Risk Compensation for Workers in Late Imperial Austria

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Risk Compensation for Workers in Late Imperial Austria[1]

ABSTRACT: We test for substitutability of wage differentials and accident insurance benefits in late imperial Austria, where a new and extensive social insurance system produced good quality statistics. We establish that workers earned compensating wage differentials and that accident insurance benefits acted as substitutes for those market based differentials. The movement from negligence liability to compulsory accident insurance in 1887 induced both gains to workers in the form of income certainty, and losses in the form of smaller risk differentials.

Among Adam Smith's aphorisms in *Wealth of Nations* was this observation: "The wages

of labour vary with the ease or hardship, the cleanliness or dirtiness, the honourableness

or dishonourableness of the employment."[2] As in so much of *Wealth of Nations*, Smith's

observations elicited a steady stream of tests of this hypothesis. Do wages respond to workplace

risk, rising to compensate workers who accept more dangerous work? In general, the hypothesis

has held up well. However in the last century or so, accident insurance, especially when imposed

by the state on all workplaces or all firms in a particular industry, should have displaced at least

some of those differentials. In a totally free market, wages would compensate workers for risk;

under accident insurance ("workmen's compensation") a worker is automatically compensated

for his losses after an accident has occurred. Whether the market, the law, or both ultimately

compensated workers for their risk exposure is an empirical question. This paper considers that

question in a case study of Austria just after the government imposed accident insurance on a

broad swath of the working class. It finds evidence that compensating wage differentials and

accident insurance benefits were substitutes. Even after several years of compulsory accident

insurance, the market still provided wage premia for risk of relatively minor accidents, permanent

disability, and death. The results are similar to those found in present day Austria, suggesting that

the persistence of such wage differentials is a long term phenomenon.[3]

Development of Austrian accident insurance

In Austria as elsewhere in Europe, guilds that provided for workers and their families in the event of injury or illness dated back to the Middle Ages. In some scholarly perspectives Austrian efforts to provide more general programs of social insurance were of a piece with the Enlightenment era policies of Maria Theresia and Joseph II.[4] Under the common law, the abilities of injured workers to extract damages from their employers were severely limited. The first Austrian efforts to encourage employers to make sure their sick and injured employees were taken care of came in 1837. This law recommended four weeks of benefits, including payments for hospital treatment, for laborers, journeymen, and apprentices. But ambiguities and lack of enforcement failed to win it much support among industrialists and so workers' situations changed little. In 1859 the *Gewerbeordnung* aimed to force "large industrial undertakings"— defined as those employing over twenty workmen—to join extant sick funds or start their own. Unclear distinctions between ordinary sickness and workplace injury, the small number of available funds, and confusion about responsibility for claims payments prevented this law from having much of an effect.[5] Attempts to revise it followed in 1867, the year in which the Austro-Hungarian Empire was established from the Habsburg Monarchy, and 1882.[6] By the latter date, of course, state provision of social insurance was already an accomplished fact in the German-speaking world.

Germany had initiated state insurance provision, and German accident insurance was intimately related to negligence liability. One of the first laws created under the new Empire in 1871 reformed employers' liability.[7] Under the old regime a worker injured on the job was entitled to damages only if he could prove that the injury stemmed from his employer's negligence. The results were much as described by Price Fishback and Shawn Kantor in the American case: Few injured workers received any compensation. Lawsuits were long and costly, and even when the injured worker prevailed, the foreman or fellow-servant who was found liable often had no assets he could sell to pay the damages.[8]

The German *Haftpflichtgesetz* of 7 June 1871 was, as it turned out, a last-ditch attempt to

reform the system of negligence liability before the radical transformation to compulsory accident insurance. The 1871 law made the owner of the firm liable for his own negligence and the negligence of his representatives but did not change the state of fellow-servant liability or that from risk of business. Instead, it made it easier for workers to sue their employers, and that they did. The amount of litigation increased even though the plaintiff continued to bear the burden of proof. This was a particular problem in industrial or mining settings where proof of employer's negligence was often destroyed during the accident. After a decade of this ineffective law, wrote American observers, all parties were ready for thoroughgoing reform. The result was compulsory, nationwide accident insurance.[9]

In Austria, from 1879 the government led by Count Eduard von Taaffe considered how social insurance might be adapted to its own situation. In more recent years the scholarly literature has emphasized the initiative shown by Taaffe rather than the more traditional view of *fortwursteln*, or "muddling through" domestically and taking its lead from Bismarck abroad.[10] In any case, both government and business were interested in accident insurance for reasons similar to those driving its creation in Germany, in part because so much of Austrian industry was owned by Germans who were familiar with that system. Just as Bismarck desired to keep labor radicalism at bay, in Austria fear of violence combined with self-interest on the parts of business owners to induce legislative efforts first to create a compulsory accident insurance system, and later a sickness insurance program.[11]

The gradual, if geographically uneven, industrialization of Austria over this period lay behind accident insurance proposals. The average annual rate of industrial growth in all of Austria was over three percent by a variety of estimates for the period 1885-1913.[12] By and large the growth was steady, with a slight downturn only in the mid-1890s, and only in some accounts.[13] Sectors with the greatest growth rates included metals and machine building, and two-thirds of value added around 1912 came from iron and cotton textiles.[14] As industrialization proceeded, concern grew for the safety of workers in larger and more capital-intensive production processes. By 1890 about three-fifths of the Austrian labor force worked in agriculture, a share that fell to about half

by 1910; in Bohemia this share was already just two-fifths by 1890 and a third by 1910 and in Slovenia analogous shares were three-fourths and two-thirds respectively.[15]

