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Public-sector wages and corruption: An empirical study

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Abstract

An important public-policy question is whether public-sector wages can be used to deter corruption. We study the relation between public-sector wages and corruption in China.

Our measure of corruption is the value of bribes obtained by government officials as reported in court proceedings. The data cover the period 1985 to 2014. We hypothesize that the public-sector wage is a reference point for bribe payers and bribe takers in determining the value of bribes, and that external wage opportunities for comparison with public-sector wages, as proposed by the fair-wage hypothesis, are not required to determine the relation between public-sector wages and corruption. Our empirical estimates confirm our hypothesis. We find no consistent support for the fair-wage hypothesis but a systematic U-shaped relation between the public-sector wage and corruption measured as the value of bribes. We conclude that 'carrots' of higher public-sector wages reduce corruption when the public-sector wage is low, but, when the public-sector wage is high, 'sticks' rather than carrots seem to be required to deter corruption.

Key words: Corruption; Public-sector wages; The fair-wage hypothesis; China
JEL code: J380, J450, D073, O570

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1. Introduction

In economies with extensive corruption, a primary public-policy question concerns the role of the public-sector wage. A version of the efficiency-wage hypothesis proposes that higher public-sector wages deter corruption because of high personal losses from apprehension and dismissal from public service or public administration (Kligaard 1988, 1997; Mookherjee 1995; van Rijckeghem and Weder 2001). Higher public-sector wages have also been proposed to reduce corruption by attracting more honest persons into government employment (Bond 2008). A higher public-sector wage does not however ensure honesty when bargaining over the value of a bribe can take place (Mookherjee and Png 1995). Bribery may moreover be endemic to a government bureaucracy, as when promotion in a government bureaucracy requires bribing higher level officials (Kahana and Liu 2010), in which case not honesty determines the individual decision whether to seek and accept bribes, but the requisites of personal career success. Another theoretical model, by Besley and McLaren (1993), shows how different corruption outcomes arise depending on the rule for determination of the wage of a potentially corrupt tax inspector.

With the theory overall ambiguous about whether high public-sector wages are an effective policy against corruption, mixed results have also been reported in empirical studies.[1] We add to the empirical literature on public-sector wages and corruption by

[1] Ades and Di Tella (1997), Rauch and Evans (2000), and Treisman (2000) found no robust evidence that higher public-sector wages deter corruption whereas other studies (van Rijckeghem and Weder 2001; Herzfeld and Weiss 2003; Pellegrini and Gerlagh 2008, and Dutt 2009) concluded the contrary. La Porta et al. (1999) reported that higher government wages increase corruption in Muslim and Catholic countries. Goel and Rich (1989) using data on state-level corruption convictions for the United States found that higher public-sector wages reduce corruption. Also using U.S. data, Alt and Lassen (2014) reported that public-sector wages have little effect on corruption. Di Tella and

studying the case of China. Our empirical results show that corruption has a U-shaped relation with public-sector wages.[2] The relation is robust across empirical specifications in the short and long run and the means of estimation. Our estimates also show that, as a region's per capita income increases, the effect of a higher public-sector wage in reducing corruption diminishes: at a sufficiently high regional per capita income, a higher regional public-sector wage is associated with increased corruption.[3]

2. Basic concepts and measurement

Before presenting our empirical estimates, we outline basic concepts and issues involved in measurement of corruption.[4]

2.1 The definition of corruption in China

Chapter 8 in the Criminal Law of China defines corruption by public officials and temporary employees in government. Corruption-related crimes include bribe taking, bribe extortion, embezzlement, misappropriation of public funds or state assets, and holding property for which legitimate sources cannot be identified.

2.2 The data for measurement of corruption

Schargrodsky (2003) studied an anticorruption program in Buenos Aires and found that higher wages reduce procurement prices for public hospitals, on condition that audit intensity takes at least intermediate levels.

[2] The same result of a U-shaped relation was found by Schulze et al. (2016) for Russian regions.

[3] Le et al. (2013) using a pooled dataset of 113 countries also found that the effect of public-sector wages on corruption depends on a country's income level.

[4] For a broader view of corruption issues, see Hillman (2019, chapter 14).

The corruption data for our study are from the China Corruption Database that we have compiled. The source of the data is court records for corruption convictions for the period 1985-2014. Corruption was rampant during our data period.[5] The data from court records provide the precise value of the bribe received by convicted government officials. We use the value of the bribe as the measure of 'corruption'. This measure of corruption is objective and relates to individuals. Corruption is measured by the monetary value of bribes that individuals received and not perceptions or surveys, and is not in aggregate terms.[6] Our sample consists of 32,860 corrupt convictions in 30 provinces across China.[7] The sample is some 5 percent of all court cases.[8] We have no knowledge of how corruption cases were initiated in the judicial system in China. Aidt et al. (2018) used a sample of government officials who had no criminal convictions to do the Heckman calculations and found that selection bias in the sample of convicted government officials is not a major concern. This applies to our study. We are using

[5] According to official statistics, around one million corruption cases were detected with court convictions in this period. According to the reports of the Supreme People's Procuratorate of China, around 30,000 corruption cases are detected and officials convicted each year on average. See: http://www.spp.gov.cn/gzbg/.

