‘Development of Business Cycle Indicators (leading and coincident) for the Rwandan economy: Step 1- Indicators for the construction sector’

Final Report

By

The Institute of Policy Analysis and Research (IPAR- Rwanda)

And

RWI - Leibniz Institute for Economic Research (RWI)

For

GIZ-Rwanda

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Contact Person: Philipp Jäger (RWI)

Dr. Alexandre Simons (IPAR)

E-mail: philipp.jaeger@rwi-essen.de,

a.simons@ipar-rwanda.org, Cell phone: 0781849722

1. Background & Purpose of the project

Timely information on economic activity is crucial for policy making and evaluation. Fiscal stimulation, for instance, is most advantageous in times of recession and superfluous at best during economic upswings. However, official data on economic activity is only available with a substantial time lag. This is particularly true for National Accounts data, which, in addition, is often revised substantially after first publication. National accounts data is therefore not well suited for a reliable assessment of economic activity in real-time (Simone 2001). A common practice to fill this information gap is to supplement National Accounts data with indicators of a higher (monthly or quarterly) frequency that are available prior to official statistics.

Table 1 provides an overview over existing indicators in the Rwandan context. So far mostly monetary indicators, collected by the National Bank of Rwanda, were available. Moreover, some real indicator such as industrial production and turnover, even though not publicly available, are collected by the National Institute of Statistics of Rwanda (NISR) and the National Bank of Rwanda (BNR). Information on the production of important branches of activity (agriculture, construction, and tourism), however, was lacking. Thus, the purpose of this project was to construct a single comprehensive business cycle indicator for the construction sector. Moreover, a short report (two-pager) has been created to quickly inform the public and policy makers about the current state of the construction sector.

Table 1. Existing indicators in Rwanda

Publicly available	Not publicly available
Yield curve	Industrial production
Exchange Rate	Turnovers
Consumer Price Index	BNR's Composite Indicator of Economic Activity(CIEA)
Producer Prices	
Commodity prices (IMF)	
Money supply	

Even though the time frame of the project was limited (slightly more than one month), the Institute of Policy Analysis and Research (IPAR-Rwanda) was able to acquire many of the intended indicators or has been given the approval to obtain additional important data (building permits, tax receipts, turnover, rents etc.) in the future. Moreover, IPAR-Rwanda launched a new business climate survey for the construction sector that is expected to provide new information for policy makers. In addition, the comprehensive construction indicator that has been build based on a limited set of indicators (cement production plus imports, credit to private sector) performs already

very satisfactorily. For the third quarter 2017, the indicator points to a moderate increase in construction activity.

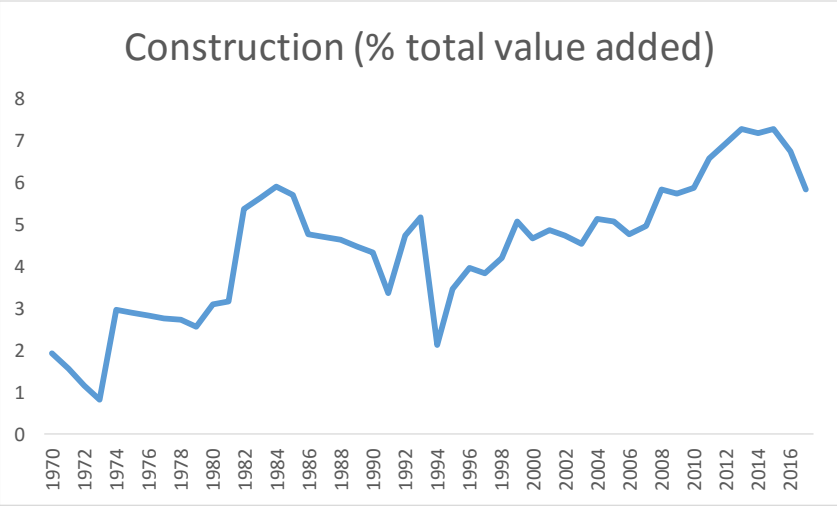
The calculation of this indicator will now serve as a benchmark for future business cycle indicators, namely in the areas of: agriculture, tourism and trade which will enable IPAR-Rwanda to conduct independent business cycle forecasts. This project has been conducted as a cooperative endeavor of IPAR-Rwanda and the RWI located in Germany.

2. Indicators for the construction sector

2.1. Relevance of the construction sector

Analyzing construction activity is important because the contribution of the construction sector to total value added has increased substantially from the beginning of the century and reached more than seven percent in 2015 (Figure 1). Since 2016, however, the construction sector performed worse than the whole economy, which is partly due to the fact that major construction projects (Kigali Convention Center, Marriott etc.) have been completed (El-Gammal et al. 2017). Nonetheless, construction still contributes almost the same amount to Rwandan GDP (around 7%) as the whole manufacturing sector combined. Thus, given the importance of the construction sector–it is also the third biggest sector of employment after agriculture and trade–it is vital that policy makers have sufficient information to react to these trends or even anticipate them in advance (National Institute of Statistics of Rwanda 2017).

Figure 1: Construction in % of total valued added, 1970-2017



Source: NISR, before 2006: UN-National accounts, 2017: average of the first two quarters

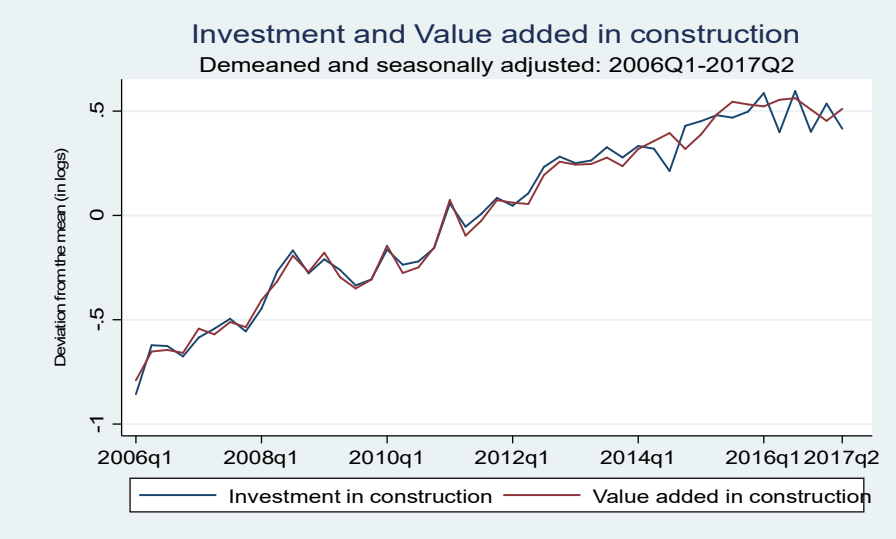
Since national accounts data is only available with a time lag of at least three months, it is currently difficult to assess the state of the construction sector in real-time

(nowcasting) or even anticipate future trends (forecasting). Therefore, IPAR-Rwanda and RWI aimed to build business cycle indicators specifically for the construction sector and publish them on a regular basis to inform policy makers and other interested parties. The indicator should combine the following characteristics: high predictive power, easy to update and available 1-2 months prior to the publication of the national accounts data.

