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Article

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Macroeconomics and the Construction Sector: Evidence from Portugal

By Leonida Correia[*] & Maria João Ribeiro[±]

Construction activity is considered one of the primary indicators of a country's global economic evolution. This article aims to study the cyclical fluctuations of construction production and its relationship with the aggregate business cycles in Portugal over the last six decades. We started by analysing the evolution of an indicator set inherent to the functioning of the construction sector. Then, we extracted the construction output cycles and examined their association with the Portuguese business cycles since the 1960s, focusing on crisis periods. The results demonstrate that the construction sector contributes significantly to the Portuguese economy and the cyclical construction activity fluctuations correlate strongly with the aggregate fluctuations, albeit with greater instability. Finally, we discuss the current problems the construction sector faces and the COVID-19 pandemic effects.

Keywords: *construction sector, business cycles, volatility, synchronisation, crisis*

Introduction

The construction sector mobilises significant material and human resources, making it a human activity with substantial economic and social importance. In many countries, construction output is considered a primary indicator of global economic activity evolution, usually accounting for 5-10% of the overall gross domestic product (GDP) (Park et al. 2012). According to the European Construction Sector Observatory (ECSO), the broad construction sector has a vital role in the European Union (EU) economy, representing approximately 9% of the GDP, 18 million direct jobs and 3 million enterprises[1].

The construction industry is also a vital component of national output in Portugal. This sector provides the private and public infrastructures with the products needed for various activities and services, such as trade and other industries (Baganha et al. 2002). It is a sector with specificities that distinguish it from other sectors, including an extensive value chain and vast network of inputs. Consequently, the construction industry provides positive externalities to other activities and generates significant multiplier effects (Nunes 2001).

Construction output is an integral part of national output, and it is possible that, in most cases, a shock in construction output will eventually affect the

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[1]https://ec.europa.eu/growth/sectors/construction/observatory/objectives_en. Accessed 10 May 2021.

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aggregate economy (Tse and Ganesan 1997). On the other hand, it is well accepted that construction activity is procyclical but more volatile than the aggregate economy, experiencing more pronounced expansions in growth phases and deeper recessions during periods of crisis (Baganha et al. 2002, Dell'Ariccia et al. 2020). The procyclicality and pronounced volatility of construction output imply that crises could negatively influence this sector. This effect was apparent in the Portuguese construction market during the last global financial crisis, which spread to the EU after 2008.

Notwithstanding the interest of this issue, few empirical studies have investigated the cyclical associations between the construction sector and the aggregate economy. Specifically, to the authors' knowledge, no published empirical study has explicitly discussed the cyclicality of the Portuguese construction sector. In this sense, the main objective of this study is to analyse the cyclical fluctuations of construction production and evaluate their degree of association with the aggregate business cycles in Portugal over the last six decades.

To achieve this goal, after reviewing the relevant literature, we employed a set of indicators inherent to construction activity that allowed us to make a succinct characterisation of the construction industry and visualise the sector's evolution. We then used statistical methods to extract the cycles and calculate the standard deviations to measure the cyclical volatility and correlation coefficients to investigate the contemporaneous and lead-lag associations between the cycles of construction output and aggregate output business cycles, paying particular attention to the periods of economic crisis. After analysing the volatility and correlation results, we expose some concluding remarks, including a discussion about the construction sector' problems, emphasising the effects of the current COVID-19 pandemic.

Literature Review

The construction sector accounts for a significant proportion of most countries' GDP. It includes a combination of diverse types of activities and creates the facilities needed for the production and trade of several sectors. Given its close inter-linkages with other sectors, it is well recognised that the construction industry has a relevant impact on the output and employment of the entire economy.

The relationship between construction output and economic growth has received significant attention from researchers. The majority of the studies reported a positive association between GDP growth and various construction output measures (Hosein and Lewis 2005, Sun et al. 2013). Since the construction industry involves the supply of capital infrastructure, a critical factor for long term growth, it can positively impact economic growth. It also generates substantial employment opportunities, creating further investment in other sectors of the economy through a multiplier effect. Since construction is labour-intensive, large segments of the nation's work force are active when the sector is favourable. On the contrary, given the association mentioned above, weakened construction activity would negatively impact economic activity and employment. Thus, construction is often considered a barometer of economic conditions (Sun et al.

2013), but it does not necessarily mean that it drives economic growth. Some authors (Yiu et al. 2004, Lopes et al. 2011) reported the contrary, this is, that construction activity follows economic growth.

Construction activity is also considered one of the primary sources of development and modernisation processes. The complexities of the relationship between a country's level of construction activity and its state of development have been the subject of investigation over the years (Ruddock and Lopes 2006). Given the enormous backward and forward linkages with the economy, it has been concluded that there is a close correlation between the state of development of the construction sector and the social and economic development of a country (Luchko et al. 2020). Moreover, it is agreed that construction activity should be regarded as a significant component of investment programmes, particularly for developing economies where per capita incomes are low.

