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Is Chinese Food Regulation Effective?

A study of the Chinese Food Safety Law of 2009 and its effect on elderly health

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ABSTRACT

In 2008, Chinese milk products were contaminated with melamine, a compound commonly found in plastic. The following year, China implemented the Food Safety Law (FSL) in order to protect the population from food safety risks. This analysis studies the effect of the FSL on self-rated elderly health by regressing government health expenditure (increased due to FSL) on self-rated health, interviewer-rated health, positivity and milk consumption post-2009. The results show that the FSL had an insignificant effect on elderly health, positivity and milk consumption, which highlights the ineffectiveness of the FSL.

INTRODUCTION

How did the Chinese Food Safety Law (FSL) of 2009 affect elderly health? Since the Great Famine—the three years of widespread famine from 1959 to 1961 that killed anywhere from 16.5 to 45 million people (Meng et al. 2015)—the Chinese government's food regulation system has had a spotty record protecting the Chinese population from unsafe food products. In 2008, melamine, a compound used for making plastics, contaminated the majority of Chinese powdered milk products. In China these products are most commonly consumed as infant formula and protein powder. As a result of the products' contamination, six infants died, and approximately 100,000 children were hospitalized.

Food scandals such as the melamine incident highlighted failures of Chinese government regulation and enforcement. As a result, the government implemented the FSL to mitigate or prevent future public health emergencies stemming from food production and processing. Primarily through increased government expenditures and stricter regulatory requirements, the Chinese government attempted—and is still attempting—to foster and promote safer food through more effective regulation.

There is minimal research on the effect of food scandals on the health of the Chinese population, and even less on Chinese food regulation. The literature primarily focuses on assessments of which food regulation policies are most effective, as well as on historical analyses of Chinese policy. My research focuses on whether and to what extent the FSL has been effective in preventing health problems within the Chinese populace, using China's large and growing community of elderly citizens as a proxy for population as a whole. Using an empirical approach, I test the effectiveness of the FSL on elderly health. Using data from the National Bureau of Statistics of China (for government expenditure) and the Chinese longitudinal Health Longevity Survey (for elderly health data), I regress government expenditures on elderly health.

Furthermore, I regress government expenditures on elderly milk consumption as a test of the first order effect of the FSL following the melamine milk scandal of 2008 and the subsequent implementation of the FSL in 2009.

LITERATURE AND BACKGROUND

The literature review and background information in this analysis are structured as follows: i. Literature on food regulation in China, ii. Literature on the effect of government regulations on elderly health across national boundaries, iii. The conclusion drawn from the literature review.

i. Food Regulation in China

The literature on food regulation in China demonstrates that food regulation, though weakly enforced, is gradually becoming more effective. In recent years, scholars have argued that the government of China has become more accountable to its population. Lu et al. (2014) saw a general trend of local governance addressing and protecting the population from compromised food. Xue et al. (2013) also argued that following the 2008 melamine milk scandal inspections and surveillance of food production increased. However, this increase in protection is unequally distributed. In urban areas food safety problems are less prevalent. Holtkamp et al. (2014) claim this differential is due to higher government expenditure in areas of greater productive value to the economy.

There is some dispute on the extent to which authoritarian tendencies within the Chinese government affect the effectiveness of its food regulation efforts. Although some argue that command policies enforced by the government would be the most efficient way to ensure food safety (Liu 2010), others promote independent regulators as the preferred approach to achieving

this result (Li et al. 2010). There is little debate, however, that citizens' increasing access to information is pressuring the Chinese government to be more accountable to the populace on many fronts, perhaps most emphatically on issues affecting food safety.

Liu (2010) analyzes the transition of the Chinese government's food safety regime over time and splits the transition in three general timeframes: command and control, mixed regime and, most recently, transitional regulatory state. The most recent timeframe, in which a transitional regulatory state predominates, shows a higher trend for regulation. However, Liu (2010) argues that the recent transition to a less authoritarian regime is preventing China from using the command policies upon which it has traditionally relied, making food regulation generally less effective.

