

Does the Value of a Statistical Life Vary with Union: Evidence from Tunisian Data

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Abstract: This paper measures the value of a statistical life for union and nonunion workers. To avoid the problem of a selectivity bias arising if richer people choose safer jobs, we consider risk as an endogenous variable. The endogeneity of job risk implies that ordinary least squares estimates of the wage equation may be biased and this should be corrected. Accordingly, we use instrumental variables techniques. Using original data from “*la Caisse nationale de la sécurité sociale*”, we found that organizing workers in union generates a value of statistical life at least two times higher than for non-union workers (344,595.2 dinars for non-union and 985,459.7 dinars for union workers). In addition, we found evidence of wage differentials for hazardous work. However, these values of statistical life are much lower than those estimated in developed countries. This study could provide useful results for policymakers to reduce the risk of death in Tunisia.

Keywords: Compensating Wage Differentials, Unions, Value of Life

1. Introduction

In this paper, we use a Tunisian dataset on accidents in the workplace to estimate the value of a statistical life (VSL) for workers in union and nonunion environments.

The contrast between union and nonunion workplaces is important, since a connection is often made between worker and participation and improved workplace safety. In addition, unions are sometimes said to have better knowledge both of workplace risks, and of the preferences of inframarginal workers. If this is the case, then special government policies will be required for the nonunion sector.

As it is, in terms of Tunisian law, only workers in firms which recognize an independent trade union are able to demand a safety representative, who is empowered inter alia, to inspect the workplace every three months or whenever there has been a major change or after a reportable accident. However, 90% of Tunisian private sector workers work in establishments employing less than 100. Further, there has been a tendency over the past decade for union recognition to diminish, and for a rise in the proportion of establishments dealing with health and safety matters without consultation. The question therefore arises as to whether anything further

need be done to protect workers in nonunion plants.

The majority of studies in the United States indicates that unionized workers receive higher compensating wage differentials than non-union workers (Fairres, 1989; Gegax et al., 1991; Moore and Viscusi, 1990 and Viscusi, 1979).

The selection process could also be different in the union and nonunion sectors. This is because the personnel office in unionized firms is under greater pressure to recognize and reward ability so as to offset the higher union pay, with the result that unionized workers have more unmeasured ability than their nonunion counterparts, *ceteris paribus*. Correctly measured, therefore, we might expect to find larger compensating wage differentials for unionized workers, combined with the choice of less risk, *ceteris paribus*.

In Tunisia, no study has evaluated the effectiveness of labor markets in terms of resource allocation or the role of the union on the statistical value of human life in the workplace. The objective of this work is to study the effect of unionization of workers in determining the statistical value of human life.

The second section discusses the compensating wage differentials theory. The hedonic model is exposed in the third section. The description of the data and the empirical results are presented in the fourth and the fifth sections, respectively. The last section concludes.

2. The Compensating Wage Differentials Theory

The compensating wage differentials theory back to Adam Smith¹. He noted in 1776 that workers must be compensated through higher wages relative to that determined by the market to encourage them to take up jobs with disadvantages in terms of working conditions, other things being equal.

Thaler and Rosen (1976) contributed to the development of this theory by referring to the concept of the wage premium related to the probability of being a victim of an accident at work or occupational disease. They analyzed the behavior of the worker in the labor market. The worker can choose between higher wages and less secure employment or less pay and a safer environment. For its part, the employer will choose between higher labor costs and higher security costs. The main result of the compensating wage theory is that the workers require a wage premium risk in order to keep the same level of utility of a safer job than the high-risk job, all things being equal.

Smith (1979) presents a review of studies looking at the risk premium. The justification of the risk premium is that the worker would choose a job that maximizes his utility not only in respect of wages earned, but also in respect of the working conditions associated with the job. Therefore, in the case of an unpleasant working condition, for example, the existence of a high risk of accident, the worker would require in addition to salary, a risk premium to compensate for the disutility suffered. This risk premium depends on the preferences of the worker to risk, that is to say, the degree of aversion to risk. A worker whose degree of risk aversion is low chooses a job with a high risk and requires a higher salary. Contrariwise, a risk aversion worker would prefer a safer job and would be satisfied with low wages.

