Dating the Portuguese business cycle

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Abstract
The aim of this article is to establish a reference business cycle chronology for Portugal over the last four decades. Drawing on a non-parametric approach embedding the NBER's business cycle dating procedure, a monthly business cycle chronology is provided and its robustness is assessed resorting to a large data set. (JEL: C23, C55, E32)

Introduction

The study of business cycles has been a key research area for a long time in economics. In this respect, one should mention that there are two types of business cycles in the economic literature: the classical business cycle and the growth cycle. Classical cycles refer to alternating periods of contraction and expansion whereas growth cycles refer to alternating periods of acceleration and slowdown of economic activity. In general, before the economy gets into a recession, there is a deceleration of activity and it usually accelerates before attaining an expansionary phase. Moreover, there might be decelerations that do not translate into recessions or accelerations that do not correspond to expansionary phases. Hence, the timing of the turning points does not necessarily coincide between the two kinds of cycles.

While the former concept relies on the level of economic activity, the latter draws on deviations from a long-run trend. From a practical point of view, the first is more tractable as the second one entails a decomposition in trend and cycle which are unobservable components. Thus, the analysis of growth cycles is conditional on the method chosen to de-trend macroeconomic time series.

Typically, the business cycle chronologies refer to the dating of classical cycles. The most notable and well-known case of dating peaks and troughs in economic activity is the National Bureau of Economic Research (NBER) for the United States.[1] At the time NBER was established in 1920 by Wesley Mitchell and colleagues, the study of business cycles was settled as one of the primary objectives. In this respect, one should mention the pioneer work

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1. For further details visit the NBER site at http://www.nber.org/cycles/main.html

"Measuring Business Cycles" written jointly with Arthur Burns in 1946 where a now widely accepted definition of business cycles was provided (p. 3):

> Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle; in duration, business cycles vary from more than one year to ten or twelve years; they are not divisible into shorter cycles of similar characteristics with amplitudes approximating their own.

The NBER started publishing its first business cycle dates in 1929 and since 1978 a business cycle dating committee chaired by Robert Hall determines the business cycle turning points. More recently, following NBER's approach, the Economic Cycle Research Institute (ECRI) and the Centre for Economic Policy Research (CEPR) also determine business cycle turning points for twenty other countries[2] and the euro area, respectively.[3]

Naturally, the establishment of a business cycle chronology is certainly a complex task. The NBER business cycle dating committee mentions that:

> The chronology comprises alternating dates of peaks and troughs in economic activity. A recession is a period between a peak and a trough, and an expansion is a period between a trough and a peak. During a recession, a significant decline in economic activity spreads across the economy and can last from a few months to more than a year. Similarly, during an expansion, economic activity rises substantially, spreads across the economy, and usually lasts for several years.

As it is clear from above, the definitions of recession and expansion used by the NBER are vague and involve judgment. In 1971, Gerhard Bry and Charlotte Boschan introduced a non-parametric algorithm at the NBER that comes closest to translating the NBER's definition into practice. Basically, the algorithm relies on a set of filters and rules to spot local minima and maxima in the level (or log-level) of the series. A local minimum is a trough and the following local maximum a peak so that the period between trough and peak is an expansion, and from peak to trough a recession. The algorithm assumes that a full business cycle (peak to peak or trough to trough) should last at least fifteen months, each business cycle phase (peak to trough or trough to peak) should last at least five months and peaks and troughs should alternate.

As stressed, for example, by Watson (1994), the algorithm developed by Bry and Boschan (1971) is able to replicate quite well the turning points selected by experts. The Bry-Boschan algorithm has been applied by King

2. Canada, Mexico, Brazil, Germany, France, United Kingdom, Italy, Spain, Switzerland, Sweden, Austria, Russia, Japan, China, India, Korea, Australia, Taiwan, New Zealand and South Africa.

3. For further details visit the ECRI site at https://www.businesscycle.com/ecri-business-cycles/international-business-cycle-dates-chronologies and CEPR site at http://cepr.org/content/euro-area-business-cycle-dating-committee

and Plosser (1994), Watson (1994), Artis and Osborn (1997), Mönch and Uhlig (2005), Stock and Watson (2010, 2014), among many others.