Regional variation was considerable by a variety of measures, not just share of labor force in agriculture.[16] Per capita income around 1912 differed by about a factor of three between Lower Austria (around Vienna) and the much poorer Carpathian lands. Similar differences can be found in terms of literacy and savings rates. However, it is also clear that product and factor markets in the Austrian provinces were becoming increasingly integrated. Net emigration from low wage lands such as Galicia and net immigration into high wage Lower Austria led to the convergence of regional average wages.[17] Even the length of the workday varied, in part due to differences in industrial specialization. In 1907 Küstenland (the Littoral around Trieste) a third of workers toiled for nine or fewer hours per day, while in Bukowina, far to the East (now in Romania and the Ukraine) only three percent worked fewer than ten hours on typical day.[18]

The eventual legislative success of compulsory accident insurance depended on some factors unique to the multilingual and far-flung Habsburg Empire and others common to social insurance in general. One debate considered whether to organize accident insurance by industry or by region. The former would enjoy industry-specific knowledge of particular risks, but would be costly in terms of the many languages needed to operate across Austria and the considerable distance of Vienna from insured plants. Regional insurance would economize on such transactions costs, but would suffer from a smaller risk pool. Ultimately the regional system was chosen. The Left hoped to fund the system through *ex post* assessments based on benefit expenditures; the Right and more business-oriented Liberals succeeded in imposing actuarially determined (that is, experience-rated) premiums to be paid into reserve funds, with a central reserve fund in Vienna acting as a kind of re-insurance. Since the German-speaking lands such as Lower Austria around Vienna were relatively more industrialized, Slavic leaders recognized that exclusion of agricultural workers would create an incentive for young people to migrate away from the farm and into the factory.[19] As a result, they fought to include workers in agriculture and forestry in the accident insurance program, but that was not to happen until reforms of the mid-1890s.[20]

The difference between negligence liability and accident insurance regimes for Austrian workers can be seen in causes of accidents in the early 1890s (Table 1, below). Assessment of fault was determined by government investigators who did not have any incentive to blame either side, since workers were to be compensated by the accident insurance funds in any case. The table indicates that less than two percent of accidents were attributable to employer negligence, and nearly three-quarters to the amorphous "unforeseen contingencies." Thus if workers had been able to recover their losses only if their employers were negligent—as under the previous liability regime—then few injured workers had any hope of recovery. Just over a quarter of workers caused their own injuries, and seven in ten accidents were nobody's fault at all. Accident insurance greatly increased the probability of an injured worker receiving at least some of his lost wages.

From the last revision of voluntary accident insurance in 1882, Austria moved quickly to make accident insurance compulsory. The 1887 accident insurance law aimed to cover workers in large establishments and in industries characterized by high injury rates, and those who worked with heavy machinery. An 1894 law extended coverage to transportation, warehousing and storage, and some government employees. Miners were already covered by systems established much earlier and were excluded. In general the Austrians followed the German model with one exception. They allowed employers to deduct ten percent of premium payments from workers'

Table 1. Assessment of Accident Cause, Austria, 1890-1894

	Number	% of all accidents
Fault of victim:		
Imprudence and gross negligence	10,937	22.60%
Disobedience of rules or neglect to use safeguards	1,563	3.23
Willful misconduct	7	0.01
Fault of employer:		
Defective plant	413	0.85
Omission of safeguards	218	0.45
Gross carelessness	53	0.11
Fault of third person	762	1.57
Unforeseen contingencies	33,976	70.20
Unknown	471	0.97
Total	48,400	99.99

Source: Weber, "Employers' Liability," p. 279.

Table 2. Experience Rating of Contributions to Accident Insurance Fund

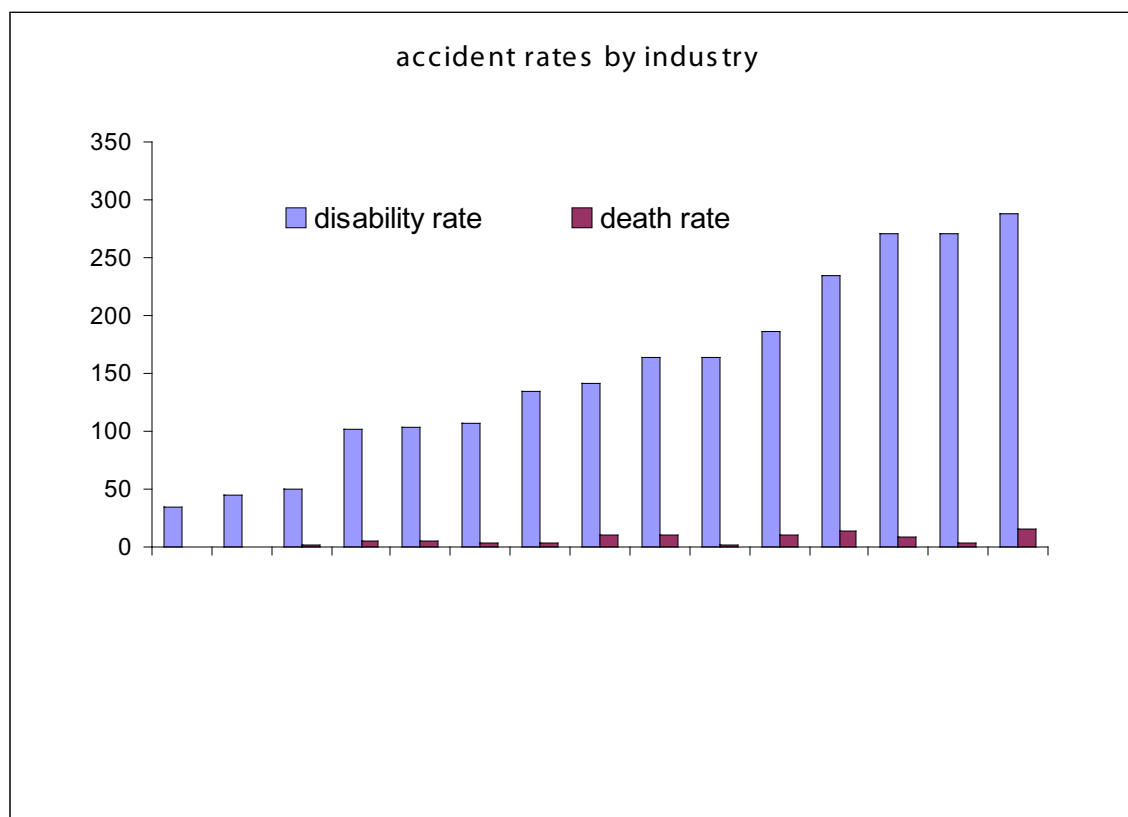| risk class	Example of industry in 1905-1909 ratings	percent of basic contribution
A	silk and velvet factories, not using power	1-3
B	silverware factories, not using power	3-5
I	majolica ware manufacturing	4-8
II	chocolate and candy factories	7-11
III	floss silk spinning	10-14
IV	barrel making, not using power	13-19
V	manufacture of scales of various types, using power	16-24
VI	paper and pasteboard factories	20-30
VII	mangling [textiles]	25-37
VIII	working of turned wood, using power	31-47
IX	manufacture of ordnance	39-57
X	blast furnaces	48-70
XI	manufacture of nitroglycerin	59-87
XII	erection of iron construction work, iron bridges, boilers	73-100