The results of these empirical studies (Blomquist, 2004; Alberini and Krupnick, 2003; Hammit and Liu, 2003; Vassanadumrongdee and Matsuoka, 2005 and Madheswaran, 2007) support the hypothesis of the existence of a risk premium, and show that it plays a regulatory role for the market to determine the optimal combination of wage-risk.

The theory of compensating wage differentials assumes perfect information for workers. In addition, according to Dionne and Lanoie (2004), workers' mobility is essential to the wage-risk analysis. However, in reality, workers are poorly informed about job hazards in each firm. The worker may be unable to distinguish between jobs with low risk and high-risk jobs.

Thaler and Rosen (1976) and Viscusi (1983) support the hypothesis that unionized workers receive a wage premium for higher risk than others. Indeed, union workers are better informed than the other workers about the firm's risk because they have access to information for institutional reasons. The dissemination of such information to union workers results in a higher risk premium required for risky jobs. In addition,

unions often act by putting pressure on employers to improve working conditions or to pay a wage risk premium for higher risk jobs.

3. The Hedonic Wage Model

The basic framework for hedonic wage model requires data on workers' wages, job risks and other characteristics. The wage that the worker is willing to accept reflects the utility expected from the job characteristics. A worker's indifference curve shows his tradeoffs between the wage rate and the risk of death in the workplace, as described above. Since workplace safety influences firm productivity and costs, the isoprofit curve measures the tradeoffs between job risk and wages. The hedonic wage function is the envelope of mutual tangencies between firm isoprofit curves and worker indifference curves.

Thus, the reduced form of the hedonic wage function can be specified as follows:

$$\ln(W_i) = g(X_{it}, X_{jt}) + \mu_i, \quad (1)$$

where $\ln W_i$ is the natural logarithm of the i th individual worker's wage rate, X_{it} = i th individual worker's characteristics (These include EDUCATION, EXPERIENCE, GENDER, PERMANENCE STATUS, MARITAL STATUS, and UNION), X_{jt} = i th individual worker's job characteristics² including RISK (mortality rate measured at the firm level), and μ_i = random error term.

Furthermore, we consider RISK as an endogenous variable. Indeed, it is arguable that, in the individual's choice of job riskiness, safety should be considered as a normal good. Consistent with this notion is that individuals with greater human capital and earning potential will experience an income effect and select jobs with less risk. If disturbances reflect unobserved heterogeneity among individuals, then those with unobserved characteristics which enable them to earn higher wages will also lead them to find safer jobs. Therefore, the endogeneity of job risk implies that ordinary least squares estimates of the wage equation may be biased and this should be corrected. Accordingly, we use instrumental variables technique.

4. Data Source

The data in this study are taken from one main source, the *Caisse nationale de la sécurité sociale*. This organization is in charge of workplace accidents in Tunisia. It compensates the victims of accidents, administers an experience rating scheme to finance the system, and is responsible for accident prevention (monitoring and enforcement of safety regulations, training, subsidies for protective equipment, etc.).

We have data on a random sample of 7978 employees working in the private sector for the 2002 year. This year is

¹ Smith, A., *The Wealth of Nations*

² These also include MANUFACTURING INDUSTRY and location; SHORE, INTERIOR, SOUTH-WEST, Tunis area is default

chosen because it is the last year that was made available to us. Definitions and descriptive statistics of the variables are presented in Table 1.

The dependent variable used in this study is the natural logarithm of the monthly average wage rate. The average number of fatal injuries should affect positively the wages based on the theoretical foundations of the compensating wage differentials.

The interest variable, UNION, defined as a dummy variable for unionized workers, takes into account for the market labor forces interaction. The main objective of the

union is to defend the interests of workers, improves the working conditions and guards the workers' standards of living.

The unionization rate in Tunisia is about 22%, but it is much lower in private industries (18%). This can be explained by the fact that some private companies are laying off union leaders to get rid of the pressure resulting from their presence in terms of defending the interests of workers and the requirements of good working conditions. Theoretically, UNION variable should positively influence the perceived wage premium.

