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Short and Long-Term Relationships among the Surety Bond Market, the Building Sector, and Relevant Nominal Variables Related to the Construction Industry: The Mexican Case (2006-2014)

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ABSTRACT

This paper is aimed at examining the relationship among the surety bond market, the building sector, and several important nominal variables related to the construction industry en México during 2006-2014. To do this, we use vector autoregressive and cointegration models in order to find short- and long-run relationships. We also perform a Granger causality analysis and an impulse-response examination, as well as variance decomposition. The main finding is that the surety industry responds to changes in: GDP from construction, credits for the construction sector, revenues of the private construction, and credit defaults. We also find empirical evidence that in the long run the surety industry reacts to: The government investment, the default in this industry, and the interest rate.

Keywords: Surety Markets, Building Sector, Nominal Variables, Time Series Analysis
JEL Classifications: G22, E44, C32

1. INTRODUCTION

Although the use of sureties is a common practice around the world, there are very few studies on the effect of this market on the building sector in the Mexican case. Moreover, the particular legal status in Mexican regulation and the comparatively smaller penetration of surety bonds in the economic activity makes of this study an almost unexplored field in the Mexican economy[1]. González-Ramírez (2003) states that the presence of the commercial surety industry in Mexico began in 1895[2] but has previous antecedents with the Lares code of 1854 as Cruz-Barney (2006) mentions in his paper. Despite its tradition and the important role of managing the counterpart risk in the execution of projects or the performance of counterpaties, the surety industry is a relatively small part of the Mexican financial system. Its participation in the Mexican economy, according to the National Insurance and Bonding Comission (Comisión Nacional de Seguros y Fianzas [CNSF]) in direct premiums was about 7,701 millions Mexican pesos in 2013, which represented the 0.047% of the Mexico gross domestic product (GDP)[3]. With that direct premium, the surety industry secured an amount equivalent to the 5.7% of Mexico's GDP. In such contracts, most of them administrative sureties were used to cover the construction sector or the delivery of services or products; being the government the main beneficiary. To make a deeper analysis of this small part of the Mexican financial system, we will briefly describe the classes of surety bonds available in the market (Rosas-Rodríguez, 2016):

1 We may define a surety bond as a three-party agreement in which the company as the issuer of a bond (the surety) joins with a second party (the principal) in guaranteeing to a third party (the owner/obligee) the fulfillment of principal's obligation.

2 This began with the permission granted to the American Surety Company of New York for establishing an office in Mexico.

3 The Mexican GDP in 2013 was 16,830,523 millions of current Mexican pesos. (Instituto Nacional de Estadística y Geografía, 2016)

Table 1: Importance of administrative sureties in the mexican economy

Type of Bond	Contract	Net written premium	Liability for surety in force	%	Liability for surety in force estimated
Advance payment	Construction	$1,127,319,512	$106,090,699,358	20%	
Advance payment	Delivery	$397,391,579	$47,207,840,130		
		$1,524,711,091	$153,298,539,488		$110,069,498,348
Advance payment	Construction	$1,445,101,463	$147,217,943,112	35%	$106,090,699,358
Advance payment	Delivery	$1,286,869,213	$102,431,297,125		$197,222,046,578
		$2,731,970,676	$249,649,240,237	40%	
Total		$7,701,954,545	$556,007,153,138		$307,291,544,926
Percentage assured by Surety Bonds					$768,228,862,315
Amount of the contracts estimated				6.04%	$ 1,016,944,470,527.00
Total amount of the contracts estimated					$16,830,523,000,000
PIB (4Q 2013)				4.53%	$ 762,708,352,895.00
% of PIB assured by Surety Bonds					16,830,523,000,000
Public Sector					
Total amount of the contracts estimated					
PIB (4Q 2013)					
% of PIB assured by Surety Bonds					

1. Administrative (73.56% of premiums): This group includes bid bonds[4], advance payment bonds[5], payment bonds[6], performance bonds[7], and maintenance and warranty bonds[8].
2. Fidelity (20.14% of premiums): This group is used to protect the firms from losses associated with employee dishonesty.
3. Judicial (2.56% of premiums): The court requires these bonds to guarantee the opposing litigant payment of costs and damages.

Due to the market share of the surety industry, we show the importance of the administrative bonds in the Mexican economy in Table 1.

It is also significant to point out that the use of sureties is mandatory according to the Acquisitions and Leases of the Public Sector Law (Honorable Congreso de la Unión, 10 de Noviembre de 2014)[9] for any person selling goods or services to the Mexican government. The law asks government contractors to assure between 10% and 30% (depending on several factors) of contracts involving:

1. The acquisitions and lease of personal property.
2. The supply of movable property to be incorporated or allocated to property necessary for carrying out public works.
3. The purchase of maintenance services to real estate.
4. The reconstruction and maintenance of movable property; outsourcing; insurance; transportation of personal goods or persons, and hire cleaning and security services.
5. The engagement of long-term services.
6. The hiring of consultants, consulting, studies and research.

Not only de government asks its contractor for such assurances, but the private sector also asks for them to its contractors in projects if they have none or little previous relationship, experience or general information about those contractors. In such cases, the surety bonds create confidence by removing part of the credit or operational risk from the contract. Figure 1 shows the evolution of the use of surety bonds in the government and private sector in recent years.

Since the core of the surety bond industry is the credit risk management, its macroeconomic factors seem to be partially countercyclical[10], In this regard, we show the relation between Net Written Premium (NWP) and GDP in Figure 2.

With the available data, we can see that the credit risk associated with the use of the administrative surety bonds is the nucleus of the industry. And inside of that administrative branch of the sector, the construction (private and public) sector is the greatest client for the surety industry. Because of that, we may expect that the macroeconomic factors that affect the growth of the NWP received by this subsector of the financial system are related to the construction sector and its credit risk.

As it can be seen in the specialized literature, the driving macroeconomic factors for the construction industry are: The credit given to the industry, the disposable income, and the interest rate. These three variables affect the availability of fresh funds. The interest rate is also affected by the default rate of the industry. In this regard, Adams and Füss (2010), Panagiotidis and Printzis (2015), Myers (2013), and Jiang and Liu (2015) provide a deeper insight into the macroeconomic determinants of the construction sector, while Chen et al. (2013), Xiang et al. (2012) and Owusu-

4 These bonds are issued to guarantee that the bidder will enter into a contract at the bid price and will post the required payment and performance bonds to the owner in the terms of the contract.

5 These bonds are issued to guarantee that the principal will use any monies advanced to him in accordance with terms of the bonded contract.