Ineffective regulatory policy has led to a sharply decreasing trend in consumer trust of food. Although there is no government-mandated policy to certify food as safe, the majority of China's population seems willing to pay more for food that has been certified as safe by a regulatory body (Xu et al. 2010). This preference for safe food is also true of consumers in the international community. International exports of food items produced in Chinese cities where limits on the pesticide residue on food are strictly enforced are substantially higher than in regions where they are not (Dou et al. 2015). It appears both domestic and international pressures are driving the government to increase food safety.

In 2003 China created a regulatory and enforcement institution within the government called the State Food and Drug Administration (SFDA). The SFDA delegated responsibility for different sectors of food safety enforcement to a variety of governmental departments operating independent of the SFDA. This approach proved ineffective due to a lack of cooperation between the departments, leading to a "great waste of resources" (Chen 2009). Miscommunication, poor

coordination, and differing agendas between these external departments remain problematic. Differing food safety standards across departments is a particular impediment. If one department (e.g. the Department of Agriculture) employs standards that result in a particular food product being declared safe, another department's standards may classify the food as toxic (Chen 2009). This delegated approach to standards and enforcement, though presumably positive in its intentions, has led to repeated failures in food safety.

Partially filling the vacuum created by ineffective government approaches, voluntary food safety systems have come into existence. In general terms, these external safety certification resources allow food producers to enroll in an inspection service to have their products scrupulously tested against an effective standard so as to allow the producers to promote their food safety to otherwise skeptical Chinese consumers. One such system is the Food Quality Safety Market Access System (QS system). In theory, this system should be effective in providing consumers with legitimate information on what food is certified safe and what is not. However, due to the voluntary nature of this and similar non-governmental certification regimes there is such low participation from food producers (often because it would be too expensive—too much of a pricing handicap—to meet the QS standard) that the practical benefit to consumers is hugely diminished. Because of the low penetration of external certification systems within the food production sector these voluntary regimes are essentially ineffective (Bai et al. 2007).

The most significant effort to date by the Chinese government to improve its approach to food safety was the FSL. The FSL strengthened punishments for local officials and producers found to be violating food safety standards (Jia et al. 2013). The FSL is by far the most

progressive law to be adopted in China to promote improved food safety. However, scholars argue that:

- the FSL's penalties are still too low for large producers (Jia et al. 2013),
- implementation mechanisms are weak (Lam et al. 2013) and
- enforcement is inconsistent and rife with corruption (Ni et al. 2009).

Furthermore, China lacks enough trained chemical and food science specialists to effectively oversee and administer the FSL (Pei et al. 2011). Pei et al. (2011) makes the instructive observation that China has less food scientists than in Germany, even though China's population is more than 17 times greater¹.

Observations of the myriad of structural deficiencies undermining the FSL have led to many practical suggestions on how to make food regulation in China more effective. Li et al. (2010) suggests that a regulatory system broadly independent of the Chinese government would be more effective due to the inherent neutrality of third parties. This approach would assumedly also diminish the influence of politically connected industries and businesses on food safety policy and enforcement. Jia et al. (2014) suggests the implementation of on-site inspection systems, particularly in the dairy sector, might be useful. Under the right circumstances and with proper oversight, on-site inspections might promote less corruption and more accountability while also creating a tangible negative incentive for producers to provide safe food.

Risk assessment is a key component of balancing the imperative of food safety with the costs implicit in food regulation policies (Unnevehr et al. 2015). Though the FSL attempted to incorporate risk assessment in policy-making deliberations, research suggests a lack of reliable

¹ Population statistics calculated from Worldometers real-time population counter used by the United Nations and BBC News.

² Data for milk consumption only began in 2008, with the second wave of interviews.

data from producers and the government itself hindered the assembly of the data needed to adequately quantify consumer risk (Liu et al 2013). Research generally supports the view that if the Chinese government could obtain and then distribute reliable health data, its regulatory policies would likely be significantly more effective.

ii. Government Regulation and Elderly Health Across National Boundaries

In order to create an empirical framework to study the effect of the FSL on elderly health, it is important to understand other research regarding the effect of government regulation on elderly health across a broader sampling of national populations. Of most interest for purposes of creating a framework are the empirical models used in the following studies. To a lesser extent the changes in elderly health that were observed are also of interest.