Table 1. Descriptive statistics of the sample

Dependant variable	Definition	Mean			Standard deviation
		All workers	Union	Non-union	
Log (WAGE)	Logarithm of the monthly average wage rate	5.75	5.75	5.75	0.19
Independents variables					
RISK	The fatal injuries per 1000 workers	8.77	8.72	8.78	0.33
SHORE	Dummy for Shore location	0.58	0.60	0.584	0.49
INTERIOR	Dummy for Interior location	0.086	0.087	0.086	0.28
SOUTH-WEST	Dummy for South-west location	0.018	0.019	0.018	0.13
MANUFACTURING	Dummy for Manufacturing industry	0.51	0.50	0.516	0.49
MARITAL STATUS	Dummy for married worker	0.64	0.64	0.64	0.47
EDUCATION	The number of educated years	7.18	7.21	7.17	2.41
PERMANENCE STATUS	Dummy for a permanent status worker	0.43	0.44	0.43	0.49
EXPERIENCE	Number of years of experience	4.81	4.93	4.78	6.64
GENDER	Dummy for men	0.91	0.91	0.91	0.27
UNION	Dummy for unionized worker	0.18	1	0	0.38

We use controls variables (STATUS and EXPERIENCE, GENDER, MARITAL STATUS and EDUCATION) that serve as control characteristics of the labor supply.

EDUCATION and EXPERIENCE variables are used to account for the effect of human capital on wage disparities. We expect that wage increases with the level of education so that workers with a high level will have higher wages.

Similarly, the experience variable should vary positively with wages because the “learning by doing”³ is an important explanation of the increase in the productivity resulting in higher wages. We expect that a married, experienced worker and male should have a higher wage.

We control for industries and areas location to take account of the characteristics of the labor demand. Three dummies variables for the area location (SHORE, INTERIOR and SOUTH-WEST) were introduced. We also use a dummy variable for the MANUFACTURING industry.

5. Empirical Results

The hedonic wage equation (1) can be written in more detail by:

$$\begin{aligned} \ln(WAGE) = & \beta_0 + \beta_1 RISK + \beta_2 PERMANENCE STATUS + \beta_3 UNION \\ & + \beta_4 EXPERIENCE + \beta_5 MARITAL STATUS + \beta_6 EDUCATION \\ & + \beta_7 GENDER + \sum_{i=8}^{10} \beta_i \times LOCATION_i + \beta_{11} MANUFACTURING \end{aligned} \quad (2)$$

Six variants of the equation (2) have been estimated (the complete model, one without industry dummy, one without location dummies, one without industry and location dummies, one without PERMANENCE STATUS, one without EXPERIENCE), and results are reported in Table 2. The explanatory power of the regressions is fairly good. Because of space limitations⁴, we report only the instrumental variables regression estimates for the four first variants of the equation (2).

The coefficients are stable, positive and significant, and the control variables are most significant with the expected sign. The risk coefficient varies from 0.0919 to 0.181. The determination coefficient is between 0.27 and 0.45.

The first model gives the highest coefficient of determination. Married, experienced, well educated, male, working in a manufacturing industry and located workers in the area of the interior of Tunisia or southwest requires a

³ It means that running repeatedly a task or set of tasks, the assets will be faster and more productive.

⁴ Complete results are available upon request.

higher wage premium for hazardous work.

Thus, according to all estimated models, the risk of accidents affects significantly the increase of wage. Thus, the compensating wage differentials theory is empirically confirmed in the case of Tunisia which implies the existence of a risk premium for hazardous work.

Similarly, the effect of the union variable is important in determining the wage premium according to all models. The coefficient variable is robust and statistically significant at 1%.

Estimated Premiums risks are used to estimate the value of the implicit life. For example, according to the first model, the effect of a unit increase in fatality risk on the worker's gain is 0.135. Evaluate the wage premium to the average salary of 314.19 dinars provides an estimate of the willingness to pay to avoid a fatal accident of 42.41 dinars. A unit increase in fatal accidents increases actually the risk of annual deaths by 1/1000. Multiplying by 12 to annualize the figure, and by 1000 to reflect the scale of the variable "fatality risk", the result of estimating the value of statistical life is 508988.86 dinars. According to Table 2, the value of statistical life in Tunisia is between 504,717.3 and 558,994.2 dinars.