The relationship between construction, economic growth and development can be analysed in the context of the role of investment in economic growth[2]. As Papanikos (1988) stated for Greece, this relationship is not necessarily regarded as positive in the literature. In theory, we can have two diametrical explanations for the role of investment in construction, with significant implications for the design of government investment policies. For example, on the one hand, investment in construction may restrict the funds available for other more productive investments, such as machinery and equipment, not promoting economic growth and development (Petras 1984). On the other hand, investment in construction may increase other types of investment, including investment in industry, promoting economic growth and industrial development (Skouras 1985). By using the investment data of Greece for the postwar period, Papanikos tested both assertions empirically and found evidence in favour of Skouras's argument, that is, the investment in construction does not decrease the funds available for other types of investment, such as for industry, and that has played a significant role in Greece's economic development.

Whereas the evidence for the relationship between economic growth and development is substantial, literature exploring the cyclical development of the construction sector is scarce. This observation is not surprising if we consider that the concept of business cycles is a relatively modern phenomenon. Specifically, for the construction sector the best-known cycle was identified in 1930 by Simon Kuznets. The Kuznets cycle, a long swing of economic activity lasting 15-20 years, is attributed to housing and building construction investment. Over time, some authors have examined if the economic evolution of countries is well described by Kuznets' construction cycle. For example, Fenoaltea (1988) found that construction in Italy displayed clear cyclical movements, following the characteristic Kuznets cycle.

Other authors showed that most of the cyclical patterns in construction are similar to the business-cycle characteristics of investment in the macro-economic

[2]As demonstrated since Solow (1956), the economic growth results from the increase of capital and labour inputs, and technological progress as measured by total factor productivity (TFP). There have been quite numerous studies on TFP of construction industry, but it goes beyond the scope of this study.

literature. Stock and Watson (1998) performed a comprehensive study of numerous post-war US time series and found that investment in structure, especially residential structure, is highly volatile and procyclical. The same authors also demonstrated that employment in construction is more than twice as volatile as the cyclical component of real GDP. Sun et al. (2013) also found that construction is highly procyclical using a dataset for 23 advanced economies (including Portugal) and 25 emerging economies from 1990-2011. The authors based this analysis on the construction share dynamics, or in other words, the added value of the construction industry as a share of the GDP.

It is also agreed that a significant reason for the procyclical nature of construction activity is its sensitivity to credit conditions. This result is not unexpected since construction activity is a type of investment and, as demonstrated by literature, is typically driven by factors such as general economic conditions, stock market performance, and credit conditions (Sun et al. 2013). Dell'Ariccia et al. (2020), using industry-level data on output and employment for 55 countries between 1970 and 2014, investigated which industries benefit and suffer during credit booms. They reported that sectors that are less tradable, more labour-intensive, and more dependent on external finance are more sensitive to the credit cycle. In particular, construction and finance (a distant second) were identified as the sectors that benefited the most during booms and experienced a more severe slowdown during busts. The authors confirmed the procyclicality of the construction sector and highlighted that it is the industry that displays most robust acceleration/deceleration in both value-added and employment growth during booms/busts. Moreover, they demonstrated that construction is the only sector consistently displaying significant asymmetry between good and bad booms.

Given such characteristics (e.g., procyclicality and significant construction activity volatility), it is expected that economic recessions will have adverse effects on this sector worldwide. This proposal was apparent in the Portuguese construction sector during the last global financial crisis, which spread to the EU after 2008, strongly impacting the Portuguese economy. Besides the 2008 Great Recession, Portugal has experienced a sovereign debt crisis since 2011 that required subsequent fiscal consolidation measures in the form of Economic and Financial Assistance Programmes provided by the International Monetary Fund, European Commission and European Central Bank from 2011-2014 (Correia 2016, Correia and Martins 2019). As a result, Portugal had to apply several austerity measures, which led to a reduction in public infrastructure and private investment due to the increasing difficulty of getting credit for investors and the general public. Since the Portuguese construction sector is strongly dependent on access to financing, it has declined significantly during this crisis, relative to other European countries and in absolute terms (Reis 2013). This reduction led to severe unemployment and bankruptcy of many construction firms, particularly those excessively dependent on domestic markets (Cruz et al. 2019).

Despite the undeniable influence of the crisis, some authors point out that the decrease in construction activity occurred before the economic crisis. According to Reis (2013), the explanation for the Portugal’s slump in growth was the misallocation of substantial capital inflows received after 2000 through an underdeveloped banking sector. The argument is that these European funds,

received after Portugal joined the European Monetary Union in 1999, have financed fewer productive firms in the nontradable sector, drawing resources away from more productive tradable firms, thus generating a slump in productivity and growth. The evolution in nontradables was uneven across sectors, with the expansion in employment and value added concentrated in wholesale and retail trade and community and other services (e.g., education, health care, and social work), while construction intensely contracted. This vision is shared by Cruz et al. (2019), who stated that deserting large infrastructure development projects has led to a fall in the revenue of most enterprises in a sector that is highly dependent on public infrastructure.

