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IMPORTANCE In 2010, insurers operating in the Egyptian insurance market were required to separate their life and health (L&H) operations from their property/casualty (P/C) operations. Specifically, insurers operating in both segments were required to form two completely separate companies.

OBJECTIVES To examine how the decree, enacted in 2008, affected solvency in the P/C segment of the market.

EVIDENCE We analyze individual insurer-level data from the Egyptian insurance market for 2006–2015. Each insurer provides detailed financial data, which allows us to create ratios commonly used to detect financial distress, including eight of the ratios that make up the Insurance Regulatory Insolvency System (IRIS). We use a Poisson regression analysis to examine whether the decree had an appreciable effect on the probability of insolvency in the post-decree period.

FINDINGS We find that the number of out-of-range solvency ratios increased significantly following the decree, suggesting an increase in the probability of insolvency in the post-decree era. Ratios that are particularly important—i.e., those more likely to be out of range post-decree—largely include those related to surplus levels.

CONCLUSION AND RELEVANCE The combination of L&H and P/C operations in one business entity may provide additional solvency benefits. Our analysis highlights specific concerns that may provide insurance regulators with important insights in Egypt further direction for ensuring the solvency of the P&C market.

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ABSTRACT

In this article, we evaluate the effect of a recent change in regulation of insurers operating in the Egyptian insurance market that required all insurance companies to separate their life and health (L&H) and property/casualty (P/C) activities. We examine, specifically, the effect on the solvency of P/C insurers when they are required to form two completely separate companies for their operations (i.e., divest of their L&H business). Separating into separate entities may increase the transparency of the insurer's operations, especially with respect to how they allocate capital across the company. Using financial data for all insurers in the Egyptian market for the period 2006–2015, we test whether solvency—captured via 13 solvency surveillance ratios—is affected by the decree. For robustness, we run the analysis for the whole market and for private companies only, focusing on P/C insurers only before and after the decree. Our findings indicate that the likelihood of insolvency, based on our evaluation of solvency ratios, increased after the decree.

Keywords: Insurance regulation; solvency; IRIS ratios: Insurance regulation; solvency; IRIS ratios

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1. Introduction

Financial regulations targeting insurers often follow periods of financial turmoil, as policymakers intervene to provide corrective actions through new regulatory actions. The major concerns of insurance industry regulation are protecting policyholders and guaranteeing the financial stability of insurers. However, regulatory responses can, consequently, pose a significant risk to the whole insurance sector and have unintended consequences for insurance market stakeholders.[1] Any new regulation affecting insurer operations should be evaluated in light of the potential impact (e.g., solvency of insurers considering that it is our main concern, the protection of insurance consumers, and the general functioning of the insurance market because both insurer and consumer behaviors can shift). After all, the regulation may have unforeseen, unintended consequences.

One of the major concerns of insurance regulators is the identification of insurers that are financially distressed and potentially insolvent. The nature of the insurance product necessitates this focus to ensure the smooth functioning of the market (Van Gestel et al., 2007). Thus, U.S. insurance regulators use early warning systems that use various measures of financial performance to determine whether the insurance company is healthy (financially stable) or non-healthy (financially distressed). Further, a measure of solvency helps regulators determine the type of corrective action that might be required to address a financially distressed insurer (i.e., whether a distressed insurer should be placed into receivership, rehabilitation, or liquidation).[2] Predicting insolvent insurance and evaluating insurers' financial performance are pivotal concerns for insurance managers, investors, government regulators and legislators, and policyholders.

In this paper, we focus on a recent change to the regulation of insurers in Egypt to provide new insights on solvency prediction. The Egyptian insurance market has developed significantly over the last 20 years. In 1995, there were 12 companies in operation: four public and eight in the private sector. By 1998, the number increased to 18 insurers as an additional six private insurers were formed. By 2008, 29 companies were operating in Egypt.

The Egyptian insurers are regulated by the Egyptian Financial Supervisory Authority (EFSA). The EFSA issued Decree 118 in 2008 that required all insurers in Egypt to separate their life and health (L&H) and property/casualty (P/C) insurance operations effective July 2010. This decree was motivated, primarily, by considerable financial troubles of one of the public companies, El Ahlia Insurance Company. The financial statements of this company, an L&H insurance provider, showed continuous losses. The decree required the merger of this company with the other two public sector companies—El Sharq Insurance Company and Misr Insurance Company—into Misr Insurance Company (MIC), thus creating the biggest insurance company in the Middle East, with capital of about 1.9 billion Egyptian pounds (EGP) or approximately $78 million in 2022. The immediate post-decree P/C sector in Egypt contained MIC and

1. Studies from Bhattacharya, J., et al. (2004), Posner, E., et al (2013), and Eling, M., (2021) mentioned that regulating the insurance industry may result in a considerable level of riskiness.

