

INTERACTION OF CONSTRUCTION COSTS AND OUTPUT IN LATVIA

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Abstract. Growth of an economy is strongly linked with the growth of the construction sector. An increased construction output must influence the costs in this area. Analysis of the construction output and construction costs in Latvia for the time period since 2006 until 2017 shows an average effect. The main goal is to forecast construction costs and output in Latvia. Comparative analysis of costs and output dynamics was done, and a general trend can be proven, but heteroscedasticity is being observed. The effect of construction output on costs is limited in scale, but similar in general tendency and author offers his discussion for possible reasons for inconsistencies in construction sector changes.

Keywords: *construction costs, construction output, salaries, building material costs.*

JEL code: L74

Introduction

Latvian construction market has seen a very dynamic development during the 21st century. During the peak periods of 2006-2007 the construction output has seen some staggering double digits growth per year. But the 2008-2010 economic turmoil resulted in construction output dropping by more than 40% in one year. One must conclude, that the construction market is very prone to high amplitude on growth rates and instability. At the same time the construction costs are of great interest to many subjects in the economy. The private sector is dependent on the costs and a high unpredictability of construction costs can force certain customers to delay initiation of construction projects until a more stable time moment. Governmental institutions are a significant customer for the road, bridge and infrastructure construction companies and are following the construction cost fluctuations with unease. One of the reasons is the budgeting issue – unstable costs result in budgeting and price setting issues. Another reason is productivity – high rise of construction costs due to increase in employee wages can lead to decreased productivity in the construction market.

In order to understand the general shifts in the construction sector, Author is going to look into the dynamics of both the construction output and construction costs for the time period since 2006 until 2017. Further forecasts will be made to assess the possible development in short-term. Increased construction output should lead to a higher demand for workforce and building materials, hence increased overall construction costs. To test this assumption Author will analyse the causal links between construction output and costs overall and per sub-sectors.

Literature Review

There are two main sources of literature for this research paper. Primarily, author looked into articles in journals covering approaches to analysis of construction costs in different countries and theoretical opinions on these matters. Some literature is devoted to prediction of construction costs for individual projects. Research of Emsley et al (2002) looks into application of data modelling using neural network approach to predict the total construction costs. In this case a dataset of nearly 300 building projects was used to collect necessary data. Elhag et al (1999) creates a system of ranking influencing factors. A scale for rating each factor ranging from 1 to 3 is used with an increased significance of the respective factor. The factors are based on individual projects, hence this approach can't be directly used on a national scale. Nevertheless the concept of scaled weight of factors can be considered by applying to macro-level factors that influence the construction market of a nation. Moon et al (2017) describes construction cost forecasting Construction Cost Index. This index can be used for temporal correction of cost data, planning, fluctuation etc. It is widely used by the US construction industry for construction projects. Its use is limited to an individual project, but the calculation of the CCI is based on macroeconomic data. Authors developed a CCI forecasting model employing

ARIMA method to model further tendencies of the CCI. Interventions were used to decrease the influence of events as recessions or policy changes.

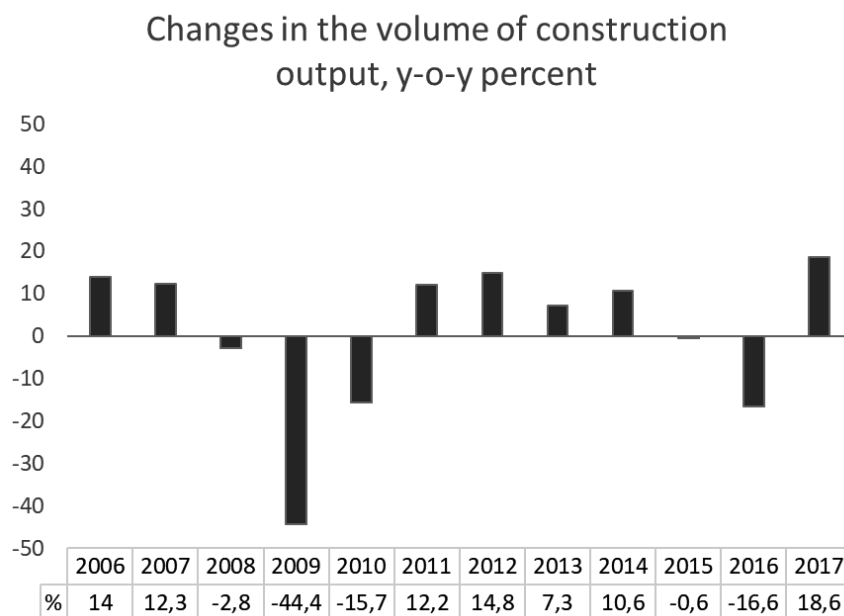
The methodological approach has been studied by Hwang (2011) and Emsley et al. (2002). A significant amount of factors, that contribute to the costs in the construction area have been analysed by Cheng (2014) and in the collective research by RS Group (2016) for the Ministry of Welfare of Latvia. Long (2017) even argues, that the increase of construction costs can have a political ramifications by limiting the state options in finishing infrastructure projects.