The relevance of European funds for the Portuguese economy dates back to the country joining the European Economic Community (EEC) in 1986. Portugal's construction sector benefited from substantial funds to build roads, schools, transports, hospitals, water and energy supply systems and other infrastructure to overcome its infrastructure gap during the 1990s. Thus, the construction sector and the whole economy experienced an excellent phase in this decade. However, due to several factors, including the excess subcontracting, low degree of specialisation and know-how of the workers and small internationalisation of firms, in the early 2000s, the sector was confronted with difficulties that became worse after the 2008 crisis (Cruz et al. 2019). As the present study demonstrates in the next section, based on a succinct analysis of some relevant indicators, it was in this overall context of financial, economic and sovereign debt crises that the Portuguese construction sector declined sharply, in terms of employment, the number of enterprises, gross value added and respective share in GDP from 2008-2014.

The Portuguese Construction Sector: Analysis of Some Relevant Indicators

To provide a succinct characterisation of the evolution of the construction sector in Portugal, we analysed some relevant indicators, including enterprises, employment and GDP percentages. The National Institute of Statistics (INE - Instituto Nacional de Estatística), published by the Database of Contemporary Portugal (PORDATA - Base de Dados Portugal Contemporâneo), was the primary source of the original data used in this section[3]. The definition adopted throughout the compilation of the data corresponds to a narrow definition of the construction sector, which refers to sector "F – Construction" as defined by the most recent revision, Rev.2, of the NACE - European Classification of Economic Activities (European Commission 2008)[4]. According to NACE-Rev.2, the construction sector includes: developing and constructing residential and non-residential buildings, roads, railways, utility projects, demolition and site preparation, electrical plumbing, and other installation and specialised construction activities.

[3]https://www.pordata.pt/en/Portugal, accessed in May 2021.

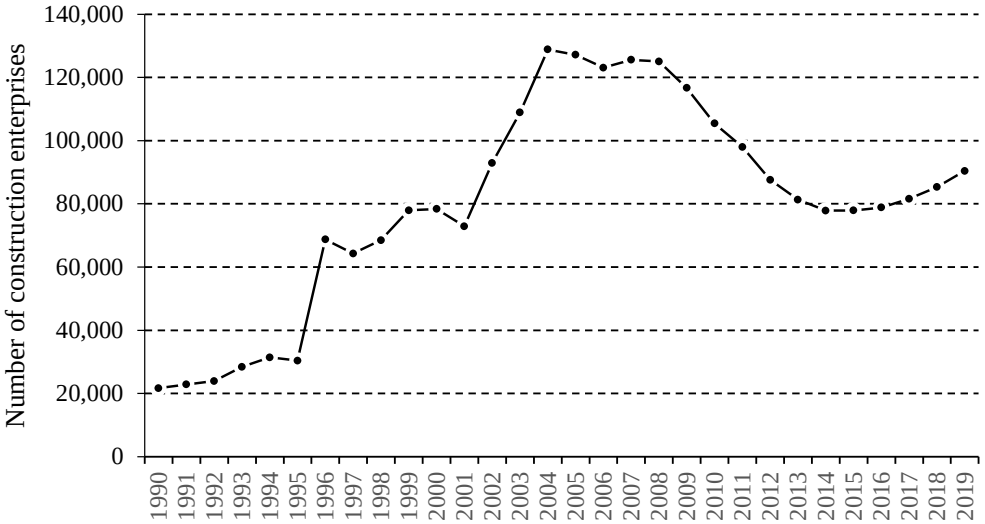
[4]NACE is the acronym for "Nomenclature statistique des activités économiques dans la Communauté européenne".

Enterprises

As mentioned in the previous section, after acception to the EEC in 1986, Portugal received substantial European funds that contributed to a remarkable transformation in the construction sector over the last decades. As shown in Figure 1, the number of enterprises in the Portuguese construction sector more than quadruplicated from 1990-2019. However, the evolution over time was not characterised by a continuous growth trend. The sector experienced overall growth (479%) from 1990 to 2007, with more intense growth observed from 2001-2004, reaching a maximum of 128,832 firms in 2004. According to Cruz et al. (2019), the boom during the 1990s was not structured, meaning there was an evident fragmentation in the existing productive structure, leading to a high degree of subcontracting in the construction sector.

The number of firms was drastically reduced from 2007 to 2014 due to the global crisis that spread to Europe and strongly affected the Portuguese economy. In fact, in 2014, there were only 77,844 Portuguese construction firms, 38% below the 2007 level. As the country's economic situation recovered after 2014, many enterprises experienced gradual growth, reaching 90,430 firms in 2019.