2. Examples of studies that address solvency surveillance systems include: BarNiv and McDonald (2004); Vaughan (2009); Xie et al. (2011); Cummins and Weiss (2014); and Jia et al. (2021).

17 private P/C insurance companies. Aside from the El Ahlia's financial troubles, one can only speculate on the motivation for the decree. Through the merger of the four public companies, MIC now has a better competitive position with better capitalization. Separation of the activities may provide better transparency of the financial condition of the P/C versus L&H operations, but it is not clear whether there were concerns about manipulation or obfuscation. While any additional motives for enacting the decree are not clear, the decree provides a unique opportunity to evaluate how a separation of activities may influence insurer solvency.

The insurance sector in Egypt is considered a crucial segment of the financial sector. However, it is widely recognized as underpenetrated, with assets representing less than 2% of the Egyptian GDP. To give a perspective in U.S. dollars, the total value of the premiums was $2.63 billion in 2021, up from $2.23 billion in 2020. The total losses paid by the Egyptian insurers was $1.3 billion dollars in 2021, up from $1.04 billion dollars in 2020. In this period, policyholders' rights increased from $4.3 billion dollars in 2020 to $4.9 billion dollars in 2021. The total value of insurance companies' investments increased at the end of the fiscal year 2021 and reached $7.3 billion, a sizable increase from the $5.99 billion dollars reported at the end of the previous fiscal year. The value of insurance companies' total assets increased from $7.14 billion in 2020 to $8.5 billion in 2021, and the amount of insurance coverage reached $520 billion in 2021. The volume of coverage written on the L&H side was $49.6 billion in 2021 compared to $47.2 billion in 2020. Also, the volume of coverage written on the P/C side was $318 billion in 2021 compared to $273.8 billion in 2020.

This paper proceeds as follows: In Section 2, we present a brief review of solvency surveillance systems and discuss prior literature related to insurance regulation and insurer solvency. Our data and methodology are provided in Section 3. Section 4 contains our findings, and a final section provides our conclusion.

2. Background

The EFSA does not currently conduct a formal solvency surveillance program in Egypt. However, regulators are concerned with the solvency of Egyptian insurers as they are in any country, due to the fiduciary duty and the nature of the insurance product. We provide a brief review of the programs that have been used in the U.S. to emphasize the current limitations for assessing solvency of Egyptian insurers and note that our study of insurer financial performance highlights potential opportunities for the EFSA going forward. This section also provides a review of the relevant research.

Solvency Surveillance

The National Association of Insurance Commissioners (NAIC) began calculating financial ratios from U.S. insurers' annual statements in 1972. The ratios were designed to provide an early indication of insurers' financial condition that might require regulatory attention sooner than regularly scheduled examinations.3 In 1979, this simple system was named the Insurance Regulatory Information System (IRIS). Over time, the system has evolved into a multi-phased year-round tool.

3. For a complete history of the Insurance Regulatory Information System (IRIS), see the Government Accounting Office (GAO) (1990).

The U.S. insurance market adopted the Financial Analysis and Surveillance Tracking (FAST) in 1993 and the riskbased capital (RBC) system in 1994. For some time now, these two models have been considered the main models to predict insolvent insurers. However, while both FAST and RBC have been adopted to predict financial distress among insurance companies, predictive accuracy is quite low (Cummins et al., 1995). A major drawback of RBC and FAST models is that they provide only a snapshot for the insurance company's situation at a determined point (Grace et al., 1998).

The main concern of the FAST and IRIS approaches is to allow regulators to take further regulatory actions with the insurers that have ratios that fall outside of a specified range. FAST consists of 29 ratios and corresponding scores for those ratios. When the FAST model was introduced, there had been claims that insurance companies were able to manipulate the IRIS ratios (Grace et al., 1998). However, all the appropriate information introduced through the IRIS system is incorporated in the FAST system.[4]

RBC models consider the amount of capital that a company should hold to protect customers against adverse financial developments and undesirable outcomes based on risk assessment. The RBC formula considers four major forms of risks: 1) credit risk; 2) off-balance sheet risks; 3) underwriting risks; and 4) assets risks. Regulators compare an insurance company's actual capital to the amount obtained through the RBC calculation and take action if the ratio falls below a certain level to avoid insolvencies and insurers' financial distress.

The scores and ratios values in IRIS and FAST have changed over time due to the availability of added information, which may guarantee more accuracy compared to RBC calculations. RBC is considered the weakest system to predict insurers' insolvencies and the less accurate system among models that regulators use to predict insurance companies' insolvency (Grace et al., 1998; Pottier and Sommer, 2002; Cummins et al., 1999).

