE**

Standardized spectral density functions of RSGR50TD, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 5.0018 | 6.0258 | 6.1879 |
| | | ( 2.9579) | ( 3.7797) | ( 3.2906) |
| .19635 | 32.0000 | 6.4292 | 6.5169 | 5.8263 |
| | | ( 2.6885) | ( 2.8905) | ( 2.1909) |
| .39270 | 16.0000 | 4.0287 | 4.2978 | 4.0227 |
| | | ( 1.6847) | ( 1.9062) | ( 1.5127) |
| .58905 | 10.6667 | .90500 | 1.0091 | 1.6597 |
| | | ( .37844) | ( .44756) | ( .62411) |
| .78540 | 8.0000 | .73149 | .39423 | .55091 |
| | | ( .30588) | ( .17485) | ( .20716) |
| .98175 | 6.4000 | .32251 | .26099 | .27683 |
| | | ( .13486) | ( .11576) | ( .10410) |
| 1.1781 | 5.3333 | .28188 | .12932 | .15678 |
| | | ( .11787) | ( .057360) | ( .058953) |
| 1.3744 | 4.5714 | .12660 | .083157 | .10210 |
| | | ( .052939) | ( .036883) | ( .038394) |
| 1.5708 | 4.0000 | .16683 | .070082 | .075322 |
| | | ( .069763) | ( .031084) | ( .028323) |
| 1.7671 | 3.5556 | .087037 | .060355 | .062766 |
| | | ( .036396) | ( .026769) | ( .023602) |
| 1.9635 | 3.2000 | .12006 | .052753 | .053583 |
| | | ( .050204) | ( .023398) | ( .020149) |
| 2.1598 | 2.9091 | .065160 | .044135 | .044523 |
| | | ( .027248) | ( .019575) | ( .016742) |
| 2.3562 | 2.6667 | .085052 | .031077 | .032374 |
| | | ( .035566) | ( .013784) | ( .012174) |
| 2.5525 | 2.4615 | .039988 | .020180 | .021018 |
| | | ( .016721) | ( .0089505) | ( .0079036) |
| 2.7489 | 2.2857 | .059042 | .0098460 | .011735 |
| | | ( .024689) | ( .0043670) | ( .0044128) |
| 2.9452 | 2.1333 | .024459 | .0051530 | .0067522 |
| | | ( .010228) | ( .0022855) | ( .0025390) |
| 3.1416 | 2.0000 | .052112 | .0040610 | .0052442 |
| | | ( .030818) | ( .0025472) | ( .0027888) |

**GERMANY**

Standardized spectral density functions of RSGER50DT, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 7.8682 | 8.3292 | 6.9987 |
| | | ( 4.6531) | ( 5.2245) | ( 3.7218) |
| .19635 | 32.0000 | 5.2291 | 5.7374 | 5.4027 |
| | | ( 2.1866) | ( 2.5447) | ( 2.0316) |
| .39270 | 16.0000 | 1.8414 | 1.9820 | 2.5977 |
| | | ( .77000) | ( .87909) | ( .97682) |
| .58905 | 10.6667 | .97594 | .74292 | 1.0483 |
| | | ( .40810) | ( .32951) | ( .39419) |
| .78540 | 8.0000 | .73560 | .61808 | .65325 |
| | | ( .30760) | ( .27414) | ( .24564) |
| .98175 | 6.4000 | .67428 | .57825 | .56814 |
| | | ( .28196) | ( .25647) | ( .21364) |
| 1.1781 | 5.3333 | .52938 | .46425 | .47302 |
| | | ( .22137) | ( .20591) | ( .17787) |
| 1.3744 | 4.5714 | .38458 | .34225 | .37617 |
| | | ( .16082) | ( .15180) | ( .14145) |
| 1.5708 | 4.0000 | .39746 | .34017 | .33095 |
| | | ( .16620) | ( .15088) | ( .12445) |
| 1.7671 | 3.5556 | .32285 | .29261 | .28712 |
| | | ( .13501) | ( .12978) | ( .10796) |
| 1.9635 | 3.2000 | .25892 | .21900 | .22476 |
| | | ( .10827) | ( .097133) | ( .084517) |
| 2.1598 | 2.9091 | .19660 | .16265 | .16820 |
| | | ( .082212) | ( .072141) | ( .063248) |
| 2.3562 | 2.6667 | .16125 | .12257 | .12418 |
| | | ( .067430) | ( .054365) | ( .046694) |
| 2.5525 | 2.4615 | .12200 | .085443 | .089100 |
| | | ( .051018) | ( .037897) | ( .033504) |
| 2.7489 | 2.2857 | .094105 | .058505 | .066400 |
| | | ( .039352) | ( .025949) | ( .024969) |
| 2.9452 | 2.1333 | .094697 | .058461 | .060334 |
| | | ( .039599) | ( .025929) | ( .022687) |
| 3.1416 | 2.0000 | .095691 | .061649 | .060802 |
| | | ( .056590) | ( .038669) | ( .032333) |

**POLAND**

Standardized spectral density functions of RSPOL50DT, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 6.1114 | 7.0282 | 6.6508 |
| | | ( 3.6141) | ( 4.4084) | ( 3.5368) |
| .19635 | 32.0000 | 6.2435 | 6.4106 | 5.8222 |
| | | ( 2.6108) | ( 2.8433) | ( 2.1893) |
| .39270 | 16.0000 | 3.2241 | 3.5292 | 3.6318 |
| | | ( 1.3482) | ( 1.5653) | ( 1.3657) |
| .58905 | 10.6667 | 1.1490 | 1.1136 | 1.5872 |
| | | ( .48046) | ( .49390) | ( .59685) |
| .78540 | 8.0000 | .87042 | .59973 | .65732 |
| | | ( .36398) | ( .26600) | ( .24717) |
| .98175 | 6.4000 | .23169 | .19394 | .29018 |
| | | ( .096886) | ( .086021) | ( .10911) |
| 1.1781 | 5.3333 | .31455 | .13547 | .15157 |
| | | ( .13153) | ( .060084) | ( .056994) |
| 1.3744 | 4.5714 | .12398 | .093915 | .10412 |
| | | ( .051845) | ( .041654) | ( .039151) |
| 1.5708 | 4.0000 | .15982 | .055429 | .066364 |
| | | ( .066833) | ( .024585) | ( .024955) |
| 1.7671 | 3.5556 | .071312 | .048786 | .054889 |
| | | ( .029820) | ( .021638) | ( .020640) |
| 1.9635 | 3.2000 | .12930 | .055120 | .054440 |
| | | ( .054069) | ( .024448) | ( .020471) |
| 2.1598 | 2.9091 | .067826 | .052694 | .053181 |
| | | ( .028362) | ( .023371) | ( .019998) |
| 2.3562 | 2.6667 | .10548 | .046953 | .047928 |
| | | ( .044110) | ( .020825) | ( .018022) |
| 2.5525 | 2.4615 | .056683 | .042764 | .044070 |
| | | ( .023703) | ( .018967) | ( .016572) |
| 2.7489 | 2.2857 | .092687 | .040872 | .042479 |
| | | ( .038758) | ( .018128) | ( .015973) |
| 2.9452 | 2.1333 | .056001 | .043699 | .044177 |
| | | ( .023418) | ( .019382) | ( .016612) |
| 3.1416 | 2.0000 | .095918 | .046375 | .045369 |
| | | ( .056724) | ( .029089) | ( .024127) |

**HUNGARY**

Standardized spectral density functions of RSHUG50DT, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 6.4345 | 7.4287 | 7.1061 |
| | | ( 3.8052) | ( 4.6597) | ( 3.7790) |
| .19635 | 32.0000 | 6.7171 | 6.9437 | 6.2597 |
| | | ( 2.8089) | ( 3.0797) | ( 2.3538) |
| .39270 | 16.0000 | 3.5616 | 3.8208 | 3.8199 |
| | | ( 1.4893) | ( 1.6946) | ( 1.4364) |
| .58905 | 10.6667 | .74023 | .73590 | 1.3817 |
| | | ( .30954) | ( .32639) | ( .51955) |
| .78540 | 8.0000 | .58537 | .25304 | .39008 |
| | | ( .24478) | ( .11223) | ( .14668) |
| .98175 | 6.4000 | .24956 | .17606 | .19516 |
| | | ( .10436) | ( .078088) | ( .073385) |
| 1.1781 | 5.3333 | .26689 | .11725 | .12620 |
| | | ( .11160) | ( .052003) | ( .047455) |
| 1.3744 | 4.5714 | .10590 | .059913 | .073954 |
| | | ( .044284) | ( .026573) | ( .027809) |
| 1.5708 | 4.0000 | .11156 | .019060 | .032424 |
| | | ( .046649) | ( .0084539) | ( .012193) |
| 1.7671 | 3.5556 | .053135 | .017363 | .021102 |
| | | ( .022219) | ( .0077012) | ( .0079351) |
| 1.9635 | 3.2000 | .086110 | .021546 | .022168 |
| | | ( .036008) | ( .0095564) | ( .0083358) |
| 2.1598 | 2.9091 | .048572 | .022845 | .022412 |
| | | ( .020311) | ( .010133) | ( .0084277) |
| 2.3562 | 2.6667 | .068290 | .016484 | .017900 |
| | | ( .028557) | ( .0073112) | ( .0067310) |
| 2.5525 | 2.4615 | .034864 | .012620 | .015863 |
| | | ( .014579) | ( .0055972) | ( .0059649) |
| 2.7489 | 2.2857 | .064306 | .019300 | .021130 |
| | | ( .026891) | ( .0085600) | ( .0079454) |
| 2.9452 | 2.1333 | .050664 | .031635 | .030154 |
| | | ( .021186) | ( .014031) | ( .011339) |
| 3.1416 | 2.0000 | .077344 | .036369 | .034182 |
| | | ( .045740) | ( .022812) | ( .018177) |

**BULGARIA**

Standardized spectral density functions of RSBUL50DT, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 7.1981 | 8.2210 | 7.6402 |
| | | ( 4.2568) | ( 5.1566) | ( 4.0630) |
| .19635 | 32.0000 | 6.9498 | 7.2209 | 6.5149 |
| | | ( 2.9062) | ( 3.2027) | ( 2.4498) |
| .39270 | 16.0000 | 3.2457 | 3.5148 | 3.6824 |
| | | ( 1.3572) | ( 1.5589) | ( 1.3847) |
| .58905 | 10.6667 | .59491 | .52574 | 1.1948 |
| | | ( .24877) | ( .23318) | ( .44928) |
| .78540 | 8.0000 | .54229 | .20660 | .30679 |
| | | ( .22677) | ( .091632) | ( .11536) |
| .98175 | 6.4000 | .21764 | .14249 | .15568 |
| | | ( .091009) | ( .063200) | ( .058540) |
| 1.1781 | 5.3333 | .22768 | .076313 | .091292 |
| | | ( .095207) | ( .033847) | ( .034329) |
| 1.3744 | 4.5714 | .075302 | .031220 | .048349 |
| | | ( .031489) | ( .013847) | ( .018181) |
| 1.5708 | 4.0000 | .11324 | .015162 | .021084 |
| | | ( .047352) | ( .0067248) | ( .0079281) |
| 1.7671 | 3.5556 | .038653 | .0096199 | .014394 |
| | | ( .016163) | ( .0042667) | ( .0054125) |
| 1.9635 | 3.2000 | .085492 | .015581 | .016276 |
| | | ( .035750) | ( .0069106) | ( .0061202) |
| 2.1598 | 2.9091 | .039259 | .018195 | .019154 |
| | | ( .016417) | ( .0080702) | ( .0072027) |
| 2.3562 | 2.6667 | .073746 | .018682 | .019904 |
| | | ( .030838) | ( .0082860) | ( .0074846) |
| 2.5525 | 2.4615 | .039048 | .021816 | .022974 |
| | | ( .016329) | ( .0096761) | ( .0086388) |
| 2.7489 | 2.2857 | .075372 | .027476 | .027090 |
| | | ( .031518) | ( .012186) | ( .010187) |
| 2.9452 | 2.1333 | .045355 | .030019 | .029739 |
| | | ( .018966) | ( .013314) | ( .011183) |
| 3.1416 | 2.0000 | .074902 | .029712 | .030042 |
| | | ( .044295) | ( .018637) | ( .015976) |