Figure 1. *Number of Enterprises in the Portuguese Construction Sector, 1990-2019*

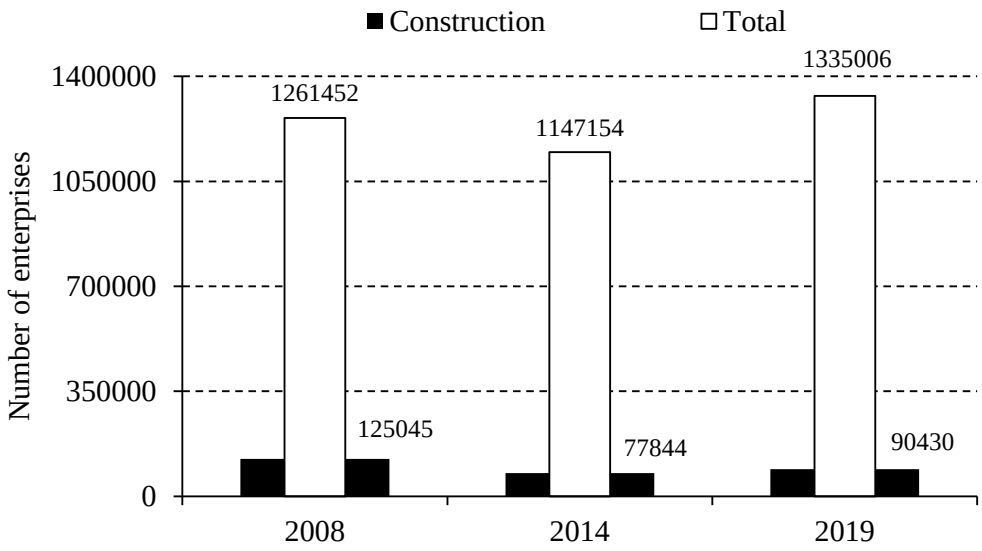


Source: INE/PORDATA Database [Accessed May 2021].

Explicitly analysing the evolution between 2008 and 2014 (Figure 2), corresponding to the financial and economic crisis period, we observed that the crisis significantly impacted the number of construction enterprises, as evidenced by a 38% decrease. As pointed out by the literature review above, there were severe difficulties in obtaining credit in the Portuguese economy during the crisis. Dell'Ariccia et al. (2020) demonstrated that this strongly affected the construction sector, which is particularly sensitive to credit conditions. Thus, this reduction in the number of construction firms was primarily due to difficulties in obtaining credit by the public and private investors. Furthermore, Delloite (2018) showed

that larger construction companies acquired small and medium-sized firms, expanding services or realising vertical integration.

Figure 2. *Number of Enterprises in Portugal, Total and the Construction Sector, 2008, 2014 and 2019*

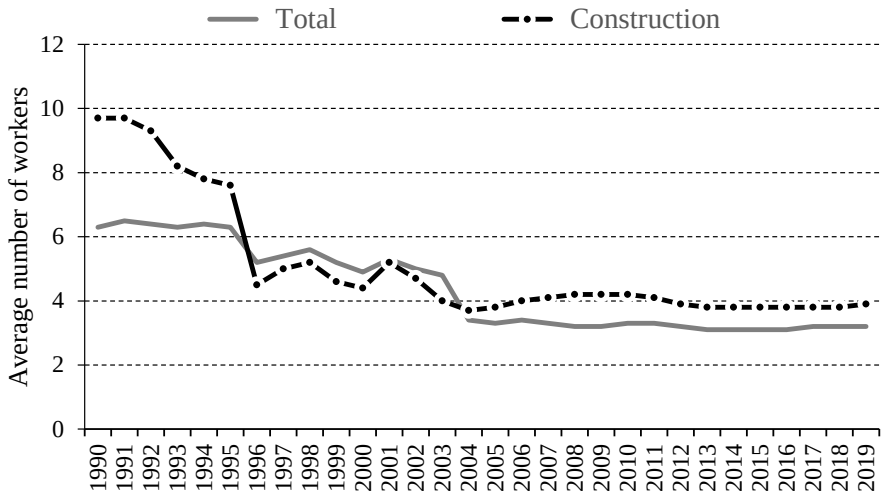


Source: INE/PORDATA Database [Accessed May 2021]

As the aggregate economic activity recovered in 2014, the total number of firms and the construction sector grew by 16% from 2014-2019 (Figure 2). However, these numbers failed to reach pre-crisis levels.

The Portuguese construction sector is mainly composed of small and medium-sized enterprises (SMEs). According to the most recent numbers by European Commission (2020), SMEs employed 87% of the total work force in the Portuguese broad construction sector in 2017, showing their importance in this sector's employment. Comparing the average size of construction sector enterprises (i.e., personnel) and the entire economy, we see that this sector follows the evolution of the entire economy over time (Figure 3). In other words, as the average size of firms in Portugal goes up or down, the same occurs in the construction sector.

Figure 3. *Average Size of Enterprises in Portugal, Total and the Construction Sector, 1990-2019*



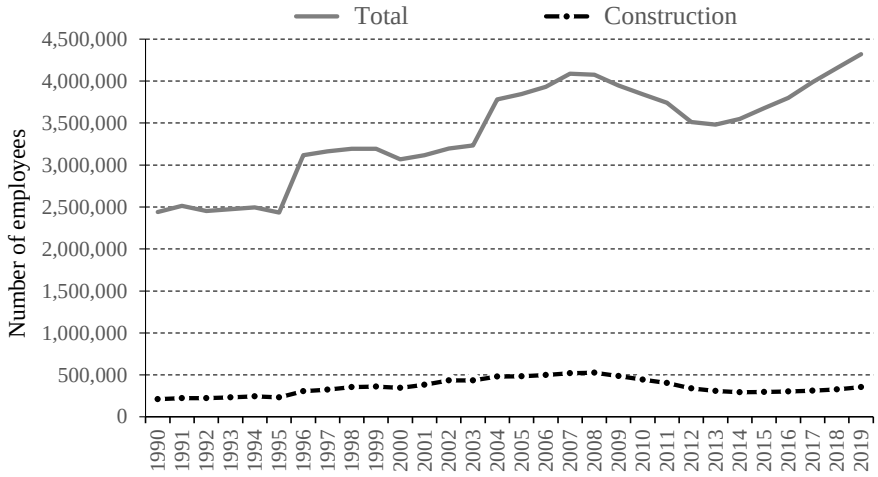
Source: INE/PORDATA Database [Accessed May 2021]