2.2 The reference series for the construction indicator

To now/forecast construction activity, we first needed to define our reference series, i.e. the series that is supposed to be now- or forecasted. In the case of construction two series are natural choices: Total valued added in the construction sector as well as the construction part of gross fixed capital formation, both measured in constant prices. While total valued added in the construction typically closely matches profits plus compensation of employees in the construction sector, the construction part of gross fixed capital formation measures the value of newly build houses and roads. Thus, both variables are closely related, but measure slightly different concepts. In order to get a comprehensive picture of the construction sector, the project has investigated both measures. However, given that the evolution of both time-series is empirically very closely related (see Figure 2), we decided to focus on valued added only, which is slightly less volatile and more accurately measured. Thus, the indicators will be chosen based on their performance to now/forecast construction value added. The fact remains that given close link between the two potential reference series the results also hold for investment in construction.

Figure 2: Comparison of potential reference series[1]



[1] Demeaned means that we subtracted the sample mean for each observation so that they have a mean of zero.

2.3 Data collection of construction indicators

Table 2 shows indicators that are likely to have explanatory power for the construction sector as well as the potential data supplier. The selection was guided by two principles: economic relevance and timeliness. Thus, indicators need to be economically related to the construction activity and should also be available earlier than the National accounts data. In general, all indicators are likely to be available prior to the publication of the national accounts. However, there are two exceptions. First, construction employment is based on labor force surveys that are only conducted bi-annually (In February and in August). Second, current and projected resident population are also not updated in a high-frequency. Given the economic importance of employment and future resident population, we also collected data for these indicators, both, however, will enter the construction publication (two-pager) only for descriptive purposes. In the following, we describe how and what data has been collected during the project, which data is not available and which data has been agreed to be provided but has not been obtained yet.

Generally, indicators can be collected using one of the following two complementary approaches

1. Collection of new information, e.g. by surveys. This approach produces purposeful information, but is time consuming and often expensive.
2. Condense information on economic activity from various already available indicators. This approach has the advantage that it is cheap and quick. The disadvantage is that the information content depends heavily on the available data.

Throughout this project, we used both approaches. We collected survey data from construction companies and created a business climate index by asking the companies for their current business situation as well as their business outlook. Mostly, however, we relied on already existing information.

2.3.1. Business climate indicator

Typically, companies are well informed about the business environment they operate in, because their profits depend on a profound understanding of the market. Thus, in many countries, surveys among market actors accompany business cycle indicators from administrative sources. In Rwanda, regular company surveys are missing. Beginning with this project, IPAR-Rwanda has launched a business climate survey among construction companies. From now on this survey will be repeated on a regular basis (at least every three months) to inform the public and policy maker. Moreover, the survey should help to improve the now-/forecast performance for the construction indicator.

Table 2: Obtained indicators for the construction sector

Construction data		**Status**
Valued added in the construction sector	NISR (National accounts)	Publicly Available
Investment in construction	NISR (National accounts)	Publicly Available
Indicators		
Sentiment indicator		
Current business situation	Major construction companies	First survey results obtained
Business outlook	Major construction companies	
Direct indicators of construction activity		
Turnover in construction	NISR/BNR	Obtained
Employment in construction	NISR	Obtained
Input		
Imports of construction material (cement, metals etc.)	BNR	Obtained
Industrial production (cement)	NISR/BNR	Obtained
Prices		
PPI (input sectors)	NISR	Obtained
Prices for construction materials	NISR	Partly obtained
Prices for housing	NISR	Obtained
Financial data		
Loans (mortgages)	BNR	Obtained
Administrative data		
Building permits	City of Kigali	Obtained
Dwellings completed	City of Kigali	Not available
Fixed Asset Tax Rate revenues	RRA	Not yet obtained*
Public construction/investment	MINECOFIN	Not yet obtained
Other construction related		
Resident population	NISR	Obtained
General indicators of the economy		
Leading indicator BNR	BNR	Obtained
Credit to private sector	BNR	Obtained

* Institution agreed to share the information, waiting for the data to be sent.

The survey consists of ten questions (Table A1). Most importantly, companies are asked about their current business situation as well as their expectations about the business situation in the next six months. This information is then aggregated into one business climate index for the construction sector inspired by the ifo-business climate index in Germany, which is simple to calculate but has been shown to have good predictive power for future economic development (Henzel and Rast 2013) Therefore, the balance of the answers "good" and "poor" for the current situation and "better" and "worse" for the future expectations are calculated. The balance for both values (current and future) is then averaged. Irrespective of the short period in which the project has been executed, we have already obtained answers from 37 Rwandan construction companies. Moreover, we expect additional answers from additional companies soon, given that we have been in contact with them.

Box 1: Survey's results

Out of the 37 companies, 8 assess their current situation as "good" (22.9%) while 21 (60%) rate their current business situation as "poor". This relatively negative evaluation is mainly driven by a large share of small construction companies in our sample (73%). For companies with more than 10 employees, 40% (6 companies) assess their current situation as "good" and only 33.3% (5) rate their current business situation as "poor". For companies with more than 100 employees the current situation looks even more favorably, 75% (3) report a good business situation and no company rated their current situation as poor. Interestingly, business expectations are favorably across the board. Among all companies, 30.6% expected the business situation to improve within the next 6 months while only 11.1% expected it to deteriorate. Differences based on company size in the case of business expectations are much less pronounced than for the current business situation.

All in all, the value for the balance for December 2017 is -8.8[2], on a scale from 100 ("Perfect conditions") and -100 ("Disastrous conditions"), and hence relatively modest. However, as indicated above, this is driven by smaller companies which do not have much weight in the construction economy. Thus, the business climate indicator does not indicate that construction activity was weak in the construction sector in the third quarter and fourth quarter of 2017. For the future, the survey points to a moderate increase in construction activity. Employment prospects also support this: 36.1% of the companies stated that they will hire additional staff in the next six months, while only 25% said they will reduce staff.

Given that the business climate indicator is only generated from today onwards, we are not able to investigate the predictive power of the indicator. Thus, so far, we cannot draw quantitative conclusion for construction activity based on the survey. However, since the indicator provides completely new information, we believe it is already interesting for the public and policy makers in itself. To make the business climate index comparable over time, we will adjust future results if the composition of the companies changes (e.g. more or less small companies). Generally, we expect that the change in the business climate index will be more informative about future trends in the constructions sector than the absolute value of the index.

We also asked for challenges that construction firms face (multiple answers allowed). The main challenges according to the survey are: Strong competition (56.8%), Obtaining loans (48.7%) and high taxes (40.5%). Obtaining loans tends to be a challenge for smaller companies only. None of the companies that employ more than 100 employees reported that obtaining loans is a challenge.

