Implications of Changes in Labor Standards: A Computational Analysis for Mexico

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ABSTRACT

In this paper, we study the economics of one form of inadequate labor standards in Mexico. In particular, it is often alleged that Mexican workers are misinformed about the inherent danger of the jobs they perform and, accordingly, are not fully compensated for accepting these hazards. We provide a simple theoretical model of the implications of this informational problem for real wages, employment, and safety levels. Given the ambiguity that results in some of these predictions, we simulate the effects of tighter enforcement of safety standards in a computable general-equilibrium model of the Mexican economy. Our results indicate that such enforcement has a noticeably positive impact on the economic welfare of workers. It is also possible for capital owners to gain welfare in a Pareto improvement, due to induced increases in demand for capital for risk abatement purposes. Welfare gains for workers are strengthened if we allow for capital imports. Finally, enforcing the labor standard tends to move workers into the safer sectors, while output and exports expand in those sectors as well.

INTRODUCTION

The economics of labor standards again have become a critical policy issue, in part because of U.S. insistence that Mexico sign a side agreement to NAFTA committing itself loosely to upgrading and enforcing its measures concerning labor protection. Movement toward international harmonization of labor standards, along the lines of those found in certain high-income economies, promises to become a significant demand in the next round of multilateral trade negotiations, much to the concern of numerous developing countries (Anderson 1995).

As is often the case, the attention of policymakers has become focussed on this issue prior to there being much empirical analysis of the effects of different international labor standards on outputs, employment, and trade. As an initial step in this regard, in this paper we develop an applied general equilibrium model of the Mexican economy that may be used to investigate the effects of inadequate standards on sectoral output, employment, and wages, along with Mexican welfare. We model one aspect of labor standards of particular interest, the limited protection for worker safety in numerous sectors. We do so in the context of a small open economy in order to avoid consideration of terms-of-trade effects, though we model impacts on trade volumes.

In our model, the existence of inadequate provisions for worker safety represents a structural information problem in the labor markets that generates a suboptimal allocation of workers across sectors and reductions in worker utility. By removing the information prob-

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lem via stronger safety standards, the economy is moved toward the efficient outcome, resulting in increases in aggregate welfare and worker utility. It is also possible for capital owners to gain real income as demand for risk-abatement capital expands.

The paper is organized as follows. In the next section, we provide a simple theoretical analysis of labor standards, focusing on the information distortion associated with limited worker safety laws. The third section presents the model, along with some comments about its calibration. In the fourth section, we simulate three counterfactual experiments involving removal of a particular distortion in the labor market, characterizing the implications for welfare, employment, and trade. In brief, we find that a Pareto improvement is available for Mexico by virtue of enforcing a full revelation of the risks involved in working in various sectors. Welfare gains may be enhanced by allowing international capital mobility as well. Concluding remarks are given in the final section. Finally, Appendix A gives a short comparative overview of Mexican and U.S. labor standards; Appendix B presents the model in detail; and Appendix C provides a glossary of of the model parameters.

THEORETICAL ISSUES IN OCCUPATIONAL SAFETY STANDARDS

A brief comparison of Mexican and U.S. labor standards (see Appendix A) suggests that, at least on paper, Mexican labor standards are not necessarily weaker than U.S. standards. For example, Mexican workers have rights to organize, to bargain collectively, and to strike that are in several ways more protective than are U.S. laws. Mexican workers have rights of appeal and reform of working conditions that seem to go beyond those of U.S. laborers. Further, Mexico has requirements for paying minimum wages that provide at least a subsistence living for the workers affected.

Seen in this light, it may be surprising that Mexico's standards have come under critical scrutiny. One essential difficulty is that the standards are effective in a relatively small portion of the economy, covering large-scale manufacturing, distribution, and government activity. Agriculture, services, and the large informal sector largely escape this regulatory structure. Even within the large firms in the formal economy, complaints about lax enforcement are common, as are concerns about exceptions provided in the *maquiladora* assembly platforms.

It is the weak enforcement of occupational safety and health standards that concerns us here. Specifically, limited enforcement of Pareto-optimal safety standards acts as a distortion in the sense that actual real wages and safety levels differ from their optimal values. In turn, output and trade levels are distorted. We wish to calibrate a model to the distorted situation and simulate the impact of removing the distortion via full enforcement of optimal standards.

While the model we simulate is complex, it is useful at this point to motivate the economic analysis by means of a relatively simple general equilibrium depiction. First, consider the sufficient conditions under which endogenously set labor standards would be considered Pareto-optimal (Dickens 1984; Brown, Deardorff, and Stern 1993). These conditions include: (1) all markets are perfectly competitive; (2) firms set wage and safety levels to maximize profits; (3) for the chosen safety level, there exists a wage at which the firm can hire the desired amount of labor; (4) agents are perfectly aware of wage and safety levels at all firms; and (5) there are no external economies. The distortion consists of relaxation of condition 4, such that workers do not know true safety levels.

Commodities are produced in various sectors of the economy using technologies that differ in the inherent physical risks they impose on workers.[1] Such risks—which include exposure to toxins, industrial accidents, and the like—are well documented for the United States, and the relative incidence of this exposure across sectors is likely to hold in Mexico as well (see U.S. Department of Labor 1995). Abating these risks requires production technologies that use labor and/or capital resources that must be shifted away from production of commodities. Abatement activities could include sweeping shop floors, upgrading capital equipment with scrubbers, and so on. Note that if abatement activity is significant in the economy, the relative capital intensity of abatement would be an important influence on output in commodity sectors. In any event, it is costly to abate risks and these costs vary across sectors. Further, and key for our analysis, any increase in abatement requirements or costs changes factor demands and prices, thereby inducing substitution between labor and capital that must be taken into account.