[6] Previous studies of corruption have used corruption perception indices and survey data to measure corruption. The corruption indices are subjective and impressionistic and measure neither frequency nor magnitude of corruption practices (Mocan 2008). Data derived from surveys can involve misreporting (Bertrand and Mullainathan 2001; Liu and Peng 2015). A primary reason for misreported survey answers is expressive, with answers given predicated on a pre-decided personal identity, or attitudes to the identity of others (Hillman 2010). Other studies, as we do, used law-enforcement data to study corruption (Goel and Rich 1989; de Monte and Papagni 2001, 2007; Alt and Lassen 2014; Schulze et al. 2016). These studies do not use individual data on government officials convicted for corruption. As in other papers that draw on the China Corruption Database (for example Aidt et al. 2018), in our present study, corruption is uniquely measured using individual-level data on the magnitude of bribes.

[7] Tibet is the only region dropped from the sample. Too few observations are available (less than 20).

[8] We have on average 32,860/622=53 observations for a region per year. By the rate of 1,000 convictions per region per year, our sample accounts for 53/1,000=5.3%.

the same data sample.

2.2 Income growth and the public-sector wage

During our data period, China experienced rapid income growth.[9] Per capita income and also public-sector wages increased, as shown in figure 1, which also shows that the average public-sector wage in China has exceeded average per capita income.

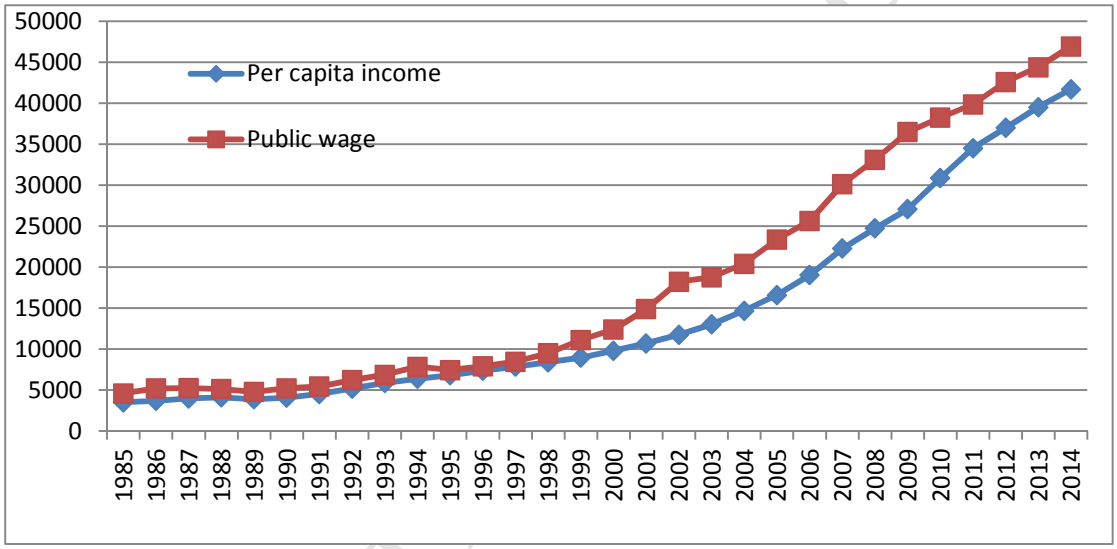

Figure 1 Real per capita income and public-sector wages in the sample period

2.3 The hypothesis

A bribe payer and bribe taker require a reference for determining the value of a bribe. The bribe payer needs to decide how much to offer as a bribe. For calculating the probability that a bribe will be accepted, the bribe payer can use a government official's wage.[10] The

[9] Per capita income increased from $523 in 1985 to $6,136 in 2014. Average public-sector wages increased from $685 per year in 1985 to $7,151 in 2014. See figure 1. All values have been deflated by the Consumer Price Index into 2010 constant prices. The conversions to US dollars for per capita income are not amended for purchasing-power-parity.

[10] See Aidt (2003).

official's wage can be a signal observable to both parties. If per capita income affects corruption, we expect growth in income to influence the relation between public-sector wages and the value of bribes. Our hypothesis is that values of individual bribes as the measure of corruption vary systematically with the value of public-sector wages across regions and with per capita income across regions (our regions are the provinces in China).

2.4 The 'fair-wage' hypothesis

The 'fair-wage' hypothesis is that government officials refrain from corruption if they believe that their public-sector wage is fair relative to alternative wages or incomes in the private sector. The hypothesis has been tested using different relative wage indicators.[11] The hypothesis therefore has different variants based on the alternative wage that government officials might use for comparison with the public-sector wage. Empirical studies of the fair-wage hypothesis using the different wage comparisons have yielded different and conflicting results.[12] We constructed relative wage indicators to use to mimic for our data past studies of the fair-wage hypothesis. As in the previous studies, different results were obtained depending on the relative-wage indicator used. We find that, in the case of China, the closest comparator to public-sector wages is the average wage for the state sector, which

[11] The indicators are (1) the ratio of the legal income for government officials to a reference such as per capita income (La Porta et al. 1999; Rauch and Evans 2000; Treisman 2000; Pellegrini and Gerlagh 2008); (2) the public-sector wage relative to the wage in manufacturing (Rauch and Evans 2000; van Rijckeghem and Weder 2001; Le et al. 2013); (3) the public-sector wage relative to the wage in business counseling (Schulze et al. 2016); (4) the public-sector wage relative to pay for middle accountants (Goel and Rich 1989); and (5) public-sector wage relative to the average non-government wage (Alt and Lassen 2014).