[2] $\frac{(22.9\%\ \text{"}good\text{"} - 6\ \%\ \text{"}poor\text{"}) + (30.6\%\ \text{"}more\ favorable\text{"} - 11.1\%\ \text{"}less\ favorable\text{"})}{2}$

2.3.2. Remaining construction indicators

The remaining data was collected in the following way: First, we gathered data that is already available online (e.g. at the homepage of BNR and NISR). This included the producer price index, resident population or the national accounts data. Given that Rwanda scores relatively well on statistical capacity based on the World Bank index, the available data should satisfy certain quality standards. Secondly, we collected indicators from Rwandan authorities that have not been made publicly available yet, however, previous publications had indicated that they exist. Third, we requested additional data from other Rwandan entities (e.g. City of Kigali, Rwandan revenue authority-RRA) to increase the portfolio of available business cycle indicators.

Table 2 also indicates what data could be collected from the authorities. Irrespective of the short period in which the project has been executed (slightly more than one month), most intended indicators were obtained. This includes all publicly available information as well as data that has not been made publicly available such as industrial production of cement, turnover in construction, mortgage credits, long-run time series for imports of construction materials and building permits in Kigali. Moreover, for fixed asset tax receipts, RRA has already agreed to share the data with IPAR. However, it will take some time until the RRA has compiled the data. Therefore, we expect the next update of the indicator in March to include this additional indicator.

2.4. Testing the predictive power of the construction indicators

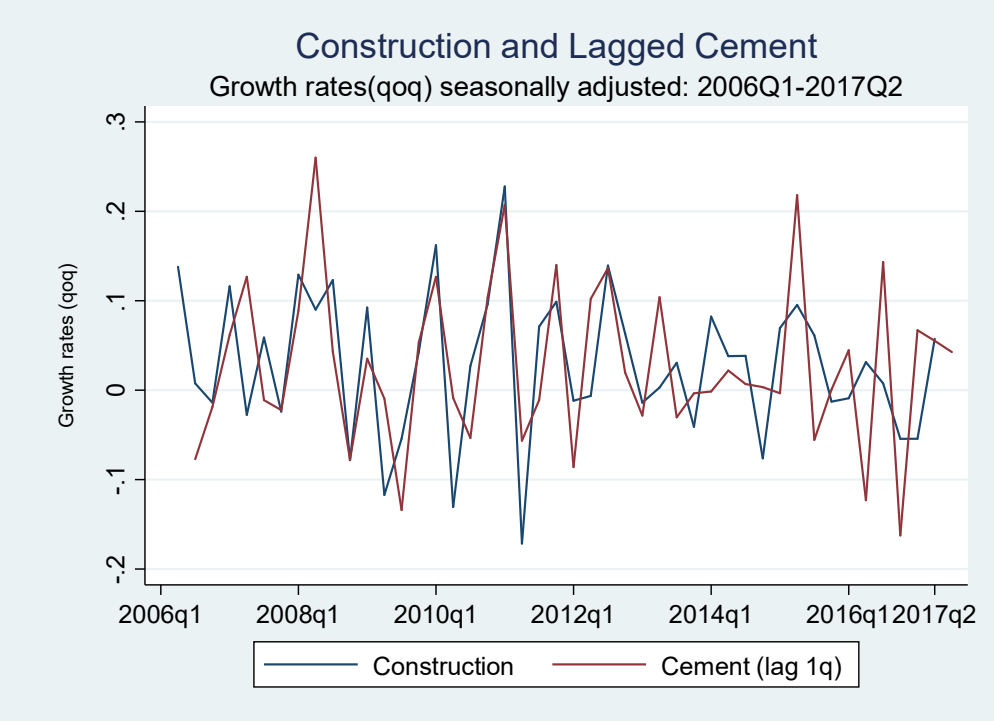
Before the predictive power of the indicators can be assessed, the indicators had to be homogenized to the same (quarterly) frequency as the national accounts. Therefore, if needed, monthly values have been averaged to quarterly values. Moreover, the data has been seasonally adjusted[3], because changing weather conditions or other seasonal factors potentially affect economic outcomes (e.g. harvest, prices and available budgets) and therefore influence the now/forecast outcome. In addition, forecasting is more accurate using seasonally adjusted data (Bell and Sotiris. 2010). To reduce the problem of different scales, we express every variable in growth rates[4].

We started by a simple descriptive exercise and plotted the seasonally adjusted growth rates of several indicators vis-a-vis the reference series. This procedure already reveals some promising indicators for now- and forecasting. Especially, the sum of lagged

[3] For the ease of replicability, we opted for a simple seasonal adjustment procedure and regressed the original values on quarterly dummies. We then took the residual of these regressions, which represent the seasonally adjusted and demanded equivalent of the original series, as our input variable for the analysis.
[4] More precisely, we use log-differences.

imports and production of cement (in kgs) matches the evolution of value added in construction well, even though the relationship seems to have weakened over the last three years (Figure 3). The other indicators do not perform nearly as well as cement. This can be explained by the fact that the NISR measures the value added in construction mainly with cement.

Figure 3: Relationship construction and cement (production plus import)[5]



In the following, we test the relationship between construction valued added and the indicator more formally by using regression models. Specifically, we regress value added in construction on its own lagged values as well as on the construction indicators and its lags (all variables in growth rates, starting with 4 lags) and select indicators (and lags) that have significant explanatory power for construction activity. We only select indicators that provide information that is not already captures by the past values of construction activity. As expected based on the previous results, cement (production plus imports) has by far the highest (additional) explanatory power for value added in construction. Credit to the private sector, Loans for the construction sector, import prices of construction materials, turnover in construction and the evolution of rents also have a statistically significant relationship with construction value added even if past values of construction activity are controlled for.[6]

Given that the selected indicators are potentially highly correlated, it is also important to test their explanatory power combined. Using more indicators -instead of simply

[5] Growth rate qoq: Evaluate the growth rate of variables quarter to quarter.
[6] Building permits are only available for a shorter period. Hence, there forecast performance could not been evaluated empirically.

using one- will only make sense if the indicators measure different components of construction activity. In order to test this, we regress construction activity on its own lags as well as on current values of cement and the other indicators. We continue by deleting variables that do not increase the fit (based on the adjusted R^2) of the regression[7]. Unfortunately, no other indicator increased the fit of the regression, which partly might be also due to the limited sample size. Thus, our first indicator will only be based on cement imports and production.

To also exploit the information included in the other indicators that may not reasonably be combined with the other indicators due to a lack of degrees of freedom, we also build an indicator based on bridge-models. Therefore, we regressed construction activity on one indicator only, and the predicted construction activity is based on the relationship with the respective indicator. We run regressions for each indicator that has been identified above and then average the forecast for each regression. We weight the average based on the forecast performance of each regression as measured by the root-mean-square error (RMSE). We also give more weight to longer time series, because they might be more accurately be identified and suffer less from overfitting.

$$Weight\ of\ a\ variable = (1/e(RMSE)) * e(N)$$

We run bridge-models with two different specifications: First, we simply regress construction on the indicator and a variety of lag combinations. Second, we do the same but add lags of construction activity. Thus, we end up with two additional indicators: one "plain" bridge-model indicator and one "autoregressive" bridge-model indicator.