Risk abatement is the act of supplying worker safety. Since safety is a desirable commodity to workers, we take it to be an argument in the utility function of workers, who exhibit a preference tradeoff between commodities and safety. The basic insight is that safety has opportunity costs, in that safer jobs command lower wages, thereby implying reduced consumption possibilities. Formally, consider Figure 1, which shows worker indifference curves for wages and safety levels. The lines labeled c_H and c_L indicate given levels for the value of marginal product of labor (VMPL) in high-risk and low-risk industries, respectively. Suppose initially that labor standards are fully enforced, so that labor has full information about the risk characteristics of both sectors. Equilibrium in the labor and safety markets requires that firms set VMPL equal to the joint marginal cost of an additional worker and the safety provided that worker:

$$P_H MPL_H = w_H = w + c_H \cdot s_H \tag{1}$$

$$P_L MPL_L = w_L = w + c_L \cdot s_L \tag{2}$$

Here, w is the wage that all sectors would pay in the absence of risk, while the additional terms indicate the marginal costs of risk abatement (c_H, c_L) and the profit-maximizing per-worker levels of safety.[2] These VMPL schedules reflect the marginal cost functions. We assume that marginal costs are higher in the high-risk sector, generating a steeper VMPL line. Workers, meanwhile, must be indifferent between working in either sector because they are intersectorally mobile. In both sectors, then, the cost of a marginal gain in safety must equal the marginal rate of substitution between wages and safety. In equilibrium, therefore, the high-risk sector pays a higher wage and offers lower safety than does the low-risk sector, as may be seen at points A^* and B^*. Again, note clearly that workers are compensated with both wages and safety, which is a key component of our model.

Now, suppose that labor standards are weakly enforced, resulting in the informational asymmetry that workers do not fully appreciate the danger inherent in their jobs. We justify this notion by supposing that the government suppresses (or simply fails to force disclosure of) information on injury rates. As a result, firms would not be required to compensate workers for the hidden risks in their jobs, resulting in a subsidy from workers to firms in the form of lower wages:

$$(P_H MPL_H)' = w_H' = w + \beta_H c_H' \cdot s_H' \tag{3}$$

$$(P_L MPL_L)' = w_L' = w + \beta_L c_L' \cdot s_L' \tag{4}$$

Here, the β terms indicate the proportion of the information on true risks that is revealed to workers and, therefore, is embodied in wages. The smaller is β, the larger is the informational distortion. It induces workers to believe that jobs are safer than they really are, causing them to accept a lower wage for every level of safety. In Figure 1, suppose that only the high-risk sector suffers from this distortion, thereby shifting down its VMPL line to c_H'. This shift is composed first of a parallel movement downward, due to the lower required wage. However, because workers in this sector will demand both lower wages and lower safety, the VMPL line will also get flatter under our assumption that marginal costs are rising in risk abatement.[3] At point A', workers in the high-risk sector achieve both lower wage and less safety (substituting into more risk in order to mitigate the impact on the wage), though it is conceivable that the cost of risk abatement could fall sufficiently that workers end up even safer than at point A^*. Thus, there is theoretical ambiguity on this point.

Points A' and B^* cannot be a general equilibrium, because worker utility levels differ. We would expect labor to move from sector H to sector L, reducing the wage in the latter and

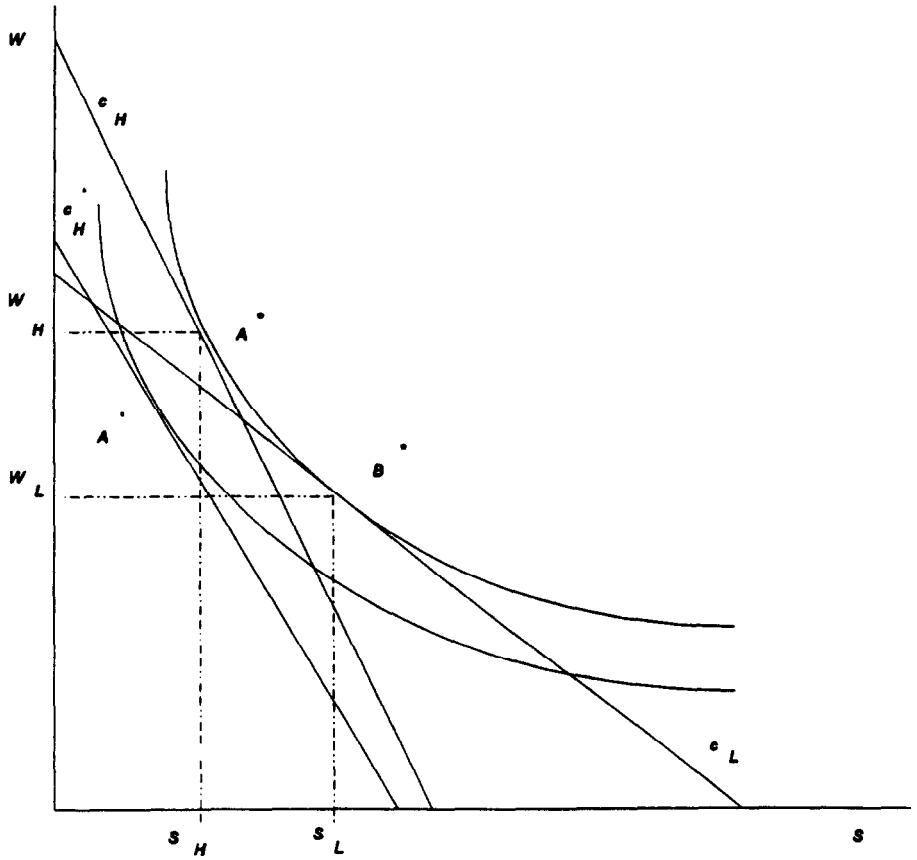

Figure 1. **Per-Worker Wage and Safety Effects of Labor Standard Enforcement**

raising it in the former until again there is equality in the composite wage and safety packages in both industries. The new equilibrium would lie at points along some indifference curve between the two in Figure 1. Wage rates will be lower in both sectors, with an ambiguous impact on safety levels, depending on preference tradeoffs between wages and risk abatement. Notice that an information asymmetry in either sector is sufficient to reduce wages and change safety levels endogenously. In any event, worker utility is reduced as a result of the information distortion and the implicit wage subsidy to firm owners.