Source: U.S. Commissioner of Labor, *Twenty-Fourth Annual Report*, 53-68.

wages, whereas in Germany employers paid directly the entire premium. According to a Czech legislator, that ten percent from the workers' point of view proved that the insurance program was not charity; the insured workers themselves were paying for part of their coverage.[21] In granting compensation the question of negligence was to be ignored. Nearly all injuries that stemmed from workplace accidents were covered.[22]

Provision of benefits was the responsibility of two separate but related organizations. Sickness insurance funds provided both sick pay and medical benefits for the first four weeks of an episode. After that point, accident insurance funds assumed payments of sick pay benefits while the sickness insurers continued to pay for necessary medical care. Average annual earnings were paid at a rate of 300 times the worker's daily wage. Total disability pensions provided 60 percent of the worker's annual earnings; partial disability was compensated on a pro-rata basis up to half the worker's annual earnings.[23]

The accident insurers charged experience rated premiums to the firms they covered. The gradations were finely determined. Fourteen industrial categories each included several (up to 28) subcategories divided by accident risk, with payments adjusted further by seven regional insurance groups (*Anstalten*) headquartered in Prague, Vienna, Salzburg, Graz, Brünn, Lemberg, and Trieste. Rates were revised every five years. In the 1904 to 1909 rating period, there were 557 different industrial classes for risk rating. Table 2 (above) shows how premiums were set in
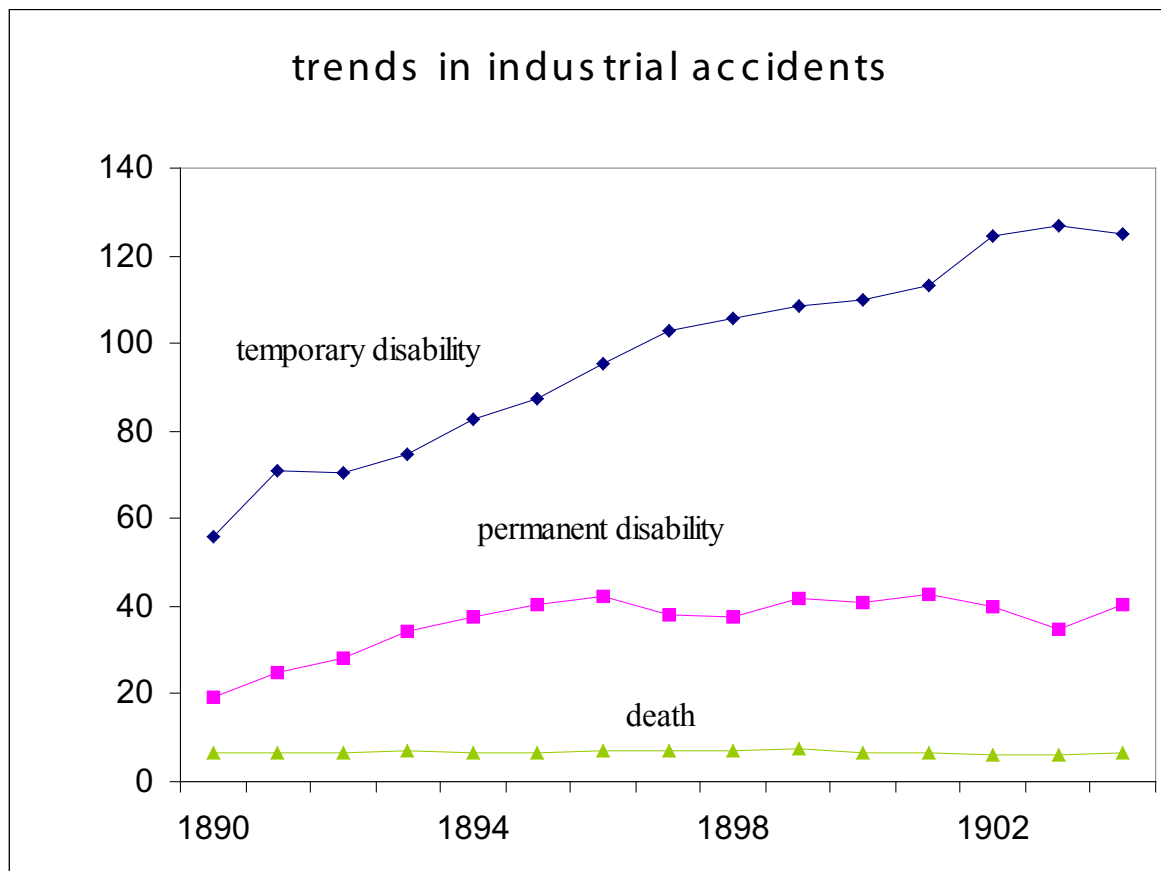
Figure 1. Accident Rates by Industry