[12] See the studies indicated in footnote 7.

includes not only public administration and public services, but also research and educational institutions, public hospitals and healthcare, and state-owned enterprises for cases salaries are also paid from government budgets.

3. Data

In the panel dataset that we use for estimation, the average values of bribes grew from 2,371 RMB ($870.40) in 1985 to 45,525 RMB ($7411.12) in 2014, with an uneven distribution across the 30 provinces from which our data is drawn (see figure 2 below). We use the absolute value of the average yearly salary for public officials as the indicator of a region's public-sector wage.[13] Public officials consist of civil servants in government and the Communist Party agencies, the police, the army and other security forces, the judicial system, public NGOs, and various temporary government employees.

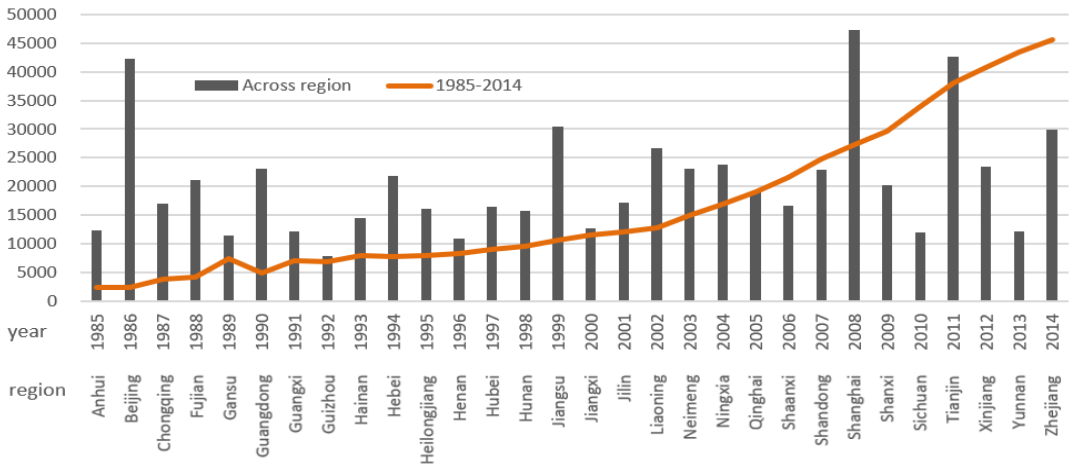

Figure 2 Corruption distribution across time and region

[13] According to the Statistical Bureau of China, public-sector wages comprise the salary, allowances, bonuses and other earnings paid from the government budget.

Many factors can affect corruption in a society. To reduce potential omitted-variable bias, we control for several regional-level variables. (1) Greater anti-corruption efforts deter corruption. The judiciary system in China is highly centralized but anti-corruption efforts can vary across regions. We control for law enforcement as measured by the number of corruption-related crimes detected by the law enforcement agency in a province in a year, a signal observable to both bribe givers and bribe takers. (2) A larger government size implies more corruption through rent seeking and rent extraction activities (Park et al. 2005). We measure government size by the ratio of bureaucrats to employment in a province. (3) We control for the regional income level measured by real GDP per capita and (4) for the openness of the regional economy. Openness is usually measured as the ratio of imports and exports to GDP. Because corruption occurs in the course of importing and exporting, we use instead the ratio of FDI to regional GDP as the openness indicator.[14] We control for two demographic factors, (5) ethno-fractionalization and (6) education. We measure regional ethnic diversity by the share of minorities in a regional (or provincial) population, and education by the ratio of enrollments in secondary schools to local population. (7) For social change, we control for urbanization measured by the share of urban dwellers in a province.[15] Data on law enforcement is taken from the statistical yearbooks of the People's Procuratorate

[14] On trade and corruption, see De Jong and Bogmans (2011). Chen (1991) documented how regional authorities in China created trade barriers. The trade barriers could involve corruption through circumvention by bribes but nor were the decentralized internal trade barriers legal. On recentralization and corruption, see Chen et al. (2002).

[15] We do not include political instability because of high political stability in China during the sample period.

of China. Data on the other variables are from the statistical yearbooks published by provincial governments. Table A1 in the Appendix presents the data summary.