The aim of this article is to establish a reference business cycle chronology for Portugal over the last forty years. We start by applying the Bry-Boschan algorithm to quarterly real GDP. For comparison purposes, we also report the resulting business cycle chronology using the popular rule-of-thumb of at least two consecutive quarters of decline in economic activity to define a recession. Bearing in mind the caveats of relying solely on a single series while aiming at establishing a monthly chronology, we then resort to the coincident indicator for the Portuguese economy (see Rua (2004)). The monthly coincident indicator is a composite indicator representative of a wide spectra of economic activity which is regularly released by Banco de Portugal. Drawing on the coincident indicator, a monthly reference business cycle chronology is established. Finally, we resort to a large monthly dataset for the Portuguese economy to assess the robustness of the previously obtained monthly chronology following Stock and Watson (2010, 2014).

Dating with quarterly GDP

As it is widely recognized, GDP is a natural proxy for measuring aggregate economic activity. Actually, Burns and Mitchell (1946, p. 72) state that:

> Aggregate [economic] activity can be given a definite meaning and made conceptually measurable by identifying it with gross national product

Hence, we firstly rely on real GDP to obtain a quarterly business cycle chronology. In particular, we apply the Bry-Boschan algorithm (BB hereafter) to the log-level of real GDP. However, since GDP is available only on a quarterly basis, the original BB algorithm cannot be applied as it was developed for monthly series. Hence, we resort to the modified BB algorithm proposed by Harding and Pagan (2002) which shares the same features of the original BB algorithm but adapted to the quarterly frequency (the so-called BBQ).

In the case of Portugal, due to data availability constraints, the time period under analysis ranges from the beginning of 1977 up to the end of 2015. In particular, as quarterly real GDP is currently released by INE only for the period since the first quarter of 1995, we use the historical series regularly updated and disclosed by Banco de Portugal which start in the first quarter of 1977 on a seasonally adjusted basis. One should mention that such series coincide with the quarterly GDP series released by INE since 1995.

The resulting quarterly business cycle chronology is presented in Table 1 and the log-level of Portuguese quarterly real GDP is displayed in Figure 1 along the recessionary periods denoted by the shaded areas.

Business cycle dates		Duration (in quarters)			
Peak	**Trough**	**Contraction**	**Expansion**	**Cycle**	
		Peak to trough	Previous trough to this peak	Trough from Previous Trough	Peak from Previous Peak
1980 Q2	1980 Q4	2	-	-	-
1983 Q1	1984 Q1	4	9	13	11
1992 Q2	1993 Q2	4	33	37	37
2002 Q1	2003 Q2	5	35	40	39
2008 Q1	2009 Q1	4	19	23	24
2010 Q3	2012 Q4	9	6	15	10
Average		*5*	*20*	*26*	*24*