## A.2: Spectral density estimation of GDP p.c. time series subsequent to Hodrick Prescott trend elimination (1950-2010)

**UK**

Standardized spectral density functions of UKD50, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .35049 | .21796 | .78488 |
| | | ( .20727) | ( .13672) | ( .41739) |
| .19635 | 32.0000 | 1.3486 | 1.3270 | 1.5125 |
| | | ( .56392) | ( .58855) | ( .56875) |
| .39270 | 16.0000 | 3.0479 | 3.1542 | 2.7689 |
| | | ( 1.2745) | ( 1.3990) | ( 1.0412) |
| .58905 | 10.6667 | 3.2453 | 3.4721 | 3.1137 |
| | | ( 1.3571) | ( 1.5400) | ( 1.1708) |
| .78540 | 8.0000 | 2.2892 | 2.4240 | 2.4397 |
| | | ( .95727) | ( 1.0751) | ( .91739) |
| .98175 | 6.4000 | 1.4411 | 1.4846 | 1.6496 |
| | | ( .60261) | ( .65847) | ( .62032) |
| 1.1781 | 5.3333 | 1.2464 | 1.2183 | 1.2337 |
| | | ( .52118) | ( .54034) | ( .46391) |
| 1.3744 | 4.5714 | 1.0442 | 1.0011 | .96599 |
| | | ( .43667) | ( .44401) | ( .36324) |
| 1.5708 | 4.0000 | .62898 | .62856 | .68524 |
| | | ( .26302) | ( .27879) | ( .25767) |
| 1.7671 | 3.5556 | .53943 | .47869 | .48647 |
| | | ( .22557) | ( .21231) | ( .18293) |
| 1.9635 | 3.2000 | .37942 | .33941 | .33227 |
| | | ( .15866) | ( .15054) | ( .12494) |
| 2.1598 | 2.9091 | .20271 | .15729 | .18631 |
| | | ( .084767) | ( .069763) | ( .070057) |
| 2.3562 | 2.6667 | .13704 | .086363 | .099243 |
| | | ( .057304) | ( .038305) | ( .037319) |
| 2.5525 | 2.4615 | .10409 | .052735 | .057152 |
| | | ( .043526) | ( .023390) | ( .021491) |
| 2.7489 | 2.2857 | .064881 | .026650 | .034443 |
| | | ( .027131) | ( .011820) | ( .012952) |
| 2.9452 | 2.1333 | .074545 | .026511 | .028271 |
| | | ( .031172) | ( .011758) | ( .010631) |
| 3.1416 | 2.0000 | .061931 | .027116 | .028288 |
| | | ( .036624) | ( .017009) | ( .015043) |

**ITALLY**

Standardized spectral density functions of ITD50, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .29578 | .13557 | .48123 |
| | | ( .17492) | ( .085038) | ( .25591) |
| .19635 | 32.0000 | .84611 | .78657 | .98364 |
| | | ( .35381) | ( .34887) | ( .36988) |
| .39270 | 16.0000 | 2.1191 | 2.2063 | 1.9945 |
| | | ( .88615) | ( .97856) | ( .75001) |
| .58905 | 10.6667 | 2.7296 | 2.8023 | 2.4874 |
| | | ( 1.1414) | ( 1.2429) | ( .93534) |
| .78540 | 8.0000 | 1.9665 | 2.1507 | 2.2642 |
| | | ( .82234) | ( .95390) | ( .85141) |
| .98175 | 6.4000 | 1.9010 | 2.0241 | 2.0500 |
| | | ( .79492) | ( .89775) | ( .77087) |
| 1.1781 | 5.3333 | 2.0821 | 2.0425 | 1.8027 |
| | | ( .87066) | ( .90592) | ( .67788) |
| 1.3744 | 4.5714 | 1.0064 | 1.0832 | 1.1866 |
| | | ( .42085) | ( .48044) | ( .44618) |
| 1.5708 | 4.0000 | .61558 | .56249 | .72493 |
| | | ( .25742) | ( .24948) | ( .27259) |
| 1.7671 | 3.5556 | .73976 | .68040 | .63936 |
| | | ( .30935) | ( .30178) | ( .24042) |
| 1.9635 | 3.2000 | .61439 | .59943 | .56150 |
| | | ( .25692) | ( .26587) | ( .21114) |
| 2.1598 | 2.9091 | .40519 | .36769 | .38520 |
| | | ( .16944) | ( .16308) | ( .14485) |
| 2.3562 | 2.6667 | .23846 | .20094 | .22824 |
| | | ( .099717) | ( .089122) | ( .085825) |
| 2.5525 | 2.4615 | .19235 | .12805 | .14026 |
| | | ( .080436) | ( .056794) | ( .052742) |
| 2.7489 | 2.2857 | .12407 | .091450 | .11109 |
| | | ( .051880) | ( .040561) | ( .041775) |
| 2.9452 | 2.1333 | .17960 | .12772 | .12756 |
| | | ( .075101) | ( .056648) | ( .047966) |
| 3.1416 | 2.0000 | .18369 | .15681 | .14432 |
| | | ( .10863) | ( .098361) | ( .076749) |

**GREECE**

Standardized spectral density functions of GRD50, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .51582 | .47954 | 1.0337 |
| | | ( .30505) | ( .30079) | ( .54971) |
| .19635 | 32.0000 | 1.5951 | 1.5886 | 1.6530 |
| | | ( .66703) | ( .70459) | ( .62157) |
| .39270 | 16.0000 | 2.8919 | 2.9296 | 2.5389 |
| | | ( 1.2093) | ( 1.2994) | ( .95471) |
| .58905 | 10.6667 | 2.4770 | 2.7119 | 2.6111 |
| | | ( 1.0358) | ( 1.2028) | ( .98186) |
| .78540 | 8.0000 | 2.0823 | 2.1721 | 2.1777 |
| | | ( .87077) | ( .96340) | ( .81890) |
| .98175 | 6.4000 | 1.6792 | 1.6852 | 1.6574 |
| | | ( .70218) | ( .74745) | ( .62321) |
| 1.1781 | 5.3333 | 1.0566 | 1.0771 | 1.1626 |
| | | ( .44185) | ( .47774) | ( .43717) |
| 1.3744 | 4.5714 | .87424 | .82249 | .86116 |
| | | ( .36558) | ( .36480) | ( .32382) |
| 1.5708 | 4.0000 | .73563 | .70675 | .69527 |
| | | ( .30762) | ( .31347) | ( .26144) |
| 1.7671 | 3.5556 | .56507 | .52404 | .53509 |
| | | ( .23630) | ( .23243) | ( .20121) |
| 1.9635 | 3.2000 | .40773 | .37724 | .40190 |
| | | ( .17050) | ( .16732) | ( .15113) |
| 2.1598 | 2.9091 | .36620 | .31888 | .32860 |
| | | ( .15313) | ( .14144) | ( .12357) |
| 2.3562 | 2.6667 | .31446 | .29029 | .28632 |
| | | ( .13150) | ( .12875) | ( .10766) |
| 2.5525 | 2.4615 | .28504 | .24029 | .23316 |
| | | ( .11919) | ( .10657) | ( .087675) |
| 2.7489 | 2.2857 | .18358 | .15589 | .16653 |
| | | ( .076768) | ( .069142) | ( .062622) |
| 2.9452 | 2.1333 | .15816 | .10858 | .12054 |
| | | ( .066138) | ( .048158) | ( .045327) |
| 3.1416 | 2.0000 | .13954 | .10239 | .10774 |
| | | ( .082518) | ( .064226) | ( .057297) |

**GERMANY**

Standardized spectral density functions of GERD50, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .17712 | .030825 | .14507 |
| | | ( .10474) | ( .019335) | ( .077145) |
| .19635 | 32.0000 | .33088 | .23333 | .35136 |
| | | ( .13836) | ( .10349) | ( .13212) |
| .39270 | 16.0000 | .89448 | .86585 | .93282 |
| | | ( .37404) | ( .38403) | ( .35077) |
| .58905 | 10.6667 | 1.6646 | 1.7543 | 1.6735 |
| | | ( .69606) | ( .77809) | ( .62929) |
| .78540 | 8.0000 | 2.2275 | 2.3497 | 2.1280 |
| | | ( .93148) | ( 1.0422) | ( .80017) |
| .98175 | 6.4000 | 2.0059 | 2.1029 | 1.9739 |
| | | ( .83881) | ( .93272) | ( .74224) |
| 1.1781 | 5.3333 | 1.3242 | 1.3712 | 1.4732 |
| | | ( .55373) | ( .60817) | ( .55396) |
| 1.3744 | 4.5714 | 1.0642 | 1.0685 | 1.1667 |
| | | ( .44500) | ( .47391) | ( .43872) |
| 1.5708 | 4.0000 | 1.1870 | 1.1567 | 1.1216 |
| | | ( .49637) | ( .51302) | ( .42174) |
| 1.7671 | 3.5556 | 1.0671 | 1.0926 | 1.0734 |
| | | ( .44623) | ( .48461) | ( .40363) |
| 1.9635 | 3.2000 | .96185 | .95898 | .95153 |
| | | ( .40221) | ( .42534) | ( .35780) |
| 2.1598 | 2.9091 | .80871 | .79366 | .79476 |
| | | ( .33818) | ( .35201) | ( .29885) |
| 2.3562 | 2.6667 | .63828 | .62806 | .63931 |
| | | ( .26691) | ( .27857) | ( .24040) |
| 2.5525 | 2.4615 | .56207 | .50505 | .51186 |
| | | ( .23504) | ( .22401) | ( .19247) |
| 2.7489 | 2.2857 | .41147 | .39598 | .43848 |
| | | ( .17206) | ( .17563) | ( .16488) |
| 2.9452 | 2.1333 | .49659 | .44962 | .45452 |
| | | ( .20766) | ( .19942) | ( .17091) |
| 3.1416 | 2.0000 | .53321 | .51634 | .48529 |
| | | ( .31533) | ( .32387) | ( .25807) |