Source: U.S. Commissioner of Labor, *Twenty-Fourth Annual Report*.

a few industrial classifications. The variation in premium payments was substantial; differences of a factor of 100 were possible. In Prague and Vienna, the base payment was 7.81 percent of wages, so that, for example, ironworkers paid that full amount while silk workers paid closer to 0.08 percent of wages in premiums. Figure 1 (above) shows a considerable difference in injury and death risk by broad industrial classification: from lowest risk to highest, the difference was a factor of about seven for nonfatal accidents.[24]

The accident insurance system in Austria grew steadily. In 1890 it covered 1,231,818 workers, and eighteen years later in 1907 that figure was just over three million. Figure 2 (next page) shows three distinct trends in accident rates by severity of accident. Rates of accidents that led to temporary disability rose sharply, about tripling from 1890 to 1903. Rates of permanently

Figure 2. Trends Over Time in Overall Austrian Accident Rates

trends in industrial accidents

temporary disability

permanent disability

death

accidents / 10,000 FT insured workers

1890   1894   1898   1902

Source: U.S. Commissioner of Labor, *Twenty–Fourth Annual Report*.

disabling accidents rose slightly to about 1896 and then leveled off. Fatal accident rates did not change over this period. Contemporary observers attributed the increase in relatively less serious accident rates to a learning process: "As the insured persons become more familiar with the operations of the law, they would report accidents more carefully and thereby succeed in securing compensation for a larger proportion of cases."[25]

Historical studies of compensating differentials

Present day tests of compensating wage differentials in the presence of accident risk have tended to confirm their existence despite widespread accident insurance.[26] Testing for their presence in this paper allows us to assess how efficiently markets in the past processed

information of interest to participants on both sides. The most extensive studies of compensating differentials in the United States have been conducted by Price Fishback and Shawn Kantor along with Seong-Wook Kim. They examined late nineteenth century wage surveys in a variety of American cities and states, as well as railroad wage and injury reports. They found that accident risk was less than fully compensated by wage differentials.[27] Railroads, on the other hand, tended to provide compensating differentials for risk of death that replicated value-of-life estimates found elsewhere.[28] The advent of workmen's compensation and its more certain payment of post-accident damages, though, was associated with offsetting reductions in wages.[29] It seems reasonable to conclude that American markets did generate compensating differentials for accident risk, although they may have been small (outside of railroads) and in some cases were balanced out by opposite reactions in wage rates.

Was the European experience similar to the American experience? The European social insurance programs were far more developed than were American ones, of course.[30] Work has only recently begun on testing for wage differentials in Europe. So far the results are mixed. Wayne Lewchuk examined occupational mortality risk in France with a rather small sample. He found strong evidence that long hours on the job raised risk of accidental death, but did not find evidence of compensating wage differentials under the French system of voluntary accident insurance.[31]

The most systematic study to date is that by Javier Silvestre on early twentieth century Spain. Accident compensation schemes dated from very early in the century and were combined with a plan to inspect safety conditions in factories. However, inspections proved to be sporadic and ineffective, and the level of post-accident compensation was generally far less than losses incurred by an injured worker. He concluded that, regardless of the letter of the law, "the main problem [was] not the lack of labor standards but the inefficiency with which weak bureaucracies with limited resources enforce[d] labor laws." Perhaps as a result of this ineffective enforcement, Silvestre found wage differentials that correlated positively, significantly, and robustly with accident risk in Spain between 1909 and 1920.[32]
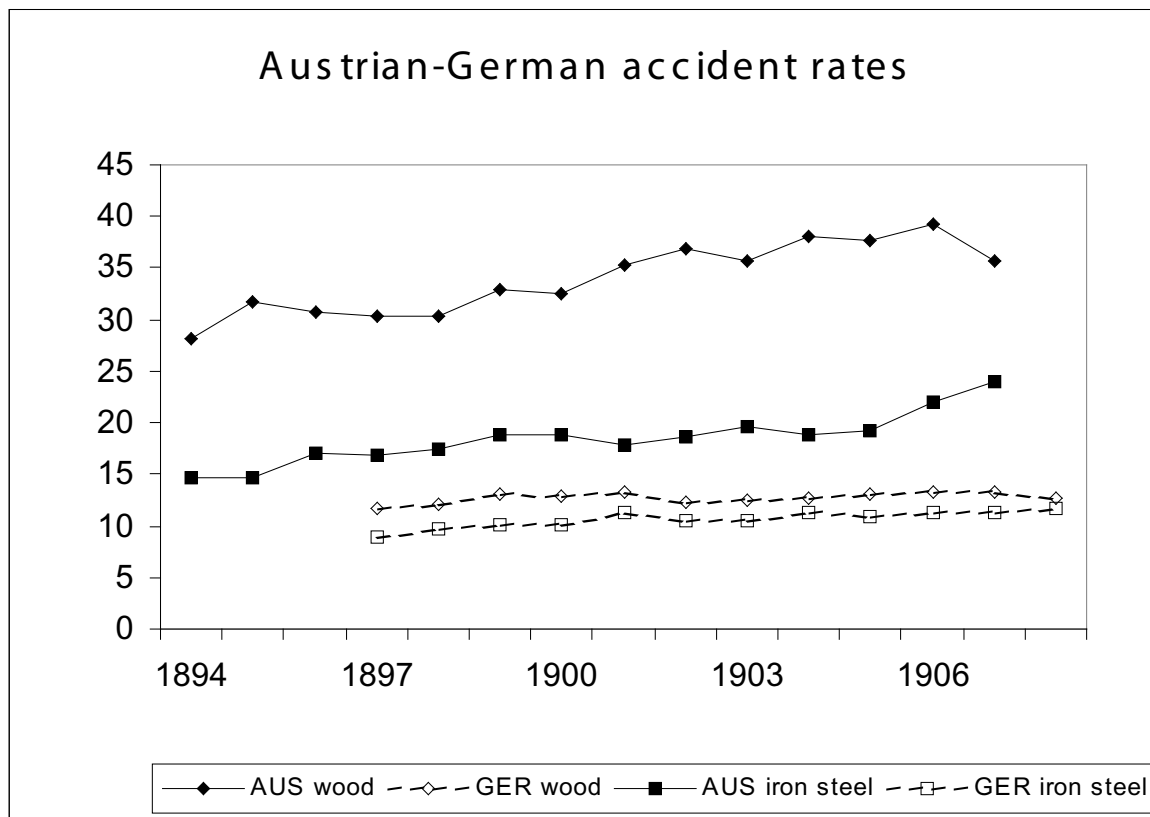
Data sources