Secondarily, research on specific countries has been used. As the main source Author can mention the Latvian research by Inovatīvās Konstrucijas (2018), a group research for the Ministry of Economics of Latvia aimed at analysing and forecasting both construction output and construction costs for Latvia. Additional foreign research has been done on this topic by Elhag et al. (1999) and Gyourko et al. (2006).

In general there is scarcity of research looking into effect of output and costs in construction market on a national level.

Research results and discussion

The construction market in Latvia has seen a lot of turmoil since 2006. The early years of this period saw a healthy construction output growth of 14% in 2006 and 12.3% on 2007. After these years Latvian economics were thrown into economic recession never seen since the previous century. The market bubble in the immobility market has been names as one of the main reasons for the economic recession in Latvia. That implies, that a drop of construction output should be evident during the recession. This was the case in 2009 with a staggering construction output decline of 44.4%. The construction market regained it's growth only in 2011. During the period of 2011-2014 the growth kept hovering around the 10% mark. 2016 came with new correction and a temporary decline of 16.6%. This time this could not be called a sign of a new recession, since the market recovered in 2017 with a record growth of 18.6%.



Source: author's constructed based on Central Statistical Bureau of Latvia data

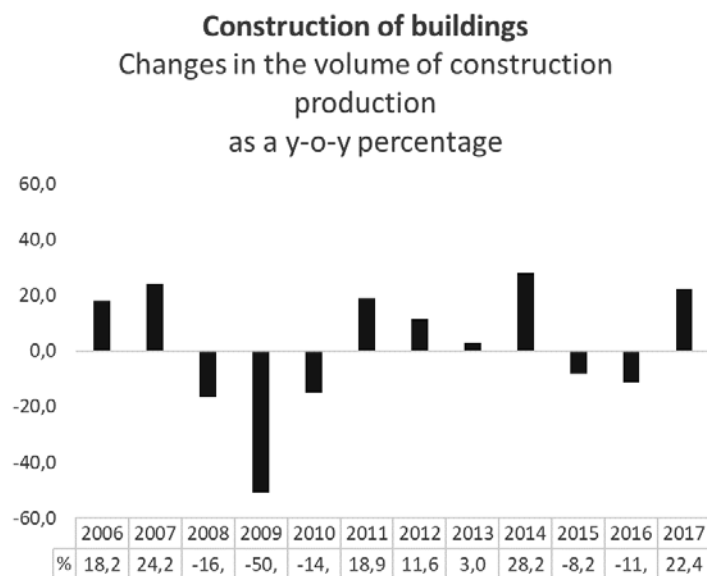
Fig. 1. Construction output in Latvia from 2006 till 2017, year-on-year percent changes

Any market, that is not homogenous, has to be analysed by splitting it into smaller details. In our case the construction sector is not an exception. This is a very varied sector with different areas that might have different development tendencies. That is also the case. The main areas, which will be differentiated in this paper, are:

