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The association of selected economic parameters in construction output – an international comparison

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ABSTRACT

The aim of this article is to illustrate the impact which the ongoing economic crisis, together with the 2012 amendment to the Public Procurement Act, has had on the construction industry in the Czech Republic (CR) and in neighbouring Austria. In 2012 and 2013, a research project entitled 'Cross-border cooperation between construction companies in the South Moravian Region, Lower Austria and the city of Vienna' was carried out. The research took the form of a questionnaire addressed to 3000 construction companies in these regions. The results of the questionnaire then underwent statistical analysis. The research showed that in the CR price was no longer linked with quality in construction work and that customers were guided by other measurable criteria, such as the warranty. The statistical investigation among companies also showed that there is a clear relationship between quality and the cost of the work carried out, and that the warranty is an important criterion for measuring the quality of construction work.

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Construction industry; price; quality; warranty; public procurement

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1. Introduction

Within Central Europe, the construction industry and the production of building materials represent an important sector which contributes to economic growth, creates new job opportunities, transforms the landscape and also puts innovation into practice. However, it is also currently encountering problems due to the absorption of unqualified labour from the countries of the former Eastern Bloc, and it is also beset by corruption. The approach of construction company management during the economic crisis has had to contend with increasing competitive pressure and a dynamic environment, as well as growing demands to ensure competitive success with a view to long-term development. This leads to new challenges and approaches, which are reflected in decisions about the basic parameters relating to quality and adequate warranty periods for construction output (Zathurecký et al., 2013).

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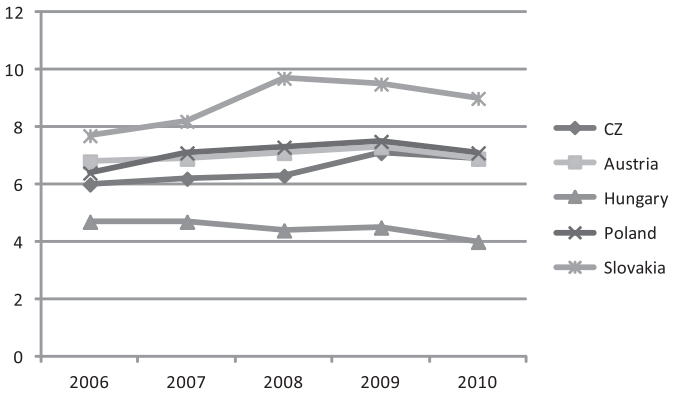

Figure 1. The construction industry's share of GDP as a %, measured by gross added value. Source: Eurostat.

As Figure 1. shows, in the countries of the Visegrad Four, namely the Czech Republic (CR), Poland and Hungary, the construction industry occupies a similar position as a sector of the national economy, around 7%. In Austria the construction industry's share is slightly less (under 5%), unlike Slovakia, where the construction industry's share of GDP is the most significant of all the countries represented (around 9%). This shows the importance of the construction industry within the economies of the Visegrad Four countries, which have had a much shorter period of development of the market economy, and in Austria with its developed market economy, which has also been part of the EU's internal market for a longer time.

New insights can be gained by comparing countries (Kessler, 2007): in our case, the CR, whose construction industry has operated within a market economy over a shorter period, and Austria, a country with a well-established market economy. This information can also be applied in the near future in countries with a market economy where a privatisation of state property has taken place (Škuflič et al., 2013) and has possibly had an effect on construction companies, as in the CR.

In 2012 and 2013, as part of the European project 'The development of small and medium-sized businesses in cross-border areas', research was carried out into 'Cross-border cooperation between construction companies in the South Moravian Region, Lower Austria and the city of Vienna'. The objective of this research was to identify competitive advantages resulting from the application of a strategy of cross-border cooperation between SMEs in the construction industry operating in the South Moravian Region, Lower Austria and the city of Vienna. A total of 3000 companies operating in these regions were approached. These companies belonged to the sector 'F construction industry according to CZ – NACE classification', namely sections 41 – construction of buildings, 42 – civil engineering and 43 – specialised construction activities.