Chen et al. (2007) studied the effect of Taiwan's national health insurance program on elderly health. The authors used a difference-in-difference (DID) methodology, comparing health pre- and post-implementation. They found the insurance program led to a statistically significant drop in elderly mortality rates.

In 1997, the United States implemented a program requiring testing for Salmonella in meat products. Chui et al. (2009) ran a time series model with Poisson distribution to see the effect of this program on elderly hospitalization rates. The program did in fact decrease Salmonella-related hospitalization rates.

Another study analyzed the effect of the Mexican conditional cash transfer program, Progresa, on the elderly mortality rate (EMR). The program was implemented in phases, which is reflected in the empirical analysis, regressing program intensity on the EMR. Barham et al. (2013) found this program had a statistically significant negative effect on the EMR.

Ironically, the analysis that most matches this study's focus on self-rated measures of health in the elderly along with this study's use of OLS regression arrives at a contradictory result. Islam and Smyth (2014) study not government health expenditures but rather a significant alternate source of health expenditure for the elderly in China, the implicit resources of their children. They studied the effect of the Chinese one-child policy on health in old age and like this study they primarily employed an OLS regression technique. Contrary to the study presented here, however, Islam and Smyth's (2014) research suggests that having fewer children as a result of China's "One Child" policy—and thus presumably having less financial support from that child or (more rarely) children was correlated with increased self-rated health in the parents.

iii. Conclusion

The effectiveness of food regulation in China is progressing, but is still not yet strong enough to evoke food safety confidence in consumers.

The FSL in 2009 is the most progressive and stringent food safety regime in China's modern history. However, the FSL has been implemented in ways that undermine the integrity of its policy formulation and the practical effectiveness of its enforcement. For instance, though risk assessment is essential to effective food safety regulation, China lacks adequate data with which to measure such risk. More fundamentally, inappropriate political influence on FSL-related policymaking dilutes much of the intent of the original legislation while corruption in food safety enforcement moots the effectiveness of FSL policies themselves. As a result China has—and continues to—suffer continuing scandals stemming from inadequate food safety.

The literature contains a number of practical suggestions for improving the effectiveness of food safety regulation as well as the enforcement of same. Creating an independent regulatory

body and putting substantially more emphasis on-site inspections are the most significant suggestions found in this literature review.

METHODOLOGY

Data

There are two primary sources of data for this study: the National Bureau of Statistics China (NBS) and the Chinese Longitudinal Healthy Longevity Survey (CLHLS). The data for expenditure comes from NBS, spanning from 2004 to 2015. Expenditure is split by region. However, expenditure data lacks specific details on the funds specifically allocated to food regulation implementation. Therefore, expenditure on health is used as a proxy for food regulation implementation. Chinese legislation in 2009 does not show increases in health expenditure other than the FSL.

The CLHLS is a survey of 9,093 randomly selected elderly Chinese citizens (ranging from 65 to 123 years old) from 22 provinces, spanning the period of 2005 through 2011. The survey was conducted three times during this period: 2005, 2008 and 2011. After controlling for interviewees who died prior to 2009, the sample size decreased to 6,273.

The important variables are: self-rated elderly health, interviewer-rated elderly health, self-rated positivity, individual milk consumption, education, gender, rural status and province of residence. Self-rated elderly health and interviewer-rated health are measured on a scale from 1 – 5 (very bad – very good). The interviewees rated how often they look on the bright side of life, which will be used as the measure of positivity (1 – 5, never – always). Milk consumption is also categorized on a five-point scale, ranging from rarely/never consume milk (1) to consume almost every day (5). Education is categorized as number of years of schooling, ranging from 0 to 26

years. Gender of the interviewee is measured 1 if female and 0 if male. The rural variable is measured 1 if the interviewee resides in a rural area, and 0 if the interviewee does not, whereas province is the province in which the interviewee lives.

Descriptive Statistics

The survey was conducted in 2005, 2008 and 2011. It is important to note the average rating of self-rated health, interviewer-rated health, positivity rating and milk consumption² over time to highlight any fluctuations. Table 1 shows the average rating for the four variables in 2005, 2008 and 2011.