TABLE 1. Business cycle chronology based on the quarterly real GDP

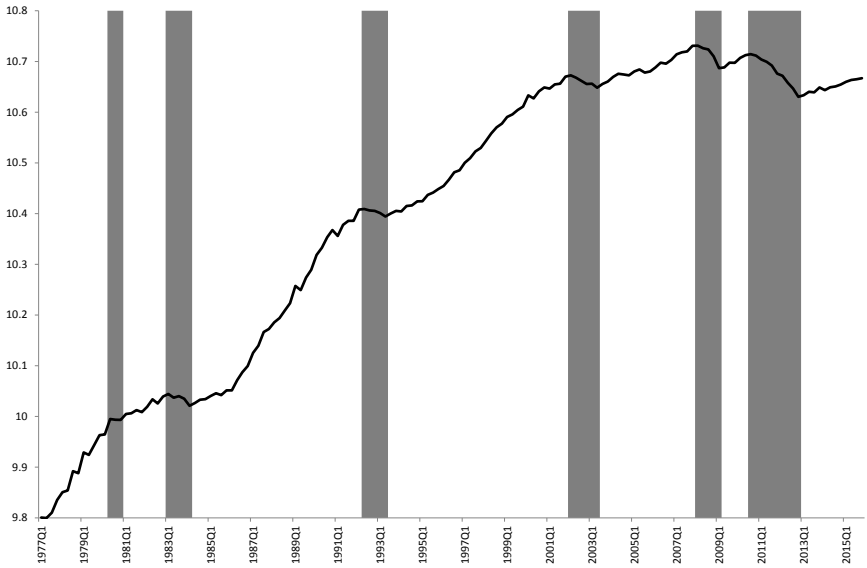

FIGURE 1: Log-level of Portuguese quarterly real GDP

The BBQ algorithm determines six peaks and six troughs since 1977. In particular, six recessionary periods are identified with the shortest recession lasting only two quarters in 1980 whereas the latest recession has been the longest one spanning through nine quarters. A stylized business cycle feature, also present in the Portuguese case, is the asymmetry between expansions and contractions. The average duration of recessions is five quarters whereas the average length of expansions is 20 quarters. This corresponds to an average duration of the Portuguese business cycle of 25 quarters.

An informal and commonly used rule-of-thumb for dating the business cycle, identifies recessions as periods recording at least two consecutive quarters of negative real GDP growth, as suggested by Julius Shiskin in an 1979 New York Times article. In Table 2, we report the peaks and troughs one would obtain by considering the above-mentioned rule-of-thumb. One can see that in most cases the peaks and troughs coincide. However this is not always the case. In particular, the peak in 1983 is dated differently, the trough in the early 2000's recession is not the same and the rule-of-thumb identifies one extra recessionary period than the BBQ algorithm in 2004.

Turning point	BBQ	Rule-of-thumb
P	1980 Q2	1980 Q2
T	1980 Q4	1980 Q4
P	1983 Q1	1983 Q3
T	1984 Q1	1984 Q1
P	1992 Q2	1992 Q2
T	1993 Q2	1993 Q2
P	2002 Q1	2002 Q1
T	2003 Q2	2002 Q4
P	-	2004 Q2
T	-	2004 Q4
P	2008 Q1	2008 Q1
T	2009 Q1	2009 Q1
P	2010 Q3	2010 Q3
T	2012 Q4	2012 Q4

TABLE 2. Turning points with BBQ algorithm and rule-of-thumb

Note: P and T denote Peak and Trough, respectively.

In this respect, the NBER business cycle dating committee states that most of the recessions in the United States do consist of two or more quarters of declining real GDP, but not all of them, and that the committee's procedure for identifying turning points differs from the two-quarter rule in a number of ways. For instance, the depth of the decline in economic activity is considered. In the Portuguese case, the recessionary period identified by the rule-of-thumb in 2004 corresponds to an accumulated decrease over that period of only 0.3 per cent which was not classified by the BBQ algorithm as a recession. Hence, notwithstanding the similitude of dates reported in Table 2, one should

be cautious when relying solely on the rule-of-thumb of two consecutive quarters of negative real GDP growth.

Dating with the monthly coincident indicator

Although real GDP can be a useful proxy for measuring aggregate economic activity, it suffers from several shortcomings. For instance, GDP is available only at a quarterly frequency and may suffer from measurement errors. In this respect, Burns and Mitchell (1946, p. 73) qualified the previously quoted sentence by referring that:

> Unfortunately, no satisfactory series of any of these types is available by months or quarters for periods approximating those we seek to cover.

Moreover, the U.S. Department of Commerce (1984, p. 65) acknowledges that:

> Aggregate economic activity cannot be defined precisely, and no single time series measures it adequately; however, a variety of statistical series measure some of its major aspects.

In fact, one the features of the NBER committee's procedure is not to rely solely on real GDP but using a range of other indicators as well. Furthermore, a considerable emphasis is put on monthly indicators in order to attain a monthly chronology.

A possible approach is to consider a monthly composite coincident index for the whole economy. In this respect, one should mention the pioneering work of Stock and Watson (1989, 1991, 1993) who considered a factor model in order to extract a common factor summarizing the co-movements from a small number of indicators. Such a composite indicator is aimed at capturing the overall state of the economy and can be used to date the business cycle. This is the so-called average-then-date approach for dating the business cycle.