To further discuss the effect of the union on the wage premiums, we can extend the model (2) by introducing the cross variable RISK-UNION in the following equation:

$$\begin{aligned} \ln(WAGE) = & \beta_0 + \beta_1 [RISK \times UNION] + \beta_2 [RISK \times (1-UNION)] \\ & + \beta_3 PERMANENCE STATUS + \beta_4 EXPERIENCE \\ & + \beta_5 MARITAL STATUS + \beta_6 EDUCATION + \beta_7 GENDER \\ & + \sum_{i=8}^{10} \beta_i \times REGION_i + \beta_{11} \times MANUFACTURING \end{aligned} \quad (3)$$

In Table 3, we distinguish between unionized and non-unionized workers. The effect of the risk variable on the wage is more than twice for unionized workers. This is mainly due to the fact that the union membership increases the bargaining power of workers. Indeed, the union shall inform the workers of hazardous job which encourages them to require a higher risk premium. This shows the main role of

union in improving workplace safety.

Table 4 shows that the behavior of workers is different when we distinguish between experienced and non-experienced workers. Experienced workers have a higher VSL (644,073 dinars) than the other.

The value of life for experienced workers (Table 5) is almost one third if we are not unionized. Thus, prevention is affected by two factors; work experience, and membership of a trade union.

Being unionized generates a higher VSL, especially in the manufacturing industry. Contrariwise, the VSL gap between unionized and non-unionized workers is lower in the other industries. Delire and Levy (2004) support our results, workers prefer high wages and high-risk jobs. However, for Sandy and Elliott (2005), the hypothesis of the existence of a wage premium is rejected.

To compare our results with those in developed countries, we must convert our estimates in dollars. When we convert 508,988.86 dinars in dollars, the VSL is about \$ 364,228.45. As expected, this value is lower than the estimates conducted in developed countries. Blomquist (2004) identified several studies that have determined the value of a statistical life in the United States during the period 1990-2002. This value is between 1.7 million and 7.2 million (US \$ 2000). In Taiwan the value of statistical life ranges between 2.61 million and \$ 7.18 million dollars (Hammit and Liu, 2004).

Cropper and Freeman (1991) investigated 17 studies, and argue that the value of a statistical life is between \$ 1.9 million and \$ 6.4 million (in US dollars 1990). Viscusi (1993) and Viscusi and Aldy (2002) find that recent estimates of the value of life are clustered in the range of 3-7 million (US \$ 1990).

Similarly, the value of life in Tunisia is lower than the values of life in developing countries like India, 0.8 million (Madheswaran, 2007). The value of statistical life in Thailand is of the order of \$ 1.48 million (Vassanadumrongdee and Matsuoka, 2005). However, the value of statistical life in Iran is relatively low, 0,066,750 USD (Brajer and Rahmatian, 2004).

Table 2. Estimation of equation 2 by instrumental variables.

	Model (1)	Model (2)	Model (3)	Model (4)
VARIABLES				
RISK	0.135*** (0.0218)	0.134*** (0.0219)	0.148*** (0.0219)	0.146*** (0.0219)
UNION	0.255*** (0.00882)	0.255*** (0.00884)	0.256*** (0.00887)	0.255*** (0.00888)
MARITAL STATUS	0.0776*** (0.00722)	0.0769*** (0.00724)	0.0788*** (0.00726)	0.0781*** (0.00727)
GENDER	0.479*** (0.0124)	0.477*** (0.0124)	0.480*** (0.0125)	0.479*** (0.0125)
EXPERIENCE	0.0885*** (0.00979)	0.0894*** (0.00981)	0.0899*** (0.00981)	0.0903*** (0.00983)
PERMANENCE STATUS	0.112*** (0.00745)	0.113*** (0.00747)	0.111*** (0.00749)	0.112*** (0.00750)
EDUCATION	0.994*** (0.0251)	0.990*** (0.0251)	0.990*** (0.0251)	0.986*** (0.0251)

	Model (1)	Model (2)	Model (3)	Model (4)
SHORE	0.00578 (0.00773)	0.00930 (0.00773)	-	-
INTERIOR	0.0534*** (0.0133)	0.0507*** (0.0133)	-	-
SOUTH-WEST	0.227*** (0.0262)	0.224*** (0.0263)	-	-
MANUFACTURING	0.0421*** (0.00693)	-	0.0386*** (0.00693)	-
CONSTANT	5.268*** (0.0145)	5.289*** (0.0141)	5.279*** (0.0138)	5.300*** (0.0133)
OBSERVATIONS	7978	7978	7978	7978
R-SQUARED	0.367	0.365	0.360	0.358
VSL	508,988.86	504,717.3	558,994.2	552,274.6

Standard deviation in parentheses, VSL: Value of Statistical Life

*** p<0.01, ** p<0.05, * p<0.1

Table 3. Estimation of equation 3 by instrumental variables.