From 1990-1996 and 2001-2004, the construction sector's average enterprise size was significantly attenuated from 9.7 to 4.5 and 5.2 to 3.7 workers on average, respectively. After 2004, the average size of enterprises remained constant, with no significant changes (about four workers) and slightly above the average size nationally (about three workers). Thus, this feature was not affected during the crisis period.

Employment

Construction is a nontradable and labour-intensive industry (Dell'Ariccia et al. 2020), and Portugal is no exception. Figure 4 shows the evolution of the number of workers employed in the construction sector and the total number of workers employed in Portugal from 1990-2019.

Figure 4. *Employees in Portugal, Total and the Construction Sector, 1990-2019*



Source: INE/PORDATA Database [Accessed May 2021]

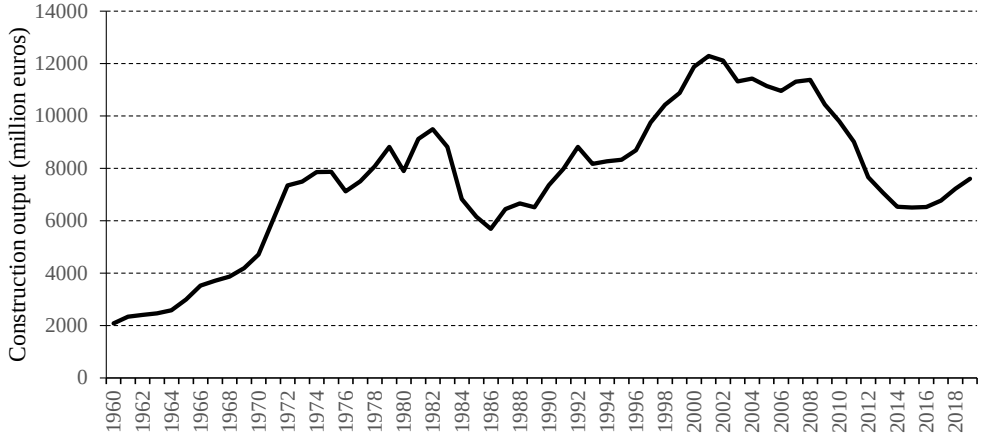
In line with the overall economy, construction employment continued to grow until the 2008 Great Recession. As explained above in the previous section, during the crisis, the lack of funds, drop in prices and reduced work for construction enterprises resulted in many firms closing and laying off employees, consequently reducing construction employment by 44% over the 2008-2014 period. This observed decrease was much more pronounced than at the national level, where the total number of employees decreased by only 13% in the same period. After 2015, construction employment improved after the aggregate economic recuperation and grew by 19% up to 2019 with notable growth in 2019 (8%). A similar rise in total employment growth (18%) was also observed.

Therefore, and contrary to what happened with total employment, the growth from 2015-2019 was not robust enough to re-establish the number of workers employed in the construction sector in 2008 (525.5 thousand and 353.4 thousand in 2008 and 2019, respectively) or back to the levels reported two decades previously.

Share in GDP

Next, we calculated the share of Gross Value Added (GVA) of the construction sector according to the total GVA[5], at 2016 constant prices in millions of euros, to analyse the importance of the construction sector to the Portuguese GDP. As shown in Figure 5, plotting these variables allows us to visualise the evolution of the construction output from 1960-2019.

Figure 5. *Portuguese Construction Output, Millions of Euros, 1960-2019*



Source: INE/PORDATA Database [Accessed May 2021]

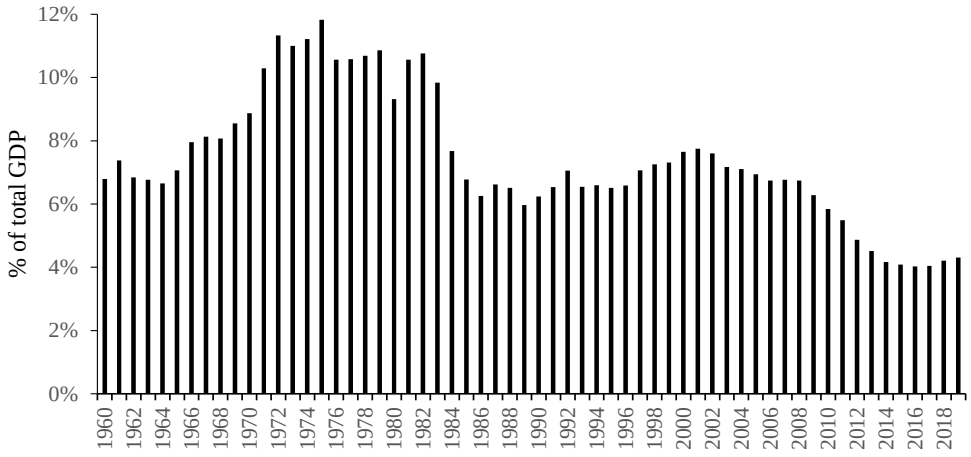
Between 1960 and 2002, construction production tended to grow, despite a significant reduction during the 1983-1986 period. After the entrance of Portugal into the EEC in 1986, as previously mentioned, the country benefited from substantial structural funds, that promoted infrastructure development and