In the Portuguese case, a monthly coincident indicator for economic activity is disclosed by Banco de Portugal every month since June 2004. This composite indicator has been proposed by Rua (2004) drawing on the methodology of Azevedo *et al.* (2006).[4] In particular, from a starting set of hundreds of series a subset of variables have been chosen according to several criteria namely availability on a monthly frequency, timeliness, a reasonable time span, a noteworthy co-movement with the economic cycle and with the aim of obtaining a broadly based activity measure. Hence, besides real quarterly GDP, the set of information of the coincident indicator includes retail sales volume which intends to capture private consumption developments. Regarding investment, it considers the sales of heavy commercial vehicles

4. See Rua (2015) for a historical assessment of the performance of the coincident indicator in tracking Portuguese economic developments.

reflecting Gross Fixed Capital Formation (GFCF) in transportation equipment as well as cement sales which portray GFCF in the construction sector. From the supply side, the manufacturing production index captures the industrial sector behavior which is typically a strongly cyclical sector. In order to take on board the evolution of income and wealth, it includes the households' assessment of their current financial situation. Concerning the labor market, new job vacancies are considered. Finally, to reflect external environment, it includes a weighted average of the current economic situation assessment of the Portuguese main trade partners, where the weights are each country's share in Portuguese exports. The trend-cycle underlying the coincident indicator is available on a monthly frequency since January 1977.[5]

As the monthly coincident indicator for the Portuguese economic activity is a composite indicator that merges information both from real GDP as well as from other relevant economic variables and being available at a monthly frequency, it seems particularly suitable for dating the business cycle.

Hence, we now determine the peaks and troughs of the coincident indicator, in its trend-cycle format, through the use of the monthly BB algorithm. The monthly business cycle chronology in presented in Table 3 and the log-level of the trend-cycle underlying the coincident indicator along with the identified recessions is displayed in Figure 2.

Business cycle dates		Duration (in months)			
Peak	**Trough**	**Contraction**	**Expansion**	**Cycle**	
		Peak to trough	Previous trough to this peak	Trough from Previous Trough	Peak from Previous Peak
March 1983 (Q1)	February 1984 (Q1)	11	-	-	-
July 1992 (Q3)	June 1993 (Q2)	11	101	112	112
April 2002 (Q2)	February 2003 (Q1)	10	106	116	117
November 2007 (Q4)	April 2009 (Q2)	18	56	74	66
September 2010 (Q3)	April 2013 (Q2)	31	17	48	35
Average		*16*	*70*	*88*	*83*

TABLE 3. Business cycle chronology based on the monthly coincident indicator

Note: The corresponding quarterly dates are presented in parentheses.

5. Note that, although the coincident indicator is released as the year-on-year change of the estimated trend-cycle, herein we naturally consider the log-level of the trend-cycle for the purpose of dating classical business cycles.