**POLAND**

Standardized spectral density functions of POLD50, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .90329 | .45096 | .78329 |
| | | ( .53418) | ( .28287) | ( .41655) |
| .19635 | 32.0000 | .93088 | 1.0052 | 1.6026 |
| | | ( .38926) | ( .44582) | ( .60263) |
| .39270 | 16.0000 | 3.6268 | 3.9929 | 3.6677 |
| | | ( 1.5166) | ( 1.7710) | ( 1.3792) |
| .58905 | 10.6667 | 5.7160 | 5.8051 | 4.5997 |
| | | ( 2.3902) | ( 2.5748) | ( 1.7296) |
| .78540 | 8.0000 | 2.3766 | 2.7928 | 2.9305 |
| | | ( .99382) | ( 1.2387) | ( 1.1020) |
| .98175 | 6.4000 | .51858 | .47328 | 1.0625 |
| | | ( .21685) | ( .20992) | ( .39955) |
| 1.1781 | 5.3333 | .76396 | .52286 | .50109 |
| | | ( .31946) | ( .23191) | ( .18842) |
| 1.3744 | 4.5714 | .38388 | .36918 | .36831 |
| | | ( .16053) | ( .16375) | ( .13849) |
| 1.5708 | 4.0000 | .31362 | .20996 | .24391 |
| | | ( .13114) | ( .093124) | ( .091719) |
| 1.7671 | 3.5556 | .20209 | .16400 | .17210 |
| | | ( .084508) | ( .072740) | ( .064714) |
| 1.9635 | 3.2000 | .18444 | .11283 | .12010 |
| | | ( .077127) | ( .050042) | ( .045163) |
| 2.1598 | 2.9091 | .11037 | .084294 | .091138 |
| | | ( .046151) | ( .037387) | ( .034271) |
| 2.3562 | 2.6667 | .13867 | .079025 | .077732 |
| | | ( .057988) | ( .035050) | ( .029230) |
| 2.5525 | 2.4615 | .082415 | .061738 | .062666 |
| | | ( .034463) | ( .027383) | ( .023564) |
| 2.7489 | 2.2857 | .095634 | .042152 | .046464 |
| | | ( .039991) | ( .018696) | ( .017472) |
| 2.9452 | 2.1333 | .055784 | .037223 | .040891 |
| | | ( .023327) | ( .016510) | ( .015376) |
| 3.1416 | 2.0000 | .097322 | .043930 | .041577 |
| | | ( .057554) | ( .027555) | ( .022110) |

**HUNGARY**

Standardized spectral density functions of HUGD50, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .60393 | .76061 | 1.5434 |
| | | ( .35715) | ( .47709) | ( .82079) |
| .19635 | 32.0000 | 2.4137 | 2.3543 | 2.3113 |
| | | ( 1.0093) | ( 1.0442) | ( .86911) |
| .39270 | 16.0000 | 3.6242 | 3.7433 | 3.1885 |
| | | ( 1.5155) | ( 1.6603) | ( 1.1990) |
| .58905 | 10.6667 | 2.6538 | 2.9289 | 2.8840 |
| | | ( 1.1097) | ( 1.2991) | ( 1.0845) |
| .78540 | 8.0000 | 2.0059 | 2.0389 | 2.1286 |
| | | ( .83878) | ( .90432) | ( .80043) |
| .98175 | 6.4000 | 1.4828 | 1.5157 | 1.5372 |
| | | ( .62005) | ( .67225) | ( .57805) |
| 1.1781 | 5.3333 | 1.1140 | 1.0697 | 1.0615 |
| | | ( .46583) | ( .47442) | ( .39915) |
| 1.3744 | 4.5714 | .63188 | .58874 | .63409 |
| | | ( .26423) | ( .26113) | ( .23844) |
| 1.5708 | 4.0000 | .33262 | .26810 | .33821 |
| | | ( .13909) | ( .11891) | ( .12718) |
| 1.7671 | 3.5556 | .27625 | .20194 | .21882 |
| | | ( .11552) | ( .089565) | ( .082284) |
| 1.9635 | 3.2000 | .22402 | .17827 | .18236 |
| | | ( .093679) | ( .079066) | ( .068573) |
| 2.1598 | 2.9091 | .20975 | .16049 | .15906 |
| | | ( .087712) | ( .071184) | ( .059813) |
| 2.3562 | 2.6667 | .16576 | .12798 | .13129 |
| | | ( .069315) | ( .056763) | ( .049369) |
| 2.5525 | 2.4615 | .14206 | .099081 | .11154 |
| | | ( .059403) | ( .043945) | ( .041943) |
| 2.7489 | 2.2857 | .14462 | .11566 | .12108 |
| | | ( .060476) | ( .051297) | ( .045529) |
| 2.9452 | 2.1333 | .18973 | .15086 | .14402 |
| | | ( .079340) | ( .066913) | ( .054155) |
| 3.1416 | 2.0000 | .17395 | .15578 | .15345 |
| | | ( .10287) | ( .097710) | ( .081605) |

**BULGARIA**

Standardized spectral density functions of BULD50, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .94468 | 1.0929 | 1.5654 |
| | | ( .55866) | ( .68552) | ( .83246) |
| .19635 | 32.0000 | 2.1088 | 2.0608 | 1.9922 |
| | | ( .88184) | ( .91405) | ( .74912) |
| .39270 | 16.0000 | 2.6735 | 2.7364 | 2.3861 |
| | | ( 1.1180) | ( 1.2137) | ( .89725) |
| .58905 | 10.6667 | 1.8746 | 1.9986 | 2.1193 |
| | | ( .78391) | ( .88644) | ( .79693) |
| .78540 | 8.0000 | 1.7021 | 1.8080 | 1.9184 |
| | | ( .71174) | ( .80189) | ( .72137) |
| .98175 | 6.4000 | 2.0976 | 2.0844 | 1.8608 |
| | | ( .87715) | ( .92452) | ( .69971) |
| 1.1781 | 5.3333 | 1.3899 | 1.4487 | 1.4227 |
| | | ( .58121) | ( .64256) | ( .53498) |
| 1.3744 | 4.5714 | .73163 | .73619 | .87077 |
| | | ( .30594) | ( .32652) | ( .32744) |
| 1.5708 | 4.0000 | .67034 | .56329 | .58315 |
| | | ( .28031) | ( .24984) | ( .21928) |
| 1.7671 | 3.5556 | .42737 | .42894 | .46038 |
| | | ( .17871) | ( .19025) | ( .17312) |
| 1.9635 | 3.2000 | .49199 | .41542 | .40160 |
| | | ( .20573) | ( .18425) | ( .15101) |
| 2.1598 | 2.9091 | .34577 | .33633 | .33415 |
| | | ( .14459) | ( .14917) | ( .12565) |
| 2.3562 | 2.6667 | .29120 | .23688 | .25429 |
| | | ( .12177) | ( .10506) | ( .095621) |
| 2.5525 | 2.4615 | .22395 | .20122 | .21081 |
| | | ( .093651) | ( .089248) | ( .079269) |
| 2.7489 | 2.2857 | .24379 | .19860 | .18916 |
| | | ( .10195) | ( .088086) | ( .071131) |
| 2.9452 | 2.1333 | .19019 | .15347 | .15161 |
| | | ( .079531) | ( .068068) | ( .057011) |
| 3.1416 | 2.0000 | .12978 | .092495 | .12377 |
| | | ( .076748) | ( .058017) | ( .065819) |

## A.3: Spectral density estimation of GDP growth series subsequent to linear trend elimination (1950-2010)

**UK**

Standardized spectral density functions of RSUKGRWT, sample 1951 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .61335 | .57897 | .78646 |
| | | ( .36573) | ( .36617) | ( .42170) |
| .19635 | 32.0000 | 1.0385 | .98106 | 1.0466 |
| | | ( .43789) | ( .43874) | ( .39681) |
| .39270 | 16.0000 | 1.5755 | 1.6248 | 1.5172 |
| | | ( .66428) | ( .72665) | ( .57525) |
| .58905 | 10.6667 | 1.8038 | 1.8523 | 1.7071 |
| | | ( .76054) | ( .82836) | ( .64723) |
| .78540 | 8.0000 | 1.4912 | 1.5102 | 1.5526 |
| | | ( .62876) | ( .67539) | ( .58868) |
| .98175 | 6.4000 | 1.2544 | 1.3392 | 1.4958 |
| | | ( .52892) | ( .59890) | ( .56714) |
| 1.1781 | 5.3333 | 1.7947 | 1.8289 | 1.6861 |
| | | ( .75673) | ( .81790) | ( .63927) |
| 1.3744 | 4.5714 | 1.7361 | 1.7574 | 1.5841 |
| | | ( .73202) | ( .78594) | ( .60060) |
| 1.5708 | 4.0000 | .93397 | .99249 | 1.1357 |
| | | ( .39380) | ( .44385) | ( .43061) |
| 1.7671 | 3.5556 | .84315 | .82824 | .89812 |
| | | ( .35550) | ( .37040) | ( .34052) |
| 1.9635 | 3.2000 | .98572 | .93549 | .83715 |
| | | ( .41562) | ( .41836) | ( .31741) |
| 2.1598 | 2.9091 | .61517 | .62921 | .64740 |
| | | ( .25938) | ( .28139) | ( .24546) |
| 2.3562 | 2.6667 | .45052 | .40585 | .45045 |
| | | ( .18996) | ( .18150) | ( .17079) |
| 2.5525 | 2.4615 | .39575 | .34984 | .35449 |
| | | ( .16686) | ( .15645) | ( .13441) |
| 2.7489 | 2.2857 | .32837 | .29508 | .30174 |
| | | ( .13845) | ( .13196) | ( .11441) |
| 2.9452 | 2.1333 | .31303 | .26279 | .26648 |
| | | ( .13199) | ( .11753) | ( .10104) |
| 3.1416 | 2.0000 | .26659 | .23532 | .25162 |
| | | ( .15897) | ( .14883) | ( .13492) |