The subject of inquiry was the parameters of construction output, which also included pricing strategy, which is connected to the quality of products and services. With regard to the above, the parameters obtained and the lack of information about this area to date (CEEC Research) indicate that it would be beneficial to examine the approach of construction companies in the CR and Austria towards the above-mentioned parameters.

Construction companies from both countries are still faced with the fallout from the economic crisis, which had negative effects on both countries (Figure 2 and Figure 3). The very ability to adapt to changes in the environment and react to the impact of the crisis indicates the success of companies and may demonstrate their competitiveness in the markets in which they operate. As is evident from graphs 2 and 3, the consequences of the economic crisis have made themselves felt in both countries. Austria was mainly affected by the crisis in 2009 and 2010, unlike the CR, where, despite a seemingly 'moderate' initial impact in 2009, the economic crisis struck with full force in 2011 and continues to this day (Figure 2 and Figure 3).

Predictions that the crisis in the construction industry would end in 2012 have been shown by several studies to be false (Kislingerová, 2013) and, in comparison with the manufacturing industry, the crisis still persists. Between 2007 and 2012, prices in the construction industry reached their lowest level. The fall in prices was recorded at an annual level of −0.7%. Development in 2013 was not overly optimistic in the first quarter, when the price of construction output dropped quarterly by 0.4% and annually by one percent (Český statistický úřad, 2013). From analyses of the construction market it is clear that a whole host of factors have had an impact on the construction trade as a whole. One of the most important factors was the reduction in investment by both the state and private sectors.

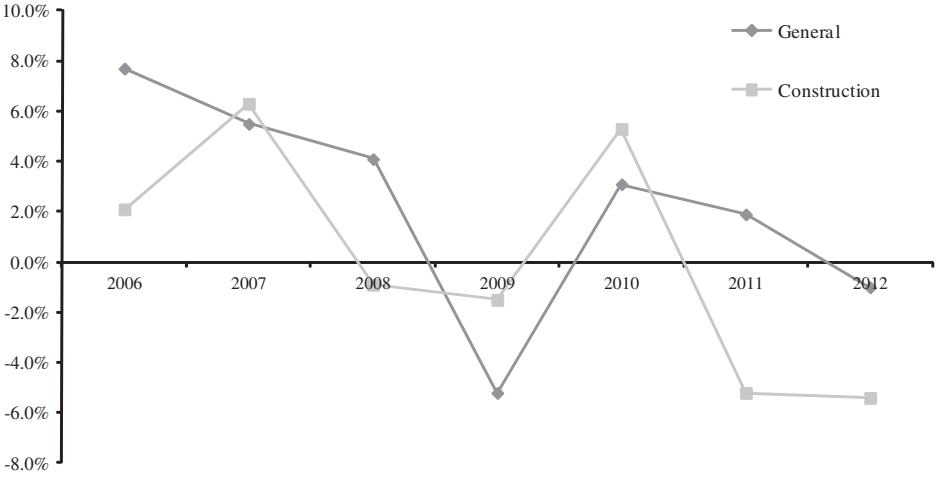

Figure 2. Development of percentage change in gross added value in a comparison of the construction industry and the economy in general in the CR. Source: Eurostat, 2013c.

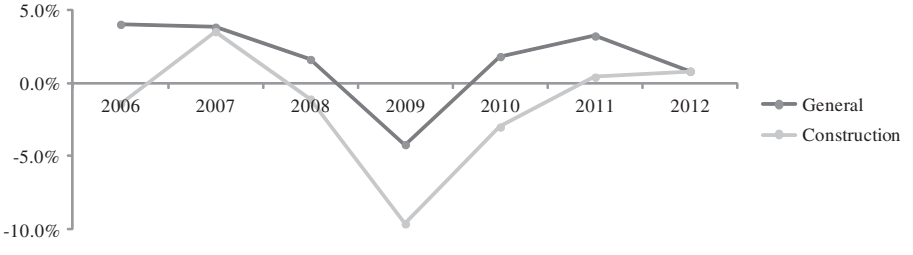

Figure 3. Development of percentage change in gross added value in a comparison of the construction industry and the economy in general in Austria. Source: Eurostat, 2013c.