6 These bonds are issued to guarantee the payment of a contract.

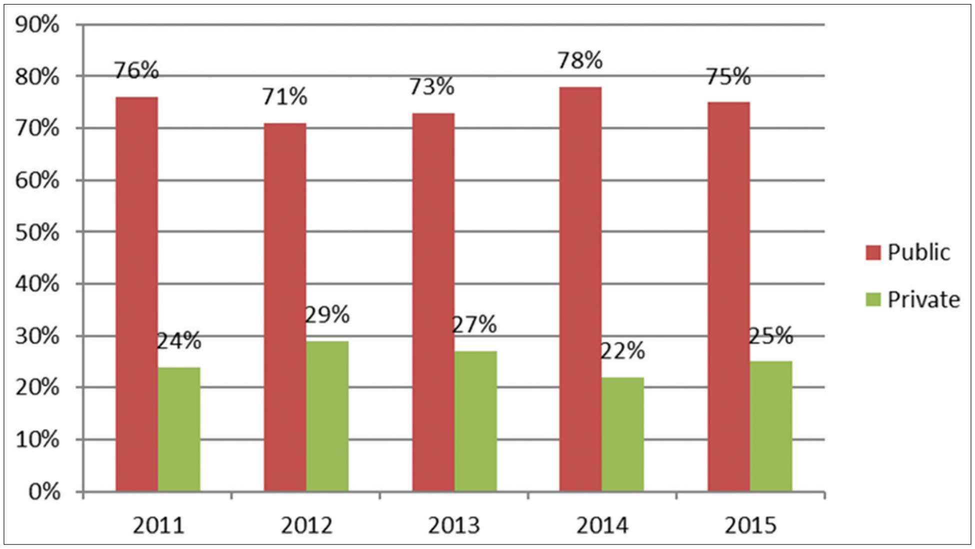
7 These bonds are issued to guarantee to the owner the performance of the contractor.

8 These bonds are issued to guarantee a completition and quality of the work by the principal.

9 Articles 48 and 70 (7th paragraph).

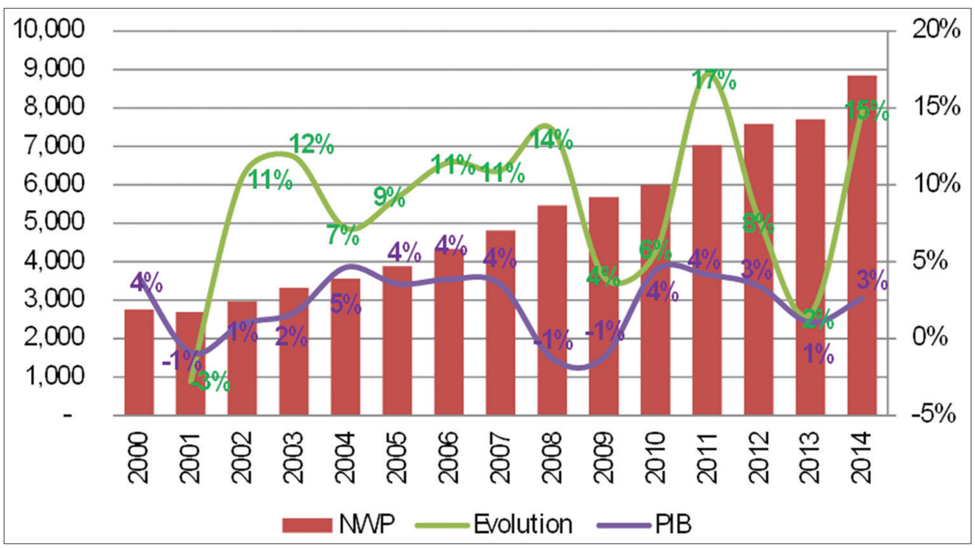
10 In 2009 while Mexico's GDP fell 4.7%, the surety industry grew 0.4%. But in 2013 with an economic growth of 1.4%, the surety industry fell 2.3%.

Figure 1: Market Share by the public and the private sector



Source: Grupo Aserta, 2015

Figure 2: Relation of Net Written Premium and gross domestic product



Source: Authors' own elaboration with data from www.cnsf.gob.mx

Manu et al. (2014) examine the effect of the credit risk in the construction sector.

This paper focuses on the macroeconomic factors related to the construction sector that impact the administrative surety bond market and carries out an econometric analysis of their relationship as time changes. For doing so, in Section 2, we perform Granger's (1969) causality tests[11]. Later, on Section 3, we develop Autoregressive Vector and cointegration models to examine the existence of short- and long-run relations between macroeconomic variables related to the construction sector and the NWP associated with the surety industry[12]. Finally, we conclude in section 4.

11 Similar works can be found in Anaman and Osei-Amponsah (2007) and Song and Gao (2007).

12 Compare with Chen and Patel (1998) and Jiang and Liu (2015).

2. ANALYSIS OF THE RELATIONSHIP OF THE SURETY BOND MARKET AND ECONOMIC VARIABLES RELATED TO THE CONSTRUCTION SECTOR

In the previous section, we described the surety market and carried out an initial overview of the economic factors that may affect the NWP received by this industry. As we specified previously, our contention is that the macroeconomic determinants of administrative surety bonds are those from the construction sector of the economy because the building industry is the most important user of these bonds.

To analyze the effect of macroeconomic variables related to the building sector on the NWP paid to the surety industry, we suppose that these variable define a system of structural equations where the innovations from any of economic variables related to the construction sector affect the entire system; although the changes in the NWP does not statistically affect the macro variables. Before doing any further econometric work, we should assure, at least, that all the time series involved in the system and the system itself are weakly stationary. To do so, we show in Table 2 a resume of the, initially, chosen variables (quarterly observations from 2006 Q3 to 2014 Q4), and we show in Table 3 the KPSS test (Kwiatkowski et al., 1992) of the variables included in the system.

After being reasonably confident about the stationary time series[13], we show in Table 4 a set of statistically significant Granger causality relations among the variables to be used in the vector autoregressive (VAR) model.[14]

The statistically significant relations shown in Table 4 suggest a bidirectional relationship between the series of global indicator of economic activity in the construction sector (SER_IGAE_IND_FIS_CONS) and the NWP charged by the surety companies (SER_FIANZAS). It also shows Granger causality from the NWPs (SER_FIANZAS) to the number of defaults in the construction sector (SER_INCUMP_CONS), the payments in advance to construction companies (SER_ING_CONST_ANT), and Income for the building as principal contractor (SER_ING_CONST_EJEC). It is also remarkable the Granger causalities from the Interbank Interest Rate for 91 days (SER_TIIE91)[15] to the payments in advance to construction companies (SER_ING_CONST_ANT) and the average cost of money to the banks (SER_CCP).

The main gain for the paper of performing this Granger causality test is the statistical justification for using variables related with the construction sector to explain the movements in the NWP as a part of an "economic subsystem." In this case, the "subsystem" includes some exogenous variables in the VAR modeling as in Breitung and Lütkepohl (2004) and Lütkepohl (2006).

3. SHORT- AND LONG-RUN ANALYSIS OF THE STUDIED VARIABLES

We start out our analysis with Sims' (1980) proposal. This author advocates for the use of VAR models instead of structural simultaneous equations because the distinction between endogenous and exogenous variables should not be a priori, and "arbitrary" constraints to ensure identification are not required (Verbeek, 2008).

Figure 3 shows the behavior of the individual time series included in the VAR model. We observe that they exhibit a not comparable behavior and that they share peaks (of different sizes) along some parts of the sample, implying a "group" behavior as proposed by Blanchard and Quah (1989) and Blanchard (1989).