**ITALLY**

Standardized spectral density functions of RSITGWT, sample 1951 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .32994 | .30848 | .40478 |
| | | ( .19674) | ( .19510) | ( .21704) |
| .19635 | 32.0000 | .59451 | .48496 | .53618 |
| | | ( .25067) | ( .21688) | ( .20329) |
| .39270 | 16.0000 | .80162 | .84576 | .85251 |
| | | ( .33799) | ( .37824) | ( .32323) |
| .58905 | 10.6667 | 1.2732 | 1.2415 | 1.1489 |
| | | ( .53682) | ( .55520) | ( .43561) |
| .78540 | 8.0000 | 1.1946 | 1.2544 | 1.2875 |
| | | ( .50368) | ( .56099) | ( .48814) |
| .98175 | 6.4000 | 1.3177 | 1.4270 | 1.3916 |
| | | ( .55557) | ( .63816) | ( .52764) |
| 1.1781 | 5.3333 | 1.5763 | 1.4937 | 1.2967 |
| | | ( .66462) | ( .66800) | ( .49164) |
| 1.3744 | 4.5714 | .68309 | .74649 | .91259 |
| | | ( .28802) | ( .33384) | ( .34601) |
| 1.5708 | 4.0000 | .72718 | .67701 | .84792 |
| | | ( .30660) | ( .30277) | ( .32149) |
| 1.7671 | 3.5556 | 1.2809 | 1.2901 | 1.1801 |
| | | ( .54009) | ( .57697) | ( .44743) |
| 1.9635 | 3.2000 | 1.4122 | 1.4492 | 1.3196 |
| | | ( .59546) | ( .64810) | ( .50033) |
| 2.1598 | 2.9091 | 1.0739 | 1.1077 | 1.1135 |
| | | ( .45279) | ( .49537) | ( .42218) |
| 2.3562 | 2.6667 | .82242 | .80420 | .84591 |
| | | ( .34676) | ( .35965) | ( .32073) |
| 2.5525 | 2.4615 | .72398 | .65590 | .70290 |
| | | ( .30526) | ( .29333) | ( .26650) |
| 2.7489 | 2.2857 | .67267 | .67416 | .76260 |
| | | ( .28362) | ( .30149) | ( .28914) |
| 2.9452 | 2.1333 | 1.0528 | 1.0464 | 1.0142 |
| | | ( .44390) | ( .46795) | ( .38455) |
| 3.1416 | 2.0000 | 1.2561 | 1.2947 | 1.1698 |
| | | ( .74898) | ( .81882) | ( .62727) |

**GREECE**

Standardized spectral density functions of RSGRGRW, sample 1951 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 1.7864 | 2.0604 | 2.1294 |
| | | ( 1.0652) | ( 1.3031) | ( 1.1418) |
| .19635 | 32.0000 | 2.2667 | 2.2465 | 2.0496 |
| | | ( .95574) | ( 1.0047) | ( .77711) |
| .39270 | 16.0000 | 1.5969 | 1.6408 | 1.6184 |
| | | ( .67330) | ( .73380) | ( .61360) |
| .58905 | 10.6667 | .86597 | .94162 | 1.1790 |
| | | ( .36513) | ( .42111) | ( .44701) |
| .78540 | 8.0000 | 1.3086 | 1.2335 | 1.1252 |
| | | ( .55177) | ( .55163) | ( .42661) |
| .98175 | 6.4000 | 1.0652 | 1.0586 | .95042 |
| | | ( .44911) | ( .47344) | ( .36035) |
| 1.1781 | 5.3333 | .47475 | .43349 | .57451 |
| | | ( .20017) | ( .19386) | ( .21783) |
| 1.3744 | 4.5714 | .42728 | .37205 | .48299 |
| | | ( .18016) | ( .16639) | ( .18313) |
| 1.5708 | 4.0000 | .78446 | .72347 | .69811 |
| | | ( .33076) | ( .32354) | ( .26469) |
| 1.7671 | 3.5556 | .92002 | .95623 | .92186 |
| | | ( .38792) | ( .42764) | ( .34952) |
| 1.9635 | 3.2000 | 1.0657 | 1.0668 | 1.0153 |
| | | ( .44932) | ( .47709) | ( .38494) |
| 2.1598 | 2.9091 | .95078 | .97285 | .97190 |
| | | ( .40089) | ( .43507) | ( .36850) |
| 2.3562 | 2.6667 | .86170 | .88519 | .88464 |
| | | ( .36332) | ( .39587) | ( .33541) |
| 2.5525 | 2.4615 | .86086 | .80923 | .76549 |
| | | ( .36297) | ( .36190) | ( .29024) |
| 2.7489 | 2.2857 | .54283 | .53902 | .63193 |
| | | ( .22888) | ( .24106) | ( .23960) |
| 2.9452 | 2.1333 | .64318 | .64285 | .67875 |
| | | ( .27119) | ( .28749) | ( .25735) |
| 3.1416 | 2.0000 | .94373 | .89511 | .77464 |
| | | ( .56273) | ( .56612) | ( .41536) |

**GERMANY**

Standardized spectral density functions of RESGERGRW, sample 1951 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 1.5688 | 1.6567 | 1.5196 |
| | | ( .93545) | ( 1.0478) | ( .81481) |
| .19635 | 32.0000 | 1.3779 | 1.3992 | 1.3211 |
| | | ( .58098) | ( .62574) | ( .50090) |
| .39270 | 16.0000 | .83996 | .83712 | .93191 |
| | | ( .35416) | ( .37437) | ( .35334) |
| .58905 | 10.6667 | .67085 | .65153 | .74293 |
| | | ( .28286) | ( .29137) | ( .28168) |
| .78540 | 8.0000 | .89812 | .82675 | .77010 |
| | | ( .37868) | ( .36973) | ( .29198) |
| .98175 | 6.4000 | .77504 | .74665 | .78267 |
| | | ( .32679) | ( .33391) | ( .29675) |
| 1.1781 | 5.3333 | .78948 | .79600 | .91091 |
| | | ( .33287) | ( .35598) | ( .34537) |
| 1.3744 | 4.5714 | 1.2911 | 1.3135 | 1.2431 |
| | | ( .54437) | ( .58740) | ( .47133) |
| 1.5708 | 4.0000 | 1.5238 | 1.5496 | 1.4223 |
| | | ( .64250) | ( .69300) | ( .53926) |
| 1.7671 | 3.5556 | 1.2128 | 1.2903 | 1.3057 |
| | | ( .51136) | ( .57705) | ( .49504) |
| 1.9635 | 3.2000 | 1.1318 | 1.1202 | 1.1346 |
| | | ( .47721) | ( .50096) | ( .43018) |
| 2.1598 | 2.9091 | .99543 | 1.0050 | 1.0148 |
| | | ( .41971) | ( .44945) | ( .38474) |
| 2.3562 | 2.6667 | .93377 | .93048 | .92165 |
| | | ( .39371) | ( .41612) | ( .34945) |
| 2.5525 | 2.4615 | .86082 | .82110 | .81875 |
| | | ( .36296) | ( .36721) | ( .31043) |
| 2.7489 | 2.2857 | .68267 | .69060 | .74455 |
| | | ( .28784) | ( .30885) | ( .28230) |
| 2.9452 | 2.1333 | .81606 | .77277 | .77100 |
| | | ( .34408) | ( .34559) | ( .29233) |
| 3.1416 | 2.0000 | .83193 | .84182 | .80842 |
| | | ( .49607) | ( .53241) | ( .43347) |

**POLAND**

Standardized spectral density functions of RSPOLGRWT, sample 1951 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 2.9790 | 3.0908 | 2.8978 |
| | | ( 1.7764) | ( 1.9548) | ( 1.5538) |
| .19635 | 32.0000 | 2.5957 | 2.7021 | 2.7380 |
| | | ( 1.0944) | ( 1.2084) | ( 1.0381) |
| .39270 | 16.0000 | 2.2890 | 2.5139 | 2.5558 |
| | | ( .96511) | ( 1.1242) | ( .96905) |
| .58905 | 10.6667 | 2.6067 | 2.5602 | 2.2677 |
| | | ( 1.0991) | ( 1.1449) | ( .85982) |
| .78540 | 8.0000 | 1.3455 | 1.4070 | 1.4931 |
| | | ( .56732) | ( .62924) | ( .56611) |
| .98175 | 6.4000 | .60906 | .61196 | .86616 |
| | | ( .25680) | ( .27368) | ( .32841) |
| 1.1781 | 5.3333 | .98891 | .84054 | .75004 |
| | | ( .41696) | ( .37590) | ( .28438) |
| 1.3744 | 4.5714 | .62653 | .64404 | .64449 |
| | | ( .26417) | ( .28802) | ( .24436) |
| 1.5708 | 4.0000 | .50261 | .44730 | .50689 |
| | | ( .21192) | ( .20004) | ( .19219) |
| 1.7671 | 3.5556 | .51866 | .48677 | .46897 |
| | | ( .21868) | ( .21769) | ( .17781) |
| 1.9635 | 3.2000 | .47618 | .43182 | .42547 |
| | | ( .20077) | ( .19312) | ( .16132) |
| 2.1598 | 2.9091 | .36154 | .34664 | .38064 |
| | | ( .15244) | ( .15502) | ( .14432) |
| 2.3562 | 2.6667 | .42575 | .39778 | .39825 |
| | | ( .17951) | ( .17789) | ( .15100) |
| 2.5525 | 2.4615 | .46748 | .44969 | .40387 |
| | | ( .19711) | ( .20111) | ( .15313) |
| 2.7489 | 2.2857 | .34420 | .31200 | .31777 |
| | | ( .14513) | ( .13953) | ( .12048) |
| 2.9452 | 2.1333 | .21434 | .19861 | .23011 |
| | | ( .090374) | ( .088822) | ( .087245) |
| 3.1416 | 2.0000 | .27670 | .20848 | .20745 |
| | | ( .16499) | ( .13185) | ( .11123) |

**HUNGARY**

Standardized spectral density functions of RSHUGGWT, sample 1951 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 1.5993 | 1.8480 | 2.0306 |
| | | ( .95364) | ( 1.1688) | ( 1.0888) |
| .19635 | 32.0000 | 2.2701 | 2.2521 | 2.0943 |
| | | ( .95718) | ( 1.0072) | ( .79406) |
| .39270 | 16.0000 | 1.9499 | 2.0249 | 1.8775 |
| | | ( .82217) | ( .90555) | ( .71184) |
| .58905 | 10.6667 | 1.1607 | 1.2154 | 1.3610 |
| | | ( .48937) | ( .54353) | ( .51602) |
| .78540 | 8.0000 | 1.0787 | 1.0175 | 1.0853 |
| | | ( .45483) | ( .45506) | ( .41150) |
| .98175 | 6.4000 | 1.0399 | 1.0645 | 1.0433 |
| | | ( .43846) | ( .47608) | ( .39555) |
| 1.1781 | 5.3333 | 1.0637 | 1.0221 | .95029 |
| | | ( .44849) | ( .45709) | ( .36030) |
| 1.3744 | 4.5714 | .69358 | .68893 | .71537 |
| | | ( .29244) | ( .30810) | ( .27123) |
| 1.5708 | 4.0000 | .50938 | .45174 | .53547 |
| | | ( .21478) | ( .20202) | ( .20303) |
| 1.7671 | 3.5556 | .56177 | .53465 | .56850 |
| | | ( .23686) | ( .23910) | ( .21555) |
| 1.9635 | 3.2000 | .75791 | .74196 | .69204 |
| | | ( .31956) | ( .33181) | ( .26239) |
| 2.1598 | 2.9091 | .76839 | .74975 | .68831 |
| | | ( .32398) | ( .33530) | ( .26097) |
| 2.3562 | 2.6667 | .53584 | .50433 | .55311 |
| | | ( .22593) | ( .22554) | ( .20971) |
| 2.5525 | 2.4615 | .47432 | .44517 | .53755 |
| | | ( .19999) | ( .19909) | ( .20381) |
| 2.7489 | 2.2857 | .76737 | .75000 | .74965 |
| | | ( .32355) | ( .33541) | ( .28423) |
| 2.9452 | 2.1333 | 1.0312 | 1.0495 | .99173 |
| | | ( .43481) | ( .46935) | ( .37602) |
| 3.1416 | 2.0000 | 1.0750 | 1.1270 | 1.0827 |
| | | ( .64100) | ( .71275) | ( .58054) |