[5]We computed the share of the GVA of narrow construction sector in the total GVA at basic prices (GDP at basic prices) and not at market prices (GDP at market prices) since market prices also includes taxes and excludes subsidies.

stimulated construction sector development, especially during the 1990s. With the deepening of the European integration process and incorporation of new countries into the EU, Portuguese construction enterprises broadened their horizons, expanding within the national territory and throughout EU member states. However, this evolution progressively decreased up to 2008. Over the 2008-2014 period, the Portuguese construction sector experienced a drastic decline in construction activity, falling by about 43% and around a 15% decrease in 2012. However, the construction GVA started to evolve positively in 2016, growing by 0.3%. From 2016 until 2019, as the Portuguese economy improved, the sector also showed evidence of a growth phase due to the increased demand for construction-related services. In 2019, the growth rate was around 5%.

As shown in Figure 6, the Portuguese share of the construction GVA in the GDP oscillated over time, as was observed for other European countries (Sun et al. 2013).

Figure 6. *Share of the Portuguese Construction Output in GDP (% of Total), 1960-2019*



Source: INE/PORDATA Database [Accessed May 2021].

There was a positive evolution in the share between 1960 and 1975, after which it fell from 12% in 1975 to 7% in 1996. The observed increase in the construction sector's share of the GDP during the last half of the 1990s was mainly due to significant growth in public investment and demand for construction for large-scale projects, such as EXPO 98. After obtaining an 8% share of the GDP at the beginning of the 2000s, the construction sector progressively contributed less to the GDP, a decrease that became more accentuated after 2008. As mentioned previously, this behaviour was driven mainly by the financial, economic and sovereign debt crises that affected the Portuguese economy between 2008 and 2014 and, albeit to a lesser extent, the development of other sectors. According to the most recent figures in 2019, the construction output was about 4% of the total GDP.

Cycles of the Construction Sector: Volatility and Synchronisation with the Portuguese Business Cycles

This section analyses the cyclical fluctuations of the construction sector over the 1960-2019 period and compares the volatility and the co-movements with the Portuguese business cycles.

Data and Methods

The annual time series of the GVA of this sector to measure the construction production cycles and the total national GVA (GDP at basic prices) was used to obtain the Portuguese business cycles, both at 2016 constant prices, in millions of euros in the 1960-2019 period. Data are obtained from the PORDATA database (pordata.pt/en/Portugal). Table A.1 in the Appendix contains the descriptive statistics for the time series used.

We used two of the more popular trend-cycle decompositions methods to extract the cyclical component of both variables: The Hodrick-Prescott (HP) filter (Hodrick and Prescott 1997) and the Baxter-King band-pass (BK) filter (Baxter and King 1999). As the results obtained are qualitatively similar and because the BK filter is preferable from a theoretical point of view (Stock and Watson 1998), for simplicity, we will only present the outputs generated using the BK filter[6]. This filter was configured to extract cycles with a periodicity of between 1.5 and 8 years, corresponding to a typical business cycle duration[7].

The standard deviation of construction production and aggregate business cycles was utilised to evaluate volatility. We assessed the degree of synchronisation between these variables by calculating Spearman correlation coefficients, contemporaneous, with leads and lags. We choose to compute Spearman's rank correlation because it has the advantage of being insensitive to the possible asymmetry of the distribution of the variables or the presence of outliers, thus not requiring the data to be normally distributed.

Spearman's rank correlation coefficients indicate the strength of association between two variables, with values ranging from -1 to +1. Strong positive correlation values are indicative of the procyclical behaviour between the two cycles. On the other hand, negative correlation values indicate counter-cyclical behaviour. Alternatively, correlation values close to zero point to acyclical behaviour (Sørensen and Whitta-Jacobsen 2010).

More specifically, we computed the contemporaneous bivariate correlations and the lagged and forward two-year correlations of the construction GVA cycle with the Portuguese business cycles (as measured by GDP). Among those five correlations, we chose the highest figure (maximum correlation). Hence, we defined corr (y_{t+i}, x_t) as the correlation between the construction production cycle (y_{t+i}), with $-2 \leq i \leq 2$, and the business cycle (x_t). If the maximum correlation

[6]For the HP filter, we set $\lambda = 6.25$ which is the customary value for annual data (Ravn and Uhlig 2002). The results obtained from the application of HP filter are available upon request.