Figure 4 provides an overview over the three indicators and construction activity. All indicators perform reasonably well over the last three years. The cement indicator performs very well over the period 2007 to 2017 (Figure 5), however, the relationship has weakened over the last three years. While the cement indicator explains around 75% of the variation in construction activity over the last ten years, it explains only 34% in the last three years. The bridge models have a better fit and explain 45% (AR bridge model) and 58% (plain bridge model) in the last three years. Thus, we will take all three indicators into consideration.

[7] The regression model is presented in the appendix.

Figure 4: Relationship construction and construction indicators

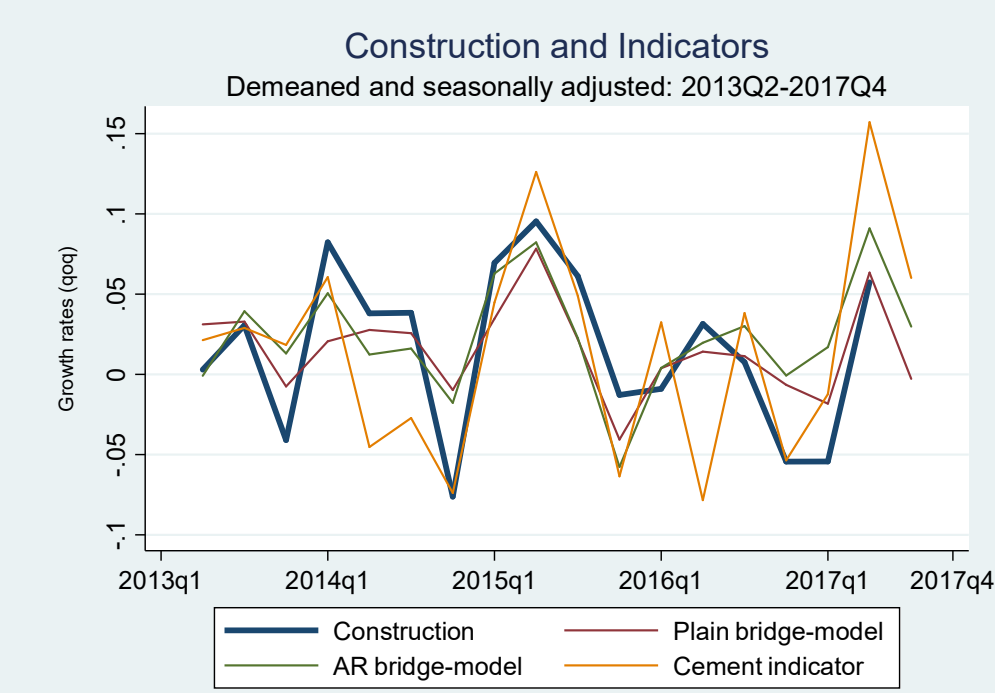
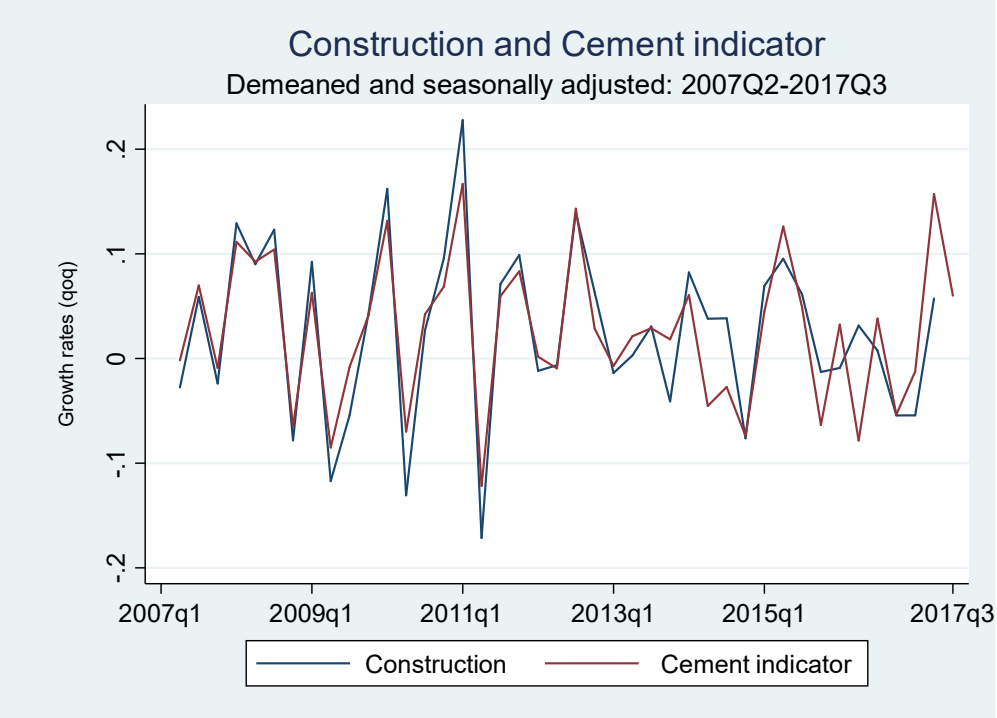


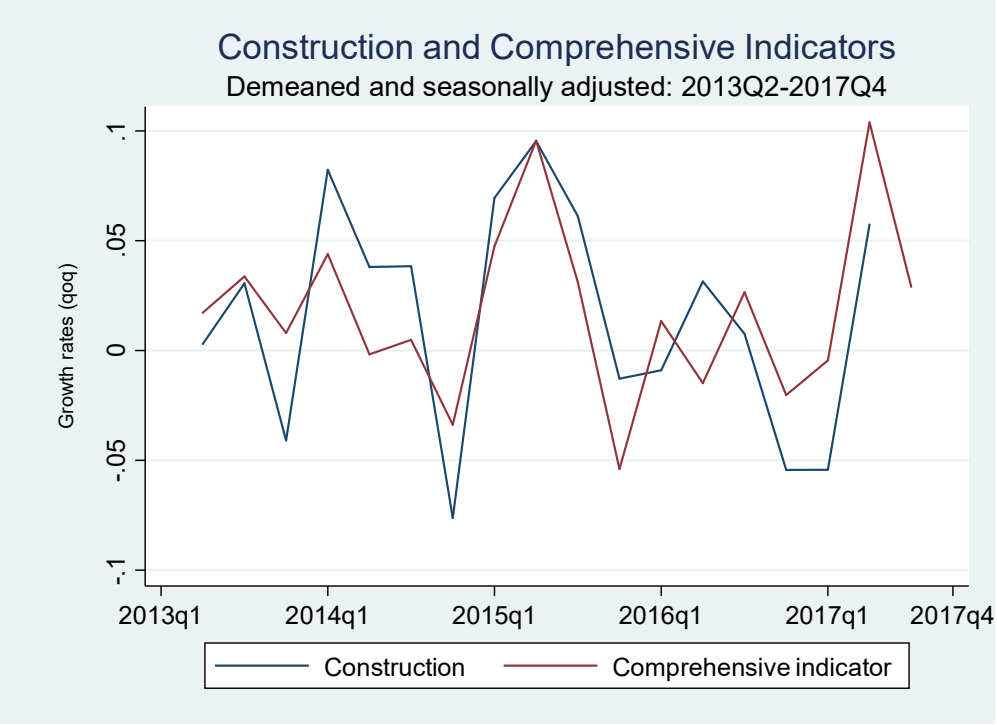
Figure 5: Relationship construction and cement indicator