The drop in orders came first of all from the private sector. It was not until 2010 that reductions in public-sector investment began (Český statistický úřad, 2013). This led to a greater supply of construction work within the construction market, manifesting itself in a greater intensity of competition. During the crisis this resulted in a price war and fiercer competition. Another accelerator of the crisis was the introduction of an amendment to the Public Procurement Act in 2012. According to research by CEEC Research (2013) and Otidea (2012), the 2012 amendment to the Public Procurement Act led to significant pressure to lower the costs of public procurement. This resulted in the sort of behaviour by representatives of state and local government whereby, often through fear of being accused of a lack of transparency in making decisions on public contracts, the main criterion became the lowest price. The end result is that the cost of construction work is often unrealistic and exhibits the characteristic of dumping costs. In many cases the lowering of prices leads to a lowering in the quality of the work carried out and the output offered (Vrbka, 2012).

The objective of this article is to present research results pertaining to the competitiveness of construction companies from selected countries during the period of the ongoing economic crisis. This article aims to establish what relationship the selected parameters – price, quality and warranty – have to construction output in a comparison of the two countries which were the subject of empirical research. As regards the acquisition of data from both countries (Austria representing a developed market economy and the CR representing a country in the post-transformation phase of a market economy), the results obtained can be projected onto a more general level in an international context.

2. Theoretical basis

The success of construction companies is associated with environmental factors to which they can react to varying degrees, or adapt, with this determining their market competitiveness. In terms of linking success and competitiveness, as in other industries, the competitiveness of construction companies can be understood as an attribute of the organisation which allows it to achieve success in a competitive environment with a view to long-term growth (Zich, 2010, 2014). This can also be linked to the basic definition of competitiveness, which is related to the business's market position and its competitive potential (Žitkus & Mickeviciene, 2011). In a theoretical view of construction companies' competitiveness, the parameters of price, quality and warranty are among the important economic parameters which influence success and long-term prospects (Zathurecký et al., 2013). Recent research shows that the success of a business in the market is not only a consequence of competitiveness itself, but also depends on competitive advantage – that which allows a business to be more successful in the market than its competitors (Blažek, 2007). Competitive advantage as a greater ability to compete can be seen as a value which a company is capable of creating for its customers, whether it be through lowering the price of a product, offering various benefits and services, etc. (Porter, 1985).

According to several authors (Garvin, 1984; Holbrook & Corfman, 1985; Maynes, 1976; Porter, 1985; Zeithaml, 1988) competitive advantage can be defined by an objectively perceived value, based on predetermined measurable criteria of competitive strategy, where the quality of a product is expressed through warranties for the products and services offered. This kind of strategy represents a significant element in profitability and an instrument for

improving the performance, and with it the competitiveness, of a business, which reflects the quality of the products and services (Jáč et al., 2005).

If we look at competitive advantage from the viewpoint of a customer-perceived value, then competitive advantage can be defined as the price–quality ratio (Lambert, 1980), which according to Maynes (1976) customers compare to other products when making a decision about a purchase. Some other sources also regard the quality of the product on offer as a critical factor in the success of businesses in the construction trade (Belle, 2000; Burati, Mathews, & Kalidindi, 1992; Metri Bhimaraya, 2005).