There would also be an endogenous response in risk abatement in both sectors. This response is important for understanding the effects on outputs and factor incomes because it determines the change in demand for capital and labor to abate risks. If, for example, the provision of safety is highly capital-intensive, we would expect limited enforcement to reduce the demand for capital in risk abatement, lowering its return (in a closed economy) but freeing capital for absorption into the production of commodities. The effect would be output expansion biased in favor of the capital-intensive sectors.

With this background, we would expect the following results from removal of the risk-information distortion:

1. Worker utility would rise.
2. Capital-owner income could rise or fall, depending on the capital intensity of abatement technology. A small open economy with a fixed capital price would attract some capital inflows to the extent that enforcement raised the demand for capital; this would leave capital incomes unchanged but provide further gains for labor.
3. Aggregate economic welfare would rise.
4. Output changes by sector would depend on relative increases in the costs of risk abatement, capital intensity of production, and consumer preferences. Thus, impacts on output and trade would be complex.

A CGE MODEL OF ENFORCEMENT IN MEXICO

It is this complexity that we wish to capture with our CGE model. We now describe the model structure, then turn to issues of data and implementation.

General Model Structure

The model is sketched in the flow chart in Figure 2. The equations are found in Appendix B. There are 37 sectors (commodities) in the model, each of which produces output for sale at home and abroad (though some commodities are not traded). An Armington constant elasticity of transformation (CET) function allows for substitution in production between domestic goods and exports. Thus, domestic and exported goods are assumed to be differentiated.

Firms produce commodities by combining value added and intermediate inputs. Intermediate inputs are aggregated by means of standard fixed coefficients from the Mexican input-output structure. Each intermediate input is an aggregate of supply sources from the domestic market and from imports. We apply an Armington constant elasticity of substitution (CES) function in defining the intermediate composite goods.

Value added is a CES function of capital inputs and a composite labor-safety input.[4] Safety is combined with raw labor in a Leontief nest in order to produce an "effective" worker. Safety is produced with a CES production function combining labor and capital. This is the risk-abatement technology. Capital intensity is an important parameter in the

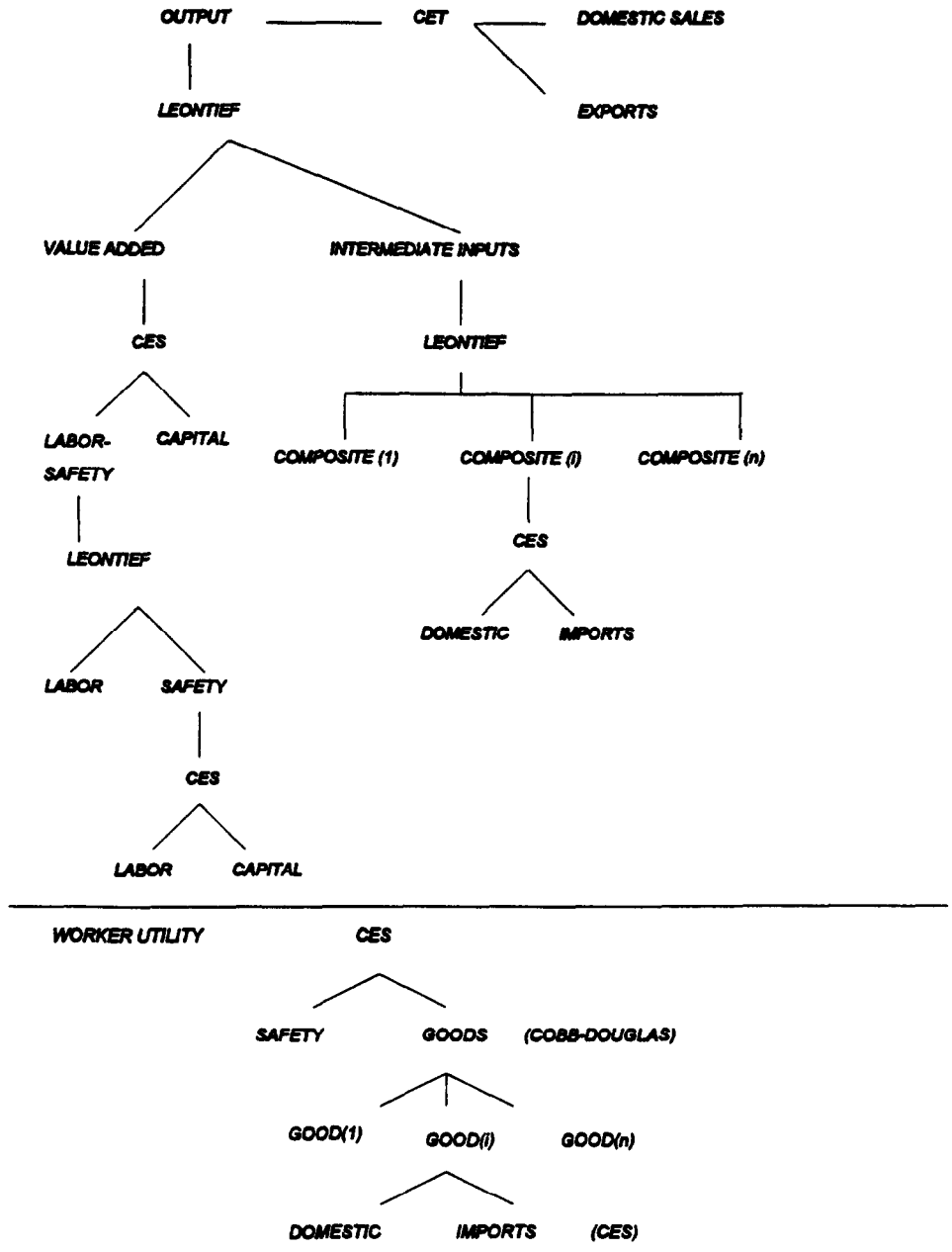

Figure 2. **Production and Worker Utility Model Structure**

model. Firms behave competitively with free entry to generate the zero-profit conditions of the model.