Table I

	Mean '05	Mean '08	Mean '11
Milk	-	1.395	1.398
Self-Rated Health	2.233	2.231	2.209
Interviewer-Rated Health	1.854	1.938	1.913
Positivity	2.067	2.061	2.061

The average rating for milk consumption increased by .003 from 2008 to 2011. Self-rated health means decreased minimally over time, whereas interviewer-rated health increased slightly. The variable for positivity remained relatively stable in the three waves of interviews.

Regressions

For the purpose of this research, there will be four tests on the effectiveness of the FSL. The first will test the effect on milk consumption, to highlight a first order effect of the FSL. The

² Data for milk consumption only began in 2008, with the second wave of interviews.

second, third and fourth show long-term effects, showing the effect on self-rated elderly health, interviewer-rated health and self-rated positivity.

For the first test, the null hypothesis is that expenditures on food regulation (by province) have no effect on milk consumption. The alternative is these expenditures will have an effect on milk consumption. If implementation of the FSL increased consumer trust of dairy products, the outcome coefficient will be positive (showing an increase in milk consumption).

The first regression tests the effectiveness of FSL on milk consumption (as a test of the first order effect), represented in equation I.

Equation I:

$$milk_{it} = \beta_0 + \beta_1 expend_log_{it} + \beta_2 expend_log_{it} * post2009 + \beta_3 edu_i + \beta_4 sex_i + \beta_5 prov_i + \beta_6 rural_i + \beta_7 age_i + v$$

$milk_{it}$ represents milk consumption for individual i in time t . $post2009$ is a dummy for expenditure after 2009 (1 if expenditure is post 2009, 0 if otherwise). $expend_log_{it}$ is the log of health expenditures in time t . The important coefficient is β_2 on the interaction term of $expend_log_{it} * post2009$. A positive β_2 would represent an increase in milk consumption.

edu_i , sex_i , $prov_i$, $rural_i$ and age_i are control variables for fixed effects across all provinces. edu_i (0 – 26 years) controls for education level for individual i . sex_i controls for gender for individual i (1 - female, 0 - male). $prov_i$ controls for province for individual i . $rural_i$ controls for rural status for individual i . age_i controls for age for individual i (65-125 years). By controlling for these effects, the regression shows the effect of the FSL of 2009 on milk consumption.

For regressions II, III, and IV, the log of government health expenditure is regressed on self-rated health, interviewer-rated health and positivity to highlight any possible changes in elderly health as a result of the FSL. The null hypothesis for these regressions is that government expenditures have no effect on self-rated health, interviewer-rated health and positivity, respectively. The alternative is that the government expenditures do have an effect.

Equations II, III, IV:

$$\begin{aligned} selfhealth_{it} &= \beta_0 + \beta_1 expend_log_t + \beta_2 expend_log_t * post2009 + \beta_3 edu_i + \beta_4 sex_i + \beta_5 prov_i + \beta_6 rural_i + \beta_7 age_i + v \\ inthealth_{it} &= \beta_0 + \beta_1 expend_log_t + \beta_2 expend_log_t * post2009 + \beta_3 edu_i + \beta_4 sex_i + \beta_5 prov_i + \beta_6 rural_i + \beta_7 age_i + v \\ positivity_{it} &= \beta_0 + \beta_1 expend_log_t + \beta_2 expend_log_t * post2009 + \beta_3 edu_i + \beta_4 sex_i + \beta_5 prov_i + \beta_6 rural_i + \beta_7 age_i + v \end{aligned}$$

The variable $selfhealth_{it}$ is the measure of self-rated health for individual i in time t . $inthealth_{it}$ is the measure of interviewer-rated health for individual i in time t . $positivity_{it}$ is the measure of positivity for individual i in time t . Unchanged from equation I, β_2 on the variable $expend_log_t * post2009$ is the coefficient of interest to measure changes in health measures and positivity post-implementation of FSL. Control variables are the same as Equation I.