In recent years the external conditions which have a significant impact on the construction trade have changed considerably. As a result of legislative changes, there has been a change to the law on public procurement, and the subsequent opening up of the competitive environment in the construction industry in recent years has led to a position in which construction firms have been offering construction work at unrealistic prices. The result has been that construction work has been carried out at the lowest possible level (Vrbka, 2012). Therefore, this situation has given rise to the concept of a 'safe price', the amount of which ensures a price that guarantees a safe, high-quality construction. As a result of the relaxing of statutory requirements for compliance with building norms within the EU, there is now a search for an objective relationship between the price and quality provided.

3. Price

In the construction industry, setting the price of a product is a relatively difficult process. Pleskač and Soukup (2001) show that there are three basic areas involved in construction work – architecture, project and engineering management and finally the building work. The end product is ultimately conceived as a complex piece of work, the price of which is based on an evaluation of the individual areas. Due to the relative difficulty of establishing the final price of a construction project, a number of construction companies use pricing methods based on a database of evaluated documentation and indicative prices for construction work. The set prices reflect changes in input prices for the construction industry, new building materials, technology, technological construction processes, etc. (ÚRS, 2013). This greatly simplifies the final price calculation, as the company sets the price on the basis of a building standard and thus avoids the difficult process of costing individual components and work. In connection with the deepening economic crisis and customer pressure to reduce prices (Záthurecký & Marinič, 2014), according to the research agency CEEC Research, this has led to a lowering of prices for construction work at the expense of the quality of the work carried out. As a result of the trend towards a reduction in the quality of construction work, the Czech Chamber of Architects (CCA) and the Czech Chamber of Authorised Engineers and Technicians (CCAET) defined the term 'safe price'. The safe price for construction work is the price which guarantees the design (and construction) of a safe, high-quality building. Buildings which are designed (or constructed) for a safe price offer guaranteed value for money over time, as with these constructions there is no subsequent increase in construction and operation costs. Vrbka (2012) and subsequently Panna (2012) have shown that reducing quality to the lowest acceptable level leads to an increase in operational costs and items described as 'extra work'. Research by the CEEC Research agency in 2013 showed that 59% of companies carried out construction work on the threshold of safe prices and 7% below the threshold of safe prices.

4. Quality

In their research, several authors (Blažek et al., 2007; Momaya & Selby, 1998) use product quality as a factor of competitiveness. A number of studies have focused on the perception of quality by the customer. Maynes (1976) shows that the customer does not view quality in absolute terms, but in relative terms, in relation to the quality of other products. Other authors (Garvin, 1984; Holbrook & Corfman, 1985; Zeithaml, 1988) have described the difference between the objective quality of a product and the perceived quality of a product. The objective quality can be defined on the basis of predetermined measurable criteria, which are usually derived from the technical requirements of production. From the viewpoint of the trader, quality is defined as a factor which is determined by the specific features, functions and performance of the product (Yoon and Kijewski (1997). However, the problem with objective quality is the instability of the indicators which describe objective quality and which change over time, as has been documented, for example, in studies of the automotive industry (Johnson & Chvala, 1996). Perceived quality has been defined by authors (Archibald, Haulman, & Moody, 1983; Gilmore, 1974; Zeithaml, 1988) as the ability of the product to meet the customer's requirements. Lambert (1980) gives another characterisation of product quality with regard to the perceived needs of the customer through quality attributes such as price (Leavitt, 1954), reputation, commercial image, market share, product features and country of origin. Dorfman and Steiner (1954) also add services to these attributes, Juran (1978) adds reliability and Feldman (1976) and Shimp and Bearden (1982) also include the product warranty among the most important attributes.