**BULGARIA**

Standardized spectral density functions of RSBULGRWT, sample 1951 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 2.8099 | 3.1293 | 2.9552 |
| | | ( 1.6755) | ( 1.9791) | ( 1.5846) |
| .19635 | 32.0000 | 2.7550 | 2.8333 | 2.5975 |
| | | ( 1.1616) | ( 1.2671) | ( .98486) |
| .39270 | 16.0000 | 1.5736 | 1.6278 | 1.6775 |
| | | ( .66351) | ( .72796) | ( .63604) |
| .58905 | 10.6667 | .64871 | .62262 | .91559 |
| | | ( .27352) | ( .27844) | ( .34715) |
| .78540 | 8.0000 | .86371 | .79273 | .82686 |
| | | ( .36417) | ( .35452) | ( .31350) |
| .98175 | 6.4000 | 1.0908 | 1.0644 | .93480 |
| | | ( .45991) | ( .47602) | ( .35443) |
| 1.1781 | 5.3333 | .80178 | .80032 | .78617 |
| | | ( .33806) | ( .35791) | ( .29808) |
| 1.3744 | 4.5714 | .51469 | .48576 | .53959 |
| | | ( .21701) | ( .21724) | ( .20459) |
| 1.5708 | 4.0000 | .44955 | .37234 | .40951 |
| | | ( .18955) | ( .16652) | ( .15527) |
| 1.7671 | 3.5556 | .40213 | .38461 | .41792 |
| | | ( .16955) | ( .17200) | ( .15846) |
| 1.9635 | 3.2000 | .58550 | .52411 | .48894 |
| | | ( .24687) | ( .23439) | ( .18538) |
| 2.1598 | 2.9091 | .53919 | .51111 | .50140 |
| | | ( .22734) | ( .22858) | ( .19011) |
| 2.3562 | 2.6667 | .49760 | .44074 | .52342 |
| | | ( .20981) | ( .19710) | ( .19846) |
| 2.5525 | 2.4615 | .67779 | .68766 | .75892 |
| | | ( .28578) | ( .30753) | ( .28775) |
| 2.7489 | 2.2857 | 1.2166 | 1.2254 | 1.1361 |
| | | ( .51298) | ( .54799) | ( .43076) |
| 2.9452 | 2.1333 | 1.3717 | 1.4106 | 1.3342 |
| | | ( .57835) | ( .63082) | ( .50587) |
| 3.1416 | 2.0000 | 1.2133 | 1.3040 | 1.3476 |
| | | ( .72345) | ( .82472) | ( .72259) |

## A.4: Spectral density estimation of GDP growth series subsequent to Hodrick Prescott trend elimination (1950-2010)

**UK**

Standardized spectral density functions of UKD, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .32584 | .11347 | .60787 |
| | | ( .19270) | ( .071176) | ( .32326) |
| .19635 | 32.0000 | 1.0669 | 1.0600 | 1.3167 |
| | | ( .44614) | ( .47013) | ( .49511) |
| .39270 | 16.0000 | 2.8999 | 3.0174 | 2.6695 |
| | | ( 1.2126) | ( 1.3383) | ( 1.0038) |
| .58905 | 10.6667 | 3.4380 | 3.6236 | 3.1543 |
| | | ( 1.4377) | ( 1.6072) | ( 1.1861) |
| .78540 | 8.0000 | 2.2284 | 2.4006 | 2.4515 |
| | | ( .93184) | ( 1.0648) | ( .92185) |
| .98175 | 6.4000 | 1.3941 | 1.4407 | 1.6643 |
| | | ( .58295) | ( .63900) | ( .62583) |
| 1.1781 | 5.3333 | 1.4203 | 1.3959 | 1.3544 |
| | | ( .59393) | ( .61914) | ( .50928) |
| 1.3744 | 4.5714 | 1.1947 | 1.1682 | 1.0867 |
| | | ( .49958) | ( .51813) | ( .40862) |
| 1.5708 | 4.0000 | .60646 | .60626 | .69190 |
| | | ( .25360) | ( .26890) | ( .26018) |
| 1.7671 | 3.5556 | .44908 | .38525 | .43366 |
| | | ( .18779) | ( .17087) | ( .16307) |
| 1.9635 | 3.2000 | .38807 | .33364 | .31594 |
| | | ( .16228) | ( .14798) | ( .11880) |
| 2.1598 | 2.9091 | .23298 | .19217 | .20666 |
| | | ( .097424) | ( .085236) | ( .077709) |
| 2.3562 | 2.6667 | .15307 | .10454 | .12177 |
| | | ( .064008) | ( .046369) | ( .045789) |
| 2.5525 | 2.4615 | .12261 | .073238 | .079878 |
| | | ( .051273) | ( .032483) | ( .030037) |
| 2.7489 | 2.2857 | .096105 | .057386 | .062404 |
| | | ( .040188) | ( .025453) | ( .023466) |
| 2.9452 | 2.1333 | .10166 | .056879 | .057892 |
| | | ( .042510) | ( .025228) | ( .021769) |
| 3.1416 | 2.0000 | .089557 | .054917 | .057343 |
| | | ( .052962) | ( .034447) | ( .030494) |

**ITALLY**

Standardized spectral density functions of ITD, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .31215 | .18195 | .41942 |
| | | ( .18460) | ( .11413) | ( .22304) |
| .19635 | 32.0000 | .74611 | .61444 | .81690 |
| | | ( .31200) | ( .27252) | ( .30718) |
| .39270 | 16.0000 | 1.6920 | 1.8234 | 1.7951 |
| | | ( .70752) | ( .80873) | ( .67501) |
| .58905 | 10.6667 | 2.8785 | 2.9546 | 2.5809 |
| | | ( 1.2037) | ( 1.3105) | ( .97048) |
| .78540 | 8.0000 | 2.4256 | 2.6060 | 2.5151 |
| | | ( 1.0143) | ( 1.1558) | ( .94576) |
| .98175 | 6.4000 | 1.7796 | 1.9619 | 2.0416 |
| | | ( .74415) | ( .87015) | ( .76770) |
| 1.1781 | 5.3333 | 1.7950 | 1.7011 | 1.5573 |
| | | ( .75063) | ( .75450) | ( .58559) |
| 1.3744 | 4.5714 | .77934 | .83194 | .95877 |
| | | ( .32589) | ( .36899) | ( .36053) |
| 1.5708 | 4.0000 | .54726 | .47819 | .62623 |
| | | ( .22885) | ( .21209) | ( .23548) |
| 1.7671 | 3.5556 | .76003 | .70730 | .64370 |
| | | ( .31782) | ( .31371) | ( .24205) |
| 1.9635 | 3.2000 | .65619 | .64654 | .60428 |
| | | ( .27440) | ( .28676) | ( .22723) |
| 2.1598 | 2.9091 | .44965 | .41876 | .43696 |
| | | ( .18803) | ( .18573) | ( .16431) |
| 2.3562 | 2.6667 | .29949 | .26026 | .28840 |
| | | ( .12524) | ( .11543) | ( .10845) |
| 2.5525 | 2.4615 | .26005 | .19990 | .21892 |
| | | ( .10874) | ( .088661) | ( .082320) |
| 2.7489 | 2.2857 | .23090 | .20304 | .23038 |
| | | ( .096555) | ( .090057) | ( .086629) |
| 2.9452 | 2.1333 | .34678 | .31121 | .30229 |
| | | ( .14501) | ( .13803) | ( .11367) |
| 3.1416 | 2.0000 | .39499 | .38108 | .34699 |
| | | ( .23359) | ( .23903) | ( .18452) |

**GREECE**

Standardized spectral density functions of GRD, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .56066 | .58055 | 1.0911 |
| | | ( .33156) | ( .36415) | ( .58021) |
| .19635 | 32.0000 | 1.6500 | 1.6156 | 1.6191 |
| | | ( .68998) | ( .71657) | ( .60882) |
| .39270 | 16.0000 | 2.6168 | 2.6264 | 2.3262 |
| | | ( 1.0943) | ( 1.1649) | ( .87473) |
| .58905 | 10.6667 | 2.1604 | 2.4296 | 2.4490 |
| | | ( .90340) | ( 1.0776) | ( .92088) |
| .78540 | 8.0000 | 2.3468 | 2.4090 | 2.2644 |
| | | ( .98134) | ( 1.0685) | ( .85149) |
| .98175 | 6.4000 | 1.8068 | 1.8302 | 1.7088 |
| | | ( .75553) | ( .81173) | ( .64258) |
| 1.1781 | 5.3333 | .73340 | .75873 | .95738 |
| | | ( .30668) | ( .33652) | ( .36001) |
| 1.3744 | 4.5714 | .60126 | .50125 | .60394 |
| | | ( .25143) | ( .22232) | ( .22710) |
| 1.5708 | 4.0000 | .66284 | .61904 | .59011 |
| | | ( .27718) | ( .27456) | ( .22190) |
| 1.7671 | 3.5556 | .62465 | .59331 | .57745 |
| | | ( .26121) | ( .26315) | ( .21714) |
| 1.9635 | 3.2000 | .52099 | .50336 | .50856 |
| | | ( .21786) | ( .22326) | ( .19123) |
| 2.1598 | 2.9091 | .46303 | .42483 | .43752 |
| | | ( .19363) | ( .18842) | ( .16452) |
| 2.3562 | 2.6667 | .40243 | .39150 | .39100 |
| | | ( .16828) | ( .17364) | ( .14703) |
| 2.5525 | 2.4615 | .40786 | .35554 | .33808 |
| | | ( .17055) | ( .15769) | ( .12713) |
| 2.7489 | 2.2857 | .25776 | .24044 | .27231 |
| | | ( .10779) | ( .10665) | ( .10240) |
| 2.9452 | 2.1333 | .28604 | .24975 | .26614 |
| | | ( .11961) | ( .11077) | ( .10008) |
| 3.1416 | 2.0000 | .35735 | .32247 | .28893 |
| | | ( .21133) | ( .20227) | ( .15365) |