Evidence: Regulatory Objectives

We refer to two strands of literature to support our analysis. First, we acknowledge studies that specifically relate regulatory responses to financial turmoil. Harrington (2009) focuses on the regulation of insurance companies, especially after financial turmoil. The author studied the American Insurance Group (AIG) and the major consequences that affected AIG and its subsidiaries due to the financial turmoil in 2008 as the turmoil affected AIG life insurers' subsidiaries through its security lending program and credit default swaps (CDS). AIG is a complex organization consisting of 70 insurers in the U.S. and 175 insurance companies in 130 countries. Because of the collapse of CDS and security lending transactions, AIG received assistance of more than $182 billion. One of the major reasons of the financial crisis was the expensive growth of CDS. AIG and other financial institutions were the main writers of CDS instruments, which provided low-cost protection against reduction in the value of mortgage-related securities for domestic and foreign banks and financial institutions. As a result, CDS protection sellers became significantly vulnerable to considerable level of mortgage

4. One commonly cited problem of using the FAST system to predict insurers' insolvencies is a look-ahead bias problem, as the availability of the latest information each year may result in biased prediction through using FAST ratios. In addition, many of the 29 FAST ratios are correlated, which creates a multicollinearity problem in the analysis (Grace et al., 1998).

default alongside with high leverage. In addition to AIG, other large insurers have experienced financial rating downgrade and financial stress due to extensive long-term investment in mortgage. The author concludes that regulation must strengthen banks' capital and promote market discipline in insurance and banking to enhance safety. In general, regulators must pay more attention to avoid a negative impact of financial turmoil on insurance companies.

Eling and Pankoke (2016) provide an empirical perspective of the benefits and costs related to financial regulation. Using data from 76 insurers collected through a survey from Austria, Switzerland, and Germany, we evaluate the benefit and cost of regulation of both the industry level and the company level. We note that regulation costs cannot be explained through differences in business complexity. In a related study, Eling (2021) provides a comprehensive analysis of insurance regulation efficiency and effectiveness in some European countries. We indicate that the annual costs of regulation increased significantly after the financial turmoil in 2008. They conclude that simple insurance regulation is better than complex insurance regulation and that improving transparency may lead to better decisions. The costs associated with increased regulation must be balanced against the benefits.

These studies emphasize the importance of focusing regulation on useful activities (i.e., efficient efforts to meet the regulatory need to promote the financial solvency of insurers and maintain a smooth-functioning insurance market). We do not know the EFSA's specific objectives for enacting the decree to separate the L&H business from P/C business, nor can we determine if the decree was the most efficient reaction to the financial problems of El Ahlia, but we can determine if the regulatory goal of promoting solvency was affected.

Evidence: Solvency Surveillance

Next, we turn to the large body of literature related to insurer solvency. Harrington and Nelson (1986) evaluate the relationship between premiums to surplus and insurance companies' characteristics such as product mix and assets. We used regression analysis to classify the insurers into two groups: 1) healthy insurers with acceptable ratios; and 2) financially distressed insurers with unacceptable ratios. Similarly, Ambrose and Carroll (1994) use IRIS ratios, AM Best's recommendations, and other financial measures to classify insurance companies as solvent and insolvent insurers. These papers were among the first to express interest in methods of solvency surveillance and how detection of financial distress may be improved. Regarding the efficiency of various categories of ratios, Ambrose and Carroll (1994) suggest that IRIS ratios outperform other measures.

Lee and Urrutia (1996) test whether a logit model or a hazard model is more accurate and applicable while predicting insolvency in the P/C industry. Also, they evaluate which model provides or includes the appropriate variables to increase the significance level while evaluating the performance of the insurance companies. Using data from 1989 to 1991 for 72 insolvent stock companies, 10 insolvent mutual firms, and 82 solvent insurers, they concluded that the use of both models increases the accuracy of predicting insurers' insolvency.

Cummins, Grace, and Philips (1999) investigate the importance of using RBC, the FAST model and Dynamic Financial Analysis (DFA) as a new model to predict insolvent insurers based on cash-flow simulation. They contributed to the extant literature by assessing the accuracy of the DFA system in predicting insolvent insurers. Also, we evaluate the DFA variables with FAST and RBC variables, which resulted in a considerable level of accuracy in predicting insolvencies in the P/C insurance industry in the U.S. insurance market. In addition, they avoid any bias in the previous studies, which resulted from adopting FAST system ratios.

Several subsequent studies employ alternative methodologies to the solvency prediction process. For example, Brockett et al. (2004) examine the efficiency of insurance companies via data envelopment analysis (DEA) using solvency, claims-paying abilities, and return on investment as outputs. These efficiency evaluations further examined stock versus mutual form of organizational structure and agency versus direct marketing arrangements. We conclude that the solvency scores used as output measures revealed no effect on the applied rankings of insurers. Based on the analysis and the applied model, the assessment of the efficiency of insurers is correct, and stock insurers are more efficient than mutual insurers

Leverty and Grace (2004) find that the use of efficiency scores improved the prediction accuracy of a model to identify or to determine solvent and insolvent insurers, likely because efficiency scores contain relevant information about financial performance. Eckles and Pottier (2011) find the opposite; company efficiency scores are found to be weak predictors of financial strength ratings. They conclude that using efficiency scores to predict or to classify insurance companies as financially stable and financially unstable companies is not sufficient.