5. Warranty

As has been shown above, some research presents the warranty as a perceived attribute of quality (Feldman, 1976; Shimp & Bearden, 1982). Research by Shimp and Bearden from 1982 demonstrated that the warranty is one of the main attributes reducing the risk linked to the purchase of a particular commodity in the perception of the customer. According to Chan and Chan (2004), in the past decade the construction industry has witnessed a change in the perception of the key factors of success. Chan's research shows that there has been a clear shift in the perception of the quality of construction output. Due to the fact that the assessment of quality is burdened by considerable subjectivity, quality in construction is measured using the warranty. His conclusions are in accordance with research carried out by Songer, Molenaar, and Robinson (1996), Wateridge (1995) and Momay and Selby (1998). One major factor behind the shift in the perception of quality is the fact that there has been a change in regulations within the EU. This was the abolition of the law on Czech Technical Standards No. 142/1991 Coll. and the law on State Testing No. 30/1968 Coll., which was replaced by the law on Technical Requirements for Products No. 22/1997 Coll., whereby the previous legal obligation to use technical norms was abandoned. Therefore, the present use of technical norms is no longer legally binding; it is a recommendation (Saulich, 2014). In accordance with Chan's research, therefore, the objectively evaluated quality of construction work is determined by the warranty provided. Some other sources present conflicting perceptions of the optimal length of warranty between the trader and the customer (Varmuža, 2012). On the basis of his research, Varmuža (2012) suggests that 57 months is the optimal warranty for construction work. He defines the warranty as a period of time during which a product has to maintain the properties covered by the warranty according

to law, based on a contract or on the warranty itself. Due to the fact that the obligation to comply with legally established norms has been abolished, from the point of view of the customer the warranty is the sole objective measurement of quality (Chan & Chan, 2004; Saulich, 2014; Neranartkomol, 2000).

On the basis of this research, it is useful to investigate the relationship between the provision of a warranty and quality and price within the construction industry, and how that is manifested in a period of instability as characterised by the economic crisis. In accordance with this objective and on the basis of the theoretical insights, the following hypotheses can be defined:

H1: There is a positive correlation between the declared quality of construction output (products as well as services) and the warranty provided for products by both Czech and Austrian construction companies.

H2: The price–quality ratio offered in construction output is worse in the case of Czech construction companies in comparison with Austrian construction companies.

6. Methodology

The research and the empirical investigation associated with it took place in the years 2012–2013. A total of 3,000 businesses operating in the aforementioned regions were contacted. These belonged to sector 'F construction industry according to CZ – NACE classification', namely sections 41 – construction of buildings, 42 – civil engineering, 43 – specialised construction activities.

On the Czech side, 177 completed questionnaires were returned, and there were 177 respondents on the Austrian side too. During the subsequent checking and data cleansing process, it was necessary to eliminate one Czech questionnaire and 74 Austrian questionnaires because the majority of the questions had not been answered. The total number of questionnaires which were the subject of further investigation was 279, with a division into 103 respondents from Austria and 176 respondents from the CR (Figure 4).

The following graph shows the breakdown of construction companies within the sample according to their focus on main construction works, earthworks or auxiliary construction works (Figure 5). Main construction works predominated among the Czech respondents. On the Austrian side a majority of respondents fell into the category of auxiliary construction works.

In terms of the representation of companies according to size, most of the construction companies on both sides belonged to the category of 11 to 49 employees. In contrast, businesses with up to 10 employees hardly figured in the research on the Austrian side (Figure 6).

In terms of the legal form of business, stock companies predominated among respondents from both the CR and Austria, followed, with a significant gap, by businesses owned by self-employed persons (Figure 7).

The initial research sample was then used to study the strategy of construction companies in the area of price and quality provided. This strategy was investigated by means of several factors which the respondents rated on a scale of one to five and compared with their major competitors: 1 = much better than our competitors; 2 = better than our competitors; 3 = same as our competitors; 4 = worse than our competitors; 5 = much worse than our competitors. The factors determined by the survey included the following: the quality of