The data used in the present study are an improvement in some ways over those used in other studies and at the same time less comprehensive. Both Lewchuk and Silvestre were able to combine data from different sources to form their studies. At points this required synthesizing or estimating various figures that introduced an additional source of error into their estimates. Lewchuk in particular was also hampered by a small sample size (n=40). Silvestre noted that several factors can influence compensating differentials: unions, accident risk, and work intensity, and he then developed estimates of each. This paper can only focus on a single question, that of accident risk. However, it does distinguish accidents by severity: whether they resulted in temporary or permanent disability or death. Also, while the immediate data source for the present paper was an American government publication, which surveyed social insurance programs in a variety of European countries including Austria, its sources were Austrian government publications.[33]

We will draw on two panels of data organized by year and industry. One panel is much larger and less aggregated. It covers 54 industries over 10 years. The other smaller panel covers 16 industries over five years. It is more aggregated, but provides information on days per work year and plant size. Both panels provided estimates of earnings, reported as the wage bill in a given industry and year, which was then divided by the number of workers and further divided by days worked where possible. Consequences of workplace accidents were reported as leading to temporary disability, permanent disability, and death. Table 3 (next page) shows mean values and standard deviations for available variables. Figure 3 (page 13) suggests that Austrian accident rates tended to be somewhat higher than those in the same industries in Germany. The best explanation lies in the waiting period for cases to move from the sickness insurance to the accident insurance system. In Austria this occurred after just four weeks, but in Germany it took thirteen weeks. Overall accident rates increased in the two countries from 1890 to 1906 by about the same proportion: 220 percent in Germany and 212 percent in Austria.[34]

Table 3. Means (Unweighted) and Standard Deviations of Variables

variable	larger sample, 1897-1906 mean (standard deviation)	sample with days worked known, 1902-1906 mean (standard deviation)
gross earnings per year or per day	787 kr (220)	5.12 kr (6.72)
number of workers in year, industry observation	24,365 (27,746)	87,415 (78,116)
number of workers per establishment	n.a.	28.93 (27.15)
work days per worker per year	n.a.	245.83 (76.62)
injury rates, events per 10,000 workers or per 10,000 worker-days		
temporary disability rate	85.2 (65.0)	0.96 (1.95)
permanent disability rate	55.5 (38.0)	0.95 (2.45)
death rate	6.4 (8.3)	0.08 (0.19)
benefit payments as a share of earnings	0.018 (0.015)	0.022 (0.015)
industry		
agricultural processing	0.04	0.125
transport	0.07	0.0625
smelting	0.02	0.0625
stones and earths	0.09	0.0625
metal	0.06	0.0625
machinery	0.11	0.0625
chemicals	0.09	0.0625
heating and lighting	0.06	0.0625
textiles	0.11	0.0625
paper and leather	0.09	0.0625
woodworking	0.06	0.0625
food and drink	0.06	0.0625
clothing	0.04	0.0625
building	0.07	0.0625
printing	0.04	0.0625
n	540	80

Figure 3. Comparison of Austrian and German Accident Rates

Source: U.S. Commissioner of Labor, *Twenty–Fourth Annual Report*.

Wage differentials and insurance benefits as substitutes

It is unrealistic to think that a new and large social program, such as compulsory accident insurance, could be implemented overnight. While the Austrian compulsory accident insurance law dated from 1887, understanding the reporting mechanism, learning how to process applications for compensation, and enforcing responsibility of the insurers to pay claims may all have taken years to work smoothly. To the extent that the new program did not efficiently process claims, thereby leaving some workers uncovered, compensating wage differentials should have persisted to provide the necessary incentive for workers to take on risky jobs. Thus, compensating differentials and insurance benefits may have been substitutes for each other.[35]

To test for this possibility, Table 4 (next page) shows the results of several regressions in which log of gross annual earnings in each industry-year entry was regressed on measures of risk and of accident insurance benefits, as well as dummies for year and industry. The larger (n=486) dataset did not provide information on workdays or number of workers per establishment, so these regressions include all available variables. The measures of risk were the accident rates per worker. These accidents were reported separately as those inducing temporary disability, permanent disability, and death, so there is a rough measure of accident severity here. In the simplest estimations, the coefficients of the linear accident rate variables serve as measures of compensating wage differentials. If they are positive and significant, then increased accident risk raised wages, as Adam Smith proposed. In addition, previous researchers have proposed that inclusion of quadratic risk variables can test for a sorting mechanism in which risk averse workers take low risk jobs (and thus require compensating differentials to take on higher risk jobs) while risk-loving workers who accept risky jobs will take on higher risk jobs without further differentials.[36] An approximate measure of the value of expected accident insurance benefits was simply the value of benefit payments in a given industry and year divided by the wage bill. Interacting this variable with the accident rates allows testing for the substitutability of accident insurance benefits for compensating wage differentials. To mitigate problems of simultaneity, we follow Kim and Fishback in using lagged values of accident rate and benefit share values on the right hand side.[37]