There are two consumers in the model, workers and capital owners. We depict the structure of worker utility in Figure 2. Our representative worker derives utility from a CES utility function combining safety and a composite of consumption goods. In allocating his

income to consumption goods, the worker follows a two-stage budgeting process. In the first stage, consumption is allocated across types of goods via a Cobb-Douglas preference structure. In the second stage, each commodity consumed is decomposed into consumption of domestic goods and imports. Domestic goods and imports are aggregated by the consumer in an Armington CES function, allowing for less-than-perfect substitution possibilities between them.

The utility function of the representative capital owner is identical to the worker's utility function except for the top-level tradeoff between safety and consumption. The capital owner is not interested in safety issues and, therefore, her utility is dependent only on consumption of commodities.

There are a number of clearance constraints in the model. Incomes must be balanced with expenditures in a series of budget constraints. Workers derive income from providing labor and are paid an implicit shadow price for expanding their effectiveness through safety, but their income is reduced to the extent that risk is not compensated by wages.[5] Capital owners gain income from providing capital, part of which income may reflect higher capital rents as a result of uncompensated wages in the context of informational asymmetry. They are also assumed to be the recipients of any current-account imbalance (net capital flows) in the case of international capital mobility.[6] We close the model by allowing an endogenous change in the "real exchange rate" (the real price of foreign currency) in order to keep the current account fixed at world prices.[7] Capital owners are assumed to pay all costs of investment and to pay for the government's provision of public goods. Investment demand and public demand are fixed. Finally, clearing conditions are imposed on all goods and factor markets (including safety, which market is cleared by the shadow price of safety), by requiring that supply equal demand in each market.[8]

The numeraire commodity is the aggregate consumption basket, which carries an aggregate price index. This price index is the numeraire price by which quantities are deflated in order to calculate real magnitudes. Welfare is measured in terms of changes in real consumption of the representative worker and capital owner. In particular, worker utility is based on the CES aggregate of goods and safety consumed in real terms, while capital-owner utility is the Cobb-Douglas aggregate of goods consumed in real terms. We report welfare changes in percentage terms in comparison to utility levels in the benchmark case. Accordingly, the utility indexes are measures of Hicksian equivalent variation for both consumer types.

Empirical Implementation

The model is constructed for computational purposes with a program written in "General Algebraic Modeling System," (GAMS), using software described in Brook, Kendrick, and Meeraus (1989). The model is solved with the MPS/GE software developed by Rutherford (1989). The data on the input-output structure and income flows of the Mexican economy (the Mexican "Social Accounting Matrix") are taken from the global trade analysis project (GTAP) data base (Hertel 1995). The GTAP data base provides a consistent set of social accounting matrices across 24 countries or regions of the world, with each matrix concorded to a 37-sector commodity basis. We calibrate our model to the benchmark matrix, imposing the information distortion we have described, and consider the implications of correcting the distortion, both with and without international capital flows.

In Table 1, we provide primary statistics for the Mexican economy in the benchmark case and identify the sectors for analysis. The first two columns give value added and the

TABLE 1. Benchmark Sectoral Statistics

Sector	*Abbreviation*	*Value Added (%)*	*Wage Bill (%)*	*Risk Index*	*Risk Comp (%)*
Paddy Rice	PDR	0.1	0	108.3	40
Wheat	WHT	0.2	0	108.3	40
Other Grains	GRO	2.0	1.7	108.3	40
Non-grain Crops	NGC	4.2	1.8	108.3	40
Wool	WOL	0	0	108.3	40
Other Livestock	OLP	3.0	2.2	108.3	40
Forestry	FRS	0.6	0.4	108.3	40
Fishing	FSH	0.4	0.3	108.3	40
Coal	COL	0.1	0.1	129.6	40
Oil	OIL	3.9	0.9	68.2	45
Natural Gas	GAS	0.1	0	68.2	45
Other Minerals	OMN	0.8	0.9	62.4	45
Processed Rice	PCR	0	0	207.2	30
Meat Products	MET	1.1	0.6	207.2	30
Milk Products	MIL	0.1	0.1	207.2	30
Other Food Products	OFP	4.0	2.1	207.2	30
Beverages and Tobacco	BET	1.4	1.1	52.0	45
Textiles	TEX	1.1	1.1	88.3	45
Wearing Apparel	WAP	0.8	0.7	99.9	45
Leather Goods	LEA	0.7	0.8	140.8	35
Lumber and Wood	LUM	1.0	0.7	172.0	35
Pulp and Paper	PPP	1.2	0.9	122.7	40
Petroleum and Coal Products	PEC	0.4	0.5	68.2	45
Chemical, Rubber, and Plastics	CRP	3.4	2.7	150.9	35
Non-metallic Mineral Products	NMM	1.8	1.2	62.4	45
Iron and Steel	IRS	1.0	0.9	169.1	35
Nonferrous Metals	NFM	0.4	0.3	169.1	35
Fabricated Metal Products	FMP	0.9	0.9	146.6	35
Transport Equipment	TRN	1.8	1.8	140.0	35
Machinery and Equipment	OME	2.3	2.5	86.6	45
Other Manufacturing	OMF	0.6	0.4	104.0	45
Electricity, Water, and Gas	EGW	1.5	1.7	140.0	35
Construction	CNS	4.8	10.6	148.1	35
Trade and Transport	TRT	28.5	20.5	140.0	35
Other Services (private)	OSP	16.2	16.4	60.0	45
Other Services (public)	OSG	9.5	23.2	60.0	45
Dwellings	DWE	0	0	132.0	40

Notes: Value Added is payments to labor and capital as a percentage of economy-wide total.
Wage Bill is wage payments as a percentage of economy-wide total.
Risk Index is the number of industrial accidents in U.S. industries as reported in the U.S. Department of Labor (1995).
Risk Comp. is the percentage of true risk premium assumed to be compensated in the baseline wage.

wage bill for each sector as a share of economy-wide totals. Production and value added are dominated by the service sectors (construction, trade and transport, and public and private other services). Among merchandise commodities, non-grain crops, oil, other food products, and chemical, rubber, and plastic products have the largest value-added shares.