4. Estimation and results

4.1 Model specification

We follow the convention of the literature in specifying our basic econometric model as

$$Corruption_{it} = \alpha + \beta * Corruption_{it-1} + \varphi * Wage_{it} + \gamma * X_{it} + \varepsilon_{it} \quad (1)$$

where *Corruption* is measured as indicated from individual observations on bribes in region i in year t; $Corruption_{it-1}$ is the one-period lagged term; *Wage* is the absolute value of the average wage paid to public workers in a province in a year; *X* is a vector of control variables; and ε is the error term. To test for nonlinearity, we add a squared term of the public-sector wage variable as an explanatory variable:

$$Corruption_{it} = \alpha + \beta * Corruption_{it-1} + \varphi * Wage_{it} + \omega * Wage_{it}^2 + \gamma * X_{it} + \varepsilon_{it} \quad (2)$$

For estimation of the effect of income on the public-sector wage-corruption relation, we use the following model:

$$Corruption_{it} = \alpha + \beta * Corruption_{it-1} + \varphi * Wage_{it} + \lambda * Income_{it} + \eta * Wage_{it} * Income_{it} + \gamma * X_{it} + \varepsilon_{it} \quad (3)$$

where *Income* is the real GDP per capita in a province deflated by Consumer Price Indexes into 2010 constant values. The other terms in equation (3) are the same as those in equation (1).

4.2 Basic results

We estimate equations (1) and (2) to determine the effect of public-sector wages on corruption.

Table 1 presents the results. To obtain a first impression, our estimation begins with the ordinary least squares (OLS) estimator. The estimates show a nonlinear relationship between corruption and public-sector wages (columns 1 and 2 of table 1). These results however may be biased and inconsistent due to unobserved region-specific influences and potential endogeneity among explanatory variables.

Table 1 Wage effect on corruption: absolute wage

Estimation method:	OLS	OLS	Dynamic GMM	Dynamic GMM	Dynamic GMM	Robust GMM estimator	Dynamic GMM
	1	**2**	**3**	**4**	**5**	**6**	**7**
Wage	-35.31**	-21.94*	-17.03***	-66.14***	-243.80***	-66.14***	-14.63*
	(-2.17)	(-1.91)	(-3.36)	(-7.98)	(-13.73)	(-4.83)	(-1.70)
Wage-sq		0.000020*		0.00065***	0.0042***	0.00065***	0.00024**
		(1.72)		(7.85)	(10.48)	(4.62)	(2.19)
Law enforcement	-151.83**	-147.77*	-96.07**	-72.92*	-793.22***	-72.92	-35.63
	(-1.97)	(-1.93)	(-2.42)	(-1.75)	(-31.85)	(-1.04)	(-0.40)
Government size†	-0.09	-0.09	0.40***	0.42***	3.66***	0.42***	0.01
	(-0.48)	(-0.49)	(4.29)	(4.56)	(24.59)	(2.78)	(0.11)
Income	-1.95	-2.36	-27.60***	-20.20***	-100.94***	-20.20***	-10.31*
	(-0.09)	(-0.11)	(-6.56)	(-6.10)	(-3.80)	(-3.69)	(-1.78)
Openness†	0.03	0.04	-0.03***	-0.04***	-0.06***	-0.04***	0.09***
	(1.32)	(1.39)	(-11.70)	(-15.94)	(-5.28)	(-9.31)	(3.21)
Ethnic diversity†	-0.01***	-0.01***	0.00	0.01***	-0.03	0.01**	0.03**
	(-3.32)	(-3.50)	(0.26)	(3.49)	(-0.49)	(2.00)	(2.08)
Education †	-0.07	-0.10	-0.16***	-0.04*	0.46***	-0.04	-0.01
	(-0.92)	(-1.29)	(-12.95)	(-1.72)	(9.23)	(-1.06)	(-0.20)
Urbanization†	0.03***	0.03***	0.01***	0.01***	0.05***	0.01**	-0.00
	(2.75)	(2.77)	(2.87)	(3.56)	(2.65)	(2.06)	(-0.22)
Lagged corruption			0.19***	0.19***		0.19***	0.27***
			(43.37)	(43.92)		(26.15)	(20.93)

R-squared	0.0693	0.0698					
Wald (p-value)			0.00	0.00	0.00	0.00	0.00
AR (1) (p-value)			0.09	0.09	0.09	0.09	0.14
AR (2) (p-value)			0.12	0.12	0.59	0.12	0.52
Sargan test (p-value)			1.00	1.00	0.18	n.a.	0.68
Diff-in Hansen (p-value)					0.84		
N	622	622	576	576	576	576	112

Notes: *t*-statistics in parentheses; *** p< 0.01, ** p< 0.05, * p< 0.10; columns 1 and 2 report estimates from the OLS estimator; columns 3 and 4 report estimates from the dynamic GMM estimator; column 5 reports estimates for the Hansen test; column 6 reports estimates from the robust GMM estimator; and column 7 reports estimates from the 5-year-average dataset; constant values are not reported.

[†]Coefficients reported after multiplication by 10^{-8}.