	Model (1)	Model (2)	Model (3)	Model (4)
VARIABLES				
RISK×(1-UNION)	0.111*** (0.0260)	0.110*** (0.0260)	0.122*** (0.0261)	0.120*** (0.0261)
RISK×UNION	0.248*** (0.0477)	0.245*** (0.0478)	0.269*** (0.0479)	0.266*** (0.0480)
MARITAL STATUS	0.0772*** (0.00759)	0.0766*** (0.00761)	0.0785*** (0.00763)	0.0778*** (0.00764)
GENDER	0.477*** (0.0130)	0.476*** (0.0131)	0.479*** (0.0131)	0.477*** (0.0131)
EXPERIENCE	0.0882*** (0.0103)	0.0891*** (0.0103)	0.0893*** (0.0103)	0.0898*** (0.0103)
PERMANENCE STATUS	0.112*** (0.00783)	0.114*** (0.00784)	0.112*** (0.00787)	0.113*** (0.00788)
EDUCATION	0.997*** (0.0263)	0.993*** (0.0264)	0.992*** (0.0263)	0.988*** (0.0264)
SHORE	0.0102 (0.00812)	0.0135* (0.00811)	-	-
INTERIOR	0.0569*** (0.0139)	0.0542*** (0.0140)	-	-
SOUTH-WEST	0.231*** (0.0276)	0.227*** (0.0276)	-	-
MANUFACTURING	0.0405*** (0.00728)	-	0.0372*** (0.00728)	-
CONSTANT	5.314*** (0.0152)	5.335*** (0.0148)	5.329*** (0.0144)	5.349*** (0.0138)
OBSERVATIONS	7978	7978	7978	7978
R-SQUARED	0.301	0.299	0.294	0.292
NON-UNION VSL	419,221.2	415,130.7	459,316.2	453,907.16
UNION VSL	933706	925,239.3	1,013,697.3	1,003,406

Standard deviation in parentheses, VSL: Value of Statistical Life

*** p<0.01, ** p<0.05, * p<0.1

Table 4. Estimation of equation 2 depending on the worker experience⁵ and industry.

VARIABLES	All workers	Experienced workers	Inexperienced workers	Manufacturing	Other industries
RISK	0.135*** (0.0218)	0.181*** (0.0614)	0.128*** (0.0232)	0.124*** (0.0268)	0.143*** (0.0336)
UNION	0.255*** (0.00882)	0.240*** (0.0231)	0.259*** (0.00950)	0.247*** (0.00977)	0.263*** (0.0148)
MARITAL STATUS	0.0776*** (0.00722)	0.130*** (0.0197)	0.0669*** (0.00772)	0.0609*** (0.00791)	0.0946*** (0.0123)
GENDER	0.479*** (0.0124)	0.431*** (0.0259)	0.498*** (0.0143)	0.510*** (0.0133)	0.438*** (0.0218)
EXPERIENCE	0.112*** (0.00745)	0.0985*** (0.0243)	0.114*** (0.00776)	0.0817*** (0.00815)	0.143*** (0.0127)
PERMANENCE STATUS	0.0885*** (0.00979)	-	-	0.103*** (0.0106)	0.0707*** (0.0169)
EDUCATION	0.994*** (0.0251)	1.020*** (0.0546)	0.987*** (0.0285)	0.953*** (0.0309)	1.019*** (0.0385)
SHORE	0.00578 (0.00773)	0.0301 (0.0201)	0.00125 (0.00834)	-0.00137 (0.00864)	0.0131 (0.0129)
INTERIOR	0.0534*** (0.0133)	0.0539* (0.0308)	0.0552*** (0.0148)	0.00781 (0.0162)	0.0845*** (0.0206)
SOUTH-WEST	0.227*** (0.0262)	0.222*** (0.0741)	0.229*** (0.0278)	0.224*** (0.0333)	0.233*** (0.0396)
MANUFACTURING	0.0421*** (0.00693)	0.0354* (0.0185)	0.0434*** (0.00744)	-	-
CONSTANT	5.268*** (0.0145)	5.363*** (0.0384)	5.257*** (0.0161)	5.313*** (0.0157)	5.274*** (0.0239)
OBSERVATIONS	7978	1402	6576	4103	3875
R-SQUARED	0.367	0.364	0.356	0.451	0.323
VSL	508,988.86	644,073	445,100.4	466,468.15	543,633.9