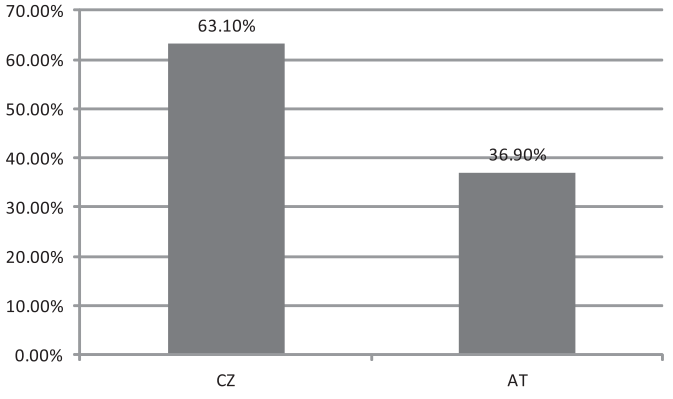

Figure 4. Respondents from Austria and from the Czech Republic. Source: Authors.

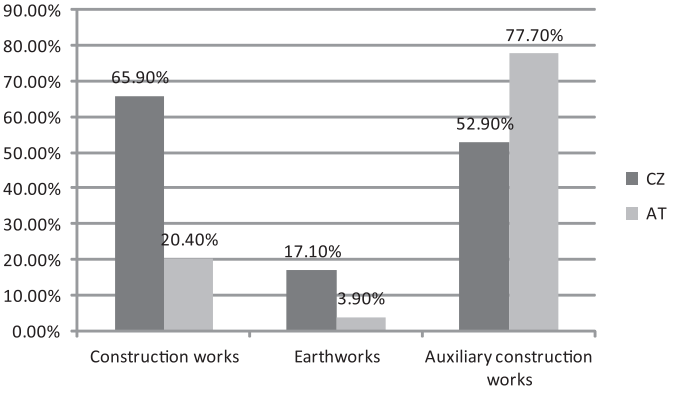

Figure 5. Sample of construction companies. Source: Authors.

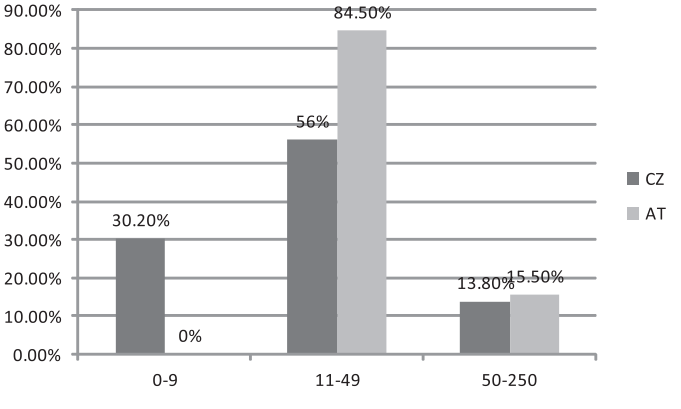

Figure 6. Size of companies. Source: Authors.

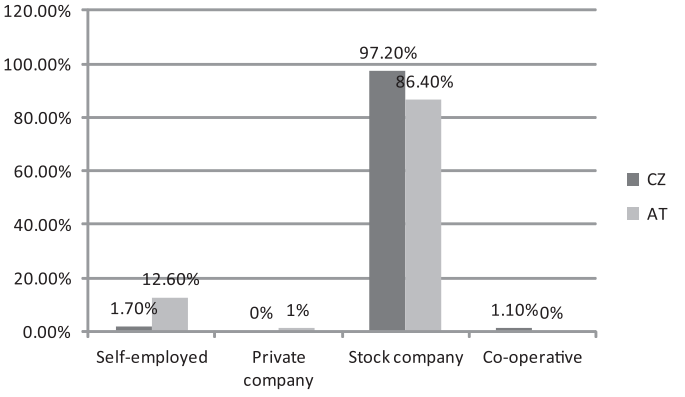

Figure 7. Legal form of business. Source: Authors.

products and services offered, the warranty provided for products and services, the price of the products and services offered. The warranty was used as an objective way of measuring the quality of the product (Feldman, 1976; Shimp & Bearden, 1982; Varmuža, 2012) and by extension the quality of construction output (Chan & Chan, 2004; Songer et al., 1996; Wateridge, 1995).