1. Residential and non-residential buildings
2. Transport objects

3. Urban infrastructure objects
4. Civil engineering.

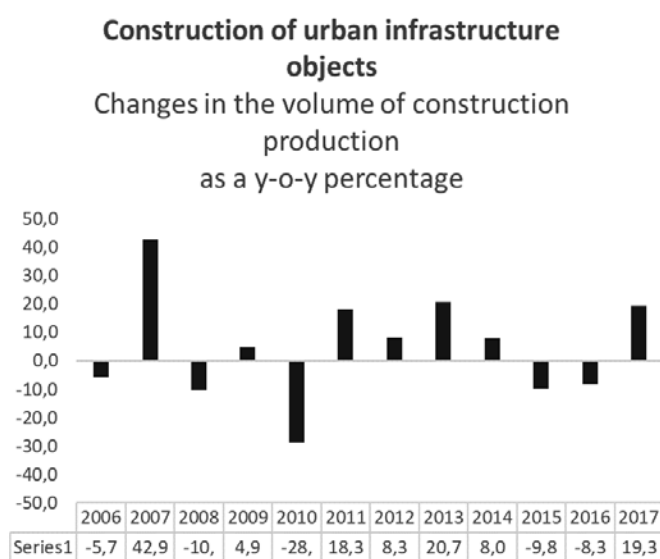
The residential buildings sector has seen a steady growth since 2011. Even the seasonal growth has been positive during winter seasons that usually have a lower construction output. The highest growth peaks have been reached in Q3 2012 with 7.3% growth relative to the corresponding quarter of the previous year. Even during the slowest growth periods in 2013 the growth was 0.6%.



Source: author's constructed based on Central Statistical Bureau of Latvia data

Fig. 2. Construction output of buildings in Latvia from 2006 till 2017, year-on-year percent changes

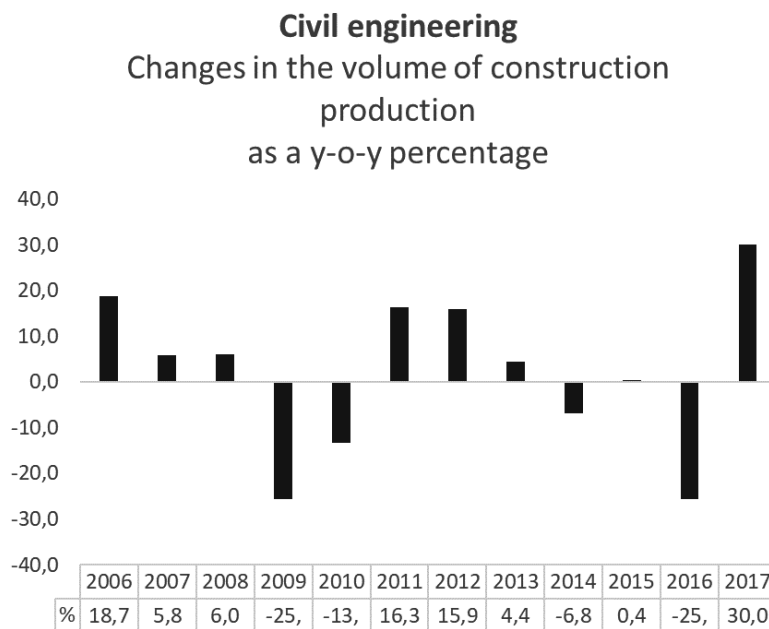
Non-residential buildings market hasn't been as stable in recent years as the residential building market. There have been no quarters with negative growth since 2012 and that is a good sign on its own. But the amplitude of growth rates is much higher than for the residential buildings market. We can observe more quarters with a growth below 1 percent – there have been 8 such occurrences in the observed period. In comparison there were only two periods with growth below 1 percent in the residential buildings market.



Source: author's constructed based on Central Statistical Bureau of Latvia data

Fig. 3. Construction output of urban infrastructure objects in Latvia from 2006 till 2017, year-on-year percent changes

A quite different picture unfolds when observing the tendencies in the construction output of transport objects. Three quarters of 2010 show a decline in construction output and both 2015 and 2016 have a decline in construction output. At the same time the small recessions are compensated with a stark growth in 2011 and 2012. The transport infrastructure is a very specific area of the construction sector. The two sub-sectors we looked at previously (residential and non-residential buildings) are mostly projects undertaken by private customers. Those could be immobility developers, private entrepreneurs, individuals etc. In the case of transport objects the main contractor usually is the government. Transportation objects include roads, bridges, canals, seaports, airports, tunnels and other infrastructure objects. Rarely are such projects financed by private entities. Governmental procurement is linked to the available financing by the State. In Latvian case significant part of transportation infrastructure projects are co-founded by the European Union. And the current financing framework coincided with the drop in construction output in 2014 and 2015. Before the drop the allocated funds have been actively used for construction and that manifests in the growth in 2011-2013. Considering the current financing framework we could expect another drop after 2019.

