Health Insurance, Minimum Wages and the Labor Market: Insights from an Experiment

Katerina Sherstyuk[*], Dolgorsuren Dorj[†], and Gerard Russo[‡§]

Abstract

We investigate, experimentally, labor market effects of two widely-discussed policy regulations: employer health insurance mandates and minimum wage increases. Using a competitive labor market framework, we verify that a minimum wage, if becomes binding, may eliminate voluntary provision of health insurance by firms to low wage workers. Mandating health insurance for all workers guarantees insurance coverage for those employed, but may lead to unemployment even if the minimum wage alone does not have this effect. Thus the interaction of two policies may result in consequences that may be overlooked if the policies are considered in isolation from each other.

JEL classification codes: C92, I18, J20, J3.

Key words: Labor market, health insurance, minimum wages.

[*]Corresponding author. Department of Economics, University of Hawaii at Manoa, 2424 Maile Way, Honolulu, HI 96822. Email: katyas@hawaii.edu

[†]National Academy of Governance, Ulaanbaatar, Mongolia

[‡]University of Hawaii at Manoa, Honolulu, Hawaii

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1 Introduction

Health care reform has been at the forefront of both public policy debate and academic literature. Widely-discussed issues include the effectiveness of proposed policies on increasing insurance coverage, the effect of increased health insurance on medical spending, how the costs are distributed among the population, and effects of health care policies on the labor market (e.g., Gruber 2011, Aron-Dine et al. 2013, Mulligan 2014).[1] Understanding the effects of specific health insurance policy interventions on insurance coverage and employment level and structure are important in evaluating policy alternatives and informing the public.

Another widely-debated policy issue concerns the minimum wage increases. The federal minimum wage for covered nonexempt employees is $7.25 an hour as of July 2009; many states have set minimum wage levels higher than the federal level. The debate over the effect of the minimum wage laws on economic outcomes is largely unsettled. Proponents of the minimum wage view it as a measure against poverty, whereas opponents argue that such wage regulation causes some low-wage workers to lose their jobs or non-salary benefits. While several recent studies suggest no negative employment effects of the minimum wage increase (e.g., Card and Krueger, 1995; Dube et al., 2010),[2] others estimate that increasing the minimum wage results in decreased employment of low-wage workers, just as the competitive model of the labor market predicts (Brown et al. 1982; Neumark and Wascher 1992; Deere

[1] See also Uwe Reinhardt's New York Times blog, `http://economix.blogs.nytimes.com/author/uwe-e-reinhardt/`

[2] A non-decreasing employment could be explained within the model of a monopsonistic labor market (Stigler, 1946), or by the efficiency wages (Rebitzer and Taylor, 1995). These models predict that a minimum wage regulation may increase both the employment and the welfare of workers.

et al. 1995 Neumark et al 2014; see also Dias et al 2013). Given this latter evidence, and because the low-wage industries such as restaurants and retail stores are highly competitive, we adopt the competitive modelling framework in this study.

In what follows we investigate, experimentally, possible interactions of health insurance policies and minimum wage regulations, an issue that has not been explicitly addressed by experimentalists. We consider the effects of employer health insurance mandates on competitive labor markets in the presence of wage rigidities such as minimum wage laws or union contracts. While the current health care reform puts an emphasis on "individual," rather than employer-provided, health insurance mandate, most individuals in the U.S. still obtain health insurance through their employer. In some states, such as Hawaii, the government mandates employers to provide insurance to full-time workers. We study the effects of employer health insurance mandates on insurance coverage and the level and structure of employment. In a related laboratory experiment, Sherstyuk et al. (2007) demonstrate that mandating health insurance for full-time workers but not part-time workers (as in Hawaii) is likely to increase insurance coverage but also lead to higher reliance on part-time exempt workers. However, they assume no wage rigidities and fully adjustable wages. In the present study, we relax the latter assumption and consider the effects of employer health insurance mandates in the presence of wage rigidities. A likely effect of an increase in a minimum wage is investigated by comparing cases of a non-binding and a binding minimum wage.