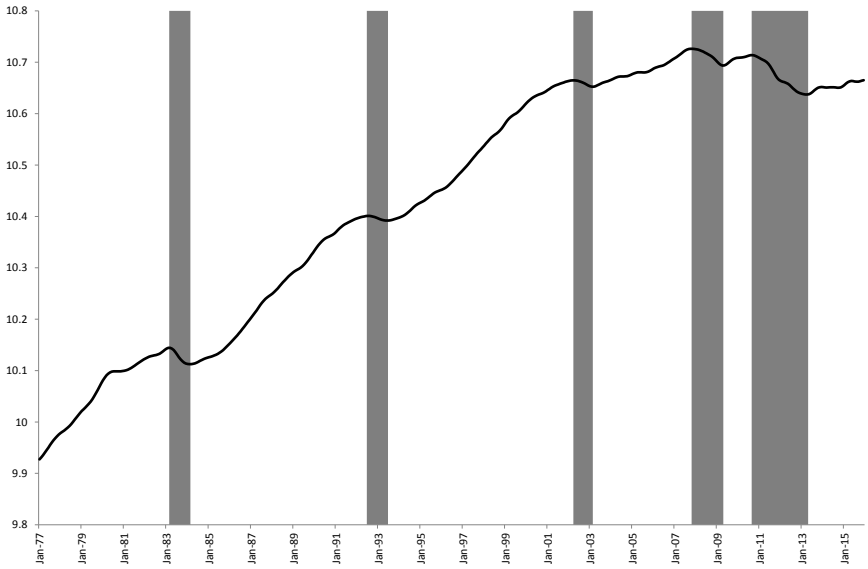

FIGURE 2: The trend-cycle underlying the monthly coincident indicator

According to this resulting monthly business cycle chronology, five recessions occurred over the last four decades. The first three lasted around 11 months, the one recorded at the time of the so-called US Great Recession lasted 18 months whereas the most recent one was by far the longest one (31 months). The business cycle asymmetry, in terms of duration, is once again present with the average recession lasting 16 months in contrast with the average length of expansions of 70 months. This corresponds roughly to an average duration of the business cycle of 86 months. However, one should bear in mind the noteworthy heterogeneity across business cycles.

When comparing with the previously discussed quarterly dating, one should note that in the monthly business cycle chronology only five recessions show up in contrast with the six recessionary periods identified with quarterly real GDP. The difference lies in the period from the second quarter of 1980 up to the fourth quarter of 1980 which is identified as a recession when drawing solely on real GDP but not when resorting to the monthly coincident indicator. In fact, the decrease in real GDP over such a short-lived period is quite marginal (-0.2 per cent). Regarding the other recessions, the monthly dating is relatively close to the quarterly one, in the sense that the month of the peak or trough typically falls within or in the adjacent quarter previously

identified with real GDP. A notable exception concerns the end of the last recession, which is determined to be in April 2013 instead of the last quarter of 2012.

Dating with a large dataset

We now turn to the use of a wide range of time series to date the business cycle. The underlying idea is to first determine the turning points individually in a large number of series and then obtain a common set of turning points. This corresponds to the date-then-average approach.

Following Stock and Watson (2010, 2014), let us consider a panel of N time series. For each time series one can determine a specific chronology, resorting to the BB algorithm, and denote τ_{is} as the turning point for series i in episode s, $i = 1, \ldots, N$, $s = 1, \ldots, S$.[6] Once the individual chronology has been established for all the N series, one can consider the following model

$$\tau_{is} = D_s + k_i + \eta_{is}$$

where D_s is the reference cycle turning point date in episode s, k_i is the mean lag of series i relative to the reference cycle, and η_{is} is a discrepancy. This model can be estimated by fixed effects panel data regression with an unbalanced panel and missing observations. In particular, one obtains estimates for the reference cycle turning point dates, D_s, as well as the corresponding standard errors.

For the empirical application of this method, we resort to the large monthly data set considered by Dias *et al.* (2015, 2016) for the Portuguese economy which comprises 126 series. It includes both hard and soft data covering business and consumers surveys (43 series), retail sales (4 series), industrial production (7 series), turnover in industries and services (20 series), employment, hours worked and wage indices in industries and services (24 series), tourism nights spent in Portugal (3 series), car sales (3 series), cement sales, vacancies and registered unemployment (5 series), energy consumption (3 series), nominal exports and imports of goods (10 series), real effective exchange rate, Portuguese stock market index and ATM/POS series.

However, Dias *et al.* (2015, 2016) considered data only since 1995. Since the aim is to cover the last forty years, longer series have been collected for most of the variables. In particular, for business and consumer surveys, which account for a large fraction of the data set, the series go back to the second half of the 80's (only the services survey starts in the late 90's). For several variables it was

6. An episode denotes a non-overlapping period which contains a single turning point of unknown date. Note that if series i has no turning point or is unavailable in episode s then τ_{is} is treated as missing data.

possible to collect data since 1977 namely industrial production, vacancies, tourism nights spent in Portugal and gasoline consumption. Other series such as car sales and cement sales begin in the early 80's whereas turnover in industries and external trade data start around 1990. Most of the remaining series are available from mid-90's onwards.[7] All series are seasonally adjusted and considered in levels (or log-levels).