Table 4 reports three regressions for each type of accident risk. The first in each triplet reports only the accident rate. The second in each set added the accident rate squared. The third in each set included interactions between risk and benefit. In regressions with linear risk variables, only the temporary disability rate was associated with significantly higher wages. But that was not the full story. In regressions with linear and squared risk terms and in regressions with risk and interaction terms, all relevant coefficients were significant and signed as expected. This suggests that in fact there was a sorting process by risk aversion and that insurance benefits and compensating differentials were in fact substitutes. Regarding the sorting hypothesis, it is

Table 4. Compensating Real Wage Differentials and Accident Insurance Benefits as Substitutes: Annual Earnings, 1897-1906

	Temporary disability			Permanent disability			Death		
	A	B	C	D	E	F	G	H	I
Accident rate	0.00017* (0.00009)	0.00084*** (0.00023)	0.0016*** (0.00021)	0.00011 (0.00021)	0.0048*** (0.00062)	0.0050*** (0.00046)	0.0011 (0.0011)	0.011*** (0.0026)	0.026*** (0.031)
Accident rate^2		-0.0000015*** (0.0000000046)			-0.000028*** (0.0000036)			-0.00031*** (0.000073)	
Accident rate* benefit			-0.040*** (0.0053)			-0.088*** (0.0076)			-0.48*** (0.06)
adjusted R^2	0.87	0.88	0.89	0.87	0.89	0.90	0.87	0.88	0.89

Dependent variable = log(gross annual earnings). n =486. *=significant at 0.10 level; **=at 0.05 level; ***=at 0.01 level. All accident rate and benefit variables lagged one year. Each regression weighted by number of workers in year, industry observation. Each regression included intercept and dummies for year and industry.

noteworthy that the accident rates that produced the maximum wage response were all greater than the mean accident rate: for temporary disability the optimal rate was 271, compared to a mean of 85; for permanent disability it was 85, compared to the mean of 56; and for deaths it was 18, compared to a mean of 6. Thus over most of the range of accident rates, an increase in accident rates was associated with an increase in wages. Well above the mean that was not the case--consistent with sorting of workers by risk-aversion.

To understand the magnitude of the substitutability of benefits and differentials, consider the regressions labelled C, F, and I. Each indicates that the compensating wage differential appears to have had two parts. One was a baseline differential that would have obtained had there been no accident insurance and the other a discount that was a function of expected accident insurance benefits. The effect of benefit availability to reduce the compensating differentials can be seen in the negative sign on the interaction coefficient, as well as its significance. These results were quite similar to those found in present day studies of compensating differentials and workers' compensation benefits.[38]

It might be easier to see the effects of insurance benefits by estimating the baseline compensating differentials with no insurance benefits and then to simulate the effects of increased benefit levels. The effect is a counterfactual estimate of how the market might have assessed accident risk in the absence of the accident insurance scheme, and then to see the extent to which accident insurance replaced market assessments. The results appear in Table 5 (below),

Table 5. Effects of Substitutability of Wage Differentials and Insurance Benefits: Percentage Change in Earnings Associated with One Additional Event per 10,000 Workers

Compensation for additional risk @ this level of benefits:	Zero benefits	Average benefits - 1 sd	Average benefits	Average benefits + 1 sd
Risk of temporary disability	0.16%	0.15%	0.09%	0.03%
Risk of permanent disability	0.50%	0.47%	0.34%	0.21%
Risk of death	2.6%	2.4%	1.7%	1.0%
Implied value of life (crowns)	204,620	188,888	133,790	78,700
Implied value of life (1967$)	$164,905	$152,244	$107,805	$63,432
Implied value of life (1990$)	$563,975	$520,674	$368,693	$216,937

Note: benefits defined as share of value of benefit payments divided by wage bill. Parameters used as estimated in Table 4.

and use the coefficients as reported in regressions C, F, and I. In all three cases, compensating wage differentials were evident, and they were greater with increasing severity of the accident. An additional accident per 10,000 workers in a system with no benefits would have increased wages by 0.16 percent in case of temporary disability, 0.50 percent in case of permanent disability, and 2.6 percent in case of death. A small amount of expected benefits, one standard deviation less than the mean, reduced each of these differentials only a small amount, since the mean benefit level was only about a standard deviation greater than zero. Increasing expected benefits from one standard deviation below the mean to the mean itself, however, reduced the compensating differential substantially. In the case of temporary disability the reduction was just under half, the permanent disability differential decreased by one-third, and the death risk differential by over one-third. At one standard deviation of benefits above the mean, the differential for temporary disability risk was almost eliminated, and that for permanent disability and for death were both reduced by about 60 percent. In this estimation, insurance benefits strongly reduced the market differential for risk taking.