The statistical analysis necessary to test the validity of the two hypotheses was performed in the statistical software R version 3.0.2 (R Core Team, 2013). In the tests a 5% significance level was used ($\alpha = 5\%$).

7. Results

The empirical investigation was carried out on construction companies in the years 2012 – 2013 in both the CR and Austria in parallel. Among other things, the questionnaire study, which was subjected to statistical analysis, helped to provide interesting results regarding internal and external developmental factors, which led to the formulation of the hypotheses given above.

One interesting finding was the fact that Czech companies evaluate themselves in relatively optimistic terms, even when their indicators of construction output are far from equalling the level of the Austrian companies. On both sides the main internal factors respondents give for their success are the quality of products and services offered and the warranties provided for the products and services.

The external factors which most trouble construction companies are the unstable political environment and rapid politico-economic changes. As far as the evaluation of the future development of the economic situation of the companies surveyed is concerned, Czech construction companies are relatively pessimistic in comparison to their Austrian counterparts. As many as 25% of construction companies view their future situation very pessimistically, whereas in Austria the figure is only 7%.

The relationship between the quality of construction output and the warranty was measured using a correlation coefficient, the value of which is r=0.44 (n=257). We verified hypothesis H1 using a test of independence for ordinal data with a one-sided alternative for a linear trend (Agresti, 2007). The test statistic was $\mathrm{M} = \sqrt{n-1}\mathrm{r} = 7.05$ and the level

Table 1. Correlation between declared quality and warranty of output in Austria and the CR.

Country	Austria	Czech Republic	Total
Correlation	0.38	0.48	0.44
Number of responses	100	157	257
p-value	<0.001	<0.001	<0.001

Source: Authors.

Table 2. Comparison of price and quality of products and services offered in Austria and the CR.

	Price			Quality			Price*Quality		
Statistic	Mean	Std. Deviation	Number	Mean	Std. Deviation	Number	Mean	Std. Deviation	Number
Austria	2.62	0.72	102	1.91	0.72	102	5.07	2.54	102
Czech Republic	2.63	0.91	161	2.06	0.75	160	5.60	3.02	156
Welch *t*-test		p=0.875 (2-tailed)			p=0.053 (1-tailed)			p=0.066 (1-tailed)	

Source: Authors.

obtained in the test was $p<0.001$, i.e. hypothesis H1 was validated. On the basis of these results, it can be claimed that if construction companies declare the quality of products and services compared to those of their competitors, this quality can be objectively ascertained by means of the warranties provided for their products and services. If we compare the strength of the link between quality and the warranty in Austria and the CR (Table 1), then according to the value of the correlation coefficient the relationship between quality and the warranty is closer in the case of the CR (Table 1).

If we focus on the price–quality ratio of the construction output of Czech and Austrian companies, the results obtained are less convincing. An overview of the respondents' evaluation of the price and quality of products is given in Table 2. The level of product prices in the construction industry relative to those of competitors (an average evaluation of between 3 – the same price and 2 – better price than competitors) is comparable in Austria and the CR (Welch's two-sample *t*-test[1]: p=0.875). In contrast, quality is evaluated as somewhat better by Austrian companies than by Czech ones. But at the 5% significance level it is not quite possible to prove statistically (p=0.053) that Austrian companies are generally better as regards quality compared to their competitors than Czech ones.

In order to test hypothesis H2 it is better to take both indicators into consideration simultaneously. We therefore introduce a new variable, which is the product of both indicators with values of 1 to 25, where a value of 1 means a much better price and quality and a value of 25 means a much worse price and quality, i.e. the lower the value, the better the price–quality ratio and, conversely, the higher the value, the worse the price–quality ratio. The price–quality ratio comes out better for the Austrian companies included in the study, and yet it is not possible to prove in general the statement H2 (p=0.066) for $\alpha = 5\%$. However, at 10% significance level we confirm H2 (Table 2).