Turning point		Deviation in months	
P	March 1983	2	(1.2)
T	February 1984	3	(1.4)
P	July 1992	0	(1.0)
T	June 1993	2	(1.0)
P	April 2002	1	(1.0)
T	February 2003	4	(0.9)
P	November 2007	3	(0.9)
T	April 2009	2	(0.9)
P	September 2010	3	(1.0)
T	April 2013	0	(0.9)

TABLE 4. Turning points based on a large data set (in deviations from the monthly chronology)

Note: The figures are rounded and the corresponding standard errors are presented in parentheses.

In table 4, we report the estimated turning points using the above panel data model as deviations from the monthly business cycle reference chronology discussed earlier along with the corresponding standard errors.[8] It is reassuring that the dates largely line up with the previously presented monthly business cycle reference chronology. In fact, the two chronologies are within a few months of each other and, in most cases, are not statistically different at a standard significance level. Even regarding the trough of the last recession identified as April 2013, which as mentioned earlier differs more markedly from the dating drawing solely on real GDP, the estimated turning point date coincides when a large data set is considered for the Portuguese economy. Hence, the above results reinforce the robustness of the business cycle chronology provided in Table 3.

7. In the Appendix, we report the full list of series along with the corresponding starting date for each series.

8. In the estimation of the panel data model, we considered as an episode the period centered at the month of the turning point identified in the previous section with a window size of 12 months.

Conclusions

In this article, it is proposed a business cycle reference chronology for the Portuguese economy. In particular, one draws on a non-parametric approach that mimics the expert system developed at the NBER for the identification of business cycle turning points. Firstly, one assesses the business cycle chronology based solely on quarterly real GDP. Then, embedding the NBER dating committee spirit, one acknowledges the caveats that may derive from relying on a single series and aim at providing a monthly business cycle reference chronology. In particular, it is considered the monthly coincident indicator for the Portuguese economy which has been regularly released by Banco de Portugal. A monthly business cycle reference chronology is established and its soundness is assessed resorting to a large monthly data set for Portugal.

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Appendix

Series	Starting date
Economic Sentiment Indicator	January 1987
Consumer Confidence Indicator	June 1986
Financial situation over last 12 months	June 1986
Financial situation over next 12 months	June 1986
General economic situation over last 12 months	June 1986
General economic situation over next 12 months	June 1986
Major purchases at present	June 1986
Major purchases over next 12 months	June 1986
Unemployment expectations over next 12 months	June 1986
Savings at present	June 1986
Savings over next 12 months	June 1986
Price trends over last 12 months	June 1986
Price trends over next 12 months	June 1986
Statement on financial situation of household	June 1986
Construction Confidence Indicator	January 1989
Building activity development over the past 3 months	January 1989
Assessment of order books	January 1989
Employment expectations over the next 3 months	January 1989
Prices expectations over the next 3 months	January 1989
Industrial Confidence Indicator	January 1987
Production trend observed in recent months	January 1987
Assessment of order-book levels	January 1987
Assessment of export order-book levels	January 1987
Assessment of stocks of finished products	January 1987
Production expectations for the months ahead	January 1987
Selling price expectations for the months ahead	January 1987
Employment expectations for the months ahead	January 1987
Retail trade Confidence Indicator	January 1989
Business activity over recent months	January 1989
Assessment of stocks	January 1989
Expected business activity	January 1989
Orders placed with suppliers	January 1989
Employment expectations	January 1989
Services confidence indicator	June 1997
Business situation development over the past 3 months	June 1997
Evolution of the demand over the past 3 months	June 1997
Expectation of the demand over the next 3 months	June 1997
Evolution of the employment over the past 3 months	June 1997
Expectations of the employment over the next 3 months	June 1997
Economic Sentiment Indicator - Germany	January 1985
Economic Sentiment Indicator - Spain	April 1987
Economic Sentiment Indicator - France	February 1985
Economic Sentiment Indicator - UK	January 1985