Industrial accidents in the United States are ranked by major sector in U.S. Department of Labor (1995). We assume that this relative ranking applies to Mexican industries as well. The highest injury rankings go to food products, metals, lumber and wood products, and chemical, rubber and plastic products, along with construction. We recalculate this index by setting the highest figure equal to 100 and scaling the others down in proportion. We assume that, in the highest-risk sectors, 40% of wages would represent a true risk premium if workers were fully compensated. That is, risk-abatement costs are assumed to represent 40% of the wage bill in the most dangerous industries under the optimal standard with full enforcement. In the other sectors, the true premium is the rescaled risk index times this maximum percentage.

To capture the notion that risk is not fully embedded in the wage, we assign sectors to four risk-compensation categories, with the highest-risk group paying 30% of the true premium (thus, the observed risk premium is $0.4 \times 0.3 = 12\%$ above the no-risk wage). The next-highest risk group pays 35% of its sectoral risk premium; the next group pays 40%; and the safest group pays 45%. Thus, the higher is this percentage, the more risk is compensated in the baseline wage and the lower is the sectoral information distortion. This procedure results in a range of risk premia in the benchmark case from a low of 4.5% in the lowest-risk sectors to a high of 12.0% in the highest-risk sectors. It also generates an implicit subsidy from workers that ranges from 5.5% in the safest industries to 28.0% in the most dangerous industries.[9]

All of the model's parameters, variables, and equations are detailed in Appendices B and C. At this point, we simply note what some of the key parameters are and their values in the simulations. First, as noted, the maximum value of safety as a percentage of wages is set at 40%. Second, the capital share of risk-abatement costs is 60%, indicating that this activity is capital intensive. Third, we assume a fairly high substitution elasticity (2) of labor for equipment in producing safety. Fourth, in the model, the elasticity of supply of safety depends on labor's ability to provide additional effective hours of work in relation to its existing exposure to risk. The ratio of "reserve" effectiveness to exposure in the benchmark is set at 2, indicating a reasonably elastic potential response. Finally, in their utility functions, workers display a substitution elasticity between the commodity composite and safety of 0.5.

SIMULATION RESULTS

We undertake three counterfactual exercises in this model, as follows.

1. *INFORMATION.* In this case, the government enforces full disclosure of safety levels to workers, thus removing the distortion.
2. *KFLOW.* In this case, we allow capital inflows in the distortion-free case.
3. *EXCESS.* This scenario examines the effects of a labor standard that is 20% above the optimum level, also allowing for capital mobility. Overregulating safety is modeled as informing workers that industries are 20% more dangerous than they really are.

TABLE 2. Welfare Effects (Hicksian EV %) and Capital-Flow Effects (%) of Labor Market Reform

Scenario	*Worker*	*Owner*	*Capital Imports*
INFORMATION	0.5	0.1	0.0
KFLOW	0.8	0.0	0.4
EXCESS	0.7	0.0	0.5

The welfare effects for workers and capital owners are summarized in Table 2. When provided full information about job safety, workers find their well-being increased by 0.5% per year, a figure that is noteworthy in that it is in the same ballpark as many static estimates of the welfare impacts of broader policy changes, such as trade liberalization. Thus, labor-market reform in this limited sense provides notable gains for workers. It also raises the real incomes of capital owners because rising capital prices associated with greater risk abatement slightly outweigh the reduction in subsidies to capital rents. The total welfare gain comes to 0.6% of baseline GDP.[10]

Fixing the information distortion in the presence of capital flows raises worker welfare even further, while capital welfare cannot change because capital prices are fixed in the world market. In short, correction of both distortions (the labor-market problem and the absence of capital mobility) generates a further gain for workers because the Mexican capital stock rises by 0.4% (see the final column). Finally, going beyond this point to an excessive labor standard cuts the welfare gain to 0.7% for workers, despite the slightly larger rise in capital inflows. The fact that aggregate welfare gains are higher here than in the INFORMATION scenario simply reflects the gains to be had from capital mobility; with no capital flows, the total welfare gain under EXCESS would be lower than under INFORMATION because of a loss to capital owners.

This model is capable also of computing intersectoral employment shifts as a result of changes in labor standards, along with impacts on outputs, imports, and exports. We present in Table 3 the results of these calculations for employment and trade. Notice that the employment reductions are greatest in the food products sectors (PCR, MET, MIL, OFP), which had the highest risk indices, while employment gains are registered in the safer industries, such as machinery and equipment (OME), other minerals (OMN), and services (OSP and OSG). Thus, the effect of removing the information distortion is to reduce employment in the dangerous sectors in favor of safer ones.

The effects on imports depend largely on impacts of reform on costs in domestic sectors relative to imports, along with changes in demand for both types of goods as worker incomes rise and in intermediate demands as sectoral output shifts. In many industries, imports actually fall slightly, suggesting a decline in the relative price of domestic goods. The response in exports corresponds slightly more to the employment effects, which are directly related to domestic outputs and, therefore, exports. In fact, the only two sectors with higher exports as a result of labor-market reform alone are other minerals (OMN) and machinery and equipment (OME). Exports are strengthened in the presence of capital inflows because these flows expand outputs in capital-intensive sectors, freeing up additional product for exports.[11] Thus, the evidence in our model as to whether stronger labor standards will cut Mexican exports, evidently the underlying hope of labor interests in the

TABLE 3. Sectoral Employment and Trade Effects of Labor Market Reform (%)