Possible effects of health insurance mandates on a competitive labor market in the presence of wage rigidities are discussed in Gruber (2000) and Wolaver et al. (2003). To the extent that workers value health insurance, mandated health insurance benefits result in lowering wages in exchange for the benefits. Under the minimum wage law or union con-

tract, however, firms will be unable to balance an increase in their health insurance cost by lowering the wage of workers who are already at the minimum wage. They may hire fewer such low wage workers, leading to unemployment. Figure 1, based on Wolaver et al. (2003), illustrates the effect of a non-binding (left) and a binding (right) minimum wage regulation. In both cases, a mandate on health insurance decreases the demand for labor, but increases its supply, as more workers desire to work at each given level of compensation. The resulting equilibrium outcomes differ between the labor markets with a non-binding and a binding minimum wage. In the graph shown on the left, if workers value health insurance dollar by dollar, the equilibrium wage drops, $W_1 < W_0$, and the employment level does not change, $E_1 = E_0$. Employers in this case are able to decrease wages with the increase in costs because the minimum wage constraint is below the new equilibrium level. However, if the minimum wage increases and becomes binding, the new market outcome (W_{min}, E_{D1}) has lower wages and lower employment compared to the initial equilibrium (W_0, E_0). The new minimum wage constraint does not allow firms a full downward adjustment on wages for increased costs, and firms desire fewer contracts, thus leading to unemployment for low wage workers. In Figure 1 (right), the amount of unemployed low wage workers is given by the difference between the number of workers E_{S1} willing to work at the minimum wage, and the demand for workers E_{D1} at this wage.

If health insurance is not mandated, firms may not offer health insurance coverage at all or lower the generosity of the coverage. Finally, under the partial mandate, which requires coverage of full-time, but not part-time workers, as in Hawaii, firms may hire low wage workers under the part-time arrangement legally freeing themselves from offering health insurance. Empirically, Thurston (1997) documents the shift from full-time to part-time