2.5. Evaluating the comprehensive indicator

To come up with one single robust comprehensive indicator, we simply average the three sub-indicators described above (cement indicator, plain bridge-model, AR bridge-model). Using averages is in fact more straightforward and provided similar results as weighting indicator. As Figure 6 shows, the comprehensive indicator performs better than the cement indicator and explains around half of the variation of construction activity over the last three years. We expect future indicators such as building permits and business climate index to further improve the fit.

Figure 6: Relationship construction and comprehensive construction indicators



2.6. Now- and forecast for the third and fourth quarter of 2017

Based on the comprehensive indicator we expect that seasonally adjusted construction activity has grown by around 3% in the third quarter of 2017 and hence slightly less than in the last quarter (6%). Applying the same model but using non-seasonally adjusted data (see Figure A1-A3 in the appendix) the nowcast for the third quarter yields a growth rate of 4%, which is higher than the non-seasonally adjusted growth rate in the last quarter (1%). Thus, according to our nowcast exercise, the slight deceleration in construction growth that we predict based on seasonally adjusted data will likely by masked by seasonal effects in the national accounts data. Nonetheless,

both nowcast predictions show above-average growth rates and therefore point to a robust recovery in the construction sector.

We also investigated whether the indicators are helpful to forecast construction one quarter ahead (e.g. for the fourth quarter of 2017). In the forecast model[8] we are not able to include first lags of construction activity or current values of cement and/or credit to the private sector because they are not available yet. Therefore, the fit of the model is inferior to the nowcasting model. However, the forecast still explains around one third of total variation in the growth rate of construction activity one quarter ahead. Our forecast model, points to sustained growth in the sector. Construction is expected to expand by 3% in the fourth quarter (5% non-seasonally adjusted)

3. Sustainability

Now that the project is finished, IPAR-Rwanda will publish a report on the construction sector. In the future, data should be constantly provided by administrative and the statistical, enabling IPAR-Rwanda to publish the newly constructed indicators on a quarterly basis. The target is to produce a publication1-2 months ahead of the dissemination of the national accounts data. The quarterly publication will be issued in the form of a concise two-pager (see appendix), that will include a short report on the current trends in the construction sector as well as the main construction indicator and sub-indices. Moreover, it should include the newly constructed business climate index for the construction.

To ensure a skill-transfer from RWI to IPAR-Rwanda, the project has been conducted in close cooperation. RWI has built the construction indicator using the statistical Software STATA which is also available at IPAR-Rwanda. Now, two researchers from IPAR-Rwanda will replicate the empirical exercise to obtain knowledge that enables them to update the indicator in the future but also to generate business cycle indicators in other sectors. The ultimate goal of this endeavor is to enable IPAR-Rwanda to produce independent business cycle forecast for specific sectors as well as the whole economy. RWI will provide guidance in course of this process if needed.

[8] The specification is provided in the appendix.

4. References

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A. Appendix

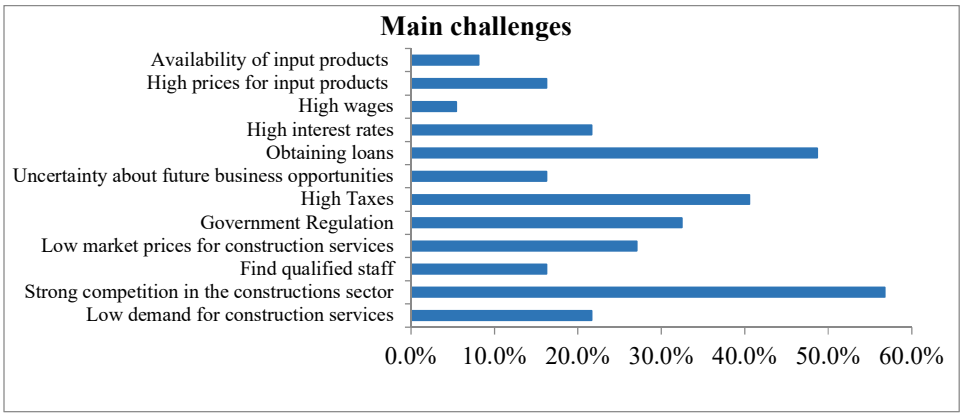
Table A1:Questionnaire Construction companies

1. How big is the market share of your company in Rwanda relative to other construction companies in Rwanda?
Big (Among the 10 biggest construction companies in Rwanda)
Medium (not among the 10 biggest, but among the 100 biggest construction companies in Rwanda)
Small
2. How many employees do you employ in Rwanda right now?
Less than 10
Between 10 and 100
Between 100 and 1000
More than 1000
3. How is the current business situation of your company in Rwanda?
Good
Satisfactory
Poor
4. In comparison to the current situation, how will the business situation in Rwanda most likely be in 6 months?
Better
Same
Worse
5. Within the next 6 months, do you plan to increase or decrease the number of employees in Rwanda?
Increase the number of employees
Decrease the number of employees
Number of employees will stay more or less the same
6. What are the main challenges that your company is facing in Rwanda right now? (up to 3 answers allowed - rank)
Low demand for construction services
Strong competition in the constructions sector
Find qualified staff
Low market prices for construction services
Government Regulation
High Taxes
Uncertainty about future business opportunities
Obtaining loans
High interest rates
High wages
High prices for input products (e.g. construction materials, energy)
Availability of input products (e.g. construction materials, energy)
No challenges
7. Where does your company mainly do business?
Rwanda
East Africa except Rwanda
Africa except East-Africa
Asia
Americas
Europe
Worldwide (no clear center of activity)

Business only in Rwanda
8. If the company also operates outside Rwanda: How is the current business situation of your company outside Rwanda?
Good
Satisfactory
Poor
Business only in Rwanda
9. If company also operate outside Rwanda: In comparison to the current situation, how will the business situation outside Rwanda most likely be in 6 months?
Better
Same
Worse
Business only in Rwanda
10. What is the nationality of the majority of your shareholders/owners?
Rwanda
East-Africa except Rwanda
Africa except East-Africa
China
Japan
Asia except China or Japan
USA
Canada
Germany
United Kingdom
France
Europe except Germany, France or United Kingdom
Latin America

Table A2. Main results from the survey

Among the 37 companies who responded to the survey. The overall result was that companies are in general Rwandans operating in Rwanda. They assess the current situation as poor and expect the situation to remain the same in the coming 6 months. Currently companies employ in general less than 10 employees but expect the number to increase in the coming years.