RESULTS

As mentioned previously, the key variable of interest is the interaction term of post2009 (1 if expenditure is post-2009, 0 if otherwise) and the log of government expenditures³. For all regressions I-IV, the interaction term coefficients are statistically insignificant. In other words, this study cannot prove the coefficient is statistically different than zero.

³ “post2009*expend_log” in regression output

However, it is important to understand the interpretations of the coefficients, despite their statistical insignificance. In table II, a 1% increase in government expenditure after 2009 is expected to lead to a 0.00017 increase in milk consumption. Although this effect is minimal and statistically insignificant, the positive coefficient reflects an increase in consumption, perhaps due to the FSL.

Table III reflects the self-rated health effects of the FSL. The coefficient of the interaction term is positive. For a 1% increase in government expenditure after 2009, we expect to see an increase of 0.00029 in self-rated elderly health. The positive coefficient reflects a possible increase in elderly self-rated health, following the implementation of the FSL.

Table IV reflects the observed elderly health by the interviewer. For a 1% increase in government expenditure after 2009 we expect to see a decrease in interviewer-rated elderly health by 0.00017. Although the effect is minimal, if not zero, it is important to note the observed health is negative while the self-rated health is positive. This divergence accentuates the difference in perception of health, as well as the limitations of using self-rated health and interviewer-rated health as the dependent variable.

Table V reflects the measure of positivity of the elderly. For a 1% increase in government expenditure after 2009, we expect to see an increase in elderly positivity due to the FSL of 0.00044.

The statistically insignificant findings reflect virtually zero change in elderly health, positivity and milk consumption due to the implementation of the FSL.

Tables VI-XI show comparisons between men versus women, rural versus urban and high education versus low education. The results highlight minimal differences between the

groups, all at a statistically insignificant level. It appears the effect of FSL, if any, was distributed evenly among different cohorts of the population (ignoring slight variation).

CONCLUSION

The FSL implemented by the Chinese government in 2009 had no to very little effect on elderly health. Historically the Chinese government has struggled to implement effective food regulation policy due to corrupt regulatory and enforcement practices amplified by the lack of reliable data of risk levels in different means of food production. The attempt to increase government expenditures to eliminate contamination and implement stricter regulation did not have the intended positive effect on elderly health.

One reason for a lack of statistically significant results may be that the Chinese government enacted this law to mollify the international community and boost lagging international exports of Chinese food products, rather than truly focusing on protecting its population. Economics and international trade pressures may have forced the Chinese government to put on a façade of stricter food regulation, when in reality the policy was expected by the government to be ineffective.

Another interpretation could be that health effects take a long time to manifest themselves in a broad population. The last survey was in 2011, only two years after the implementation of the FSL. This short period of time may not encompass the full extent of the positive health effects of the FSL. However, milk consumption as a first order effect should have been reflected immediately if the consumer truly felt the milk was safe to consume following the FSL. The results do not reflect a positive change in consumption. One reason for this could simply

be a lack of knowledge about the FSL. If the Chinese population was or becomes informed about the FSL, milk consumption may increase.

A primary limitation of this study is the scope of health effects. Data on elderly health was the only available data from China. In order to study the total effects of the FSL on health, all other significant segments of the Chinese population should be included.

Another limitation is the lack of specific data on expenditures on food regulation itself. This study used health expenditure data because it includes funds apportioned to food safety regulation. The problem with this compromise is that the empirical analysis could be reflecting other changes in health expenditure.⁴ For example, in years other than 2009 the Chinese government could have increased their efforts to provide better universal healthcare. This fluctuation could have a great impact on the results of this paper.

There is also a possibility of positive omitted variable bias from the lack of gross regional product (GRP) data available from the Chinese government. It is possible that interviewees from wealthier provinces have greater access to health care and generally have a higher quality of life, positively skewing the results. Furthermore, provinces with higher GRPs are likely to receive greater funds from the government. All these factors potentially contributed to bias.