**GERMANY**

Standardized spectral density functions of GERD, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .33027 | .29502 | .64280 |
| | | ( .19531) | ( .18505) | ( .34183) |
| .19635 | 32.0000 | 1.0645 | .98932 | 1.0340 |
| | | ( .44513) | ( .43880) | ( .38880) |
| .39270 | 16.0000 | 1.8170 | 1.8206 | 1.6738 |
| | | ( .75982) | ( .80749) | ( .62939) |
| .58905 | 10.6667 | 1.8788 | 2.0580 | 2.0140 |
| | | ( .78567) | ( .91279) | ( .75732) |
| .78540 | 8.0000 | 2.1363 | 2.1849 | 2.0201 |
| | | ( .89333) | ( .96910) | ( .75961) |
| .98175 | 6.4000 | 1.6257 | 1.6669 | 1.6416 |
| | | ( .67982) | ( .73930) | ( .61728) |
| 1.1781 | 5.3333 | 1.0106 | 1.0526 | 1.2344 |
| | | ( .42260) | ( .46684) | ( .46417) |
| 1.3744 | 4.5714 | 1.2129 | 1.1902 | 1.1805 |
| | | ( .50718) | ( .52787) | ( .44390) |
| 1.5708 | 4.0000 | 1.2721 | 1.2765 | 1.1705 |
| | | ( .53193) | ( .56619) | ( .44015) |
| 1.7671 | 3.5556 | .91229 | .93468 | .94787 |
| | | ( .38149) | ( .41456) | ( .35643) |
| 1.9635 | 3.2000 | .68354 | .65831 | .69510 |
| | | ( .28583) | ( .29198) | ( .26138) |
| 2.1598 | 2.9091 | .55653 | .51913 | .53249 |
| | | ( .23272) | ( .23025) | ( .20023) |
| 2.3562 | 2.6667 | .45123 | .42265 | .42579 |
| | | ( .18869) | ( .18746) | ( .16011) |
| 2.5525 | 2.4615 | .38625 | .33188 | .34142 |
| | | ( .16152) | ( .14720) | ( .12839) |
| 2.7489 | 2.2857 | .28838 | .26810 | .29650 |
| | | ( .12059) | ( .11891) | ( .11149) |
| 2.9452 | 2.1333 | .36303 | .30997 | .30822 |
| | | ( .15181) | ( .13748) | ( .11590) |
| 3.1416 | 2.0000 | .35148 | .33762 | .32491 |
| | | ( .20785) | ( .21177) | ( .17278) |

**POLAND**

Standardized spectral density functions of POLD, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .85828 | .47236 | .86061 |
| | | ( .50757) | ( .29629) | ( .45766) |
| .19635 | 32.0000 | 1.0912 | 1.1537 | 1.6800 |
| | | ( .45632) | ( .51172) | ( .63175) |
| .39270 | 16.0000 | 3.6389 | 3.9766 | 3.6153 |
| | | ( 1.5217) | ( 1.7638) | ( 1.3595) |
| .58905 | 10.6667 | 5.3597 | 5.4671 | 4.3906 |
| | | ( 2.2413) | ( 2.4248) | ( 1.6510) |
| .78540 | 8.0000 | 2.2869 | 2.6592 | 2.8067 |
| | | ( .95632) | ( 1.1794) | ( 1.0554) |
| .98175 | 6.4000 | .60708 | .56797 | 1.0950 |
| | | ( .25386) | ( .25191) | ( .41175) |
| 1.1781 | 5.3333 | .81493 | .59369 | .56233 |
| | | ( .34078) | ( .26332) | ( .21145) |
| 1.3744 | 4.5714 | .40582 | .38943 | .39626 |
| | | ( .16970) | ( .17273) | ( .14901) |
| 1.5708 | 4.0000 | .30674 | .20907 | .25390 |
| | | ( .12827) | ( .092730) | ( .095476) |
| 1.7671 | 3.5556 | .22864 | .18582 | .18872 |
| | | ( .095608) | ( .082415) | ( .070963) |
| 1.9635 | 3.2000 | .20579 | .13749 | .14016 |
| | | ( .086053) | ( .060981) | ( .052704) |
| 2.1598 | 2.9091 | .12013 | .092931 | .10668 |
| | | ( .050234) | ( .041218) | ( .040115) |
| 2.3562 | 2.6667 | .15446 | .099757 | .10061 |
| | | ( .064591) | ( .044246) | ( .037833) |
| 2.5525 | 2.4615 | .12604 | .10339 | .095259 |
| | | ( .052705) | ( .045856) | ( .035820) |
| 2.7489 | 2.2857 | .11672 | .068557 | .070430 |
| | | ( .048810) | ( .030407) | ( .026484) |
| 2.9452 | 2.1333 | .061313 | .039593 | .047442 |
| | | ( .025639) | ( .017561) | ( .017840) |
| 3.1416 | 2.0000 | .092709 | .038826 | .040672 |
| | | ( .054826) | ( .024354) | ( .021629) |

**HUNGARY**

Standardized spectral density functions of HUGD, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .55720 | .67982 | 1.4678 |
| | | ( .32952) | ( .42642) | ( .78056) |
| .19635 | 32.0000 | 2.3121 | 2.2806 | 2.2553 |
| | | ( .96684) | ( 1.0115) | ( .84805) |
| .39270 | 16.0000 | 3.6481 | 3.7541 | 3.1626 |
| | | ( 1.5255) | ( 1.6651) | ( 1.1892) |
| .58905 | 10.6667 | 2.6068 | 2.8769 | 2.8142 |
| | | ( 1.0901) | ( 1.2760) | ( 1.0582) |
| .78540 | 8.0000 | 1.8140 | 1.8493 | 1.9830 |
| | | ( .75856) | ( .82023) | ( .74565) |
| .98175 | 6.4000 | 1.3635 | 1.3660 | 1.3955 |
| | | ( .57016) | ( .60586) | ( .52474) |
| 1.1781 | 5.3333 | 1.0258 | .98181 | .97318 |
| | | ( .42894) | ( .43547) | ( .36594) |
| 1.3744 | 4.5714 | .60999 | .55895 | .60176 |
| | | ( .25508) | ( .24791) | ( .22628) |
| 1.5708 | 4.0000 | .34626 | .28636 | .35801 |
| | | ( .14479) | ( .12701) | ( .13462) |
| 1.7671 | 3.5556 | .33849 | .27349 | .29300 |
| | | ( .14155) | ( .12130) | ( .11018) |
| 1.9635 | 3.2000 | .35050 | .31858 | .30185 |
| | | ( .14657) | ( .14130) | ( .11351) |
| 2.1598 | 2.9091 | .33482 | .29038 | .26943 |
| | | ( .14001) | ( .12879) | ( .10131) |
| 2.3562 | 2.6667 | .20215 | .17103 | .18898 |
| | | ( .084531) | ( .075856) | ( .071062) |
| 2.5525 | 2.4615 | .16191 | .11540 | .14522 |
| | | ( .067706) | ( .051184) | ( .054607) |
| 2.7489 | 2.2857 | .20361 | .17347 | .17636 |
| | | ( .085143) | ( .076941) | ( .066317) |
| 2.9452 | 2.1333 | .27239 | .23834 | .22569 |
| | | ( .11390) | ( .10571) | ( .084865) |
| 3.1416 | 2.0000 | .26200 | .25079 | .24431 |
| | | ( .15494) | ( .15731) | ( .12992) |

**BULGARIA**

Standardized spectral density functions of BULD, sample 1950 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .71347 | .81403 | 1.3510 |
| | | ( .42193) | ( .51060) | ( .71846) |
| .19635 | 32.0000 | 1.9326 | 1.9083 | 1.8617 |
| | | ( .80815) | ( .84640) | ( .70007) |
| .39270 | 16.0000 | 2.7604 | 2.7985 | 2.3818 |
| | | ( 1.1543) | ( 1.2412) | ( .89563) |
| .58905 | 10.6667 | 1.8528 | 2.0092 | 2.1079 |
| | | ( .77478) | ( .89113) | ( .79265) |
| .78540 | 8.0000 | 1.5905 | 1.6862 | 1.8178 |
| | | ( .66510) | ( .74789) | ( .68355) |
| .98175 | 6.4000 | 1.9413 | 1.9160 | 1.7086 |
| | | ( .81177) | ( .84982) | ( .64249) |
| 1.1781 | 5.3333 | 1.2404 | 1.2940 | 1.2704 |
| | | ( .51871) | ( .57393) | ( .47770) |
| 1.3744 | 4.5714 | .62471 | .60307 | .72887 |
| | | ( .26123) | ( .26748) | ( .27408) |
| 1.5708 | 4.0000 | .51060 | .41138 | .44926 |
| | | ( .21351) | ( .18246) | ( .16893) |
| 1.7671 | 3.5556 | .35424 | .32876 | .35953 |
| | | ( .14813) | ( .14582) | ( .13519) |
| 1.9635 | 3.2000 | .42828 | .35882 | .34285 |
| | | ( .17909) | ( .15915) | ( .12892) |
| 2.1598 | 2.9091 | .34378 | .31287 | .30831 |
| | | ( .14376) | ( .13877) | ( .11594) |
| 2.3562 | 2.6667 | .28796 | .23197 | .27279 |
| | | ( .12042) | ( .10289) | ( .10258) |
| 2.5525 | 2.4615 | .32413 | .30297 | .34090 |
| | | ( .13554) | ( .13437) | ( .12819) |
| 2.7489 | 2.2857 | .54547 | .52323 | .49227 |
| | | ( .22810) | ( .23207) | ( .18511) |
| 2.9452 | 2.1333 | .62648 | .61884 | .58409 |
| | | ( .26197) | ( .27448) | ( .21964) |
| 3.1416 | 2.0000 | .55921 | .57767 | .59470 |
| | | ( .33070) | ( .36234) | ( .31625) |

## A.5: Spectral density estimation of GDP p.c. time series subsequent to linear trend elimination (1913-2010)

**UK**

Standardized spectral density functions of RSUK13DT, sample 1913 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 12.3520 | 13.0632 | 10.8993 |
| | | ( 6.4433) | ( 7.2277) | ( 5.1126) |
| .15708 | 40.0000 | 7.9764 | 8.8453 | 8.3231 |
| | | ( 2.9422) | ( 3.4605) | ( 2.7607) |
| .31416 | 20.0000 | 2.6116 | 2.8308 | 3.8025 |
| | | ( .96331) | ( 1.1075) | ( 1.2612) |
| .47124 | 13.3333 | 1.1542 | .79524 | 1.2469 |
| | | ( .42574) | ( .31112) | ( .41357) |
| .62832 | 10.0000 | .60247 | .39209 | .46129 |
| | | ( .22222) | ( .15340) | ( .15301) |
| .78540 | 8.0000 | .34691 | .16987 | .21807 |
| | | ( .12796) | ( .066458) | ( .072332) |
| .94248 | 6.6667 | .19568 | .078909 | .11345 |
| | | ( .072177) | ( .030871) | ( .037631) |
| 1.0996 | 5.7143 | .15067 | .048772 | .063801 |
| | | ( .055574) | ( .019081) | ( .021162) |
| 1.2566 | 5.0000 | .11333 | .042482 | .043967 |
| | | ( .041801) | ( .016620) | ( .014583) |
| 1.4137 | 4.4444 | .094594 | .030876 | .034304 |
| | | ( .034892) | ( .012080) | ( .011378) |
| 1.5708 | 4.0000 | .072632 | .023804 | .027403 |
| | | ( .026791) | ( .0093128) | ( .0090894) |
| 1.7279 | 3.6364 | .066746 | .020281 | .023119 |
| | | ( .024619) | ( .0079345) | ( .0076684) |
| 1.8850 | 3.3333 | .059101 | .022582 | .022990 |
| | | ( .021800) | ( .0088347) | ( .0076254) |
| 2.0420 | 3.0769 | .061098 | .024644 | .024331 |
| | | ( .022536) | ( .0096413) | ( .0080701) |
| 2.1991 | 2.8571 | .052708 | .023217 | .024098 |
| | | ( .019442) | ( .0090832) | ( .0079929) |
| 2.3562 | 2.6667 | .053113 | .022620 | .023696 |
| | | ( .019591) | ( .0088495) | ( .0078598) |
| 2.5133 | 2.5000 | .050648 | .024918 | .024487 |
| | | ( .018682) | ( .0097488) | ( .0081220) |
| 2.6704 | 2.3529 | .052299 | .024998 | .024261 |
| | | ( .019291) | ( .0097801) | ( .0080469) |
| 2.8274 | 2.2222 | .045398 | .021305 | .021589 |
| | | ( .016745) | ( .0083353) | ( .0071608) |
| 2.9845 | 2.1053 | .043907 | .017452 | .018429 |
| | | ( .016195) | ( .0068279) | ( .0061126) |
| 3.1416 | 2.0000 | .040911 | .016583 | .017189 |
| | | ( .021341) | ( .0091749) | ( .0080630) |