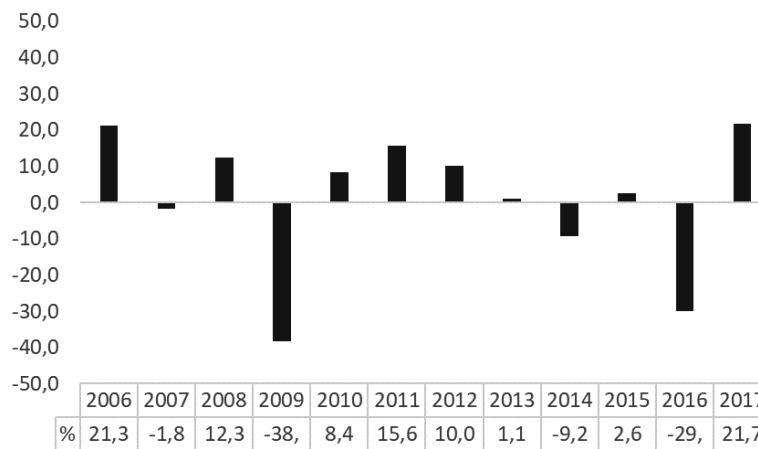


Source: author's constructed based on Central Statistical Bureau of Latvia data

Fig. 4. Construction output of civil engineering in Latvia from 2006 till 2017, year-on-year percent changes

A similar development to the transport object construction can be observed in the case of underground main pipelines construction. This sub-sector also heavily relies on governmental projects, since private entities are not prone in ordering construction of underground infrastructure (water, sewage, electricity, telecommunications etc.). The drops haven't been so severe as in transportation infrastructure, but the negative growth years coincide with the same 2015-2016 as previously observed.

Transport object construction Changes in the volume of construction production as a y-o-y percentage



Source: author's constructed based on Central Statistical Bureau of Latvia data

Fig. 5. Construction output of transport objects in Latvia from 2006 till 2017, year-on-year percent changes

By summarising the comparison of the dynamics of residential, non-residential, transport and underground main pipes construction outputs we can conclude, that the summary construction output in Latvia is summation of, sometimes, opposite forces. That shouldn't be viewed as a weakness of the market. On the contrary, Author believes, that this is a sign of market strength in being able to compensate weakness of one sub-sector with the strength of another sub-sector. Such a combination could help Latvian construction sector to overcome possible recessions that await us in the future.

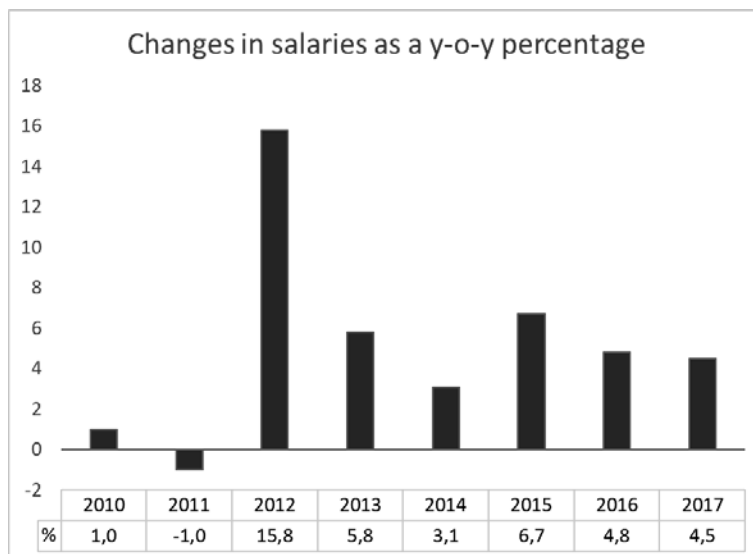
The second significant dynamic, that is of interest for this research, is the growth of construction costs. We will look at the construction costs in several sub-groups. Similar to the construction output, construction costs consist of several groups that might have different tendencies. We will look at:

1. Salaries in the construction sector;
2. Cost of building materials;
3. Maintenance and operating cost of machinery and equipment.