The final limitation is the lack of data on more direct health effects that are food-related (e.g. diarrhea). Self-rated health is an adequate measurement of health, but a more refined and specific measurement would be trends in incidents in food-related illness. An issue with

⁴ Chinese legislature from 2009 does not reflect any other changes in health expenditure, so this study can likely safely assume any changes in government health expenditure are primarily due to the FSL.

using self-rated health and interviewer-rated health is potential human differences in perception. This study's model assumes all actors are rational, but in reality an interviewer could rate an interviewees health as much worse or better than medically justified. Because this study relies on perception rather than hard medical data, there could be issues affecting its results.

Ultimately, the data suggest the FSL has thus far had an insignificant effect on the measures of human health analyzed in this study. Given the many flaws in the FSL's implementation and the many structural impediments to its execution this disconnect between intent and result is not surprising.

APPENDIX**Table II**

	Milk Consumption
expenditure_log	0.305 (3.06)**
post2009*expenditure_log	0.017 (0.35)
education	-0.002 (1.53)
gender	0.038 (2.51)*
rural	-0.018 (1.11)
age	0.000 (0.40)
R^2	0.06
N	6,683

* $p < 0.05$; ** $p < 0.01$ **Table III**

	Self-Rated Health
expenditure_log	-0.219 (1.98)*
post2009*expenditure_log	0.029 (0.52)
education	-0.000 (0.06)
gender	0.006 (0.35)
rural	0.002 (0.10)
age	0.003 (3.26)**
R^2	0.02
N	6,273

* $p < 0.05$; ** $p < 0.01$

Table IV

	Interviewer- Rated Health
expenditure_log	0.028 (0.30)
post2009*expenditure_log	-0.017 (0.35)
education	-0.001 (0.68)
gender	0.099 (6.65)**
rural	0.069 (4.58)**
age	0.014 (17.36)**
R^2	0.07
N	6,684

* $p < 0.05$; ** $p < 0.01$ **Table V**

	Positivity Rating
expenditure_log	-0.046 (0.47)
post2009*expenditure_log	0.044 (0.93)
education	-0.005 (4.21)**
gender	0.056 (3.89)**
rural	0.063 (4.27)**
age	0.003 (3.95)**
R^2	0.05
N	6,182

* $p < 0.05$; ** $p < 0.01$

Table VI

	Female Self-Rated Health
expenditure_log	-0.214 (1.39)
post2009*expenditure_log	0.035 (0.45)
education	-0.000 (0.04)
rural	0.012 (0.52)
age	0.003 (2.00)*
R^2	0.03
N	3,300

* $p < 0.05$; ** $p < 0.01$ **Table VII**

	Male Self-Rated Health
expenditure_log	-0.208 (1.31)
post2009*expenditure_log	0.023 (0.28)
education	-0.000 (0.06)
rural	-0.011 (0.40)
age	0.004 (2.44)*
R^2	0.03
N	2,973

* $p < 0.05$; ** $p < 0.01$

Table VIII

	Rural Self-Rated Health
expenditure_log	-0.527 (3.24)**
post2009*expenditure_log	-0.030 (0.35)
education	0.001 (0.61)
sex	0.023 (0.99)
age	0.004 (3.08)**
R^2	0.03
N	3,334

* $p < 0.05$; ** $p < 0.01$ **Table IX**

	Urban Self-Rated Health
expenditure_log	-0.019 (0.12)
post2009*expenditure_log	0.057 (0.72)
education	-0.002 (0.71)
sex	-0.020 (0.77)
age	0.002 (1.37)
R^2	0.03
N	2,939

* $p < 0.05$; ** $p < 0.01$

Table X

	Above 10 Years Education Self-Rated Health
expenditure_log	0.084 (0.18)
post2009*expenditure_log	0.101 (0.42)
sex	-0.034 (0.30)
rural	-0.295 (2.90)**
age	0.004 (0.59)
R^2	0.21
N	307

* $p < 0.05$; ** $p < 0.01$ **Table XI**

	Less than 10 Years Education Self-Rated Health
expenditure_log	-0.266 (2.34)*
post2009*expenditure_log	0.015 (0.26)
gender	-0.006 (0.33)
rural	0.006 (0.34)
age	0.003 (3.01)**
R^2	0.02
N	5,966

* $p < 0.05$; ** $p < 0.01$

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