Table 2: Notation for series and its description

Notation of the Series (yields)	Description
SER_FIANZAS	Net written premium received by surety companies
SER_CRED_CONST_TOT	Credit to the construction industry
SER_IGAE_IND_FIS_CONS	Economic activity global indicator of construction industry
SER_INCUMP_CONS	Default in construction industry
SER_ING_CONST_ANT	Payments in advance to the construction companies
SER_CCP	Average cost of money to the banks
SER_TIIE91	Interbank interest rate for 91 days
SER_ING_CONST_EJEC	Income for the building as principal contractor

Source: Data from INEGI (Instituto Nacional de Estadística y Geografía, 2016) and Comisión Nacional de Seguros y Fianzas (2016)

In order to estimate the short-run relationship between the variables involved in the proposed system, we performed a VAR analysis using the proxy for the construction GDP as an exogenous variable. We show the resulting estimators in Table 5.

Another remarkable empirical result about Table 5 is that the macroeconomic factors related to the building sector do influence the NWP (denoted by SER_FIANZAS). We can see this in the number of statistically significant estimated parameters. On the other hand, the relation between NWP and the regressors impact the variable related to the default in the construction sector (SER_INCUM_CONS), and trough it, it affects the rest of the "economic subsystem." This confirms the hypothesis of a relation between the administrative sureties and the management of the credit risk in the construction industry.

It is also noticeable that the proxy variable used for the GDP from construction (SER_IGAE_IND_FIS_CONS), which is exogenous in the model, affects directly the NWP. This confirms the first contention of a direct relation between the administrative sureties and the construction sector. We also want to emphasize that there is a link between each of the equations of the model given by at least one statistically significant parameter in each one of them, confirming the hypothesis of an "economic subsystem" at least, in the short-run. It is worth mentioning that the model provides the best fit from several econometric approaches. Moreover, the system seems to be stable but not normal. Other models were discarded using Akaike's criterion and other traditional econometric criteria. This kind of phenomenon is quite common in economic analysis, even with low-frequency data due to the extreme responses associated with financial variables. This suggests that there are another factors affecting the "economic subsystem". In the short-run the model is not linear or there are long-run effects that influence the short-run behavior. In Figure 4,

13 The innovations in the model are negligible in a finite time interval, see Enders (2004).

14 The number of lags comes from the optimal number of lags for the VAR model from Sims (1980). Granger's (1969) main idea behind the test is to measure if the adjustment of the model of X which includes lagged observations on X and Y (extended model) has a fit than a model of X based only on its lagged values (restricted model). Because of that, the test is a goodness of fit comparison between both models (extended and restricted) that uses an F-test due to normality assumptions in the systems innovations.

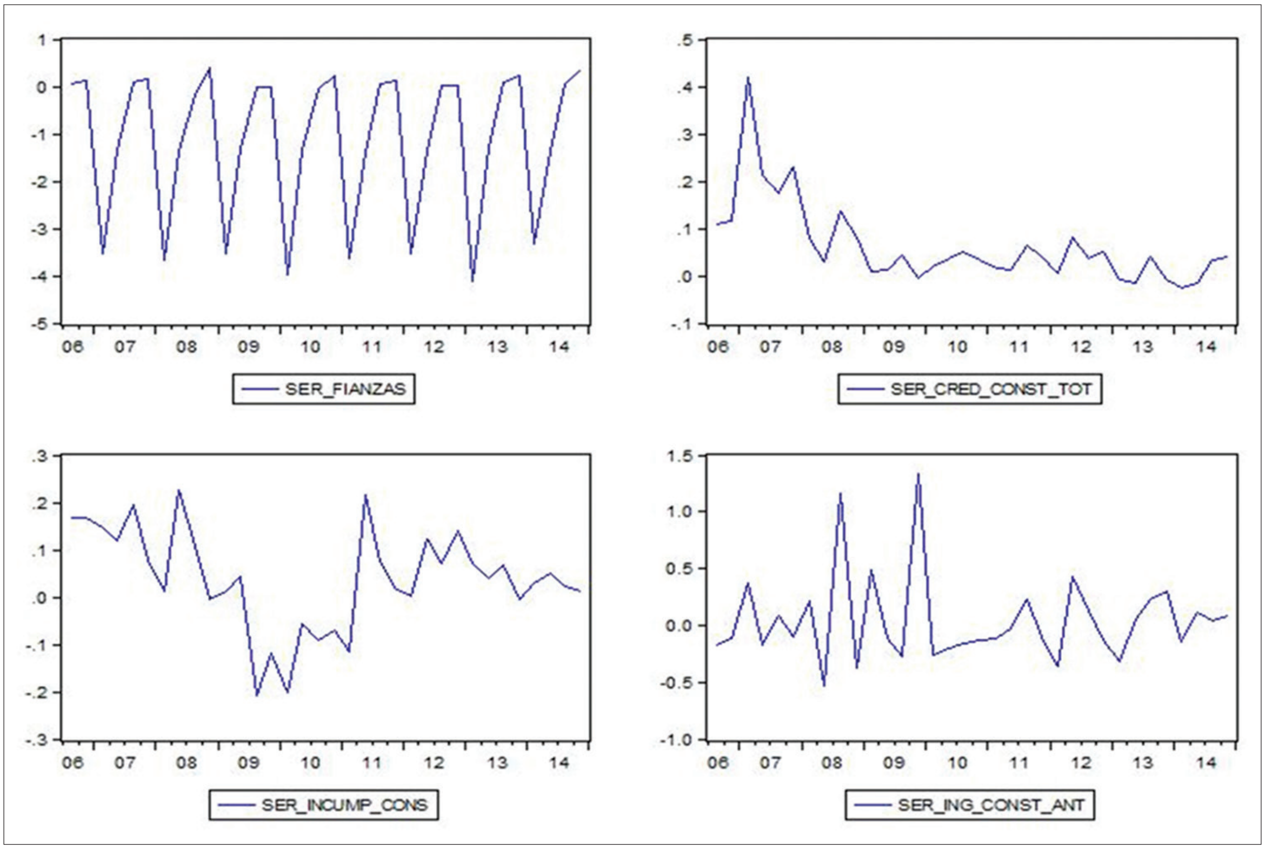
15 In this case, as usual, we take differences on the interest rate.

Table 3: KPSS test of the proposed variables for the system

Statistical Test Kwiatkowski-Phillips-Schmidt-Shin (KPSS)	**Exogenous: Constant**	
Bandwidth: 10 (Newey-West) using Bartlett kernel	**34 obs.**	**LM statistic**
H0: SER_FIANZAS is stationary	Stationary	0.169147
H0: SER_CRED_CONST_TOT is stationary	Stationary	0.445609
H0: SER_IGAE_IND_FIS_CONS is stationary	Stationary	0.231499
H0: SER_INCUMP_CONS is stationary	Stationary	0.161502
H0 SER_ING_CONST_ANT is stationary	Stationary	0.131959
Critical values asymptotic *:	5%	0.463
In all cases, no trend tests were used, so they share all the critical values		

Source: Authors' own elaboration with EViews 8 and data from INEGI (Instituto Nacional de Estadística y Geografía, 2016) and Comisión Nacional de Seguros y Fianzas (2016)

Figure 3: Growth rates of the selected variables related to the building sector



Source: Authors' own elaboration with EViews 8 and data from Comisión Nacional de Seguros y Fianzas (2016) and Instituto Nacional de Estadística y Geografía (2016)

we show the roots of the characteristic polynomial of the VAR model to show that the system as a whole is stationary. Table 6 shows the normality test applied to the model's residuals.