While the existing literature suggests a variety of approaches for solvency surveillance, each methodology requires specific financial information for its application. We assess solvency of Egyptian P/C insurers using eight of the IRIS ratios and five additional ratios culled from prior research because the specific data needed for the full IRIS analysis or other approaches is not available. As such, our analysis provides a first pass to evaluate insurers' solvency before and after a crucial decree. Due to data limitations in the Egyptian insurance market, future work should identify sources of the more detailed data to employ the methodologies suggested in the more recent solvency surveillance literature.

3. Data and Methodology

In this section, we describe our approach to evaluating solvency in the Egyptian insurance market. We provide a description of our data from the Egyptian insurance market and a discussion of the methodologies used to conduct our evaluation.

The financial data needed for evaluating the Egyptian P/C insurance market was obtained from insurers' financial statements, which are compiled in the yearly statistical book for insurance activities in Egypt. We use data for two periods around the establishment of the decree that required insurers to form separate companies for their L&H and P/C operations. We define the "pre-decree period" as the years 2005–2009 and

the "post-decree period" as the years 2012–2015. We omit data for the years 2010–2011 to avoid bias due to the announcement of the decree and the post-decree merger of the public companies. Further,[5] we do not extend our data beyond 2015 to avoid potential bias resulting from floating the Egyptian currency in 2016.

Table 1 shows the development of premiums, losses, and profits from 2006 to 2015, before and after the decree. Market-level premiums increased throughout our sample period, while losses and profitability exhibit substantial volatility before and after the decree.[6] For instance:

- The rate of change in direct premiums before the decree increased considerably: 28%, 16.9%, 16.8%, and 27.4% in 2004, 2006, 2007, and 2008, respectively. However, the same rate after the decree increased slightly to 7.7%, 14.2%, 8.5%, and 7.6% in 2012, 2013, 2014, and 2015, respectively.
- Direct losses before the decree decreased by 1.1 % from 2006 to 2007. Then it increased to 15% from 2008 to 2009. On the other hand, after the decree, the same rate increased considerably to 47% from 2011 to 2012 and then decreased by 26 % from 2012 to 2013. Finally, the rate increased again to 24.3% in 2015.
- The profit rate increased by 63.3% from 2007 to 2008, and then it decreased by 80.6% from 2009 to 2010. Conversely, the same rate peaked between 2010 and 2011 and increased by 218.4%. Finally, it decreased again between 2012 and 2013 to 33.7%.

Generally, there are considerable changes in direct premiums, direct compensations, and profits in P/C insurance sector in Egypt after the regulation as some insurers achieved losses even after separating L&H and P/C activities. However, as the volume of the Egyptian insurance market increased over the years, some insurers achieved losses—especially in the general sector, which is owned by the Egyptian government.

Table 1: Direct Premiums, Direct Losses, and Profits in the Egyptian Property/Casualty Insurance Market ($000)

Year	Direct Premiums	Annual Change (%)	Direct Losses	Annual Change (%)	Total Profits or Losses	Annual Change (%)
			Pre-Decree Period			
2003/2004	2,311,170	28	2,361,597	5.6	279,520	33.4
2004/2005	2,544,972	10.1	2,541,981	7.6	303,429	8.5
2005/2006	2,955,319	16.9	2,553,879	0.4	314,821	3.8
2006/2007	3,273,802	16.8	2,253,947	(1.1)	365,089	35.2
2007/2008	4,169,950	27.4	2,484,820	10.2	595,794	63.2

5. Egypt devaluated its currency by 48% in 2016, allowing it to float freely in order to meet a key demand by the international monetary fund. The effect of devaluation was severe on the Egyptian insurance sector: 1) it erodes the underwriting discipline and profitability of non- life insurers; 2) it increases the volume of claims exceeding the deductible (the leverage effect) and costs associated with it; and 3) it negatively affected investments' returns. The value of premiums of running policies declined significantly. As a result, including years starting from 2016 may affect our results regarding separation. In other words, all the included variables to capture the effect of separation will be affected significantly due to floating the Egyptian currency.

6. Annual direct premiums for each individual insurer in our sample are provided in the Appendix.

2008/2009	4,750,238	13.9	2,858,631	15	768,717	29
2009/2010	5,173,824	8.9	3,104,798	8.2	(149,130)	(80.6)
2010/2011	5,655,426	9.3	3,083,800	(0.7)	474,773	218.4
Post-Decree Period						
2011/2012	6,088,898	7.7	4,533,730	47	877,821	84.9
2012/2013	6,953,525	14.2	3,352,825	(26)	(582,214)	(33.7)
2013/2014	7,456,710	8.5	3,209,793	(4.3)	1,073,562	84.4
2014/2015	8,117,980	7.6	4,025,981	24.3	(1,271,427)	18.4

Source: The Egyptian Financial Supervisory Authority's (EFSA's) annual statistical book for the insurance activities in Egypt,.