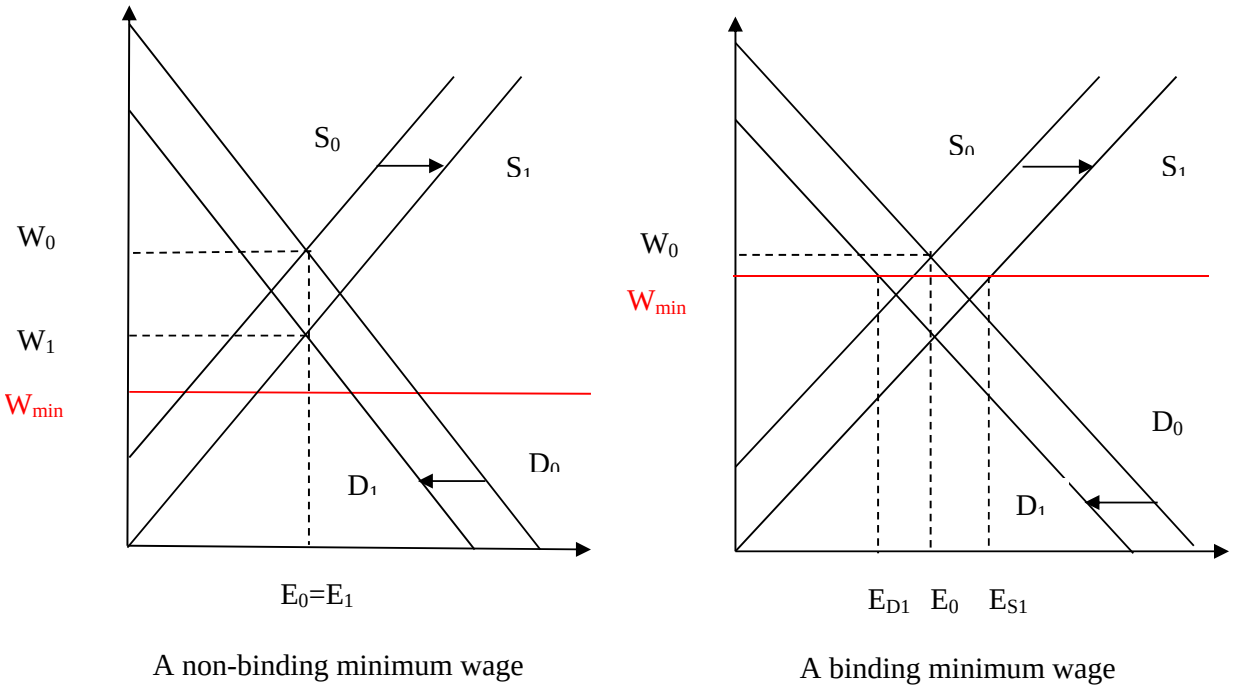


Figure 1: Effects of health insurance mandate and minimum wages on labor market

employment in industries in Hawaii that were most affected by the implementation of the health insurance mandate. Buchmueller et al. (2011) confirm that the mandate increased insurance coverage for worker groups, but also resulted in an increased reliance on exempt part-time workers. Wolaver et al. (2003) report that health insurance coverage among low-wage workers is increased by 31 percent by the mandate policy, at a cost of an estimated 0.8-5.4 percentage-point decrease in full-time employment for such workers.

In this paper we use the experimental laboratory to investigate the interaction of health insurance mandates and minimum wage laws. While the empirical evidence is overall supportive of the theoretically predicted effects of these regulations on the labor markets, it is not fully conclusive.[3] Experimental methods have the advantage of allowing researchers

[3]For example, Buchmueller et al. (2011) acknowledge that "... as with our [inconclusive] findings for wages, our data and empirical design do not allow us to rule out employment reductions arising from the

to isolate effects of specific institutional features (Plott, 1989). We employ the competitive markets modelling framework as it is widely used in the health economics literature. We do not consider moral hazard and adverse selection problems in health insurance contracts, and assume there is no asymmetric information, externalities, or uncertainty in the market. While including each of these factors may be important, we believe that a simple competitive markets model could provide useful insights into the basic tensions between wider coverage and labor market outcomes.

We test whether minimum wage regulations together with health insurance regulations affect levels and structure of employment and health insurance coverage rates as the theory predicts (e.g., Wolaver et al., 2003). Specifically, our objective is to verify, with the help of experimental laboratory, the following theoretical predictions:

1. For workers whose equilibrium wages are above the minimum wages, the minimum wage regulation will have no effect on the labor market in addition to the health insurance regulation. Providing health insurance benefits will result in lowering wages in exchange for the benefits, with no effect on employment.

2. If firms cannot adjust their wages downward due to a minimum wage increase, the firms may not offer health insurance coverage at all. If health insurance is mandated for full-time workers, but not part-time workers, the firms will hire such workers part-time, resulting in an increased share of part-time workers.

3. If firms cannot adjust their wages downwards by the cost of health insurance due to

mandate, especially for workers who face low probabilities of receiving [employer-sponsored insurance] in a voluntary market" (p. 47).

a minimum wage increase, and health insurance is mandated for all workers, the firms will hire fewer workers thus leading to unemployment of such workers.

Our experiment confirms that a minimum wage increase, in interaction with a health insurance mandate, may lead to additional efficiency distortions in the labor market. We show that minimum wages below the market equilibrium wage do not distort equilibrium efficiency or wage levels, but under the full mandate market outcomes could be still inefficient due to over-insurance. An increase in the minimum wage may result in firms opting not to offer health insurance to low wage workers when the provision is voluntarily, and in an increased demand for part-time workers under the partial mandate. We also show that if the minimum wage constraint becomes binding, health insurance mandates may lead to unemployment. This could be the case even if the minimum wage regulation alone, if not coupled with the insurance mandate, did not result in unemployment. We thus demonstrate that it is important to consider the likely effects of policy measures in their interaction; while each policy could have a smaller distortionary effect, the interactions of policies may lead to qualitatively new distortions.