Once we tested that the model is stable in mean and variance, although is not normal, we can see that it is sensible to extreme values in the innovations. Next, we analyze, through Figure 5, the variance decomposition to interpret the relative dependence of each variable on the rest of the system.

In Figure 5, we also observe that the variability of the time series associated with NWP (SER_FIANZAS) has an active autoregressive component up to two periods. After that, its inertia explains 50% of it. Similarly, the available credit for the construction (SER_CRED_CONS_TOT) explains up to 30% of that variance, leaving the defaults in the building sector (SER_INCUMP_CONS) and advance payments (SER_ING_CONST_ANT) with about 10% of the explanation. This fact, coupled with the little variability explained by the NWP (SER_FIANZAS) in all the other regressors in the system provides empirical evidence of a small and price taker industry that depends strongly on the credit and the economic cycle. The legal framework associated with the issuance of administrative surety bonds, which is related to the execution of construction projects linked to loans for financing or outsourcing to third parties can explain this behavior. To complete the analysis, we show in Figure 6, the impulse–response functions for the VAR model. To make easier the interpretation of the chart, we remember that the solid blue lines represent the mean of the pulses analyzed by Cholesky matrix, while the red dotted lines represent the 95% confidence interval. We can also observe in Figure 6 that the innovations on the NWP (SER_FIANZAS) are statistically significant up to two periods of any innovation. This

Table 4: Statistically significant relations in Granger's causality test

Granger causality tests			
Sample: 2006Q3 2014Q4	Obs.	Lags: 2	Prob.
Null hypothesis:		F statistic	
SER_IGAE_IND_FIS_CONS does not Granger cause SER_FIANZAS	32	6.86565	0.0039
SER_FIANZAS does not Granger cause SER_IGAE_IND_FIS_CONS	32	10.8785	0.0003
SER_FIANZAS does not Granger cause SER_INCUMP_CONS	32	5.56157	0.0095
SER_FIANZAS does not Granger cause SER_ING_CONST_EJEC	32	4.24069	0.025
SER_IGAE_IND_FIS_CONS does not Granger cause SER_INCUMP_CONS	32	7.5217	0.0025
SER_CCP does not Granger cause SER_INCUMP_CONS	32	4.31516	0.0237
SER_TIIE91 does not Granger cause SER_ING_CONST_ANT	32	6.34471	0.0055
SER_TIIE91 does not Granger cause SER_CCP	32	3.80228	0.0351

Source: Authors' own elaboration with EViews 8 and data from Comisión Nacional de Seguros y Fianzas (2016) and Instituto Nacional de Estadística y Geografía (2016)

Table 5: Estimators of the parameters of the VAR model

Estimated parameters for the model vector autoregressive (VAR)				
Adjusted sample: 2007Q1 2014Q4			Observations: 32	
Standard errors in () and statistical t in []				
	SER_FIANZAS	SER_CRED_CONST_TOT	SER_INCUM_CONS	SER_ING_CONS_ANT
SER_FIANZAS(-1)	–0.053667	0.007557	–0.021971	0.049428
	(–0.05445)	(–0.01028)	(–0.01065)	(–0.05277)
	[–0.98560]	[0.73525]	[–2.06238]	[0.93669]
SER_FIANZAS(-2)	–0.497289	0.006769	0.015272	–0.032221
	(–0.06138)	(–0.01159)	(–0.01201)	(–0.05948)
	[–8.10214]	[0.58423]	[1.27176]	[–0.54170]
SER_CRED_CONS_TOT(-1)	2.350742	0.453964	–0.204444	0.220108
	(–1.109)	(–0.20934)	(–0.21697)	(–1.07474)
	[2.11969]	[2.16855]	[–0.94225]	[0.20480]
SER_CRED_CONS_TOT(-2)	–3.6482	0.135912	0.412055	–0.580568
	(–1.01401)	(–0.19141)	(–0.19839)	(–0.98268)
	[–3.59781]	[0.71006]	[2.07701]	[–0.59080]
SER_INCUMP_CONS(-1)	–0.857395	0.331843	0.433821	–0.245913
	(–0.92106)	(–0.17386)	(–0.1802)	(–0.8926)
	[–0.93088]	[1.90866]	[2.40740]	[–0.27550]
SER_INCUMP_CONS(-2)	2.467941	–0.147221	0.17891	0.359032
	(–0.92924)	(–0.17541)	(–0.1818)	(–0.90053)
	[2.65587]	[-0.83931]	[0.98408]	[0.39869]
SER_ING_CONST_ANT(-1)	0.189334	–0.039303	–0.041931	–0.551814
	(–0.21298)	(–0.0402)	(–0.04167)	(–0.2064)
	[0.88896]	[–0.97759]	[–1.00628]	[–2.67348]
SER_ING_CONST_ANT(-2)	0.489924	–0.019539	–0.022845	–0.123366
	(–0.22245)	(–0.04199)	(–0.04352)	(–0.21557)
	[2.20245]	[–0.46534]	[–0.52491]	[–0.57227]
C	–1.974606	0.035582	–0.01221	0.120378
	(–0.14835)	(–0.028)	(–0.02902)	(–0.14377)
	[–13.3106]	[1.27068]	[–0.42068]	[0.83733]
SER_IGAE_IND_FIS_CONS	14.01413	0.168255	0.220609	0.585564
	–1.12812	–0.21295	–0.22071	–1.09327
	[12.4226]	[0.79012]	[0.99952]	[0.53561]
R^2	0.953703	0.498467	0.612664	0.31932
R^2 adjusted	0.934764	0.293294	0.454208	0.040859
Sum of squared residuals	3.54537	0.126328	0.135711	3.329703
Estimate deviation from equation	0.401439	0.075777	0.078541	0.389037
F statistical	50.35509	2.429496	3.866471	1.146733
Log likelihood	–10.20454	43.1477	42.00143	–9.200387
Akaike AIC	1.262784	–2.071732	–2.000089	1.200024
Schwarz SC	1.720826	–1.613689	–1.542047	1.658067
Dependent Media	–1.206183	0.059402	0.031118	0.054045
Standard deviation dependent	1.571719	0.09014	0.106312	0.397238
Log likelihood		68.80527	Akaike Criteria	–1.800329