Our sample for the ensuing analysis includes 21 Egyptian insurers for the period 2005–2015. Our objective is to test whether the decree had an appreciable effect on P/C insurer solvency in Egypt. We start by creating eight of the IRIS ratios for which we have data, and we create five additional variables that are derived from prior literature addressing solvency surveillance. We then create 13 variables that indicate whether each particular solvency ratio is in or out of range, using the ranges shown in Table 2.[7] These variables allow us to compare the extent to which solvency ratios are in-range in the pre-decree period versus the post-decree period. For completeness, Table 2 also shows the five IRIS ratios that we were not able to calculate with our data from the Egyptian insurers.

Table 2: IRIS and Other Solvency Ratio Ranges, 2016 Values

Ratio	Definition	Unusual Values Equal to Or	
		Over	Under
1	Gross Premiums Written to Policyholders' Surplus	9	---
2	Net Premiums Written to Policyholders' Surplus	3	---
3	Change in Net Premiums Written	0.33	-0.33
4	Surplus Aid to Policyholders' Surplus	0.15	---
5	Two-Year Overall Operating Ratio	1	---
6	Investment Yield	0.065	0.030
7	Gross Change in Policyholders' Surplus	0.50	-0.10
8*	Change in Adjusted Policyholders' Surplus	0.25	-0.10
9	Adjusted Liabilities to Liquid Assets	1	---
10*	Gross Agents' Balances (in collection) to Policyholders' Surplus	0.40	---
11*	One-Year Reserve Development to Policyholders' Surplus	0.20	---
12*	Two-Year Reserve Development to Policyholders' Surplus (was 0.25 pre 92)	0.20	---
13*	Estimated Current Reserve Deficiency to Policyholders' Surplus	0.25	---
14	Return on Assets	---	0.05
15	Debt Ratio	1	---

7. Ranges for each measure are provided in NAIC (2016); Cummins, Harrington & Klein (1995); Cummins, Grace & Phillips (1999); Gestel, Martens, Baesens, Feremans & Huysmans (2007); Nissim (2010); Kwon & Wolfrom (2017); and Morara & Sibindi (2021).

16	Loss Ratio	0.6	0.4
17	Underwriting and Commissions Ratio	1	---
18	Expense Ratio	1	---

*Indicates solvency ratios that were not calculated due to insufficient data

Sources: NAIC (2016); Cummins, Harrington & Klein (1995), Cummins, Grace & Phillips (1999); Gestel, Martens, Baesens, Feremans & Huysmans (2007); Nissim (2010); Kwon & Wolfrom (2017); Morara & Sibindi (2021).

Next, we create a variable, *NUMOUT*, that equals the number of ratios out of range for each insurer in each year. We test first whether *NUMOUT* is statistically different in the pre-decree and post-decree periods, as an initial indication of whether the decree may have influenced the likelihood of insolvency. This analysis is followed by a multiple regression analysis using a Poisson regression model to evaluate *NUMOUT* while also controlling for available insurer characteristics. The included insurer characteristics include *AGE* of the insurer, a *PRIVATE* insurer indicator variable, and *SIZE* measured by total assets. Our 13 solvency ratios and our control variables are shown, along with descriptions and summary statistics in Table 3.

Table 3: Summary Statistics (N = 123)

Variable	Description	Mean	Std. Dev.	Min.	Max.
A1	Gross Premiums Written to Policyholders' Surplus	2.844	3.283	0.080	16.160
A2	Net Premiums Written to Policyholders' Surplus	1.219	1.182	0.038	4.984
A3	Change in Net Premiums Written	0.325	0.616	-0.438	5.773
A4	Surplus Aid to Policyholders' Surplus	0.151	0.106	0.010	0.670
A5	Two-Year Overall Operating Ratio	0.830	0.239	0.120	1.880
A6	Investment Yield	0.053	0.072	-0.037	0.775
A7	Gross Change in Policyholders' Surplus	0.288	0.336	-0.990	1.080
A9	Adjusted Liabilities to Liquid Assets	0.683	0.184	0.334	1.334
A14	Return on Assets	0.080	0.048	-0.064	0.174
A15	Debt Ratio	0.703	0.577	0.099	3.496
A16	Loss Ratio	0.556	0.247	0.015	1.833
A17	Underwriting and Commissions Ratio	0.201	0.179	0.061	1.182
A18	Expense Ratio	0.150	0.107	0.025	0.578
Numout	Number of Ratios Out-of-Range	3.032	2.228	0.000	10.000
Post-Decree	Year Greater Than 2012	0.487	0.501	0.000	1.000
Age	Age of Insurer	25.455	25.309	1.000	109.000
Private	Insurer Is a Private Entity	0.886	0.318	0.000	1.000
Size ($B)	Total Assets	1.880	4.686	0.054	23.000

Sources: Egyptian insurers' financial pages; NAIC (2016); Cummins, Harrington & Klein (1995), Cummins, Grace & Phillips (1999); Gestel, Martens, Baesens, Feremans & Huysmans (2007); Nissim (2010); Kwon & Wolfrom (2017); Morara & Sibindi (2021).