**ITALLY**

Standardized spectral density functions of RSIT13DT, sample 1913 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 14.4017 | 15.1221 | 12.2284 |
| | | ( 7.5125) | ( 8.3668) | ( 5.7361) |
| .15708 | 40.0000 | 8.4168 | 9.4396 | 8.8958 |
| | | ( 3.1046) | ( 3.6931) | ( 2.9506) |
| .31416 | 20.0000 | 1.7124 | 1.9319 | 3.3628 |
| | | ( .63163) | ( .75582) | ( 1.1154) |
| .47124 | 13.3333 | .78733 | .25361 | .73505 |
| | | ( .29041) | ( .099221) | ( .24381) |
| .62832 | 10.0000 | .46431 | .25117 | .24064 |
| | | ( .17126) | ( .098265) | ( .079819) |
| .78540 | 8.0000 | .28399 | .10796 | .14986 |
| | | ( .10475) | ( .042238) | ( .049708) |
| .94248 | 6.6667 | .19567 | .082539 | .10669 |
| | | ( .072172) | ( .032292) | ( .035387) |
| 1.0996 | 5.7143 | .15854 | .064459 | .075009 |
| | | ( .058479) | ( .025218) | ( .024880) |
| 1.2566 | 5.0000 | .12642 | .056617 | .054649 |
| | | ( .046632) | ( .022150) | ( .018126) |
| 1.4137 | 4.4444 | .095004 | .036033 | .042222 |
| | | ( .035043) | ( .014097) | ( .014005) |
| 1.5708 | 4.0000 | .082544 | .032591 | .035671 |
| | | ( .030447) | ( .012750) | ( .011831) |
| 1.7279 | 3.6364 | .072891 | .029532 | .031305 |
| | | ( .026886) | ( .011554) | ( .010383) |
| 1.8850 | 3.3333 | .065492 | .028478 | .028121 |
| | | ( .024157) | ( .011141) | ( .0093274) |
| 2.0420 | 3.0769 | .060128 | .025327 | .025209 |
| | | ( .022179) | ( .0099089) | ( .0083617) |
| 2.1991 | 2.8571 | .050254 | .019454 | .020793 |
| | | ( .018536) | ( .0076110) | ( .0068967) |
| 2.3562 | 2.6667 | .045599 | .015815 | .017170 |
| | | ( .016819) | ( .0061872) | ( .0056950) |
| 2.5133 | 2.5000 | .043641 | .015981 | .015802 |
| | | ( .016097) | ( .0062523) | ( .0052415) |
| 2.6704 | 2.3529 | .041564 | .014939 | .015173 |
| | | ( .015331) | ( .0058445) | ( .0050325) |
| 2.8274 | 2.2222 | .039484 | .013862 | .014250 |
| | | ( .014564) | ( .0054231) | ( .0047266) |
| 2.9845 | 2.1053 | .038136 | .012727 | .013239 |
| | | ( .014067) | ( .0049794) | ( .0043911) |
| 3.1416 | 2.0000 | .037865 | .012720 | .012802 |
| | | ( .019752) | ( .0070380) | ( .0060052) |

**GREECE**

Standardized spectral density functions of RSGR13DT, sample 1913 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 12.8422 | 13.5955 | 11.2860 |
| | | ( 6.6990) | ( 7.5222) | ( 5.2940) |
| .15708 | 40.0000 | 8.1994 | 9.0913 | 8.5359 |
| | | ( 3.0244) | ( 3.5568) | ( 2.8313) |
| .31416 | 20.0000 | 2.4435 | 2.6693 | 3.7324 |
| | | ( .90129) | ( 1.0443) | ( 1.2380) |
| .47124 | 13.3333 | .99503 | .59364 | 1.0866 |
| | | ( .36702) | ( .23225) | ( .36043) |
| .62832 | 10.0000 | .52423 | .30066 | .36350 |
| | | ( .19337) | ( .11763) | ( .12057) |
| .78540 | 8.0000 | .33296 | .15686 | .19454 |
| | | ( .12281) | ( .061368) | ( .064528) |
| .94248 | 6.6667 | .22089 | .10379 | .12520 |
| | | ( .081477) | ( .040608) | ( .041528) |
| 1.0996 | 5.7143 | .15193 | .057369 | .073923 |
| | | ( .056039) | ( .022445) | ( .024519) |
| 1.2566 | 5.0000 | .11619 | .042658 | .046495 |
| | | ( .042859) | ( .016689) | ( .015422) |
| 1.4137 | 4.4444 | .093645 | .033345 | .037082 |
| | | ( .034541) | ( .013046) | ( .012300) |
| 1.5708 | 4.0000 | .081143 | .030282 | .031549 |
| | | ( .029930) | ( .011847) | ( .010465) |
| 1.7279 | 3.6364 | .065170 | .021641 | .023927 |
| | | ( .024038) | ( .0084666) | ( .0079364) |
| 1.8850 | 3.3333 | .055510 | .016709 | .017997 |
| | | ( .020475) | ( .0065370) | ( .0059692) |
| 2.0420 | 3.0769 | .050138 | .015144 | .015991 |
| | | ( .018494) | ( .0059246) | ( .0053039) |
| 2.1991 | 2.8571 | .046330 | .014607 | .015207 |
| | | ( .017089) | ( .0057146) | ( .0050440) |
| 2.3562 | 2.6667 | .042940 | .013646 | .014083 |
| | | ( .015838) | ( .0053388) | ( .0046710) |
| 2.5133 | 2.5000 | .040640 | .012868 | .012687 |
| | | ( .014990) | ( .0050343) | ( .0042081) |
| 2.6704 | 2.3529 | .037280 | .010826 | .010923 |
| | | ( .013751) | ( .0042356) | ( .0036230) |
| 2.8274 | 2.2222 | .034385 | .0081963 | .0087157 |
| | | ( .012683) | ( .0032066) | ( .0028909) |
| 2.9845 | 2.1053 | .031541 | .0062057 | .0069513 |
| | | ( .011634) | ( .0024279) | ( .0023057) |
| 3.1416 | 2.0000 | .032215 | .0062427 | .0063778 |
| | | ( .016804) | ( .0034540) | ( .0029917)) |

**GERMANY**

Standardized spectral density functions of RSGER13DT, sample 1913 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | 12.4641 | 13.1115 | 10.7966 |
| | | ( 6.5018) | ( 7.2544) | ( 5.0644) |
| .15708 | 40.0000 | 7.6988 | 8.5764 | 8.1074 |
| | | ( 2.8397) | ( 3.3553) | ( 2.6891) |
| .31416 | 20.0000 | 2.2433 | 2.4648 | 3.5505 |
| | | ( .82747) | ( .96429) | ( 1.1777) |
| .47124 | 13.3333 | 1.2048 | .79257 | 1.1770 |
| | | ( .44441) | ( .31008) | ( .39039) |
| .62832 | 10.0000 | .63231 | .46113 | .51072 |
| | | ( .23323) | ( .18041) | ( .16940) |
| .78540 | 8.0000 | .41106 | .24619 | .30083 |
| | | ( .15162) | ( .096318) | ( .099782) |
| .94248 | 6.6667 | .31341 | .19857 | .20846 |
| | | ( .11560) | ( .077688) | ( .069143) |
| 1.0996 | 5.7143 | .19464 | .10879 | .13079 |
| | | ( .071792) | ( .042561) | ( .043382) |
| 1.2566 | 5.0000 | .15212 | .077321 | .087226 |
| | | ( .056109) | ( .030250) | ( .028932) |
| 1.4137 | 4.4444 | .13267 | .075314 | .079147 |
| | | ( .048935) | ( .029465) | ( .026252) |
| 1.5708 | 4.0000 | .12831 | .078733 | .075840 |
| | | ( .047329) | ( .030803) | ( .025155) |
| 1.7279 | 3.6364 | .10218 | .060254 | .061513 |
| | | ( .037688) | ( .023573) | ( .020403) |
| 1.8850 | 3.3333 | .078980 | .041420 | .046775 |
| | | ( .029132) | ( .016205) | ( .015515) |
| 2.0420 | 3.0769 | .077114 | .042382 | .043650 |
| | | ( .028444) | ( .016581) | ( .014478) |
| 2.1991 | 2.8571 | .077110 | .045716 | .043579 |
| | | ( .028442) | ( .017886) | ( .014455) |
| 2.3562 | 2.6667 | .066213 | .037470 | .038245 |
| | | ( .024423) | ( .014659) | ( .012686) |
| 2.5133 | 2.5000 | .058361 | .030832 | .032991 |
| | | ( .021527) | ( .012062) | ( .010943) |
| 2.6704 | 2.3529 | .058667 | .032096 | .032341 |
| | | ( .021640) | ( .012557) | ( .010727) |
| 2.8274 | 2.2222 | .058773 | .033152 | .032097 |
| | | ( .021679) | ( .012970) | ( .010646) |
| 2.9845 | 2.1053 | .053864 | .028535 | .029117 |
| | | ( .019868) | ( .011164) | ( .0096577) |
| 3.1416 | 2.0000 | .050451 | .025243 | .027047 |
| | | ( .026317) | ( .013966) | ( .012687) |