2. Regression equations for the sub-indicators

Cement indicator

To now-cast construction activity based on the cement indicator we estimate the following Autoregressive Distributed Lag (ADL) model:

$$\triangle\, log\,(construction\ activity)_t = \alpha$$
$$+ \sum_{i=1}^{3} \beta_i\ \triangle\, log\,(construction\ activity)_{t-i}$$
$$+ \sum_{i=1}^{4} \delta_i\ \triangle\, log\,(cement)_{t-i}$$
$$+ \varepsilon_t$$

To forecast construction activity based on the cement indicator the estimate looks the following:

$$\triangle\, log\,(construction\ activity)_t = \alpha$$
$$+ \sum_{i=2}^{3} \beta_i\ \triangle\, log\,(construction\ activity)_{t-i}$$
$$+ \sum_{i=1}^{4} \delta_i\ \triangle\, log\,(cement)_{t-i}$$
$$+ \varepsilon_t$$

Bridge-models

For the "plain" bridge models, we run the following regression for every indicator and every lag length *j* between 1 and 4 and calculate the predicted values for every regression. We then average all predicted values obtained from the regression and weight them by the inverted value of the RMSE multiplied by the number of observations. For the forecast bridge models, we simply omit the first lag of construction activity as well as the current values for indicators.

$$\triangle\, log\,(construction\ activity)_t = \alpha$$
$$+ \sum_{i=0}^{j} \delta_i\ \triangle\, log\,(indicator)_{t-i}$$
$$+ \varepsilon_t$$

We proceed identical for the "autoregressive" bridge models, with the exception that we augment the bridge regression by autoregressive terms of construction activity.

$$\triangle\, log\,(construction\ activity)_t = \alpha$$
$$+ \sum_{i=1}^{j} \beta_i\ \triangle\, log\,(construction\ activity)_{t-i}$$
$$+ \sum_{i=0}^{j} \delta_i\ \triangle\, log\,(indicator)_{t-i}$$
$$+ \varepsilon_t$$

Figure A1: Relationship construction and cement indicator (not seasonally adjusted)

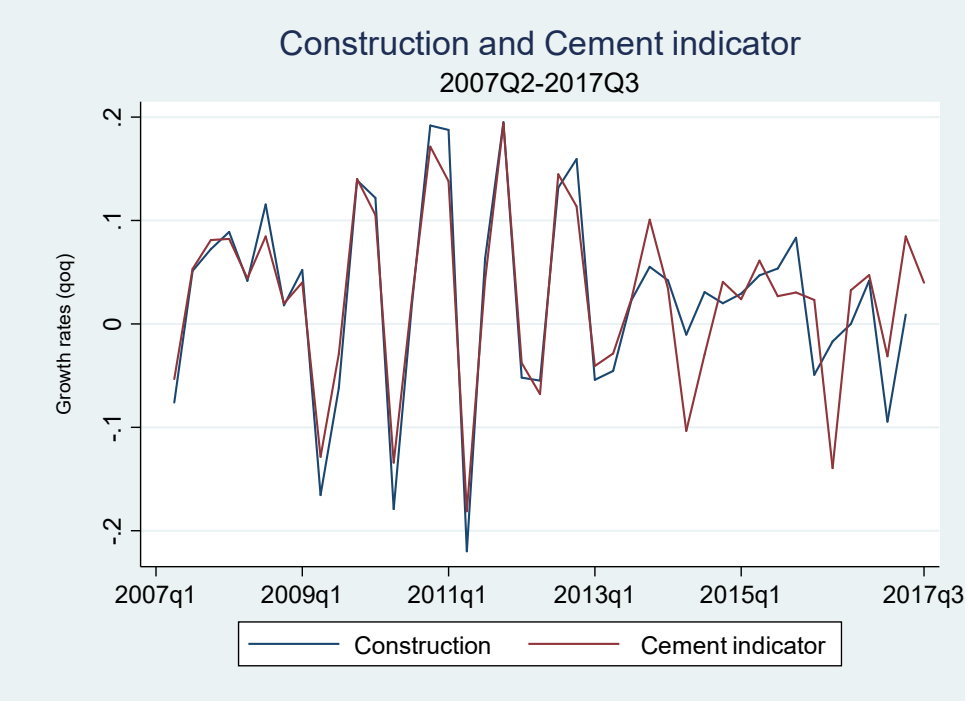


Figure A2: Relationship construction and construction indicators (not seasonally adjusted)

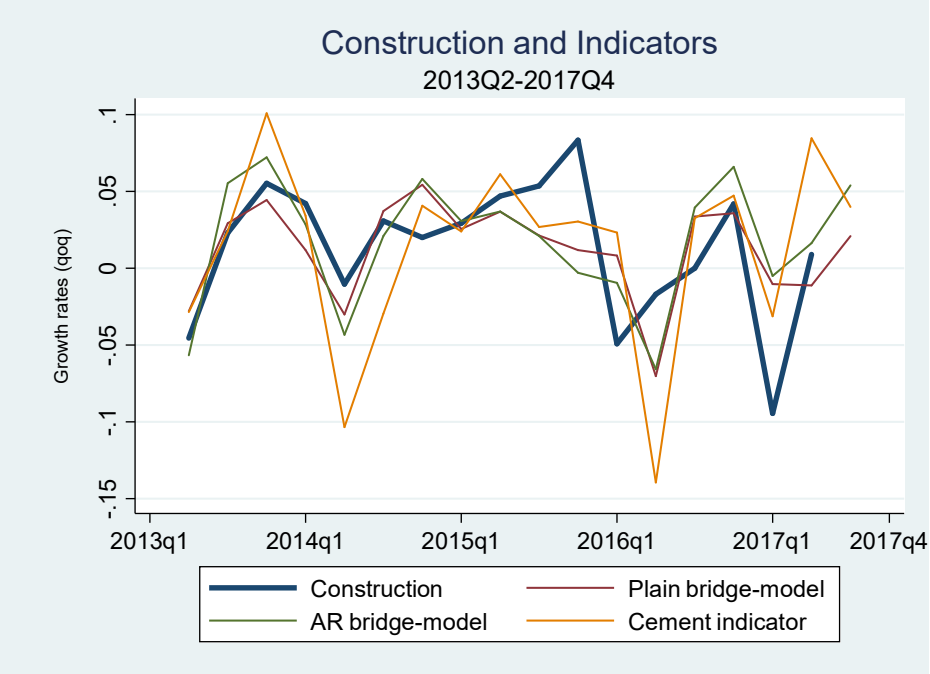


Figure A3: Relationship construction and comprehensive indicator (not seasonally adjusted)