We conduct two forms of the Poisson regression, first using a measure *POSTDECREE,* which equals one if the year is in the post-decree period of 2012–2015; otherwise, it equals zero. This allows us to compare the results in the post-decree period to the five years prior to the decree (i.e., 2007–2011). In the second form, we replace *POSTDECREE* with individual year indicators for each post-decree year (i.e., 2012, 2013, 2014, and 2015) to examine whether any post-decree changes follow a trend. The models are estimated with insurer fixed effects, and robust standard errors are provided. We estimate four equations, where the first two are estimated for all insurers in our sample, and the second are estimated for only the private insurers. After the decree, the four public insurance companies were merged. For this reason, there may be a bias in our results caused by the three insurers becoming one significantly larger insurer in the post-decree period. Thus, we re-estimate the Poisson models with just the private insurers to see if the findings are robust when the public insurer is omitted. Specifically, we estimate:

$$NUMOUT_{it} = \alpha + \beta_1 POSTDECREE_t + \beta_2 AGE_{it} + \beta_3 PRIVATE_{it} + \beta_4 SIZE_{it} + \varepsilon_{it} \quad (1)$$

$$NUMOUT_{it} = \alpha + \gamma_1 Y2012_t + \gamma_2 Y2013_t + \gamma_3 Y2014_t + \gamma_4 Y2015_t + \beta_2 AGE_{it} + \beta_3 PRIVATE_{it} + \beta_4 SIZE_{it} + \varepsilon_{it} \quad (2)$$

$$NUMOUT_{it} = \alpha + \beta_1 POSTDECREE_t + \beta_2 AGE_{it} + \beta_3 SIZE_{it} + \varepsilon_{it} \quad (3)$$

$$NUMOUT_{it} = \alpha + \gamma_1 Y2012_t + \gamma_2 Y2013_t + \gamma_3 Y2014_t + \gamma_4 Y2015_t + \beta_2 AGE_{it} + \beta_3 SIZE_{it} + \varepsilon_{it} \quad (4)$$

Each equation is estimated with and without random effects, and all estimates include robust standard errors.

4. Results

The results of the univariate proportions tests for our 13 solvency ratios are shown in Table 4, where we test whether the proportion of insurers in-range for each specific ratio is significantly different in the pre-decree versus the post-decree period. For ratios that are out-of-range, Table 4 also shows the proportion that are above or below the defined range for that ratio. The table reads as follows: the first ratio, which is defined as gross premiums written divided by policyholders' surplus, is in range for 93.8% of the sample in the pre-decree period and for 75% of the sample in the post-decree period. In both periods, insurers that are out of range were over the defined range threshold of 900 (from Table 2). The test of proportions indicates that the post-decree probability of being in range is significantly lower than the pre-decree value.

Table 4: In-Range IRIS Ratios: Pre-Decree Versus Post-Decree

Ratio	Definition	Pre-Decree			Post-Decree			Sig.
		In Range	Over	Below	In Range	Over	Below	
A1	Gross Premium Written/Policyholders' Surplus	0.938	0.062	0	0.750	0.250	0	***
A2	Net Premiums Written/Policyholders' sSurplus	0.954	0.046	0	0.750	0.250	0	***
A3	Changes in Net Premiums Written	0.744	0.243	0.013	0.648	0.326	0.026	-
A4	Surplus Aid/Policyholders' Surplus	0.785	0.215	-	0.516	0.484	-	***
A5	Two-Year Overall Operating Ratio	100	0	-	0.609	0.391	-	***
A6	Investment Yield	0.703	0.108	0.246	0.215	0.519	0.222	***
A7	Gross Change in Policyholders' Surplus	0.815	0.185	0	0.617	0.321	0.062	***
A9	Adjusted Liabilities to Liquid Assets	0.975	0.025	-	0.853	0.147	-	***
A14	Return on Assets	0.754	-	0.246	0.719	-	0.281	-
A15	Debt Ratio	0.969	0.031	-	0.654	0.346	-	***
A16	Loss Ratio	0.523	0.139	0.338	0.125	0.852	0.049	***
A17	Underwriting and cCommissionRatio	100	0	-	0.922	0.078	-	**
A18	Expenses Ratio	100	0	-	0.828	0.172	-	***
	NUMOUT	Mean: 1.784			Mean: 4.406			

***, ** and * refers to the level of sig. 1%, 5%, and 10%.

The post-decree period appears to be statistically different from the pre-decree period when the difference is defined by in-range solvency ratios; 11 of the 13 ratios are significantly less likely to be in range in the post-decree period versus the pre-decree period. The results suggest an increase in the likelihood of insolvency in the post-decree period.