The results indicate that quality and the warranty are closely related to each other. Output with better warranty terms is perceived by the customers of Czech construction companies as higher-quality output. The price–quality ratio which was examined is more favourable for Austrian companies: the investigation specifically showed that the output of Austrian construction companies is offered at comparable prices as that of Czech construction companies, but with higher quality.

8. Conclusion

The results of the research yield some hitherto unknown findings concerning the basic parameters of construction output and their mutual relationships. They reveal the interesting correlation that if construction companies declare the quality of their products and services compared with those of their competitors, then this quality can be objectively ascertained through the warranties provided for their products and services. Following on from research by Chan and Chan (2004), it was also possible to demonstrate the relationship between the quality of construction output and the warranty provided. As our statistical investigation showed, this relationship is closer in the case of construction companies in the CR. The explanation for this is a subject for further research, but on the basis of the initial findings it can be surmised that it may have been caused by legislative changes that have affected the construction industry in recent years. In particular, the relaxing of legislative measures concerning technical norms and the pressure on the price of construction work caused by a change to the law on public procurement evidently created a demand among customers for an objective way to measure the quality of construction output, which is the warranty under research here. The change to the legislation concerning the use of technical norms has obviously affected Austrian companies as well. There the relationship between the quality declared and the warranty is lower than it is for Czech companies. The cause of these correlations may lie in the criteria for the evaluation of public procurement. In Austria, price is not the main factor that decides the outcome of the tendering process, as it is for construction companies in the CR. In Austria, the outcome of the tendering process is based on the assessment of various factors.

The results of the research with regard to the second hypothesis were only verifiable at a 10% significance level; nevertheless, it was shown that there was a better price–quality ratio in construction output in the case of Austrian construction companies. Moreover, our results suggest that Austrian construction firms provide better quality in comparison with Czech companies, and for a comparable price. In the CR, the reason for this lies chiefly in the amendment to the Public Procurement Act as well as the relaxation of legislation concerning the obligatory use of legal norms. Based on the findings, it can be stated that pressure on price from the end consumer is detrimental to the quality of construction output, as has been shown by Vrbka (2012) and Panna (2012). In addition, lowering quality to the lowest acceptable level results in a rise in operating costs and an increase in items described as 'extra work'.

The practices which Czech construction companies employ in order to survive in the increasingly competitive environment of the construction trade, which has been encouraged by legislative changes, would clearly be counterproductive for Austrian companies. In Austrian tenders, the use of lower-quality materials and the limitation of the work carried out to the bare minimum, which leads to additional costs in the operation or completion of the construction output, is assessed as rigorously as the amount of the bid. Therefore, it is impossible for a company to win a public contract in a tender by offering the lowest price but at the same time providing poor quality and an insufficient level of work.

Based on the findings of this research, therefore, it is advisable to pay more attention to the method of awarding public contracts and to submit the whole process to a thorough analysis, which would ensure the rectification of mistakes resulting from the growing problem of declining quality in construction output. In the future there could be a focus

on the identification and comparative analysis of the individual processes of procurement and awarding public contracts in the construction industry, which would help to identify the key factors that have an influence on success and the overall efficiency of output. The relationship outlined above needs to be examined further, not only from the short-term perspective of awarding contracts, but also in a long-term view. The overall efficiency of procurement can only be examined retrospectively, as the total cost of the work can only be expressed after it has been in operation for several years. In the future, the identification of the key factors in the success of tenders could be the basis for future legislation, leading to a significant improvement in the conditions for the implementation of construction projects and the work of Czech construction companies.

Note

1. As there is an adequate number of data in both groups, the t-test can be used due to the central limit theorem.

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