	Employment			*Imports*			*Exports*		
	IN	*KF*	*EX*	*IN*	*KF*	*EX*	*IN*	*KF*	*EX*
PDR	–0.3	–0.5	–0.6	–0.4	–0.6	–0.8	–0.9	–0.6	–0.7
WHT	–0.3	–0.5	–0.6	–0.3	–0.6	–0.7	–1.0	–0.6	–0.7
GRO	–0.2	–0.4	–0.6	–0.4	–0.6	–0.7	–0.7	–0.5	–0.6
NGC	–0.2	–0.4	–0.5	–0.2	–0.5	–0.7	–0.8	–0.4	–0.6
WOL	–0.2	–0.4	–0.5	–0.4	–0.5	–0.7	–0.6	–0.4	–0.5
OLP	–0.2	–0.4	–0.6	–0.3	–0.5	–0.7	–0.7	–0.5	–0.6
FRS	–0.2	–0.2	–0.3	–0.3	–0.3	–0.4	–0.7	–0.2	–0.3
FSH	–0.2	–0.4	–0.6	–0.3	–0.5	–0.7	–0.7	–0.5	–0.6
COL	0.2	1.0	1.2	0.2	1.1	1.3	–0.1	1.0	1.3
OIL	0.1	0.4	0.5	0.2	–0.5	–0.7	–1.0	0.0	0.0
GAS	–0.6	0.7	0.8	–0.4	–0.3	–0.3	–1.6	0.3	0.3
OMN	0.6	0.8	0.9	–0.5	–0.3	–0.3	0.1	0.6	0.8
PCR	–1.6	–1.6	–1.7	–0.3	–0.4	–0.5	–1.5	–1.0	–1.2
MET	–1.2	–1.4	–1.5	–0.1	–0.4	–0.5	–0.8	–0.6	–0.7
MIL	–1.2	–1.4	–1.5	–0.2	–0.4	–0.5	–0.9	–0.6	–0.8
OFP	–1.2	–1.4	–1.5	0.1	–0.2	–0.3	–1.0	–0.8	–0.9
BET	0.3	0.1	0.0	–0.5	–0.7	–0.9	–0.5	–0.3	–0.4
TEX	0.1	0.0	–0.1	–0.5	–0.6	–0.7	–0.4	–0.2	–0.3
WAP	0.1	–0.1	–0.2	–0.4	–0.6	–0.8	–0.5	–0.3	–0.4
LEA	–0.7	–0.8	–1.0	–0.1	–0.2	–0.4	–0.9	–0.8	–0.9
LUM	–0.7	–0.6	–0.6	0.3	0.3	0.2	–0.8	–0.3	–0.3
PPP	–0.2	–0.2	–0.3	–0.2	–0.2	–0.3	–0.6	–0.3	–0.3
PEC	–0.1	0.1	0.1	–0.2	–0.6	–0.8	–0.8	0.0	0.0
CRP	–0.7	–0.6	–0.7	0.0	0.0	–0.1	–0.9	–0.4	–0.4
NMM	0.6	0.5	0.5	–0.2	–0.3	–0.4	–0.2	0.2	0.2
IRS	–0.4	0.1	0.2	0.4	0.9	1.0	–0.5	0.3	0.4
NFM	–0.1	1.2	1.5	0.7	1.9	2.2	–0.2	1.5	1.8
FMP	–0.4	–0.2	–0.2	0.2	0.4	0.4	–0.6	–0.1	–0.1
TRN	–0.8	–0.7	–0.7	0.0	0.0	–0.1	–1.0	–0.6	–0.6
OME	2.5	6.5	7.6	–0.1	0.3	0.3	1.9	6.3	7.4
OMF	0.0	0.1	0.0	–0.3	–0.5	–0.6	–0.7	–0.1	–0.2
EGW	–0.5	–0.4	–0.4	0.2	0.1	0.0	–0.8	–0.3	–0.3
CNS	0.0	–0.1	–0.1	0.4	0.5	0.4	–0.2	–0.3	–0.2
TRT	–0.5	–0.6	–0.7	0.0	–0.1	–0.2	–0.8	–0.4	–0.5
OSP	0.3	0.2	0.1	–0.8	–0.8	–1.1	–0.1	0.1	0.0
OSG	0.3	0.2	0.2	–1.8	–1.4	–1.7	1.0	0.7	0.9
DWE	–0.3	–0.5	–0.7	0.0	0.0	0.0	0.0	0.0	0.0

Notes: IN indicates scenario INFORMATION.
KF indicates scenario KFLOW.
EX indicates scenario EXCESS.

United States, is mixed. It depends on the initial structure of distortions in the labor market along with factor intensities and the extent of capital flows.

CONCLUDING REMARKS

Labor standards were a controversial issue in the NAFTA negotiations and may prove to be important in other international forums, such as the next round of the GATT/WTO. To use a broad brush: organized labor interests in the wealthy nations wish to induce the developing countries to implement and enforce stronger standards of labor protection. In some degree, this desire reflects a hope that doing so will reduce exports from the developing nations, thereby limiting competition in the importing markets.

In this paper, we have attempted an initial examination of the effects of labor standards on domestic welfare and international trade by calibrating a model of the Mexican economy. Even in the simple case studied here, there are a number of theoretical subtleties about preferences and costs that make predictions about the impacts of stronger labor standards somewhat ambiguous.

Subject to the sensibility of our model, it appears that a Pareto improvement is available for Mexico by virtue of correcting any distortionary signals about underlying hazards of working in various industries. Doing so improves the choice set for workers and raises their incomes, while the need for stronger abatement measures could raise capital incomes. The gain in welfare for Mexican workers is yet stronger if Mexico combines labor-market reform with free capital mobility.

APPENDIX A: U.S. AND MEXICAN LABOR STANDARDS

A short overview of American and Mexican law and practice in labor standards is of interest. For further information, readers are referred to U.S. Department of Labor (1992). Further perspective is provided in Franco (1991) and Gregory (1986). Table A1 provides a thumbnail comparison of labor laws in the United States and Mexico. Labor standards encompass the right of association, organization and collective bargaining; prohibition against forced labor; minimum age for workers; and acceptable working conditions, such as minimum wage, maximum hourly hours, and minimum safety and health standards. Also important are how well enforced such standards are and how comprehensively they apply to formal and informal economic activity.