Another indication that the decree may have had the unintended effect of increasing the probability of insolvency comes from a simple comparison of the number of solvency ratios that are out of range before and after the decree. The mean of *NUMOUT* in the period before the decree is 1.784. After the decree, the mean is 4.406. The difference is significant at the 99% level (two-tailed test). The results confirm what we found in Table 4. We find this result to be especially surprising, given the regulatory attention that should follow the decree if, in fact, the decree is intended to enhance the solvency level and support the ability of Egyptian insurers to grow and achieve profits. To the extent that this is an unintended consequence—we assume improving solvency is a concern of the regulators—we recommend that they closely evaluate the ratios most responsible so that specific activities may be targeted for improvement. We note, for example, that the ratios that include a measure of surplus seem to be particularly affected.[8] Since the Egyptian insurers are not required to report any particular solvency ratios, we suggest caution in assuming any manipulation to

8. Specific recommendations for improvement are beyond the scope of our analysis.

obscure financial distress. Rather, we acknowledge that the decree may have simply shined a light on P/C insurer operations in a new way when the insurer is divested of its L&H business.

Table 5 presents the results from the Poisson regression analysis. The first and the third models show that *POSTDECREE* is positive and significant with coefficients of 1.021 and 1.039, respectively. The inclusion of random effects in model 3 affects the significance of *PRIVATE*, but otherwise the estimated coefficients are consistent with the inclusion of random effects. The estimates indicate that, on average, insurers are out of range on one additional ratio in the post-decree period when compared to the pre-decree period. The decree has a negative impact on the insurers' level of solvency. This is surprising as the policymakers justified their action by mentioning that the decree's main concern is to reduce the probability of insurers being insolvent. Notably, *SIZE* of the insurer is negatively related to the likelihood of insolvency as we have measured it using *NUMOUT*.

Table 5: Poisson Regression Results: Full Sample (N = 123)
Dependent Variable = Numout

Variables	Model1	Model 2	Model 3	Model 4
Post-Decree	1.021***		1.039***	
	(0.123)		(0.153)	
Year 2012	-	1.204***	-	1.221***
		(0.141)		(0.154)
Year 2013	-	0.860***	-	0.874***
		(0.162)		(0.171))
Year 2014	-	1.054***	-	1.067***
		(0.147)		(0.135)
Year 2015	-	0.922***	-	0.939***
		(0.186)		(0.199)
Age	0.000	0.000		0.000
	(0.004)	(0.004)		(0.008)
Private Ownership	-1.070**			-0.980
	(0.447)			(0.753)
Size	-0.104***			-0.102***
	(0.019)			(0.108)
	1.611***			1.499**
Const.	(0.511)			(0.902)
Pseudo R2	16.7	17.5	-----	-----
Random Effects?	NO	NO	YES	YES

***, ** and * refers to the level of sig. 99%, 95%, and 90%, respectively.

Model and model 4 show the trend analysis for 2012–2015 (the years after the decree), where we evaluate whether the decree has a lasting effect on the Egyptian insurers. We find that the coefficients for our four-year indicators are all positive and significant. The coefficients suggest that the addition of about one out-of-range ratio in the

post-decree period, relative to the pre-decree period, is sustained through at least four years. As with model 1 and model 2, we note that the likelihood of insolvency, as measured by an increasing value of *NUMOUT*, is negatively related to the *SIZE* of the insurer.

The *PRIVATE* insurer indicator is negative and significant at the 90% level only for the models that do not include random effects. This suggests that the probability of insolvency is lower for private insurers relative to public insurers, all else equal.

Table 6 provides the results when we estimate the Poisson regressions for the private insurers only. Our results are consistent with those shown in Table 5 with one major exception: Among the private insurers, *SIZE* is no longer relevant to the likelihood of solvency. We expect that this measure was capturing some of the variation between the public and private insurers in the full sample.