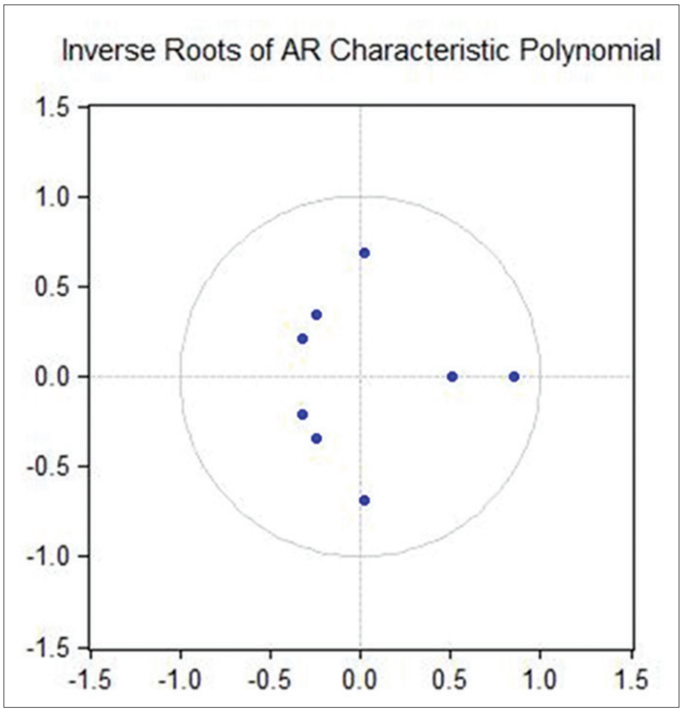
Source: Authors' own elaboration with EViews 8 and data from Comisión Nacional de Seguros y Fianzas (2016) and Instituto Nacional de Estadística y Geografía (2016).

Table 6: Normality test of the VAR residuals

Normality Test VAR model			
Orthogonalization: Cholesky (Lütkepohl)			
H_0: The residuals are multivariate normal			
Component	Jarque-Bera	Freedom degrees	P
1	0.0816	2	0.96
2	32.40106	2	0
3	3.170764	2	0.2049
4	8.305993	2	0.0157
Joint	43.95942	8	0

Source: Authors' own elaboration with EViews 8 and data from Comisión Nacional de Seguros y Fianzas (2016) and Instituto Nacional de Estadística y Geografía (2016)

Figure 4: Inverse roots of the characteristic polynomial of the vector autoregressive model



Source: Authors' own elaboration with EViews 8 and data from Comisión Nacional de Seguros y Fianzas (2016) and Instituto Nacional de Estadística y Geografía (2016)

provides empirical evidence for the role of the surety sector in managing credit risk for the building industry.

It is also worthy mentining that the loans to the construction sector (SER_CRED_CONST_TOT), the defaults in the building industry (SER_INCUMP_CONS), and the advance payments for building (SER_ING_CONST_ANT) are all of them statistically significant up to two periods; while innovation may not be statistically significant (the zero is part of the confidence interval) for the crossed effects, even when the average effect may last for several periods.

With this evidence, we now do further research examining the long-run relation for this economic system using a traditional cointegration analysis. This relationship is such that each of the equations involved in the system has a unit root, and they compensate each other in the long run[16]. The cointegration model needs that each of the analyzed time series has a unit root and that they share a common unit root. As a preliminary visual evidence for this condition, we show in Figure 7 that the system variables seem to comply this condition in their raw form (levels) even when they do not appear to be normal.

To guarantee that all of the time series possess a unit root, we show, in Table 7, a set of KPSS tests (Kwiatkowski et al. 1992) in levels[17]. As it can be also seen in Table 7, the time series have an intercept and a trend (maybe weak for some of them). Thus, all the KPSS test reflect that assumption.

Once established the existence of unit roots, it is necessary to seek empirical evidence to support the hypothesis of cointegration in the model. We show, in Table 8, the results from Johansen's test.

After performing Johansen's test, and because the information given in the VAR model about the price-taking characteristic of the surety industry, we set as exogenous variables the interbank interest rates (SER_TIIE_91) and the index of activity in the construction sector (SER_IGAE_IND_FIS_CONS) in the model stated in Table 9.

The model presented in Table 9 is the best of a series of alternatives that were discarded using the traditional econometric guidelines referred to the goodness of fit criterion (Akaike) and the independence and normality of the residuals. The model showed in Table 9 has also two cointegrating equations with statistically significant parameters at 5% shaded. In this cointegration exercise, we recall that the interbank equilibrium interest rate (SER_TIIE91), the global indicator of economic activity (SER_IGAE_IND_FIS_CONS), and total default of the banking system (SER_INCUMP_TOT) are taken as exogenous variables.

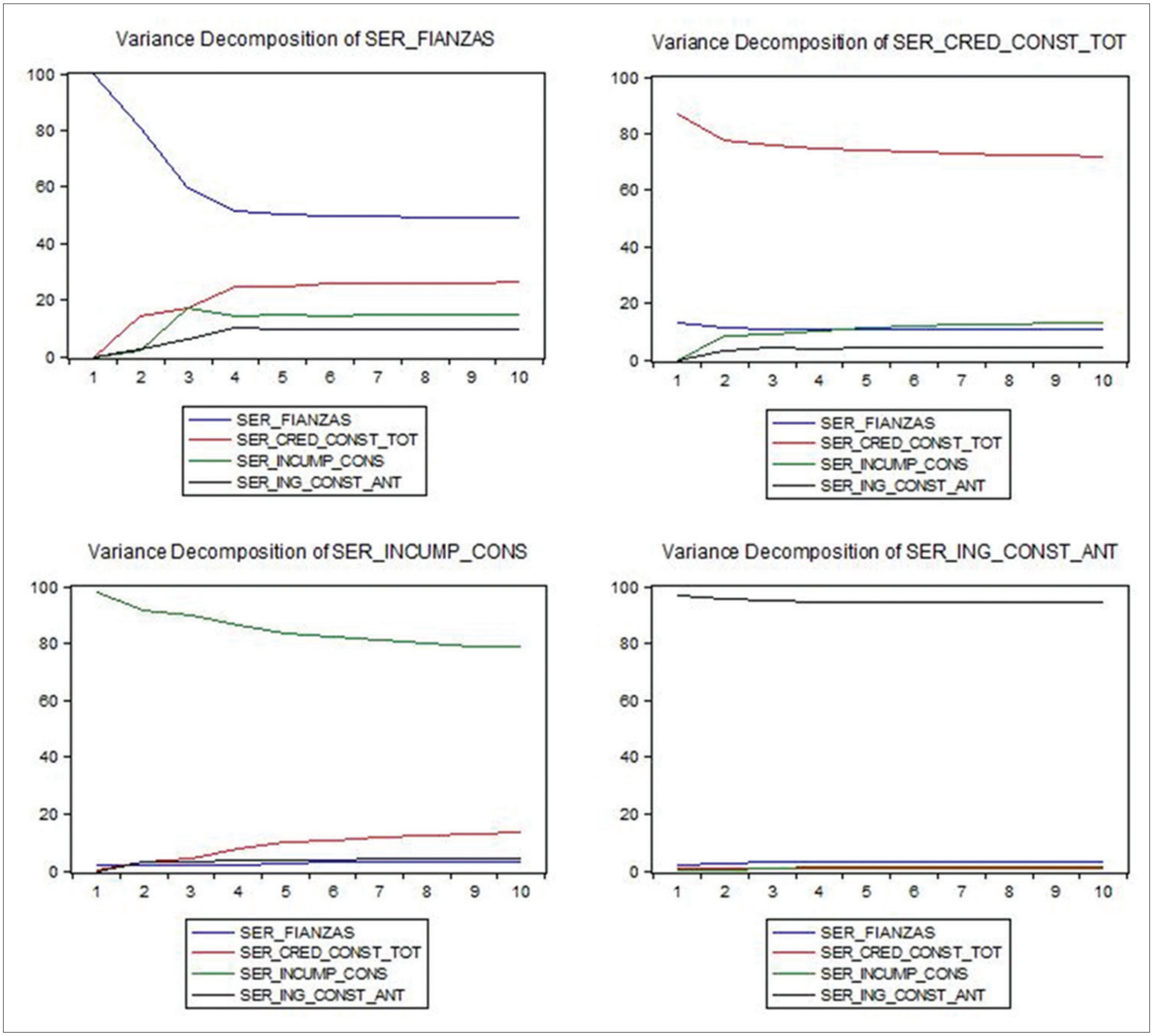
Although the choice of exogenous variables was a purely statistical issue, their exogenous nature is readily explicable for being general measures of economic activity in which the surety sector has a marginal role, although they are strongly influenced by the total default variable, which is the reason for its existence.