The first component – salaries, has been growing since 2012 in the construction market. The highest level of growth was observed in 2012 with a staggering 15.8% increase, followed by a one-digit growth between 3.1% and 6.7% per year. Previously the fast growth of salaries in the construction market in Latvia was linked with the forming of a bubble during the recession around 2008. In this case we could speculate about a new bubble, but instead we shall look at other possible causes for steady growth. And in the case of Latvia a significant role should be left for the activities of governmental bodies. Construction sector has been known as a sector with the highest level of grey economy and large share of undeclared salaries. As a result Latvian governmental institutions (Ministry of Economics, State Revenue Service and others) have been implementing rules aimed at curbing illegal activities. Few of the activities are:

1. Introduction of electronic on-site registration for construction workers;
2. Requirement to keep personnel contracts on-site;
3. Additional audit for companies that pay below average salaries;
4. Stricter requirements in State tenders for companies regarding average salaries.

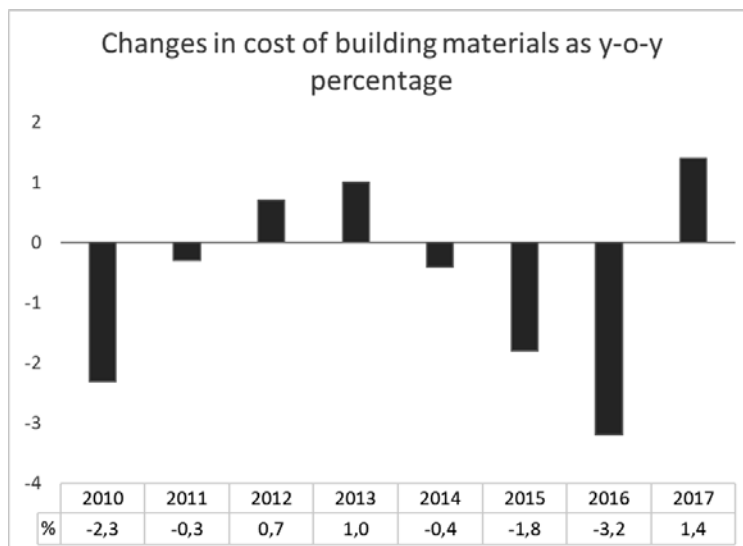
Author believes that these activities have motivated the construction companies to legalize their activities and move out of the grey-economy. As a result we are observing increase of the salaries based on statistic data that might actually show increased legalization of already de-facto salaries that have been hidden from official accounts.



Source: author’s constructed based on Central Statistical Bureau of Latvia data

Fig. 6. Changes in salaries in construction sector in Latvia from 2010 till 2017 in year-on-year percent

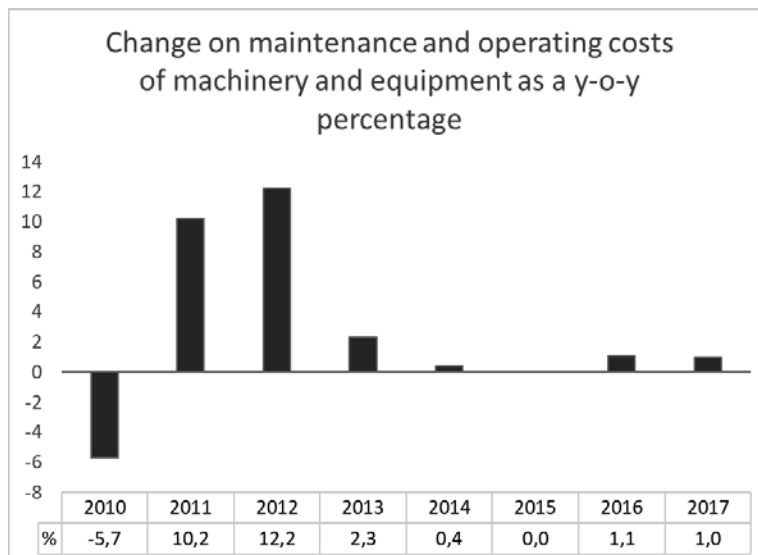
The cost of building materials has been fluctuating very wildly. The change is absolutely different from the movement of salaries. At the same time the range of fluctuations is much smaller. The highest growth of 1.4% in 2017 and lowest decline of 3.2% in 2016. The building material market is very concentrated in Latvia – both from the retail and production point of view. As a result, the prices should have been driven to their optimal point without any further potential for significant decrease.