Standard deviation in parentheses, VSL: Value of Statistical Life

*** p<0.01, ** p<0.05, * p<0.1

Table 5. Estimation of equation 3 depending on the worker experience and industry.

VARIABLES	All workers	Experienced workers	Inexperienced workers	Manufacturing	Other industries
RISK×(1-UNION)	0.111*** (0.026)	0.175** (0.0770)	0.102*** (0.0274)	0.0919*** (0.0324)	0.127*** (0.0399)
RISK×UNION	0.247*** (0.047)	0.263** (0.112)	0.246*** (0.0529)	0.263*** (0.0618)	0.235*** (0.0713)
MARITAL STATUS	0.077*** (0.0075)	0.127*** (0.0204)	0.0669*** (0.00814)	0.0611*** (0.00850)	0.0935*** (0.0128)
GENDER	0.477*** (0.0130)	0.424*** (0.0269)	0.498*** (0.0151)	0.507*** (0.0143)	0.439*** (0.0226)
EXPERIENCE	0.112*** (0.00783)	0.0990*** (0.0252)	0.114*** (0.00818)	0.0802*** (0.00876)	0.146*** (0.0132)
PERMANENCE STATUS	0.0882*** (0.0103)	-	-	0.102*** (0.0114)	0.0712*** (0.0176)
EDUCATION	0.997*** (0.0263)	0.998*** (0.0566)	0.999*** (0.0301)	0.955*** (0.0332)	1.023*** (0.0401)
SHORE	0.0102 (0.00812)	0.0279 (0.0208)	0.00702 (0.00880)	0.00228 (0.00928)	0.0178 (0.0134)
INTERIOR	0.0569*** (0.0139)	0.0630** (0.0320)	0.0565*** (0.0156)	0.00414 (0.0174)	0.0927*** (0.0214)
SOUTH-WEST	0.231*** (0.0276)	0.245*** (0.0774)	0.229*** (0.0293)	0.227*** (0.0358)	0.235*** (0.0411)
MANUFACTURING	0.0405*** (0.00728)	0.0314 (0.0192)	0.0424*** (0.00785)	-	-
CONSTANT	5.314*** (0.0152)	5.418*** (0.0394)	5.302*** (0.0169)	5.360*** (0.0167)	5.318*** (0.0247)
OBSERVATIONS	7978	1402	6576	4103	3875
R-SQUARED	0.301	0.315	0.283	0.366	0.268
NON-UNION VSL	419,221.2	621,549	354,806	344,595.2	481,480
UNION VSL	933,706	933,506.5	856,959.1	985,459.7	891,481.2

Standard deviation in parentheses, VSL: Value of Statistical Life

*** p<0.01, ** p<0.05, * p<0.1

5 Experienced worker is one with more than 10 years of experience.

6. Conclusion

In this paper, we investigated the effect of worker unionization on the statistical value of human life in Tunisia. The empirical results support the hypothesis that workers make rational decisions, taking into account the jobs-related risks. Indeed, higher job risks induce higher required wage. Thus, the assumption that the Tunisian workers receive positive wage premiums for work risks is strongly supported.

Our estimates show that the effect of the risk of accidents on the wage variable is two times higher in the case of unionized workers. In fact, organizing workers in union generates a value of human life at least two times higher than for non-union workers (344,595.2 dinars for non-union and 985,459.7 dinars for union).

This is mainly due to the fact that the union membership increases the bargaining power of workers. Indeed, the union shall inform the workers of hazardous work which encourages them to require higher risk premium. This shows the interesting union role in improving workplace safety.

The most important significance of these empirical results is their implication for economic policy makers about the performance of the labor market. Security incentives created by market mechanisms, such as the union have a great effect on the workplace safety. Therefore, this study may be useful for policy makers, health programs and safety at work wanting to reduce the risk of death.

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