It is also noticeable that total default (SER_INCUMP_TOT) keeps a long-term relationship with NWP (SER_FIANZAS). In the short-run model (VAR), the statistically significant variable was the default in the construction industry (SER_INCUMP_CONS). One explanation about this fact is the association between the building industry with the general credit market (hence the importance of TIIE and default rate combined) in the long run. On the other

16 This tool may be adequate for this research as in Ozkan et al. (2012), Sing et al. (2015) and Jiang et al. (2014). Regarding the traditional cointegration analysis see Johansen (1988), Johansen and Juselius (1990) and Harris (1995).

17 The value in SER_IGAE_IND_FIS_CONS may be not rejected, but we used the variable because of the possible false positive caused by the sharp decline in 2008 (extreme value). Details regarding this issue can be seen in Hobijn et al., 2004), Lee et al. (1997), and Lee and Schmidt (1996).

Figure 5: Variance decomposition for the vector autoregressive model



Source: Authors' own elaboration with EViews 8 and data from Comisión Nacional de Seguros y Fianzas (2016) and Instituto Nacional de Estadística y Geografía (2016)

Table 7: Unit root tests for the variables used in the cointegration model

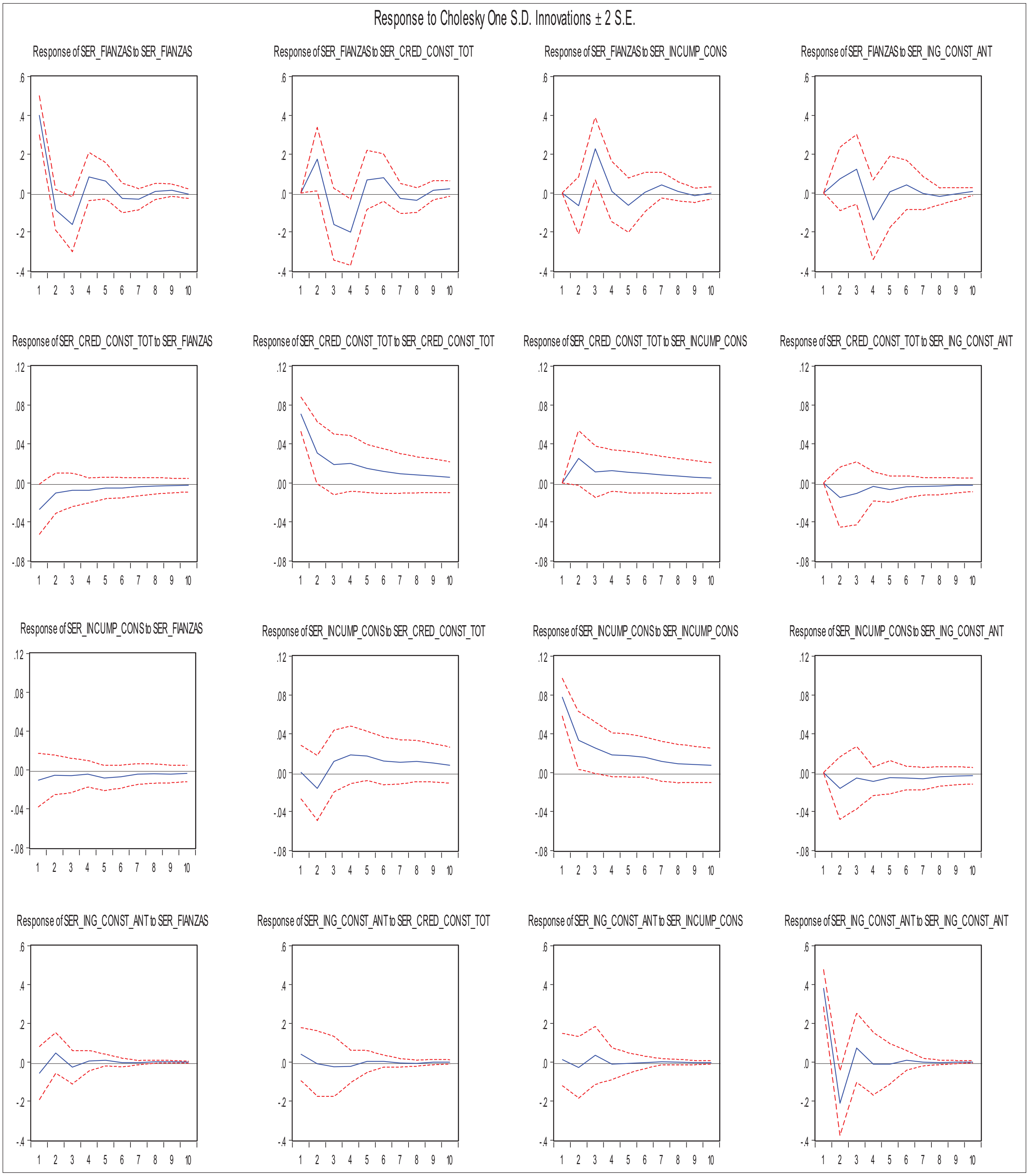
Statistical test Kwiatkowski-Phillips-Schmidt-Shin	Exogenous: Constant and trend	
Ancho de banda: 10 (Newey-West) using kernel Bartlett	35 obs.	Statistical LM
Null hypothesis: SER_FIANZAS is stationary	Nonstationary	0.147816
Null hypothesis: SER_TIIE91 is stationary	Nonstationary	0.076903
Null hypothesis: SER_IGAE_IND_FIS_CONS is stationary	Nonstationary	0.259637
Null hypothesis: SER_INCUMP_CONS is stationary	Nonstationary	0.099554
Null hypothesis: SER_INCUMP_TOT is stationary	Nonstationary	0.1094
Null hypothesis: SER_ING_CONST_SUB is stationary	Nonstationary	0.13783
	1%	0.216
In all cases trend tests were used, so they share critical values		

Source: Authors' own elaboration with EViews 8 and data from Comisión Nacional de Seguros y Fianzas (2016) and Instituto Nacional de Estadística y Geografía (2016).

hand, the dependence of NWP in administrative surety bonds on the construction sector performance is maintained and probably inherited from the short-term relationships.