To address possible omitted variable bias and endogeneity issues, we use the dynamic GMM estimator. We use this estimator for two reasons. First, the GMM estimator is especially appropriate for situations in which the dependent variable and the key explanatory variable are persistent, as is the case in our study. Second, for panel data like ours where simultaneity may exist among variables (such as corruption, wage, income, trade openness, government size, education, and urbanization), it is extremely difficult to find proper instruments for the endogenous variables. The GMM estimator saves us from the task of looking for external instruments and estimates equations (1) to (3) jointly in first differences and levels, using different sets of internal instruments for each part, i.e., the lagged levels and lagged differences of all endogenous variables and the differences of all exogenous variables.[16]

In the GMM results for the basic model,[17] the estimate for the wage variable has a negative value statistically significant at the 0.01 level (column 3 of table 1). When we add the squared term of the public-sector wage to the model, the coefficients for both the level and squared terms of the wage variable are highly significant (column 4). Both models pass the Sargan test and the test for the absence of AR (2) in the error term. We find that corruption persists, as the lagged term of corruption has a positive and significant coefficient across specifications. The estimates in the full model (column 4) display a U-shaped relation between public-sector wages and corruption.

[16] Relative to the GMM first difference estimator, the extra moment conditions in a system GMM estimator increase the estimation precision and lower potential biases from finite sample and measurement errors (Blundell and Bond 2000).

[17] We also tried with the FE estimator for the omitted variable bias and GMM first difference estimator for the potential endogeneity problem but obtained mixed results. Available upon request.

In the full model, the estimation generates 392 instruments against a panel of 576 observations and the Sargan test returns a perfect p-value of 1.00, which raises concerns of overfitting and overidentification. To address this issue, we use the Roodman program to conduct the Hansen test,[18] collapsing the instruments to 30. The results are reported in column 5. The Sargan test returns a p-value of 0.18 whereas the difference-in-Hansen has a p-value of 0.84, indicating that overidentification is not a major concern. The U-shaped relation between public-sector wages and corruption is thus retained in the GMM estimates.

As the standard error of the dynamic GMM estimator can bias downwards, we use the robust GMM estimator for the correction (see also Swaleheen 2011). Column 6 presents the results. The estimates for the wage variable have the same signs and remain statistically significant at the 0.01 level, suggesting again a U-shaped relation between public-sector wages and corruption.

The above results show that public-sector wages have a nonlinear relation with corruption in the short run. This relation may however be subject to cyclical effects. Also, wage and corruption are both relatively persistent.[19] To test for this effect, we estimate with a 5-year panel dataset based on the same sample. Corruption is measured by the average bribe in a province in a 5-year period. The other variables are proxied by the value in the initial year of each period. Although the new dataset has shrunk to 142 observations, the coefficients for public-sector wages still have the right sign and remain highly significant (column 7 of table 1). These results show that the U-shaped relation between public-sector wages and corruption is also present in the long run.

[18] We thank a reviewer for this suggestion.

[19] See also Aidt (2003), Le et al. (2013), and Schulze et al. (2016).

By the estimates in the full model, increasing wages for public officials reduces corruption when wages are low and increases corruption when wages are high enough.[20]

The estimates in the full model suggest that the income level of a province, law enforcement, economic openness and a better educated population are significant corruption inhibitors. We discuss the income effect on corruption in detail below. By the estimates in column 4, our preferred model, an increase in corruption detection and conviction by one more case leads to a decrease in corruption magnitude by 72.9 Chinese *yuan* per corrupt deal on average. An increase in the degree of economic openness by one percent decreases corruption magnitude by 35,000 *yuan* per case. A similar effect is obtainable through increases in the education level of the population. A larger government increases corruption: an increase in share of government expenditures to regional GDP by one percent increases corruption by 423,000 *yuan* on average, a large effect. Ethnic diversity is also found to increase corruption: corruption is 7,000 *yuan* higher on average in regions where the share of minorities in local population is higher by one percentage point. We also find that corruption increases with urbanization: an increase in the share of urban dwellers by one percent increase corruption by 13,000 *yuan* on average.[21]

4.3 The fair-wage hypothesis

[20] The change occurs when the yearly salary reaches 50,955.32 RMB ($7,527.19). Eight out of the thirty provinces in our sample passed this margin at the end of the sample period (Beijing, Fujian, Guangdong, Jiangsu, Qinghai, Shanghai, Tianjin, and Zhejiang). In our sample, 27,346 observations (or 83%) fall on the left part of the curve.

[21] On urbanization in China and the differential benefits, see Lu and Chen (2004). Urbanization initiated by governments presented rent-seeking opportunities and benefit from corruption in infrastructure and related public projects (Chen and Liu 2015).

To test the fair-wage hypothesis using our data, we estimated equations (1) and (2) with the following different relative wage indicators: the ratio of public-sector wages to each of the four wage references, (1) the state sector wage (*W-state*),[22] (2) the average wage of the province (*W-average*), (3) the manufacturing wage (*W-manufacture*), and (4) real GDP per capita (*W-Income*). We use the dynamic GMM method and control for the same set of independent variables as previously. Table 2 presents the results.

[22] This is the average wage for the state sector----state-owned enterprises, governments, public institutions such as schools, universities, state-owned hospitals, etc. This covers a much broader scope than wages for government workers.