It is noteworthy that both Article 123 in the Mexican Constitution and the Federal Labor Law contain strong provisions for labor protection and subsequent legislation has generally strengthened statutory protection. In fact, on paper Mexican law provides stronger safeguards for labor interests than does U.S. law in certain dimensions. However, it is commonly asserted that Mexican enforcement does not fulfill the intent of the law and that Mexican regulations are written more for symbolic intent than strict application. Moreover, the government has frequently abridged union rights with two primary tools. One is to declare strikes as null and void, which allows firms to hire replacement workers, which would not be permitted under a government-sanctioned strike. A second is to refuse to recognize small, independent labor unions; government recognition is a prerequisite for collective bargaining. Other issues are explained in the table. Our interest here is job safety and health. Again, while Mexican law is strong on paper, difficulties remain with regard to inspection and enforcement procedures.

TABLE A.1. Labor Regulations in the United States and Mexico

Type of Labor Law	*United States Law*	*Mexican Law*
Union Organization	National Labor Relations Act grants the right to bargain collectively and proscribes "unfair labor practices." Definition of a union is broad and employees are not required to join.	Article 123 of the Constitution grants the right to associate to both employees and employers. A union is less broadly defined than in the United States. Unions must be recognized by the federal government and employees may be required to join.
Collective Bargaining	Parties are not required to bargain nor make concessions and government cannot compel parties to agree. Collective bargaining agreements typically span three years.	Collective bargaining agreements may span any length of time but are subject to revision every two years regarding working conditions and every year regarding wages. A "Law Contract" covers all enterprises in a given geographical area.
Right to Strike	It is guaranteed under the NLRA, with some exempt sectors. Employers may hire replacement workers. Mediation, arbitration, and conciliation are voluntary.	It is guaranteed under the constitution. Only full strikes are allowed and some have been declared null and void by the government. Arbitration is mandatory.
Occupational Safety and Health	Occupational Safety and Health Act covers most industries and sets procedures for inspections, fines, required processes, and equipment. Enforcement is through deterrence.	The General Regulation on Workplace Safety and Hygiene covers all industries. It created government, labor, and business commissions of safety and provided the framework for safety regulations. Inspection capacity is limited and enforcement is through compliance assistance.
Minimum Wage	The Fair Labor Standards Act provides for a minimum wage, which is set by Congress. The minimum wage applies to large businesses and those businesses engaged in interstate commerce.	Minimum wages are set at least yearly by the tripartite National Commission for Minimum Salaries. Wages must be paid weekly for manual laborers and biweekly for other occupations.
Hours of Work	There are no maximum hours of work, but hours more than 40 per week must be paid at 1.5 times the normal rate. Holidays are not mandated by the federal government but states mandate some.	A 48-hour work week exists for most occupations, while overtime is paid at twice the hourly rate to 9 hours and triple beyond that. The federal government mandates 9–10 holidays per year and workers are entitled to paid vacation days at 25% of the hourly wage.
Profit Sharing	There is no legal requirement for profit sharing.	Employees have the right to share in the profits of most enterprises. The employee share (now 10%) is set by the National Commission for Employee Profit Sharing in Enterprises and a year-end bonus of 15 days' wages is required.

APPENDIX B: MODEL EQUATIONS, VARIABLES, AND PARAMETERS

1. Zero profit conditions

1.1. Domestic production Y_i:

$$-\Pi_i^r = \sum_j a_{ji} PA_j + a_{vi} PVA_i - [\theta_i^D PY_i^{1+\eta} + (1-\theta_i^D) PX_i^{1+\eta}]^{\frac{1}{1+\eta}} = 0$$

in which:

$$PX_i = ePX_i^W$$

$$PVA_j = [\theta_i^K PK^{1-\sigma} + (1-\theta_i^K) P\tilde{L}_i^{1-\sigma}]^{\frac{1}{1-\sigma}}$$

$$P\tilde{L}_i = \theta_i^L PL + (1-\theta_i^L) PS_i$$

$$PS_i = [(1-\theta_i^S)\tilde{\pi}_i^{1-\gamma} + \theta_i^S PK^{1-\gamma}]^{\frac{1}{1-\gamma}}$$

$$\tilde{\pi}_i = \frac{\pi\beta_i}{\bar{\pi}_i}$$

1.2. Armington aggregator A_i:

$$-\Pi_i^A = \left[\alpha_i^D PY_i^{1-\sigma^A} + (1-\alpha_i^D) PM_i^{1-\sigma^A}\right]^{\frac{1}{1-\sigma^A}} - PA_i = 0$$

in which

$$PM_i = ePM_i^W$$

1.3. Public consumption G:

$$-\Pi^G = \left[\sum_i \theta_i^G PA_i^{1-\sigma^G}\right]^{\frac{1}{1-\sigma^G}} - PG = 0$$

1.4. Private goods demand C:

$$-\Pi^C = \left[\sum_i \theta_i^C PA_i^{1-\sigma^C}\right]^{\frac{1}{1-\sigma^C}} - PC = 0$$

1.5. Worker final demand W:

$$-\Pi^W = \left[(1-\alpha^S)PC^{1-\sigma^W} + \alpha^S PS^{1-\sigma^W}\right]^{\frac{1}{1-\sigma^W}} - PW = 0$$

1.6. Capital imports KM (with complementarity conditions which assure that the activity is not operated if it is unprofitable to do so):

$$-\Pi^{KM} = PK^W e - PK \geq 0, \quad KM \geq 0, \quad KM\Pi^{KM} = 0$$

2. Income balance equations

2.1. Capital owner/investor:

$$M_K = PK\,\bar{K} + e\,\bar{B} - PG\,\bar{G} - PA_I I$$

2.2. Worker:

$$M_W = PL\,\bar{L} + \pi\left(\bar{S} - \sum_i Y_i \frac{\partial -\Pi_i^Y}{\partial \tilde{\pi}_i}(1-\beta_i)\right)$$