[7]To obtain the cycles, we worked with the natural logarithm of both variables because changes in the logarithm approximate its percentage changes.

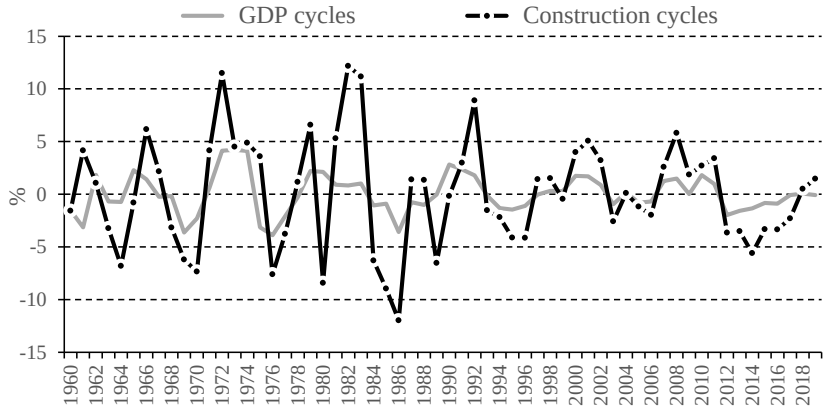
obtained is i = 0, the cycles are contemporaneously correlated, a negative i value means that the construction production cycle leads the aggregate business cycle by i years and a positive value for i signifies that the construction production cycle lags the aggregate business cycle by i years.

The whole period (1960-2019) was considered and, to obtain a more detailed analysis, we divided the total sample into four identical sub-periods: (1) 1960-1974, (2) 1975-1989, (3) 1990-2004 and (4) 2005-2019. Some of the relevant historical milestones for the Portuguese economy that occurred in these sub-periods include: (a) the time before the April 25th Revolution (sub-period 1960–1974), (b) the opening of the economy to the outside world that follows the April revolution and the process of preparing for Portugal's entrance into the EEC in 1986 (sub-period 1975-1989), (c) the inception in Economic Monetary Union in 1999 and the euro circulation in 2002 (sub-period 1990-2004) and (d) Portugal being struck by the financial and economic crisis in 2008, the sovereign debt crisis in 2011 and the presence of the Troika from 2011-2014 (sub-period 2005-2019).

Empirical Results

In general, visual inspection of the graphs of the cyclical GDP components and construction production (Figure 7) reveals a positive relationship between the two variables in the 1960-2019 period. This result suggests that the Portuguese construction industry exhibits procyclical behaviour. Concerning the construction output cycles, the most positive point (i.e., the highest peak, marking the transition from a good to bad phase) was in 1982, while the most negative point (i.e., the lowest valley marking a transition from a bad to good phase) was in 1986, coinciding with Portugal's entry into the EEC. Notably, the oscillations of the construction production tend to have greater amplitudes (ranging from -12% to 12%) than of the Portuguese GDP (ranging from -4% to 4%), demonstrating that the construction sector is more volatile than the aggregate economy, a result consistent with previous studies. We also observed lower dispersion in these amplitude ranges after the 1990s.

Figure 7. *Construction and Business Cycles in Portugal, BK Filtered, 1960-2019 (%)*



Source: authors' calculations.

The standard deviation results in Table 1 reveal that the construction activity cycles exhibit much higher volatility than the national level for the entire period and the four sub-periods analysed. Concerning the entire period (i.e., 1960-2019), the relative standard deviation (standard deviation of construction cycles relative to standard deviation of GDP cycles) is 2.8, corresponding to amplitude fluctuations about three times greater than the GDP. The results across periods show that the cyclical volatility of construction output is about two-fold greater than that of the national output in the 1960-1974 sub-period and almost four-fold greater from 1975-1989. A significant reduction in cyclical volatility was detected after the 1990s in the construction and aggregate activities, especially during the 2005-2019 sub-period. This data suggests that construction activity became more stabilised after the 1990s; however, the relative standard deviation remained high (near 3).

Table 1. *Standard Deviation of the GDP and the Construction Cycles in Portugal (%)*

	Whole period	**Sub-periods**			
	1960-2019	**1960-1974**	**1975-1989**	**1990-2004**	**2005-2019**
GDP cycles	**1.84**	2.56	1.92	1.37	1.15
Construction cycles	**5.17**	5.42	7.58	3.61	3.30

Source: authors' calculations.

At first glance, the data presented in Figure 7 indicate that the construction GVA displays a procyclical behaviour, meaning that as economic activity increases, this sector also improves and vice-versa. However, the graphical representation does not quantify the degree of association between the cycles of the two variables or identify the possible existence of leads or lags. Therefore, we calculated the correlation coefficients for the entire period and the four sub-periods (Table 2).

Table 2. *Correlation Coefficients for the Whole Sample and the Sub-Periods*

	-2	**-1**	**0**	**1**	**2**
1960-2019	-0.09	0.30**	**0.65*****	0.49***	0.11
(1) 1960-1974	-0.15	0.48*	**0.68*****	0.49*	-0.19
(2) 1975-1989	-0.10	0.19	**0.48***	0.24	0.22
(3) 1990-2004	-0.25	0.10	**0.79*****	0.58**	0.26
(4) 2005-2019	0.23	0.41	**0.93*****	0.70***	0.30

Source: authors' calculations.
Note: *, ** and *** indicates statistical significance at the 10%, 5% and 1% level.