Table 2 Wage effect on corruption: relative wage; dynamic GMM estimation

Wage reference:	W-state		W-average		W-manufacturing		W-income	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RelWage [#]	-0.19***	-0.07	-0.12**	0.38*	0.01	0.04	-0.12***	-0.22***
	(-7.97)	(-0.31)	(-2.20)	(1.73)	(0.13)	(0.23)	(-10.81)	(-4.78)
RelWage-sq [#]		-0.06		-0.19**		-0.02		0.04**
		(-0.54)		(-2.42)		(-0.22)		(2.32)
Law enforcement[‡]	-0.11***	-0.10***	-0.09	-0.13*	-0.08*	-0.10	-0.14***	-0.12**
	(-3.70)	(-2.60)	(-1.42)	(-1.95)	(-1.90)	(-1.22)	(-2.60)	(-2.04)
Government size [#]	3.35***	3.63***	2.71	4.12	5.09***	4.87***	0.69	-0.17
	(3.49)	(2.91)	(1.10)	(1.63)	(8.43)	(5.74)	(1.26)	(-0.26)
Income	-43.83***	-42.92***	-43.38***	-41.57***	-42.33***	-42.83***	-47.57***	-47.74***
	(-14.22)	(-9.68)	(-9.01)	(-8.51)	(-11.22)	(-10.91)	(-18.84)	(-20.38)
Openness[#]	-0.26***	-0.26***	-0.29***	-0.29***	-0.30***	-0.27***	-0.34***	-0.33***
	(-11.86)	(-10.18)	(-5.92)	(-5.87)	(-7.69)	(-2.80)	(-13.65)	(-13.70)
Ethnic diversity[#]	-0.02	-0.03	-0.01	-0.03	-0.01	-0.03	0.06***	0.03
	(-0.89)	(-0.97)	(-0.33)	(-0.88)	(-0.81)	(-0.65)	(2.67)	(1.04)
Education[#]	-1.21***	-1.20***	-1.41***	-1.47***	-1.83***	-1.77***	-1.65***	-1.57***
	(-6.32)	(-6.35)	(-7.84)	(-7.89)	(-17.01)	(-11.35)	(-10.23)	(-10.57)
Urbanization[#]	0.08*	0.07	0.14***	0.10**	0.10**	0.09	0.09***	0.10***
	(1.68)	(1.09)	(2.95)	(2.04)	(2.04)	(1.55)	(3.85)	(4.81)
Lagged corruption	0.20***	0.20***	0.20***	0.19***	0.19***	0.19***	0.18***	0.18***
	(128.01)	(117.00)	(57.12)	(56.82)	(105.58)	(102.03)	(70.56)	(62.09)
Wald (p-value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AR (1) (p-value)	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09

AR (2) (p-value)	0.10	0.10	0.11	0.11	0.12	0.10	0.11	0.11
Sargan test (p-value)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
N	576	576	576	576	576	576	576	576

Notes: *z*-statistics in parentheses; ***significance at 0.01, **significance at 0.05, *significance at 0.10; constant values are not reported.

‡ Coefficients reported after multiplication by 10^{-3}; #coefficients reported after multiplication by 10^{-7}.

When we use the state-sector wage as the reference for comparison with the public-sector wage, the results indicate a linear and negative relation between corruption and relative wage.[23] When the average wage of the province is the reference, the coefficient for wage is negative and statistically significant (column 3). When the squared term is introduced, the estimates for both the level and squared terms are significant but change signs (column 4), indicating an *inverted* U-shaped relation between corruption and wage. When the wage for manufacturing industry is the reference, the coefficients for wage are statistically insignificant in both models (columns 5 and 6). No relation is indicated between corruption and wage. When real per capita income is the reference, the estimates for the wage variable in both models are highly significant and have the same signs as in the benchmark model (columns 7 and 8), suggesting again a U-shaped relation between corruption and wage.

Schulze et al. (2016) argue that relative wage is a latent signal and lag the relative wage variable by one period in regressions. For comparison, we also undertake the same exercise with the one-period lagged values of the relative wages, using the same technique and controlling for the same set of explanatory variables. Table 3 presents the results. When the state wage and the regional average wage are used as the reference, a linear and negative relation is obtained between corruption and wage (columns 1 to 4 of table 3). When the manufacturing wage is used as the reference, an inverted U-shaped relation is found between corruption and wage (column 6). Only when real per capita income is used as the reference are the estimates for the wage variable highly significant with the signs (columns 7 and 8) as

[23] The coefficient for the relative wage variable is negative and statistically significant (column 1 of table 2). When the squared term for the public-sector wage is introduced into the model, the coefficients for either the level or the squared terms become statistically insignificant (column 2). All the control variables have the right signs.

in the benchmark model of table 1.