Furthermore, we may notice that in the long-term model, the NWP (SER_FIANZAS), the default of the construction sector (SER_INCUMP_CONS), and revenues that this sector of the economy

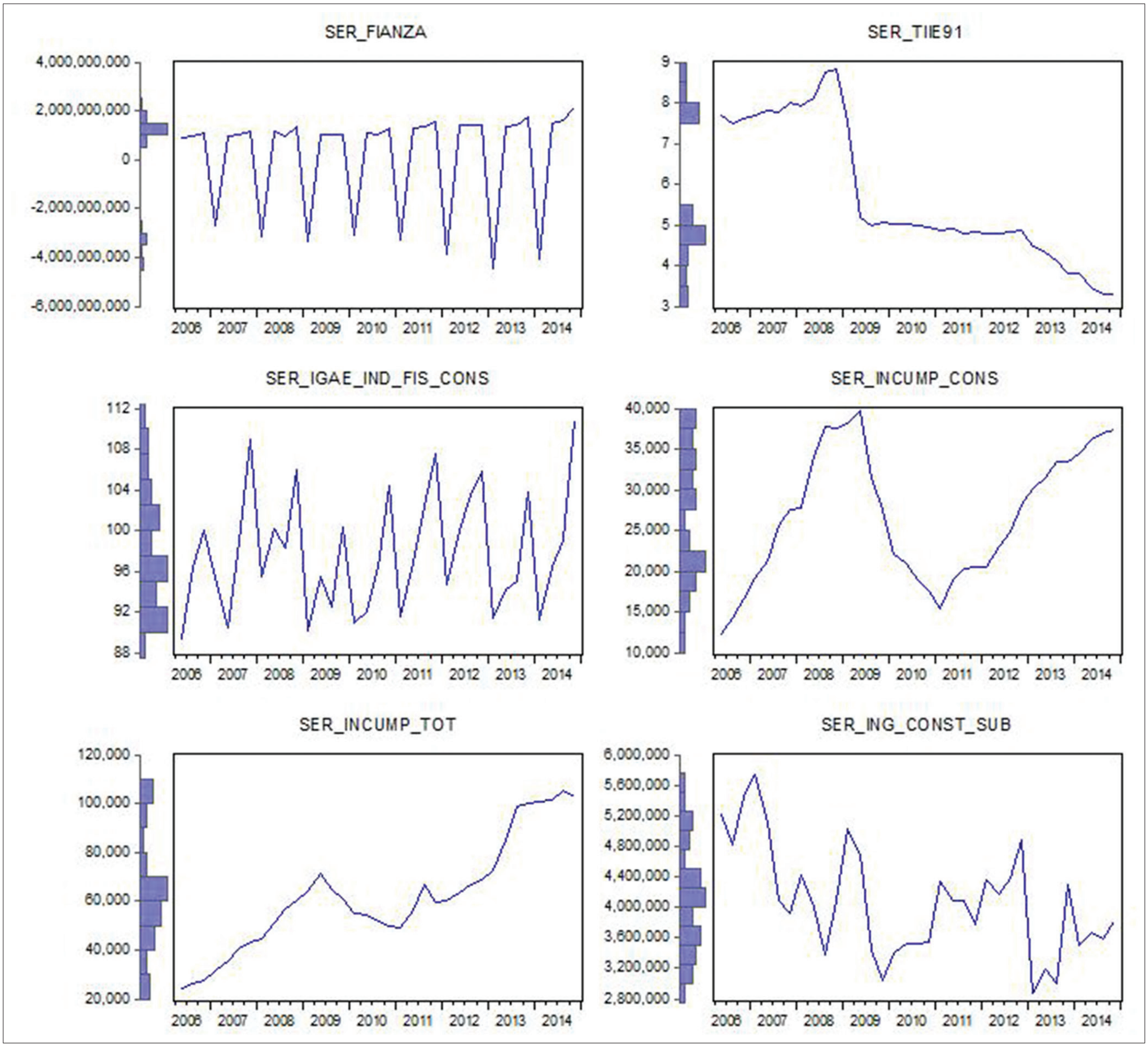
Figure 6: Impulse-response functions for the proposed vector autoregressive model



Source: Authors' own elaboration with EViews 8 and data from Comisión Nacional de Seguros y Fianzas (2016) and Instituto Nacional de Estadística y Geografía (2016)

obtains from outsourcing (SER_ING_CONST_SUB) are related. This proves the hypothesis of a long-term relationship between the building industry and surety market as a tool for hedging the credit risk. Finally, we also remark that the cointegration model has a goodness of fit of 78% with normally distributed residuals, as shown in Table 10, and without a unit root as displayed in Table 11. These two tests together, corroborate the model results, which show that the joint residuals thereof are jointly normal and stationary, which is the core assumption of cointegration models (Gregory and Hansen, 1996).

Figure 7: Trend charts and histogram of the analyzed series



Source: Authors' own elaboration with EViews 8 and data from Comisión Nacional de Seguros y Fianzas (2016) and Instituto Nacional de Estadística y Geografía (2016)

Table 8: Johansen cointegration test

Johansen cointegration test				
Adjusted Sample: 2006Q4 2014Q4				
Trend assumptions: linear deterministic trend (restricted)				
Observations: 33 after adjustments		*** Rejection of the null at the 5%**		
Rank test for cointegration		**** (MacKinnon, Haug, and Michelis, 1999) P values**		
Hypothesis		**Trace**	**0.05**	**P**
No. of CE (s)	**Eigenvalue**	**Statistical**	**Critical value**	
None*	0.891326	169.2247	117.7082	0
Maximum 1*	0.661348	95.98442	88.8038	0.0137
Maximum 2	0.585279	60.25265	63.8761	0.0972
Maximum 3	0.387198	31.20768	42.91525	0.4322
Maximum 4	0.307542	15.04715	25.87211	0.5706
Maximum 5	0.084667	2.919418	12.51798	0.886
The test indicates two members relations 5%				

Source: Authors' own elaboration with EViews 8 and data from Comisión Nacional de Seguros y Fianzas (2016) and Instituto Nacional de Estadística y Geografía (2016)