Source: author’s constructed based on Central Statistical Bureau of Latvia data

Fig. 7. Changes in building materials costs in construction sector in Latvia from 2010 till 2017 in year-on-year percent

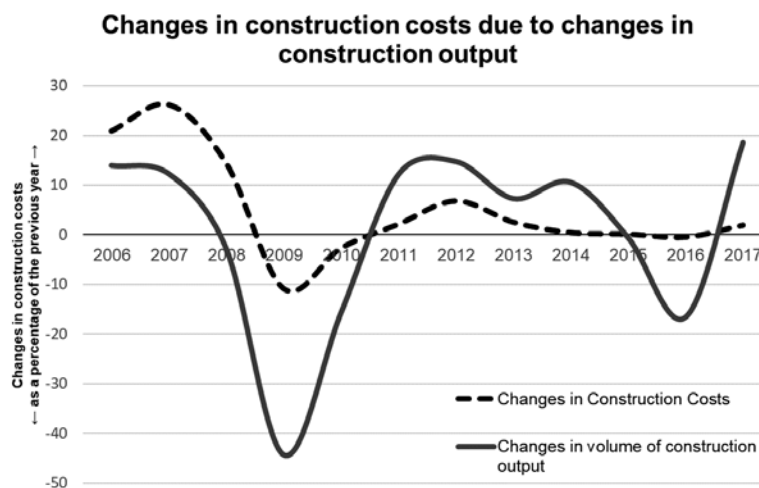
The maintenance and operating costs of machinery and equipment is a relatively small part of the total construction costs in Latvia. And since 2013 there has been a lot of movement here. The changes have been low, in 2015-2017 the growth been 0.0%, 1.1% and 1.0%. We can conclude that this market is very stable and well amortised, so we don’t expect significant changes anytime soon.



Source: author's constructed based on Central Statistical Bureau of Latvia data

Fig. 8. Changes in maintenance and operating costs of machinery and equipment in construction sector in Latvia from 2010 till 2017 in year-on-year percent

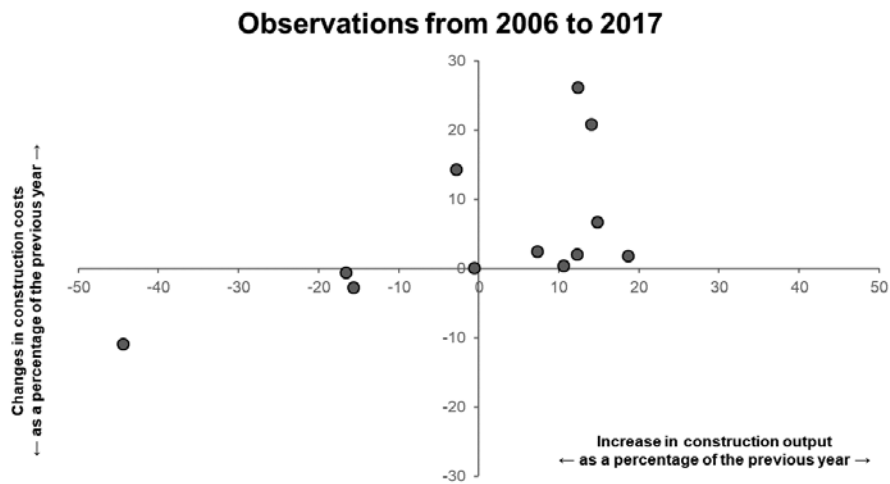
After we have looked at the time series of construction outputs and construction costs, we must look at the interaction between these two indicators. If we reason from the point of view of economic forces, there must be a causality here. If the demand for construction services increases, then it manifests itself in increased construction output. This output is the supply provided by the construction companies. To increase the construction output, the construction companies must increase demand for employees and increase their demand for construction materials, machinery and equipment. An increased demand for these goods and services should affect the prices. As a result, we should expect increase salaries (as supply of qualified personnel might be limited) and increase costs for goods used in construction.