These figures also allow for value of life estimates, using the formula $V = \Delta w/\Delta p$, where w = the increase in wages due to additional risk and p = the probability of the adverse event. The values of life were estimated with parameters from regression I, and show the effect of increasing insurance benefits. With no such benefits, the implied value of life was 204,620 crowns, which was worth about $164,905 (in 1967) or $563,975 (in 1990). Accident insurance influenced value of life calculations substantially. This amount decreased to about a third of that value for insurance benefits one standard deviation above the mean. Weiss, Maier, and Gerking estimated a value of life in Austria circa 1980 to have been approximately $2 million in 1990 U.S. dollars. Viscusi's 1993 review found that most of 27 estimates fell in the range of $3 to $7 million. Only four were below one million, as were these here.[39] Thus, the value of life implied in turn of the century Austria was considerably less than in the twentieth century United States or present-day Austria. However, these estimates are clearly larger than the estimate of $35,000 or so by Kim and Fishback for contemporary American railroad workers.[40]

Table 6. Influences on Accident Rates

	Temporary disability	Permanent disability	Death
Intercept	8.04***	10.21***	0.80***
	(0.24)	(0.23)	(0.01)
Days	–0.03***	–0.04***	–0.0032***
	(0.001)	(0.001)	(0.000053)
Workers/plant	–0.31***	–0.45***	–0.033***
	(0.03)	(0.03)	(0.0017)
Days*scale	0.0011***	0.0016***	0.00012***
	(0.000080)	(0.000078)	(0.0000047)
Adjusted R^2	0.97	0.98	0.99

Regression included variable for year and dummies for industry. Accident rates not logged due to some zero observations in death rate series.

The smaller data set allows a recalculation of these figures to check for their robustness, as well as illustrating the effects of work days per year by industry and scale, measured as the number of workers per establishment. Table 6 (above) shows estimates of regressions in which the dependent variables were accident rates, in order to test for the proposed effects of longer work time to exhaust workers and cause more accidents.[41] The relationships among days, scale, and their interaction and accident rates was consistent across accident rates. The interaction of the two was associated positively with higher accident rates. Larger plants with longer work years had significantly higher accident rates than did other plants.

Tables 7 (next page) and 8 (page 20) repeat the exercise of estimating compensating differentials, testing for sorting by risk aversion, and testing for substitutability of benefits and differentials, with much the same results. Here, the linear risk coefficient was positive and significant in all regressions, suggesting straightforward compensating wage differentials. The test for self-selection by workers according to their risk-averse or risk-loving status indicated such sorting by temporary and permanent disability rates, but not death rates. Substitutability of benefits and wage differentials appeared in the permanent disability and death regressions. In

Table 7. Compensating Wage Differentials and Accident Insurance Benefits as Substitutes: Daily Earnings, 1902-1906

	Temporary disability			Permanent disability			Death		
	A	B	C	D	E	F	G	H	I
Accident rate	0.20***	0.56***	0.28***	0.14***	0.46***	0.42***	1.83***	2.66*	3.80***
	(0.02)	(0.08)	(0.05)	(0.02)	(0.09)	(0.08)	(0.29)	(1.48)	(1.09)
Accident rate^2		-0.04***			-0.03***			-0.95	
		(0.01)			(0.01)			(1.66)	
Accident rate*benefit			-1.51			-4.16***			-28.72*
			(0.92)			(1.13)			(15.35)
Year	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.02	0.02
	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)	(0.02)
(Workers/Plant)/100	-0.18***	-0.10	-0.17**	-0.16**	-0.13*	-0.17**	-0.14*	-0.12	-0.12
	(0.07)	(0.06)	(0.07)	(0.08)	(0.07)	(0.07)	(0.08)	(0.09)	(0.09)
(Days/work year)/100	-0.31***	-0.24***	-0.31***	-0.38***	-0.28***	-0.31***	-0.36***	-0.33***	-0.30***
	(0.05)	(0.05)	(0.05)	(0.06)	(0.06)	(0.06)	(0.06)	(0.08)	(0.07)
adjusted R^2	0.89	0.91	0.89	0.85	0.87	0.87	0.84	0.84	0.85

Dependent variable = log(daily earnings) where daily earnings estimated as wage bill/number of workers*average number of work days for each industry. n =80. *=significant at 0.10 level; **=at 0.05 level; ***=at 0.01 level. All accident rate and benefit variables lagged one year. Each regression weighted by number of workers in year, industry observation.

**Table 8. Effects of Substitutability of Wage Differentials and Insurance Benefits:
Percentage Change in Earnings Associated with One Additional Event per 10,000
Worker Days**

Compensation for additional risk @ this level of benefits:	Zero benefits	Average benefits - 1 sd	Average benefits	Average benefits + 1 sd
Risk of temporary disability	28%	27%	25%	22%
Risk of permanent disability	42%	39%	33%	26%
Risk of death	380%	360%	317%	271%
Implied value of life (crowns)	194,560	184,320	162,304	138,752
Implied value of life (1967$)	$156,815	$148,562	$130,807	$111,834
Implied value of life (1990$)	$536,307	$508,082	$447,360	$382,472

Note: benefits defined as share of value of benefit payments divided by wage bill. Parameters used as estimated in Table 7.

Table 8, the degree of substitutability appeared to be less than in the larger dataset, but increases in benefits were still associated with smaller compensating wage differentials as before.[42]

Conclusions

This paper has taken a method often used in modern studies of workplace accident risk and applied it to one of the first government operated workers' compensation programs, in turn of the century Austria. Since several of those present day analyses find that compensating wage differentials and accident insurance benefits act as substitutes, it is not so surprising that we find the same occurring a century ago. Even the magnitudes of the effects were roughly similar, since the value-of-life estimates implied by wage differentials were in the same range.

The extent of substitutability is noteworthy. According to Table 5, the effect of average benefits relative to no accident insurance was a reduction in the compensating wage differential by about a third. According to Table 8, which controlled for some plant characteristics but used a smaller and more aggregated sample, the effects were smaller. There, the compensating differential was on the order of ten percent smaller for average temporary disability benefits versus no benefits and 20 percent smaller for permanent disability and death. It is clear that

despite the best efforts to set premiums according to experience-rated actuarial principles, the market was able to determine rather broad situations in which accident insurance could not completely compensate workers for the additional risk to which they were exposed. Where officials could not reckon, the market did, and so workers earned additional pay for the additional hardship they agreed to take on.