Laboratory experiments on health care are scarce, with the notable exception of market design for kidney exchanges (Roth 2008; Kessler and Roth 2011). Several classroom experiments illustrate adverse selection in the markets for health insurance (Mellor 2005; Hodgson 2014). A recent innovative line of research by J. Cox and co-authors considers ways to reduce healthcare costs and improve the quality of healthcare by providers (Cox et al., 2015a; 2015b).

Experimental studies on labor markets focus mostly on testing the model of gift exchange

between employers and employees (e.g., Fehr et al. 1998) or on matching markets (e.g., Roth 2008). A possible distortionary effect of price controls in a competitive markets setting is well-studied by experimental economists (e.g., Isaac and Plott, 1981); however, to the best of our knowledge, no experimental study has previously considered joint effects of health insurance regulations and wage controls. Sherstyuk et al. (2007) investigate the effects of health insurance mandates on competitive labor markets but assume no wage rigidities, the assumption that we relax in the present study.

The rest of the paper is organized as follows. In Section 2, we describe the experimental design. Section 3 presents experimental results. Section 4 concludes and discusses the limitations and possible priorities for future work.

2 Experimental design

2.1 Modelling framework

We adopt a simple model of a competitive labor market with employer-provided health insurance as in Sherstyuk et al. (2007). There are five firms and five workers. Each worker can supply up to two units of labor, and each firm can hire the maximum of two units of labor. Selling both units of labor to the same firm is considered full-time employment, whereas selling only one unit to a given firm – part-time employment. Each worker is characterized by a constant marginal disutility of labor (which differs across workers), and each firm – by a constant marginal revenue from each unit of labor hired (which differs across firms). There are no productivity differences if a worker chooses one-full time job or

several part-time jobs; hence the differences in the structure of employment will be entirely attributed to the nature of regulation.

Employer-based health insurance may be offered either on a voluntary basis, or is mandated for certain types of workers. If insured, a worker receives a fixed lump-sum private benefit from health insurance coverage; the benefits differ across workers. The cost of providing insurance for a firm is fixed per worker, and is the same for all firms. Hence, efficiency requires that the workers who fully value the insurance, i.e., whose insurance benefits are above the cost of insurance provision, should be insured if hired; whereas those workers who under-value insurance, i.e., whose benefits are below the cost of provision, should not be insured.

Table 1 displays the parameter values used in the experiment, and indicates efficient employment and insurance coverage outcomes.[4] Under the efficient outcome, workers 1 – 4 are hired by firms 6 – 9; worker 5 and firm 10 are extra-marginal. If hired, it is efficient for workers 1, 2 and 5 to get insurance, as they value it below the cost of provision; whereas workers 3 and 4 should not get insurance, as their benefits exceed the cost of provision. The choice of these parameter values is explained in Section 2.2 below.

2.2 Treatments

The experiment is designed to study the interaction of two types of regulations in the labor market: employer health insurance mandates, and minimum wage regulations. Accordingly, experimental treatments differ in the regulatory regime regarding the provision of health insurance, and in whether the minimum wages are binding or not. We consider the follow-

[4]Appendix A in Supplementary Materials provides formal modelling details.

Workers (sellers)			Firms (buyers)		
ID	Labor cost per unit	Insurance benefit per worker	ID	Revenue per unit	Insurance cost per worker
1*#	45	40	6*	81	32
2*#	50	40	7*	76	32
3*	45	20	8*	71	32
4*	50	20	9*	66	32
5#	68	40	10	58	32

*-it is efficient for this trader to trade if the minimum wage is non-binding, #-it is beneficial for this trader to buy insurance if trades

Table 1: Workers' and firms' costs and benefits of employment

ing three types of employer health insurance mandates: **No mandate (N)**: Unregulated markets for health insurance. Labor is traded, and insurance is offered and accepted, on voluntary basis. **Partial mandate (P)**: Firms are mandated to offer health insurance to all workers whom they hire full-time. For part-time workers, insurance is offered and accepted on voluntary basis. Insurance coverage cannot be split among several employers. **Full mandate (F)**: Firms are mandated to offer, and all workers are mandated to accept health insurance. If a worker sells his labor to several firms (takes up several part-time jobs), then he should buy full health insurance from one of the firms. Insurance coverage cannot be split among several employers.