Table 9: Cointegration model for the surety industry

Estimates of vector error correction model			
Sample (ajusted): 2006Q4 2014Q4	**Included observations: 33 after adjustments**		
Standard errors () and t-statistics in []			
Cointegration eq.:	**Equation 1**	**Equation 2**	
SER_INCUMP_CONS(-1)	1	0	
SER_FIANZA(-1)	0	1	
SER_ING_CONST_SUB(-1)	−0.003217	−152.2352	
	(−0.0016)	(−175.612)	
	[−2.00976]	[−0.86688]	
@TREND (06Q2)	−367.2137	55464160	
	(−275.106)	(−3.00e+07)	
	[−1.33481]	[1.83773]	
C	−7214.364	−4.76E+08	
Error correction:	D (SER_INCUMP_CONS)	D (SER_FIANZA)	D (SER_ING_CONST_SUB)
CointEq1	−0.361788	−4653.619	−11.44396
	(−0.05259)	(−36181.6)	(−28.1897)
	[−6.87879]	[−0.12862]	[−0.40596]
CointEq2	−4.25E-07	−2.134423	0.000158
	(−1.90E-07)	(−0.13212)	(−0.0001)
	[−2.21464]	[−16.1553]	[1.53392]
D (SER_INCUMP_CONS(-1))	−0.046583	−115764.7	−51.12026
	(−0.12142)	(−83525.6)	−65.0763
	[−0.38367]	[−1.38598]	[−0.78554]
D (SER_FIANZA(-1))	2.55E-08	0.51057	−9.43E-05
	(−1.20E-07)	(−0.08323)	(−6.50E-05)
	[0.21041]	[6.13411]	[−1.45377]
D (SER_ING_CONST_SUB(-1))	0.000405	−345.4636	−0.170526
	(−0.00039)	(−269.424)	(−0.20991)
	[1.03377]	[-1.28223]	[−0.81237]
C	−33973.33	−2.98E+10	−2662359
	(−5442.24)	(−3.70E+09)	(−2916939)
	[−6.24252]	[−7.96415]	[−0.91272]
SER_TIIE91	2480.998	−3.14E+08	156327.6
	(−382)	(−2.60E+08)	(−204745)
	[6.49476]	[−1.19377]	[0.76352]
SER_IGAE_IND_FIS_CONS	84.40224	2.98E+08	12559.77
	(−45.579)	(−3.10E+07)	(−24429.5)
	[1.85178]	[9.50778]	[0.51412]
SER_INCUMP_TOT	0.195895	37340.81	8.675773
	(−0.03052)	(−20995.2)	(−16.3578)
	[6.41872]	[1.77854]	[0.53038]
Squared R	0.840851	0.948869	0.182493
Adjusted Squared R	0.787801	0.931826	−0.090009
F−statistic	15.85021	55.67331	0.669693
Log likelihood	−278.0914	−721.6592	−485.4667
Log likelihood		−1482.823	
Akaike criterion		91.9893	

Source: Authors' own elaboration with EViews 8 and data from Comisión Nacional de Seguros y Fianzas (2016) and Instituto Nacional de Estadística y Geografía (2016)

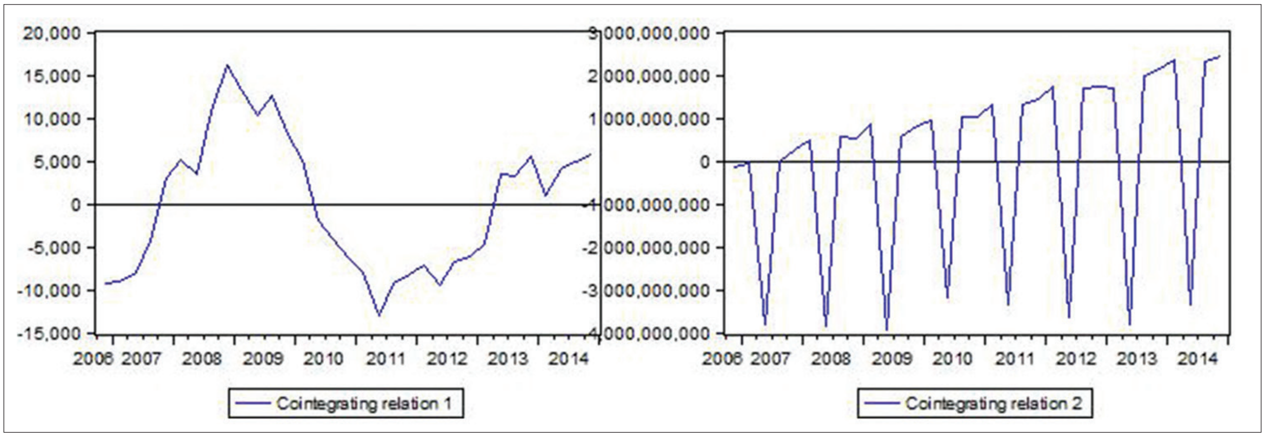
Finally, we show in Figure 8 the graphs of the cointegrating equations of the model. It is interesting to observe that the behavior of the two cointegrating vectors are similar to the behavior of default in the construction sector and NWP (the endogenous variables), which implies that the system of equations can model the long-term NWP.

The goodness of fit exhibited by the model and the desirable properties of the residuals allows us to predict the long-run path of growth of the NWP and also identify possible sources of exogenous shocks for the industry. Similarly, the model allows us to make empirical measurements of the importance of the surety industry for the building sector and its capability of managing the credit risk.

4. CONCLUSIONS

The aim of this study was to examine the behavior of the administrative branch of the surety industry and identify its relationships with nominal variables related to the building sector for the Mexican case. Our research provides empirical evidence about a close relationship between this part of the Mexican financial system and the building industry responsible for managing part of their credit risk and some operational risk associated with guarantees. Moreover, we provide evidence of the existence of an "economic subsystem" where the NWP is affected by the default in the construction sector and the proxy variable used for the GDP from construction, with at least one link between each of the equations in the VAR model; the variance

Figure 8: Graphs of the cointegrating equations of the model



Source: Authors' own elaboration with EViews 8 and data from Comisión Nacional de Seguros y Fianzas (2016) and Instituto Nacional de Estadística y Geografía (2016)

Table 10: Normality test for the residuals of the cointegration model

Normality test for cointegration model residuals			
Orthogonalization: Cholesky (Lütkepohl)			
H_0: The residuals are multivariate normal			
Component	**Jarque-Bera**	**G. de L.**	**P**
1	0.325968	2	0.8496
2	1.83318	2	0.3999
3	4.440943	2	0.1086
Joint	6.600091	6	0.3594

Source: Authors' own elaboration with EViews 8 and data from Comisión Nacional de Seguros y Fianzas (2016) and Instituto Nacional de Estadística y Geografía (2016)

Table 11: Unit root test for the residuals of the cointegrating model

Joint unit root for residuals cointegration model
Null hypothesis: unit root (unit root process for the residuals of the cointegration model)
Sample: 2006Q2-2014Q4 Exogenous variables: individual intercepts and trends
Automatic lags selection criteria based on Schwarz Information (0-2)
Bandwidth selection in kernel Newey-West
Total observations: 94

Method	Statistical	Probability
Chun Lin and Levin (normal asymptotic probabilities)	–8.25579	0

Source: Authors' own elaboration with EViews 8 and data from Comisión Nacional de Seguros y Fianzas (2016) and Instituto Nacional de Estadística y Geografía (2016).

decomposition of the model gave other piece of evidence in this sense. We also want to notice that the non-normality of the VAR residuals gave us a clue about the possibility of a long-run relation that was not explored by the VAR model. The goodness of fit and normality of the residual of the cointegration model confirmed the last idea.

The long-run analysis also demonstrates the existence of a link between the administrative sureties and the building sector, and its dependence with other nominal variables, as well as the fact that it is greatly used to manage credit and operational risks of that industry. Finally, our results show that there are other variables, apart from the construction GDP, that may explain the behavior of the surety sector since the NWP is a function of the estimated credit risk. This may be determinant due current importance of the private investment and private outsourcing related to the building sector of the economy.

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