Source: author's constructed based on Central Statistical Bureau of Latvia data

Fig. 9. Development of construction costs and construction output in Latvia from 2006 till 2017 in year-on-year percent

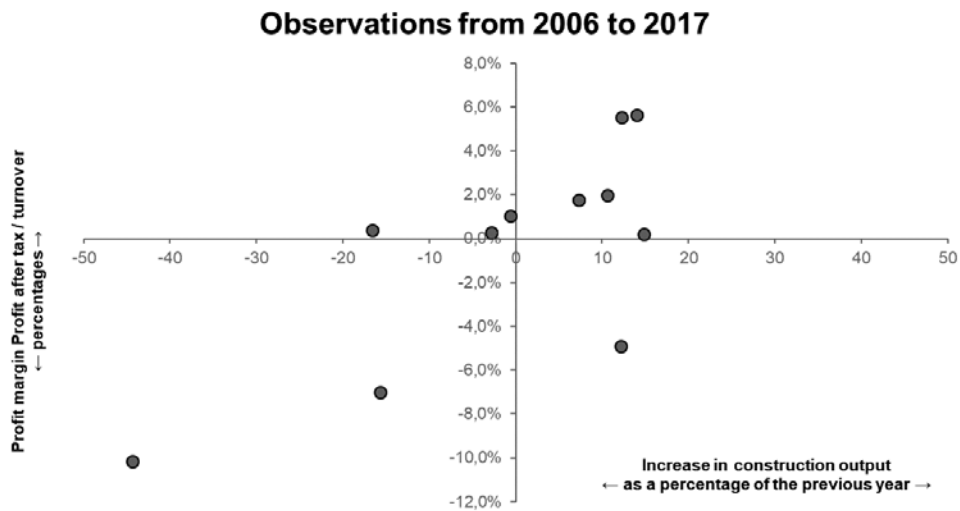
In general, we do observe the effect mentioned above. During periods of growth of construction output (2006-2007; 2011-2014; 2017) the construction costs also increased. At the same time during decline of construction output (2008-2010; 2015-2016) the construction costs either declined or had a low growth rate. But at the same time, we have to admit, that the relation doesn't appear to be very strong. So we have to look into these effects a bit deeper to determine, if there is a quantitative link and of the effect might be time dilated.



Source: author's constructed based on Central Statistical Bureau of Latvia data

Fig. 10. Scatter plot of increase in construction output and construction costs in Latvian companies, 2006-2017

The correlation chart for changes in construction output and changes in construction costs shows a general increasing tendency. The correlation coefficient between these two indicators is 0.587. We can interpret that as an average correlation, the effect can be observed, but is not very strong. The regression analyses yields us with a regression parameter of 0.334. Each increase of construction output by one percent point results on an increase of construction costs on average by 0.334 percent points. We can conclude, that the growth of construction costs is less varied as the growth of construction output. An increased dispersion of construction costs can be observed at higher construction output levels indicating heteroscedasticity in our dataset.



Source: author's constructed based on Central Statistical Bureau of Latvia data

Fig. 11. Scatter plot of increase in construction output and profit margin in Latvian companies, 2006-2017

One of assumptions for lower cost increase during the high growth periods and high decline periods is the ability of the construction companies to create dumpers for their finances. Even in dire economic situations construction companies are using their profit from successful years to compensate for the losses. They are willing to bare these losses, since maintaining of the market position is much more important than short-term losses.

Conclusions, proposals, recommendations

1. The construction output in Latvia has been unstable and prone to large fluctuations, very difficult to forecast using conventional statistical methods. Author recommends use of expert methods for further forecasting of the development of construction output.
2. Construction costs are linked to the construction output, but the correlation is average. An increase of construction output in Latvia by one unit causes the costs to increase on average by 0,334 units. The responsible government institutions are recommended to use their procurement as an instrument to normalize construction market growth, that will stabilise costs.
3. Construction sector salaries is the most volatile component of the construction costs. Other costs (building materials, maintenance and operating costs of machinery and equipment) have lower variances. The trends should become more stable since the State activities in fighting grey economy in construction market have passed their high point.
4. Further research should be done on the scale of factors, that influence both construction output and construction costs. Such a research could entail use of expert methods and factor analysis.
5. The result of this research should be used by state agencies for budgetary planning for governmental construction projects, that involve long-term financial allocation.

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