Series (continued)	Starting date
Industrial Production Index - Total	January 1977
Industrial Production Index - Manufacturing	January 1977
Industrial Production Index - Consumer goods	January 1980
Industrial Production Index - Consumer non-durable goods	January 1995
Industrial Production Index - Consumer durable goods	January 1995
Industrial Production Index - Investment goods	January 1980
Industrial Production Index - Intermediate goods	January 1980
Industrial turnover index - Total	January 1990
Industrial turnover index - Manufacturing	January 1990
Industrial turnover index - Consumer goods	January 1990
Industrial turnover index - Consumer durable goods	January 1990
Industrial turnover index - Consumer non-durable goods	January 1990
Industrial turnover index - Intermediate goods	January 1990
Industrial turnover index - Investment goods	January 1990
Industrial turnover index - Total - Domestic Market (DM)	January 1995
Industrial turnover index - Consumer goods - DM	January 1995
Industrial turnover index - Consumer durable goods - DM	January 1995
Industrial turnover index - Consumer non-durable goods - DM	January 1995
Industrial turnover index - Intermediate goods - DM	January 1995
Industrial turnover index - Investment goods - DM	January 1995
Industrial turnover index - Total - External Market (EM)	January 1995
Industrial turnover index - Consumer goods - EM	January 1995
Industrial turnover index - Consumer durable goods - EM	January 1995
Industrial turnover index - Consumer non-durable goods - EM	January 1995
Industrial turnover index - Intermediate goods - EM	January 1995
Industrial turnover index - Investment goods - EM	January 1995
Services turnover index - Total	January 2000
Vacancies	January 1977
Unemployment	December 1977
New applications for employment by the unemployed	January 1979
New job vacancies	January 1979
New occupied jobs	December 1977
Industrial employment index - Total	January 1990
Industrial employment index - Manufacturing	January 1990
Industrial employment index - Consumer goods	January 1990
Industrial employment index - Consumer durable goods	January 1990
Industrial employment index - Consumer non-durable goods	January 1990
Industrial employment index - Intermediate goods	January 1990
Industrial employment index - Investment goods	January 1990
Industrial wages index - Total	January 1995
Industrial wages index - Manufacturing	January 1995
Industrial wages index - Consumer goods	January 1995
Industrial wages index - Consumer durable goods	January 1995

Series (continued)	Starting date
Industrial wages index - Consumer non-durable goods	January 1995
Industrial wages index - Intermediate goods	January 1995
Industrial wages index - Investment goods	January 1995
Hours worked index - Total industry	January 1995
Hours worked index - Manufacturing	January 1995
Hours worked index - Consumer goods	January 1995
Hours worked index - Consumer durable goods	January 1995
Hours worked index - Consumer non-durable goods	January 1995
Hours worked index - Intermediate goods	January 1995
Hours worked index - Investment goods	January 1995
Services employment index - Total	January 2000
Services wages index - Total	January 2000
Hours worked index - Total services	January 2000
Merchandise imports - Total	January 1988
Merchandise imports - Total excluding fuels	January 1990
Merchandise imports - Consumer goods	January 1990
Merchandise imports - Intermediate goods	January 1990
Merchandise imports - Investment goods	January 1990
Merchandise exports	January 1988
Merchandise exports - Total excluding fuels	January 1990
Merchandise exports - Consumer goods	January 1990
Merchandise exports - Intermediate goods	January 1990
Merchandise exports - Investment goods	January 1990
Retail trade turnover index - Total	January 1995
Retail trade turnover index - Food	January 1995
Retail trade turnover index- Non-Durable Non-Food	January 1995
Retail trade turnover index - Durable goods	January 1995
Tourism - Number of nights spent in Portugal	January 1977
Tourism - Number of nights spent in Portugal by residents	January 1977
Tourism - Number of nights spent in Portugal by non-residents	January 1977
Light passenger vehicle sales	January 1982
Light commercial vehicle sales	January 1982
Heavy commercial vehicle sales	January 1982
Cement sales	January 1982
Consumption of electricity	January 1987
Consumption of gasoline	January 1977
Consumption of diesel	January 1987
Real effective exchange rate index	January 1993
PSI-20	January 1988
ATM/POS	September 2000