Overall, the results support a procyclical behaviour of construction production for all the periods analysed. We did not detect annual leads or lags with the Portuguese business cycle. All the correlation coefficients are statistically significant, indicating strong or very strong degrees of association. Additionally, after the 1990s, the degree of association between the two cycles experienced a considerable increase, with the highest value being attained in the 2005-2019 last sub-period (0.9). Since the 2005-2019 sub-period is plagued by Portuguese

economic crises, starting in 2008, this almost perfect association between the construction and business cycles demonstrates that the construction sector reacts to crises like the overall economy. This observation may be related to the challenge of obtaining credit for construction-related activity under difficult financial circumstances.

Concluding Remarks

The succinct characterisation of some indicators provided in this study for Portugal demonstrate relevant dynamics for the Portuguese construction sector after the 1990s, namely: (1) the number of enterprises had a systematic increase until 2007, suffering its most remarkable fall between 2008 and 2014, followed by a positive evolution; (2) the sector is mainly composed by SMEs and microenterprises; the average size decreased sharply until 2004 (from 10 to four workers), remaining relatively constant until 2019; (3) employment was gradually increased until the 2008 crisis, decreased sharply during the crisis period and then recovered and improved in parallel with the aggregate economic recuperation.

Another conclusion is the importance the construction sector has had on the national economy. The share of GDP throughout the period analysed (1960-2019) demonstrates that the construction sector greatly influences the Portuguese economy, consistently accounting for greater than 4% of the GDP. Its contribution to the national economy was significant even during the crisis in the 2008-2014 period. However, there has been a progressive loss of importance over time that was more accentuated after 2008.

Analysing the cyclical volatility of construction output in the last six decades (1960-2019), we observed more substantial amplitude fluctuations than in the national business cycle for the whole period and the four sub-periods considered. The calculation of correlations, leads and lags, both for the whole period and the four sub-periods, demonstrated that construction output had a procyclical behaviour, exhibiting a considerable degree of association with the national business cycles. Therefore, the positive and negative shocks that hit the Portuguese economy also pushed the construction sector in the same direction.

Overall, these results prove that, although construction output exhibits much greater instability, there was a strong association between cyclical fluctuations of construction and aggregate activities, in the past. For example, after the 2008 Great Recession, the behaviour suggests a similar reaction of the construction sector and overall economy in times of economic crisis. In this context, a question that naturally emerges is how the recent COVID-19 pandemic, which has highly constrained the Portuguese economy, has affected construction activity.

Official 2020 estimates indicate a 7.6% drop in the Portuguese GDP, above the 6.8% estimated for the euro area (Bank of Portugal 2021). Since the sanitary crisis due to COVID-19 has substantially decreased the purchasing power and investments, the construction sector is expected to experience an adverse reaction, considering its procyclicality. However, the construction sector's GVA increased by 3.2%, while its share in the total GVA remained practically unchanged at about 4%. Surprisingly, these figures point to an exceptionally resilient construction

sector, a feature opposite to what was observed in previous recessions. According to the Bank of Portugal (2021), the dynamism of construction activity is due to the flow of new projects, primarily residential real estate and major infrastructure works, as long as containment measures do not suspend construction projects and there is a sustained international demand in the residential component. The European Commission (2018, 2020) emphasised the positive impact of government policies supported by EU funds, to explain this favourable evolution of construction sector demand. For example, the government launched initiatives for urban rehabilitation and revitalisation or investment in the energy, infrastructure, and environmental areas, thus stimulating construction activity.

Notwithstanding these positive signs, the Portuguese construction sector currently continues struggling with issues that constrain its expansion, including the small size of most enterprises, the lack of skilled workers in some areas (bricklayers and electricians), the low salaries as compared to other countries, a complex tax system and limited liquidity (European Commission 2020). Thus, at the moment, we only have a partial view of the impact of the COVID-19 pandemic on the construction sector. The full extent of this crisis remains to be seen since it is still characterised by great uncertainty. Moreover, concerning the long-term development of the construction sector, the challenge of sustainable development (economic, environmental and social) creates additional pressure on the digitalisation of the sector, increases of its productivity and reductions of its environmental impact (Cruz et al. 2019).

Finally, we have to point out that the importance of the construction sector justifies ongoing and future research using more data and apllying more sophisticated econometric methods to improve our understanding of this sector's dynamics. As longer time series become available, a straightforward application could employ vector autoregressive models to deeply analyse and shed more light on the importance of the construction sector’s contribution to the business cycle of the Portuguese economy and to understand how the GDP reacts to shocks to the construction sector and for how long.

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Appendix

Table A.1. *Descriptive Statistics, 1960-2019, Millions of Euros*

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Aggregate production	60	30562.40	176192.70	109451.31	47401.27
Construction production	60	2076.90	12282.70	7567.71	2709.65

Source: authors' calculations.