Table 3 Relative wage lagged one-period; dynamic GMM estimation

Wage reference:	W-state		W-average		W-manufacturing		W-income	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
RelWage[#]	-0.21***	-0.04	-0.08***	-0.04	-0.04	0.28***	-0.13***	-0.25***
	(-6.06)	(-0.09)	(-2.58)	(-0.15)	(-1.03)	(2.85)	(-9.45)	(-4.47)
RelWage-sq[#]		-0.07		-0.03		-0.11***		0.04*
		(-0.34)		(-0.29)		(-2.88)		(1.88)
Law enforcement [♯]	-0.12***	-0.12***	-49.54	-44.26	-25.85	14.22	-0.13***	-0.11***
	(-4.52)	(-3.59)	(-0.83)	(-0.69)	(-0.67)	(0.34)	(-3.19)	(-2.75)
Government size[#]	3.53***	3.66***	3.58**	3.39**	4.58***	6.12***	-0.37	-0.38
	(4.41)	(4.23)	(2.32)	(2.08)	(5.94)	(6.65)	(-0.62)	(-0.36)
Income	-43.09***	-42.33***	-40.99***	-41.76***	-44.74***	-39.38***	-50.17***	-50.54***
	(-14.65)	(-11.40)	(-10.51)	(-9.73)	(-11.38)	(-11.76)	(-14.23)	(-18.75)
Openness [#]	-0.29***	-0.30***	-0.30***	-0.30***	-0.24***	-0.27***	-0.33***	-0.31***
	(-7.79)	(-6.01)	(-10.52)	(-9.69)	(-3.83)	(-7.12)	(-11.15)	(-11.46)
Ethnic diversity [#]	0.01	0.01	0.00	-0.01	-0.08***	-0.03	0.09***	0.12***
	(0.15)	(0.14)	(0.02)	(-0.12)	(-2.86)	(-0.96)	(2.91)	(4.33)
Education[#]	-1.29***	-1.31***	-1.65***	-1.63***	-1.69***	-1.90***	-1.60***	-1.45***
	(-6.15)	(-6.14)	(-5.79)	(-5.34)	(-9.57)	(-14.76)	(-7.62)	(-5.90)
Urbanization[#]	0.11***	0.11***	0.14***	0.16***	0.15***	0.08***	0.12***	0.12***
	(2.96)	(2.89)	(6.99)	(3.98)	(4.16)	(2.68)	(9.49)	(12.57)
Lagged corruption	0.19***	0.19***	0.19***	0.19***	0.20***	0.20***	0.18***	0.17***
	(60.63)	(51.07)	(15.56)	(15.56)	(66.16)	(60.13)	(58.05)	(76.60)
Wald (p-value)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sargan test (p-value)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

AR (1) (p-value)	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
AR (2) (p-value)	0.13	0.10	0.13	0.12	0.11	0.11	0.13	0.13
N	576	576	576	576	576	576	576	576

Notes: *z*-statistics in parentheses; ***significance at 0.01, **significance at 0.05, *significance at 0.10; constant values are not reported.

[ǂ]coefficients reported after multiplication by 10^{-3}; [#]coefficients reported after multiplication by 10^{-7}.

Tables 2 and 3 indicate that empirical results are mixed when we use different wage references whether or not we lag the relative wage indicator.[24] For duplicating the benchmark results, real per capita GDP seems to be the appropriate wage reference, if there is any.[25] The fair-wage hypothesis is that government officials are more likely to engage in corruption when underpaid relative to alternatives. Our results show, for our data, that testing this hypothesis requires specification of which wage comparator to use to judge 'fairness'.[26]

5. The income effect

Public-sector wages can be expected to increase as the economy grows. Figure 1 indicates such an association in China. Increases in per capita income also affect corruption when more resources are available for corruption control (Paldam 2002). In this section we evaluate how the effect of public-sector wages on corruption varies with income. We use the dynamic GMM technique to estimate equation (3), controlling for the same set of explanatory variables. Table 4 presents the results.

[24] Similar results were obtained when we used another set of relative wage indicators, the absolute difference between public-sector wages and the four wage references. These results are not reported here and are available upon request.

[25] The results obtained from regressions with the *W-Income* indicator are consistent, not only in tables 2 and 3, but also with those obtained from the estimator with the absolute value of the public-sector wage in table 1.

[26] Moreover, in China, as shown in figure 1, public-sector wages have exceeded per capita income.

Table 4 The impact of income: absolute wage

Estimation method:	Dynamic GMM	Robust GMM estimator	Dynamic GMM	Dynamic GMM	Dynamic GMM
	1	**2**	**3**	**4**	**5**
Wage	-36.27***	-36.27***	-30.36***	-36.04***	-31.49***
	(-6.70)	(-4.04)	(-3.98)	(-6.89)	(-5.69)
Income	-47.85***	-47.85***	-37.40***	-50.10***	-46.70***
	(-17.56)	(-10.37)	(-4.54)	(-17.86)	(-7.65)
Wage ×income[†]	5.98***	5.98***	3.84***	5.52***	4.61***
	(7.49)	(4.15)	(4.80)	(7.46)	(5.45)
Law enforcement	-156.55***	-156.55*	-42.73	-82.06*	-28.27
	(-2.97)	(-1.78)	(-1.18)	(-1.90)	(-0.79)
Government size[#]	4.66***	4.66***	4.73***	3.14***	4.36***
	(4.78)	(2.81)	(5.13)	(2.99)	(4.61)
Openness[#]	-0.30***	-0.30***	-0.33***	-0.31***	-0.32***
	(-13.18)	(-7.71)	(-6.95)	(-11.90)	(-8.04)
Ethnic diversity[#]	0.07**	0.07	0.03*	0.05*	0.03**
	(2.48)	(1.35)	(1.73)	(1.91)	(1.99)
Education[#]	-0.64***	-0.64**	-0.90***	-0.79***	-0.79***
	(-4.31)	(-2.45)	(-3.98)	(-5.44)	(-4.41)
Urbanization[#]	0.11**	0.11	0.14**	0.18***	0.18***
	(2.38)	(1.37)	(2.71)	(4.18)	(3.99)
Lagged corruption	0.19***	0.19***	0.19***	0.19***	0.19***
	(42.66)	(25.09)	(51.16)	(42.02)	(54.82)
Wald (p-value)	0.00	0.00	0.00	0.00	0.00
AR (1) (p-value)	0.09	0.09	0.09	0.09	0.09
AR (2) (p-value)	0.11	0.11	0.12	0.12	0.12
Sargan test (p-value)	1.00	n.a.	1.00	1.00	1.00
N	576	576	576	576	576