Table 6: Poisson Regression Results: Private Insurers Only (N = 123)
Dependent Variable = Numout

Variables	Model 1	Model 2	Model 3	Model 4
Post-Decree	1.012***		1.031***	
	(0.129)		(0.167)	
Year 2012	-	1.196***	-	1.214***
		(0.147)		(0.167)
Year 2013	-	0.875***	-	0.889***
		(0.168)		(0.179)
Year 2014	-	1.042***	-	1.059***
		(0.154)		(0.149)
Year 2015	-	0.895***	-	0.915***
		(0.190)		(0.214)
Age	-0.003	-0.002	-0.002	-0.002
	(0.005)	(0.004)	(0.008)	(0.008)
Size	0.013	0.015	-0.009	-0.007
	(0.067)	(0.059)	(0.098)	(0.096)
Const.	0.537***	0.529***	0.525***	0.516***
	(0.143)	(0.143)	(0.165)	(0.172)
Pseudo R2	15.5	16.4	-----	-----
Random Effects?	NO	NO	YES	YES

***, ** and * refers to the level of sig. 99%, 95%, and 90%, respectively.

Again, *POSTDECREE* and the time trend indicators are positive and significant. The estimates are consistently close to one, leading us to conclude an average increase in one out-of-range ratio for the insurers in the post-decree period relative to the pre-decree period.

In all models, we found the *AGE* of the insurer was insignificant. Thus, it seems to be irrelevant, for the purposes of evaluating solvency, whether an insurer was recently established or operating for a long term.

Conclusion

The Egyptian policymakers issued a decree to separate L&H and P/C activities and merged all the general sector companies into one company to reduce the consecutive losses of some general sector companies. While there is currently no explicit solvency surveillance program in Egypt, the concern for financial solvency and interest in maintaining a smooth-functioning insurance market motivate an examination of the consequences of the decree. More generally, the decree offers us a unique opportunity to estimate the potential effects of requiring insurers to separate their operations into separate entities. Our analysis shows that P/C insurers are less financially secure after the decree when measured by our NUMOUT variable—a consequence of the decree that was likely unintended. Because several of the increasingly out-of-range ratios include surplus, we suggest that insurers consider opportunities to raise more capital.

We did not evaluate the L&H side of the market in our analysis; insurers writing L&H business may have seen significant financial improvement following the decree, which would offset the results on the P/C side. The decree's separation of operations may improve the transparency of financial health for the Egyptian insurers, but the combined L&H and P/C entities may have benefited from economies of scale that are now harder to achieve in separate entities. Our results suggest negative consequences from the decree that deserve further consideration.

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Appendix

The development of premiums (%) of P/C insurers in Egypt from 2005 to 2009 and from 2012 to 2015

Company Name	2005	2006	2007	2008	2009	2012	2013	2014	2015
Misr Insurance	42.5	41.7	39.8	54.2	53.1	57	54.9	55.3	56.9
El Sharq Insurance	18.8	18	16.3	Merged	None	None	None	None	None
El Ahlia insurance	14.2	12.5	9.8	6.3	6.1	Merged	None	None	None
Total General Sector	**75.5**	**72.2**	**66.1**	**60.5**	**59.2**	**57**	**54.9**	**55.3**	**56.9**
Suez Canal Insurance	6	6.2	5.7	5.7	6.7	4.9	4.6	4.9	5.4
El Mohandes Insurance	2.7	2.8	3.7	3	3.4	2.5	2.8	2.4	2.5
ElDelta Insurance	2.7	3.9	3.9	3.7	4.2	3.2	3.4	2.9	2.5
AIG Egypt	5.6	5	5.6	4.8	4.9	4.1	4.3	3.5	1.6
Arab – Egypt Group	2.7	3.6	5.4	4	4.5	4.3	4.5	4.4	4.5
Egypt for Export Guarantee Insurance	0.03	0.03	0.05	0.05	0.1	0.04	0.04	0.03	0.03
Egyptian Association for Co-Operative Insurance	0.7	1.5	2.6	8.2	4	0.5	0.4	0.5	0.4
Ice Egypt Insurance	0.1	0.3	0.05	0.4	0.3	0.3	0.04	0.04	0.3
Royal and Sun Insurance	0.9	0.9	0.9	1.4	1.9	4.5	4.5	4.5	4.5
Alianz Insurance	1.8	2	2.8	3.9	4	3.6	3.4	3.8	3.8
Egypt – Suaidi Insurance Home	0.5	0.7	0.8	0.8	1.1	2.9	3.1	2.8	2.9
Bupa Egypt Insurance	0.0	0.003	1.9	3	3	4	4.6	4.8	4.7
Egypt Takaful Insurance P/C	None	None	None	None	0.7	1.4	1.7	1.6	1.6
Wethaq Takaful Insurance	None	None	None	None	1.4	1.1	1.1	1.4	1.4
Arope P/C Insurance	None	None	None	None	0.006	0.6	0.8	0.9	1.2
Iscan Insurance	None	None	None	None	None	1.5	1.5	1.8	1.9
Tokyo Marine Takaful Insurance	None	None	None	None	None	0.8	0.9	0.7	0.4
Arab Eastern Takaful P/C insurance	None	None	None	None	None	1.9	2	2.4	2.5
Total Private Sector	**24.5**	**27.8**	**33.9**	**39.5**	**39.5**	**43**	**45.1**	**44.7**	**43.1**
Total Insurance Market	100	100	100	100	100	100	100	100	100