3. Market clearance conditions

3.1. Labor:

$$\bar{L} = \sum_i Y_i \frac{\partial -\Pi_i^Y}{\partial PL}$$

3.2. Capital:

$$\bar{K} = \sum_i Y_i \frac{\partial -\Pi_i^Y}{\partial PK}$$

3.3. Safety:

$$S = \sum_i Y_i \frac{\partial -\Pi_i^Y}{\partial \tilde{\pi}_i} + W\frac{\partial -\Pi^W}{\partial \pi}$$

3.4. Domestic production:

$$Y_i \frac{\partial \Pi_i^Y}{\partial PY_i} = A_i \frac{\partial -\Pi_i^A}{\partial PY_i}$$

3.5. Foreign exchange:

$$\bar{B} + \sum_i PX_i^W Y_i \frac{\partial \Pi_i^Y}{\partial PX_i} = PM_i^W A_i \frac{\partial - \Pi_i^A}{\partial PM_i} + KM\ PK^W$$

3.6. Public demand:

$$G = \bar{G}$$

3.7. Investment:

$$Y_I = \bar{I}$$

3.8. Consumption demand:

$$C = \frac{M_K}{PC} + W\frac{\partial - \Pi^W}{PC}$$

3.9. Worker demand for goods and safety:

$$W = \frac{M_W}{PW}$$

APPENDIX C: GLOSSARY OF MODEL PARAMETERS

$a_{ij}(a_{vj})$	Benchmark unit intermediate input of good i (value added) per unit output of sector j.
θ_i^D	Benchmark domestic sales share of production for good i.
$\eta = \eta_i$	Output elasticity of transformation between domestic and export markets.
PX_i^W	Export price index for good i on the world market.
θ_i^K	Benchmark capital value share in gross value added for sector i.
$\sigma = \sigma_i^{KL}$	Elasticity of substitution between capital and labor/safety in sector i.
$\bar{\pi}_i$	Benchmark safety compensation rate for sector i.
θ_i^L	Benchmark labor share of labor/safety inputs to sector i.
θ_i^S	Benchmark share of risk costs abated by equipment use in sector i.
β_i	Share of worker risk which is compensated in the wage.
$\gamma = \gamma_i$	Elasticity of substitution between equipment and exposure in abating risk.
α_i^D	Benchmark value share of domestic good i in home plus imported supply.
$\sigma^A = \sigma_i^A$	Elasticity of substitution between domestic and imported varieties.
PM_i^W	Import price index for good i on the world market.
θ_i^G	Benchmark value share of good i in public demand.
σ^G	Elasticity of substitution in public demand.

(continued)

Glossary of Model Parameters *(Continued)*

θ_i^C	Benchmark value share of good i in consumer demand.
σ^C	Elasticity of substitution in consumer demand.
α^S	Benchmark value share for safety in worker welfare.
σ^W	Elasticity of substitution between safety and goods in worker welfare.
PK^W	Price index for capital in the world market.
$\bar{K}$	Initial endowment of capital.
$\bar{B}$	Initial endowment of foreign exchange (= benchmark net capital flow).
$\bar{G}$	Benchmark level of public provision.
$\bar{I}$	Benchmark aggregate investment.
$\bar{S}$	Initial endowment of "safety."
$\bar{L}$	Initial endowment of labor.
PA_i	Price index, Armington composite of domestic and imported varieties.
PVA_i	Price index for value-added inputs: capital, labor and safety costs.
PY_i	Price index for output supplied to the domestic market.
PX_i	Price index for output supplied to the export market.
e	Price index for foreign exchange (the real exchange rate).
PK	Price index for capital.
$P\tilde{L}_i$	Labor/safety cost index for sector i.
$\tilde{\pi}_i$	Price index for safety compensation in sector i.
PL	Price index for labor (the market-clearing wage rate).
PS_i	Price index for safety inputs to sector i.
π	Price index for worker safety.
PM_i	Price index for imported good i.
PG	Price index for a unit of public demand.
PC	Price index for a unit of private demand.
PW	Price index for a unit of worker welfare.
M_K	Income level for the capital owner.
M_W	Income level for the worker.
Y_i	Production for sector i (benchmark equals the domestic output value).
W	Money-metric worker welfare (benchmark is "consumption" of goods and safety).
A_i	Armington supply (benchmark is demand value for imported and home varieties).
KM	Capital imports (benchmark level equals zero).
G	Public demand.
C	Consumer final demand for goods (worker and owner).

NOTES

1. We do not consider the risks of consuming tainted products.
2. We discuss later the functional dependency of marginal costs on other economic variables.
3. In Marshallian terms, it is instructive to imagine that workers are selling safety into the market by virtue of their decisions to supply labor at different wage-safety tradeoffs across sectors. The information distortion induces an artificial expansion in the willingness to supply safety (equivalent to reducing the demand for on-the-job safety). In welfare terms, there is too much labor supplied and the shadow price of safety is below its full-information level.
4. Payments to land are distinguished in the Mexican social-accounting matrix, but these are quite small in relation to payments to other primary inputs and we simply fold land into capital, with a single representative owner in the model.
5. Recall that it is this shadow price that serves as the distortionary wedge in the model; in the distorted benchmark case the shadow price of safety (and, therefore, worker utility) is lower than in the case of full information.
6. This is a static model and there is no requirement that current-account imbalances be paid for ultimately, as there would be in a dynamic model. As a result, a deficit on current account acts as a gift to capital owners.
7. The real exchange rate is the shadow price of foreign exchange (a "commodity") required to maintain a constant current-account imbalance. A rise in the real exchange rate is consistent with a depreciation of the home currency.
8. See the equations in Appendix B, which make extensive use of Shepherd's Lemma in stating these conditions.
9. Recall that this subsidy is the difference between the composite wage under full information and the composite wage with limited information.
10. The calculation of Hicksian equivalent variations is consistent with calculating real consumption changes in relation to baseline GDP.
11. Recall that in this model, Mexican exports and imports are differentiated products, so it is conceivable to have an increase in exports in all goods despite the overall comparative advantage in labor-intensive sectors.

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