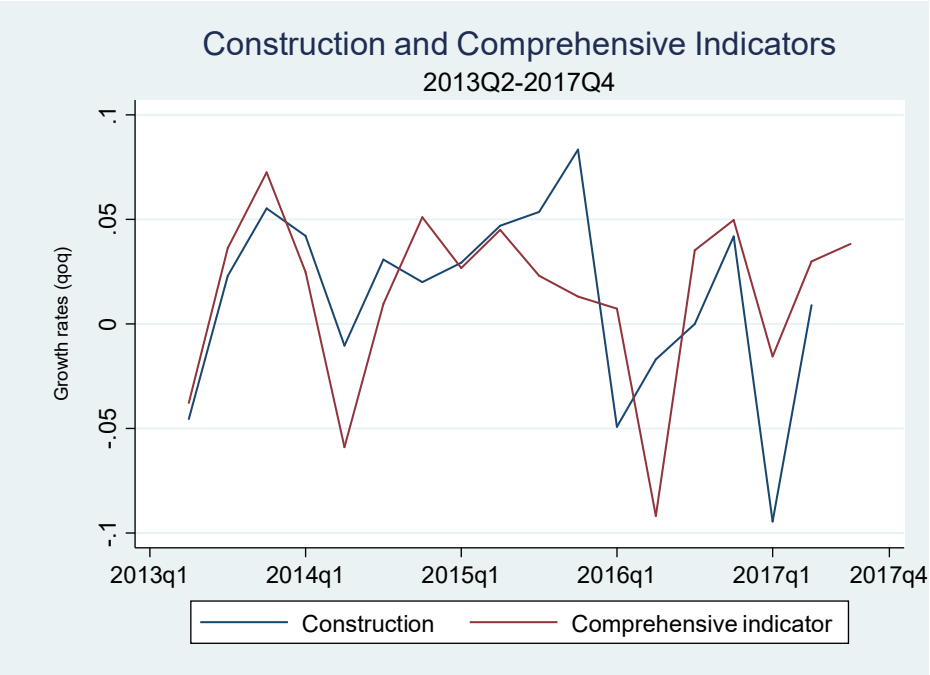


Figure A4: Original time series turnover

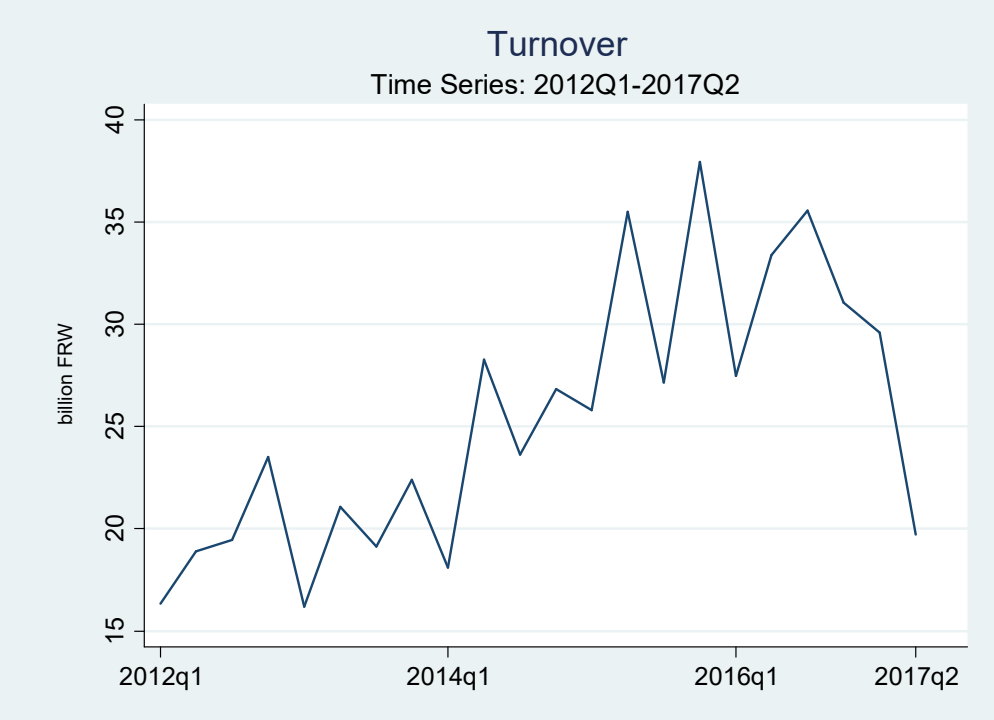


Figure A5: Original time series Actual rent

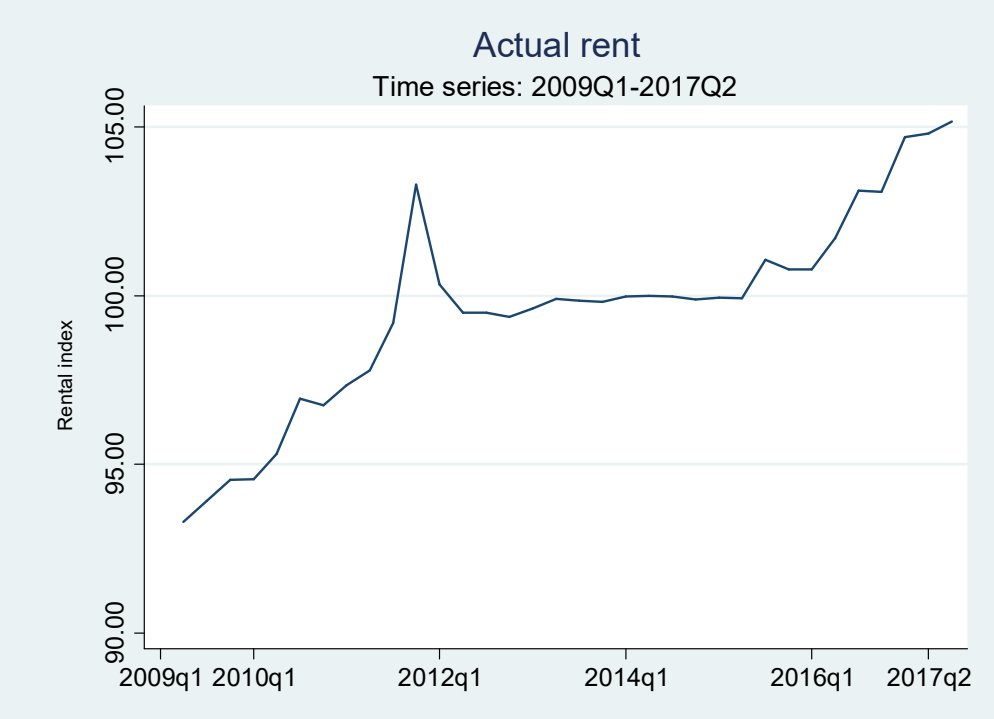


Figure A6: Original time series Loans in the construction sector

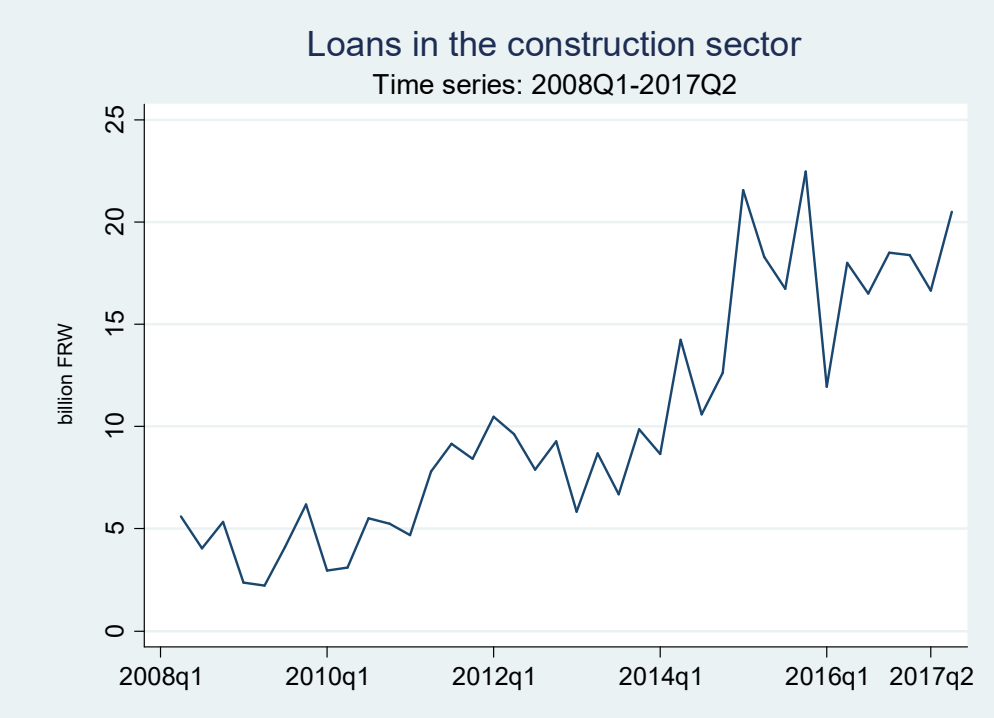