## A.6: Spectral density estimation of GDP p.c. time series subsequent to Hodrick Prescott trend elimination (1913-2010)

**UK**

Standardized spectral density functions of UKD13, sample 1913 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .43335 | .066559 | .41000 |
| | | ( .22605) | ( .036826) | ( .19232) |
| .15708 | 40.0000 | .68901 | .68508 | 1.0474 |
| | | ( .25414) | ( .26802) | ( .34740) |
| .31416 | 20.0000 | 2.6586 | 2.7277 | 2.5547 |
| | | ( .98063) | ( 1.0672) | ( .84737) |
| .47124 | 13.3333 | 3.9085 | 4.1054 | 3.5994 |
| | | ( 1.4417) | ( 1.6062) | ( 1.1939) |
| .62832 | 10.0000 | 3.2068 | 3.5067 | 3.3802 |
| | | ( 1.1828) | ( 1.3719) | ( 1.1212) |
| .78540 | 8.0000 | 2.4239 | 2.5048 | 2.5651 |
| | | ( .89407) | ( .97997) | ( .85083) |
| .94248 | 6.6667 | 1.7300 | 1.7818 | 1.8441 |
| | | ( .63812) | ( .69708) | ( .61165) |
| 1.0996 | 5.7143 | 1.3534 | 1.3083 | 1.3310 |
| | | ( .49919) | ( .51183) | ( .44147) |
| 1.2566 | 5.0000 | .93018 | .91815 | .95020 |
| | | ( .34310) | ( .35921) | ( .31517) |
| 1.4137 | 4.4444 | .70692 | .63958 | .66574 |
| | | ( .26075) | ( .25022) | ( .22082) |
| 1.5708 | 4.0000 | .47861 | .44057 | .47797 |
| | | ( .17654) | ( .17236) | ( .15854) |
| 1.7279 | 3.6364 | .41579 | .37466 | .38595 |
| | | ( .15337) | ( .14658) | ( .12802) |
| 1.8850 | 3.3333 | .39236 | .34495 | .31946 |
| | | ( .14472) | ( .13496) | ( .10596) |
| 2.0420 | 3.0769 | .22790 | .20040 | .21561 |
| | | ( .084064) | ( .078403) | ( .071517) |
| 2.1991 | 2.8571 | .15741 | .11228 | .13161 |
| | | ( .058062) | ( .043927) | ( .043652) |
| 2.3562 | 2.6667 | .13153 | .094586 | .096138 |
| | | ( .048517) | ( .037005) | ( .031888) |
| 2.5133 | 2.5000 | .11376 | .075250 | .075709 |
| | | ( .041960) | ( .029440) | ( .025112) |
| 2.6704 | 2.3529 | .082725 | .054189 | .058043 |
| | | ( .030514) | ( .021200) | ( .019252) |
| 2.8274 | 2.2222 | .082881 | .045129 | .045356 |
| | | ( .030571) | ( .017656) | ( .015044) |
| 2.9845 | 2.1053 | .060398 | .032999 | .035648 |
| | | ( .022278) | ( .012910) | ( .011824) |
| 3.1416 | 2.0000 | .065606 | .028530 | .031426 |
| | | ( .034223) | ( .015785) | ( .014741) |

**ITALLY**

Standardized spectral density functions of ITD13, sample 1913 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .34744 | .057615 | .27019 |
| | | ( .18124) | ( .031877) | ( .12674) |
| .15708 | 40.0000 | .52137 | .42062 | .74289 |
| | | ( .19231) | ( .16456) | ( .24641) |
| .31416 | 20.0000 | 1.9260 | 2.0294 | 2.0599 |
| | | ( .71040) | ( .79395) | ( .68324) |
| .47124 | 13.3333 | 3.6271 | 3.7925 | 3.2809 |
| | | ( 1.3379) | ( 1.4837) | ( 1.0882) |
| .62832 | 10.0000 | 3.3273 | 3.5557 | 3.2370 |
| | | ( 1.2273) | ( 1.3911) | ( 1.0737) |
| .78540 | 8.0000 | 2.0045 | 2.1132 | 2.3210 |
| | | ( .73936) | ( .82673) | ( .76984) |
| .94248 | 6.6667 | 1.4935 | 1.5528 | 1.7550 |
| | | ( .55090) | ( .60751) | ( .58213) |
| 1.0996 | 5.7143 | 1.8442 | 1.8156 | 1.6439 |
| | | ( .68026) | ( .71030) | ( .54526) |
| 1.2566 | 5.0000 | 1.3701 | 1.3728 | 1.2906 |
| | | ( .50536) | ( .53710) | ( .42806) |
| 1.4137 | 4.4444 | .59303 | .60045 | .76081 |
| | | ( .21874) | ( .23491) | ( .25235) |
| 1.5708 | 4.0000 | .56645 | .46945 | .52230 |
| | | ( .20894) | ( .18366) | ( .17324) |
| 1.7279 | 3.6364 | .53688 | .51192 | .50113 |
| | | ( .19803) | ( .20028) | ( .16622) |
| 1.8850 | 3.3333 | .52612 | .50116 | .48103 |
| | | ( .19406) | ( .19607) | ( .15955) |
| 2.0420 | 3.0769 | .44237 | .41225 | .39075 |
| | | ( .16317) | ( .16128) | ( .12961) |
| 2.1991 | 2.8571 | .25302 | .22641 | .25154 |
| | | ( .093329) | ( .088579) | ( .083432) |
| 2.3562 | 2.6667 | .17983 | .13776 | .15476 |
| | | ( .066331) | ( .053895) | ( .051333) |
| 2.5133 | 2.5000 | .15435 | .11011 | .11332 |
| | | ( .056932) | ( .043079) | ( .037585) |
| 2.6704 | 2.3529 | .11823 | .087385 | .096028 |
| | | ( .043609) | ( .034188) | ( .031851) |
| 2.8274 | 2.2222 | .13372 | .094650 | .097577 |
| | | ( .049324) | ( .037030) | ( .032365) |
| 2.9845 | 2.1053 | .13246 | .10844 | .10788 |
| | | ( .048860) | ( .042423) | ( .035781) |
| 3.1416 | 2.0000 | .15156 | .11737 | .11325 |
| | | ( .079058) | ( .064941) | ( .053125) |

**GREECE**

Standardized spectral density functions of GRD13, sample 1913 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .47553 | .16060 | .58316 |
| | | ( .24805) | ( .088857) | ( .27355) |
| .15708 | 40.0000 | .91932 | .94725 | 1.2716 |
| | | ( .33910) | ( .37059) | ( .42179) |
| .31416 | 20.0000 | 2.9398 | 3.0230 | 2.7108 |
| | | ( 1.0843) | ( 1.1827) | ( .89915) |
| .47124 | 13.3333 | 3.7052 | 3.8753 | 3.4121 |
| | | ( 1.3667) | ( 1.5161) | ( 1.1318) |
| .62832 | 10.0000 | 2.6185 | 2.9207 | 2.9470 |
| | | ( .96584) | ( 1.1427) | ( .97748) |
| .78540 | 8.0000 | 2.1760 | 2.1736 | 2.1873 |
| | | ( .80263) | ( .85037) | ( .72549) |
| .94248 | 6.6667 | 1.4632 | 1.4863 | 1.5232 |
| | | ( .53969) | ( .58148) | ( .50522) |
| 1.0996 | 5.7143 | .97894 | .93833 | 1.0339 |
| | | ( .36109) | ( .36710) | ( .34295) |
| 1.2566 | 5.0000 | .82927 | .76759 | .80268 |
| | | ( .30588) | ( .30030) | ( .26624) |
| 1.4137 | 4.4444 | .72424 | .70514 | .71733 |
| | | ( .26714) | ( .27587) | ( .23793) |
| 1.5708 | 4.0000 | .71851 | .67902 | .65218 |
| | | ( .26503) | ( .26565) | ( .21632) |
| 1.7279 | 3.6364 | .55049 | .53663 | .53423 |
| | | ( .20305) | ( .20995) | ( .17720) |
| 1.8850 | 3.3333 | .41834 | .37980 | .39611 |
| | | ( .15431) | ( .14859) | ( .13139) |
| 2.0420 | 3.0769 | .31572 | .28183 | .29761 |
| | | ( .11646) | ( .11026) | ( .098714) |
| 2.1991 | 2.8571 | .27652 | .23847 | .24777 |
| | | ( .10200) | ( .093295) | ( .082181) |
| 2.3562 | 2.6667 | .25644 | .22637 | .22874 |
| | | ( .094591) | ( .088561) | ( .075869) |
| 2.5133 | 2.5000 | .24546 | .21928 | .21668 |
| | | ( .090541) | ( .085790) | ( .071869) |
| 2.6704 | 2.3529 | .22786 | .19941 | .19220 |
| | | ( .084046) | ( .078016) | ( .063751) |
| 2.8274 | 2.2222 | .17589 | .14705 | .15299 |
| | | ( .064878) | ( .057530) | ( .050746) |
| 2.9845 | 2.1053 | .14580 | .11612 | .12490 |
| | | ( .053777) | ( .045430) | ( .041428) |
| 3.1416 | 2.0000 | .15366 | .11705 | .11807 |
| | | ( .080154) | ( .064759) | ( .055385) |

**GERMANY**

Standardized spectral density functions of GERD13, sample 1913 to 2010
Estimated asymptotic standard errors in brackets

| Frequency | Period | Bartlett | Tukey | Parzen |
|---|---|---|---|---|
| 0.00 | *NONE* | .40161 | .026063 | .48244 |
| | | ( .20950) | ( .014420) | ( .22630) |
| .15708 | 40.0000 | .82835 | .86238 | 1.2705 |
| | | ( .30554) | ( .33739) | ( .42141) |
| .31416 | 20.0000 | 3.1917 | 3.3333 | 2.9645 |
| | | ( 1.1773) | ( 1.3041) | ( .98329) |
| .47124 | 13.3333 | 4.2368 | 4.3741 | 3.7283 |
| | | ( 1.5628) | ( 1.7113) | ( 1.2366) |
| .62832 | 10.0000 | 2.5096 | 2.8597 | 2.9927 |
| | | ( .92567) | ( 1.1188) | ( .99265) |
| .78540 | 8.0000 | 2.0001 | 1.9987 | 2.1235 |
| | | ( .73773) | ( .78196) | ( .70436) |
| .94248 | 6.6667 | 1.6723 | 1.6457 | 1.5855 |
| | | ( .61685) | ( .64384) | ( .52588) |
| 1.0996 | 5.7143 | 1.0124 | 1.0226 | 1.1023 |
| | | ( .37343) | ( .40008) | ( .36564) |
| 1.2566 | 5.0000 | .80932 | .72945 | .78083 |
| | | ( .29852) | ( .28538) | ( .25899) |
| 1.4137 | 4.4444 | .63286 | .60973 | .62824 |
| | | ( .23344) | ( .23854) | ( .20838) |
| 1.5708 | 4.0000 | .59852 | .54226 | .52736 |
| | | ( .22077) | ( .21215) | ( .17492) |
| 1.7279 | 3.6364 | .43366 | .40450 | .41591 |
| | | ( .15996) | ( .15825) | ( .13795) |
| 1.8850 | 3.3333 | .33812 | .30291 | .33147 |
| | | ( .12472) | ( .11851) | ( .10994) |
| 2.0420 | 3.0769 | .34490 | .30959 | .30211 |
| | | ( .12722) | ( .12112) | ( .10021) |
| 2.1991 | 2.8571 | .30452 | .27804 | .26786 |
| | | ( .11233) | ( .10878) | ( .088845) |
| 2.3562 | 2.6667 | .23290 | .20405 | .20640 |
| | | ( .085905) | ( .079831) | ( .068460) |
| 2.5133 | 2.5000 | .17046 | .13688 | .14694 |
| | | ( .062874) | ( .053550) | ( .048737) |
| 2.6704 | 2.3529 | .13763 | .10440 | .11380 |
| | | ( .050767) | ( .040845) | ( .037745) |
| 2.8274 | 2.2222 | .13745 | .10527 | .10709 |
| | | ( .050701) | ( .041185) | ( .035521) |
| 2.9845 | 2.1053 | .14045 | .10994 | .10887 |
| | | ( .051805) | ( .043011) | ( .036111) |
| 3.1416 | 2.0000 | .13442 | .10707 | .10914 |
| | | ( .070117) | ( .059242) | ( .051193) |

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