Notes: *z*-statistics in parentheses; ***significance at 0.01, **significance at 0.05, *significance at 0.10; column 2 reports estimates from the robust GMM estimator whereas others report estimates from the GMM system estimator; in models where lagged values are used for the level term, values in the interaction term are also lagged by period (columns 3, 4, and 5); constant values are not reported.

[†]Coefficients reported after multiplication by 10^4; [#]coefficients reported after multiplication by 10^{-7}.

In the first regression in table 4, the coefficients for public-sector wages and income have

negative values statistically significant at the 0.01 level, whereas the coefficient for the interaction term has a positive value that is highly significant (column 1 of table 4). The model passes the Sargan test and the test for the absence of AR (2) in the error term. The estimates for the other explanatory variables have the right signs and are highly significant. Similar results are obtained when we use the robust GMM estimator (column 2), lag wage by one period (column 3), lag the income values by one period (column 4), and lag both wage and income by one period (column 5).[27] These results suggest that both higher public-sector wages and higher income reduce corruption. The negative effect of public-sector wages on corruption is however reduced by increases in income. By the estimates in column 1 of table 4, the negative effect of public-sector wages is offset to zero when income reaches 60,631.71 RMB ($8,956.60), beyond which increasing public-sector wages increases corruption. In our sample, 95.18% of (592/622) observations fall below this margin.[28]

6. Conclusions

Using our measure of corruption from the China Corruption Database as the values of bribes received by government officials, we have found no consistent evidence for the fair-wage hypothesis, which requires comparison of the public-sector wage with an external wage

[27] We conducted the same regressions, using the ratio of public-sector wages to income as the relative wage indicator. The estimates for wage and income in all five models have negative values statistically different from zero. The estimate for the interaction term has a positive value statistically significant only in the model in which the wage values are lagged by one period. These results show again that estimation with relative wage indicators to examine the relationship between corruption and wage is problematic. Estimates are available upon request.

[28] This result is consistent with the finding by Le et al. (2013) who reported that the negative effect of government wages draws to zero when income reaches U.S. $8,842 in 2012 constant price.

reference. We find evidence that the relation between the absolute value of the public-sector wage and our measure of corruption as the value of individual government officials' bribes is U-shaped. Increasing public-sector wages, *ceteris paribus*, reduces corruption when provincial public-sector wages and income levels are low. The corruption-deterrent effect of a higher public-sector wage diminishes and eventually comes to an end as provincial per capita income grows. Carrots and sticks can be used in fighting corruption. A bribe is attractive to underpaid civil servants, especially when they are struggling for subsistence. In this case, a few more carrots (increases in the public-sector wage) will work. When income grows to higher levels, sticks seem to be required as carrots alone do not satisfy insatiable people.

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Appendix A

Table A1 Data summary

Variable	N.	Mean	Std. Dev.	Min	Max
Corruption	622	704517.3	2749011	926.07	3.52e+7
Wage	622	24468.8	17113.09	3911	89285
W-state	622	21963.38	15242.58	4152	90492
W-average	622	23841.11	17184.3	4417.9	90731.3
W-manufacturing	622	21670.29	14516.82	4177	71158
RelW-state	622	1.043165	0.1251116	0.5637221	1.513112
RelW-average	622	1.117742	0.1602161	0.5706201	1.726888
RelW-manufacturing	622	1.144692	0.228012	0.5777874	2.09289
RelW-income	622	1.3376	0.4622153	0.3074278	3.047043
Law enforcement	622	1450.408	1006.252	65	8746
Government size	622	0.0196654	0.0072807	0.0052037	0.0509716
Income	622	21050.16	17875.77	2371	93114
Openness	622	0.0402799	0.055315	0.0003	0.7236
Ethnic Diversity	622	0.2701883	0.2535827	0	0.772
Education	622	0.0636822	0.0148177	0.0284	0.1102

Urbanization	622	0.410108	0.1749639	0	0.91

Data sources: Data on corruption is based on statistics of corrupt activities recorded in China Corruption Databank; data on law enforcement is taken from the statistical yearbooks of the Procuratorate of China; data on the other variables are from the statistical yearbooks published by relevant provincial governments in various years.