Figure A7: Seasonally adjusted growth rate construction and turnover

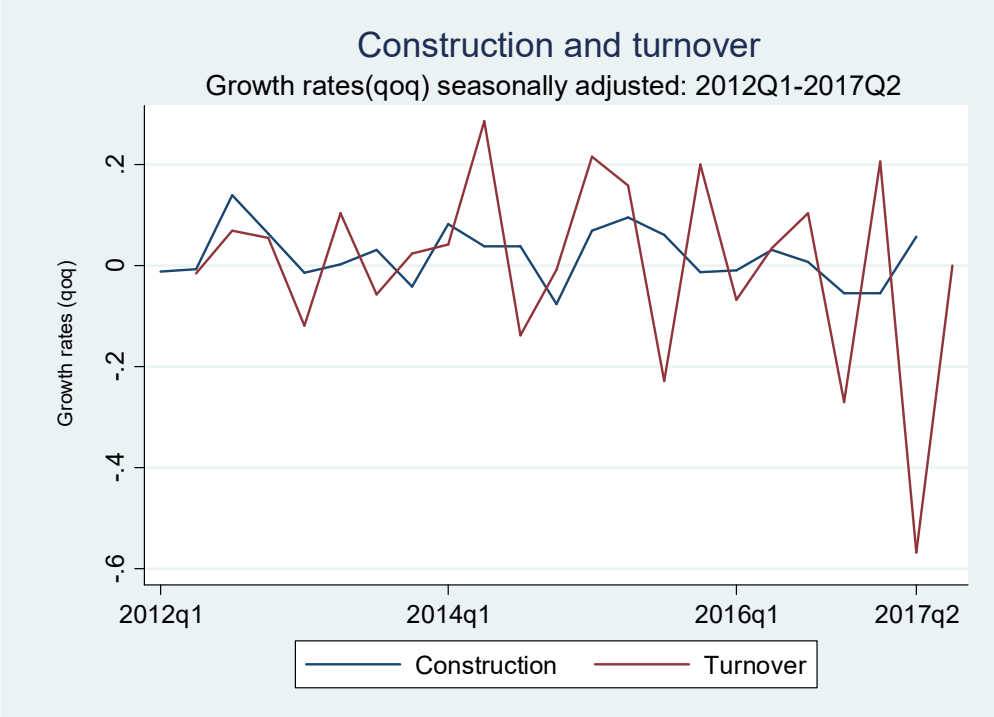


Figure A8: Seasonally adjusted growth rate construction and actual rent

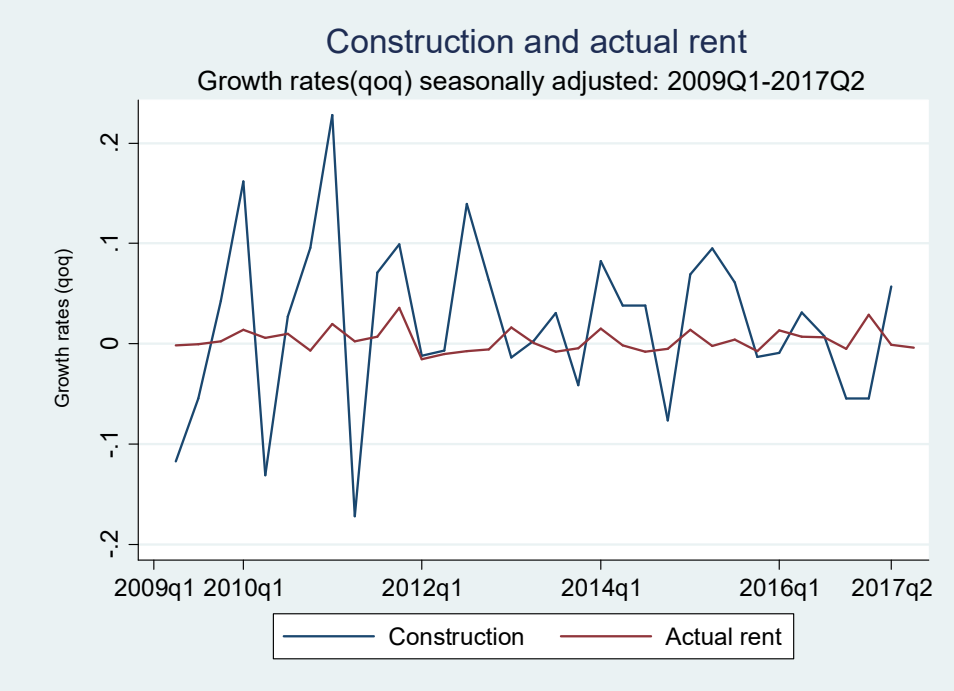


Figure A9: Seasonally adjusted growth rate construction and Loans to the construction sector