Notes

1.   *Version 2.4, December 2005*. We thank Herb Emery, Javier Silvestre, and participants at the 2005 Social Science History Association meetings for great comments on earlier versions of this paper, and Javier Silvestre for providing otherwise hard to locate contemporary documents. The authors may be contacted at john.murray@utoledo.edu

2.   Book I, Chapter IX, Part I; p. 115 in the Modern Library edition.

3.   Weiss, Meier, and Gerking, "Economic Evaluation."

4.   Maschl, "Von der Fürsorge," p. 175. On domestic politics of social insurance creation that emphasizes British as well as German antecedents, see Bachmann, "Joseph Maria Bärnreither."

5.   Jenks, Austria Under the Iron Ring, pp. 197-198.

6.   Hofmeister, "Austria"; U.S. Commissioner of Labor, *Twenty-Fourth Annual Report*, 33-34.

7.   The standard reference on German accident insurance is Wickenhagen, *Geschichte*.

8.   U.S. Commissioner of Labor, *Twenty-Fourth Annual Report*, 978-986; Fishback and Kantor, *Prelude to the Welfare State*.

9.   U.S. Commissioner of Labor, *Twenty-Fourth Annual Report*, 978-986.

10. Ebert, Die Anfäng; Jenks, Austria Under the Iron Ring.

11. Jenks, *Austria Under the Iron Ring*, pp. 196-199, 218.

12. Good, *Economic Rise*, citing work by Rudolph (3.4%) and Komlos (3.1%), pp. 258-259; Schulze, "Machine Building" on 1895-1912 (3.3%); Gross, "Economic Growth" on 1880-1911 (3.4%).

13. E.g., Komlos finds such a decline; Schulze does not.

14. On productivity growth and labor relations in metals and machine building, see Meissl, "'Bei Aufsteigender Konjunktur.'"

15. Good, *Economic Rise*, p. 47; see also Berend, *History Derailed*, pp. 134-180.

16. Uneven regional development is a debate with a long history in Habsburg economic history. Good, *Economic Rise*, summarizes on pp. 125-129.

17. Good, *Economic Rise*, pp. 112-121, 131, 150, 156. Good used wage data in Mesch, *Arbeiterexistenz*, which in turn drew wage information from accident insurance records.

18. Mesch, *Arbeiterexistenz*, pp. 53-55.

19. Other areas of relatively dense industrialization included northern and northwestern Bohemia and the Vorarlberg. See Grandner, "Conservative Social Politics." Good notes intense migration out of Bohemia and Moravia and into Lower Austria during 1900-1910; *Economic Rise*, p. 121.

20. Jenks, *Austria Under the Iron Ring*, pp. 202-206; Hofmeister, "Austria," pp. 297-299, 317-318; Grandner, "Conservative Social Politics."

21. Jenks, Austria Under the Iron Ring, pp. 204.

22. U.S. Commissioner of Labor, *Twenty-Fourth Annual Report*, 36; Weber, "Employers' Liability," 265.

23. U.S. Commissioner of Labor, *Twenty-Fourth Annual Report*, 39.

24. U.S. Commissioner of Labor, *Twenty-Fourth Annual Report*, 45-68.

25. U.S. Commissioner of Labor, *Twenty-Fourth Annual Report*, 93.

26. E.g., Leeth and Ruser, "Compensating Wage Differentials."

27. Fishback and Kantor, "Square Deal or Raw Deal?"

28. Kim and Fishback, "Institutional Change."

29. Fishback and Kantor, "Did Workers Pay."

30. Murray, "Worker Absenteeism."

31. Lewchuk, "Industrialization and Occupational Mortality."

32. Silvestre, "Wage Compensation for Workplace Disamenities."

33. The American publication was U.S. Commissioner of Labor, Twenty-Fourth Annual Report. The most important Austrian publication was Amtliche Nachrichten des k.k. Ministeriums des Innern betreffend die Unfallversicherung und die Krankenversicherung der Arbeiter. The scholarly value of data published by the accident insurance agency can be seen in the extremely detailed analysis of these data in Mesch, Arbeiterexistenz, the standard in the field. Schulze, "Machine Building," also used wage data from the accident insurance system. As far as we know, this paper is the first to use the accident insurance data to study the effect of the accident insurance system itself on labor markets.

34. Frankel and Dawson, *Workingmen's Insurance*, p. 124. Similar differentials appeared in German and Austrian accident rates during the war years. See Wheeler, "Industrial Accidents."

35. Viscusi and Moore, "Workers' Compensation."

36. Example in U.S., Olson, "Analysis of Wage Differentials"; in Austria, Weiss et al, "Economic Evaluation."

37. Kim and Fishback, "Institutional Change."

38. Viscusi and Moore, "Workers' Compensation"; Meng and Smith, "Impact of Workers' Compensation."

39. Weiss, Maier, and Gerking, "Economic Evaluation"; Viscusi, "Value of Life."

40. Kim and Fishback, "Institutional Change."

41. Maschl, "Von der Fürsorge," p. 181, quotes from the *Bericht der Gewerbeinspektor* for 1884 on the worktime-accident risk relationship.

42. A question that we are not able to answer with the available data is whether workers were better off under the negligence liability regime or with compulsory accident insurance. Since the Austrian insurance program was imposed nationwide at a point in time several years before our data series began, it is impossible to make comparisons between workers under each regime. For such an estimate in the American case, based on heterogeneous data from states with and without workers' compensation systems, see Fishback and Kantor, *Prelude*, pp. 54-87, 224-238.

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