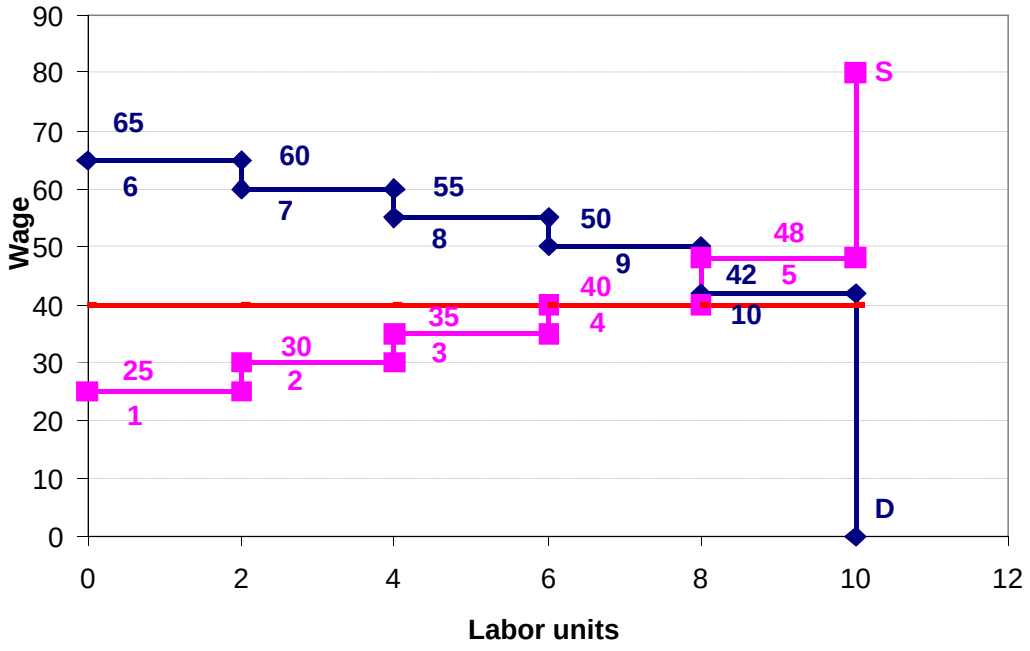
To test possible effects of the minimum wage increase, we consider two cases of minimum wage constraints: **a wage floor BELOW (B)** the equilibrium wage, or a *non-binding* price floor; specifically, for our parameter values, we set $w \geq 40$ for any unit of labor. And, **a wage floor ABOVE (A)** the equilibrium wage, or a *binding* price floor; we set $w \geq 52$ for any unit of labor. The former case may represent a low wage labor market before the minimum wage increase; whereas the latter case may apply to the market for low skilled,

low wage workers after the minimum wage increase.

The parameter values are chosen to allow to test the theoretical predictions on the effects of health insurance mandates and minimum wage increases, as outlined in Section 1 above. Under these parameter values: (1) The non-binding minimum wage $w \geq 40$ is predicted to have no effect on the market outcomes in addition to the health insurance mandate; the No mandate results in full efficiency, whereas the Full mandate is predicted to result in over-insurance of workers. (2) The higher, binding minimum wage of $w \geq 52$ is predicted to eliminate voluntary provision of health insurance by firms under No mandate, and, in addition, to lead to an increased share of part-time labor under the Partial mandate. (3) Under the Full mandate, the binding minimum wage $w \geq 52$ is predicted to lead to unemployment, even though neither the Full mandate, nor the minimum wage of $w \geq 52$, if not combined with each other, are not predicted to have this effect.

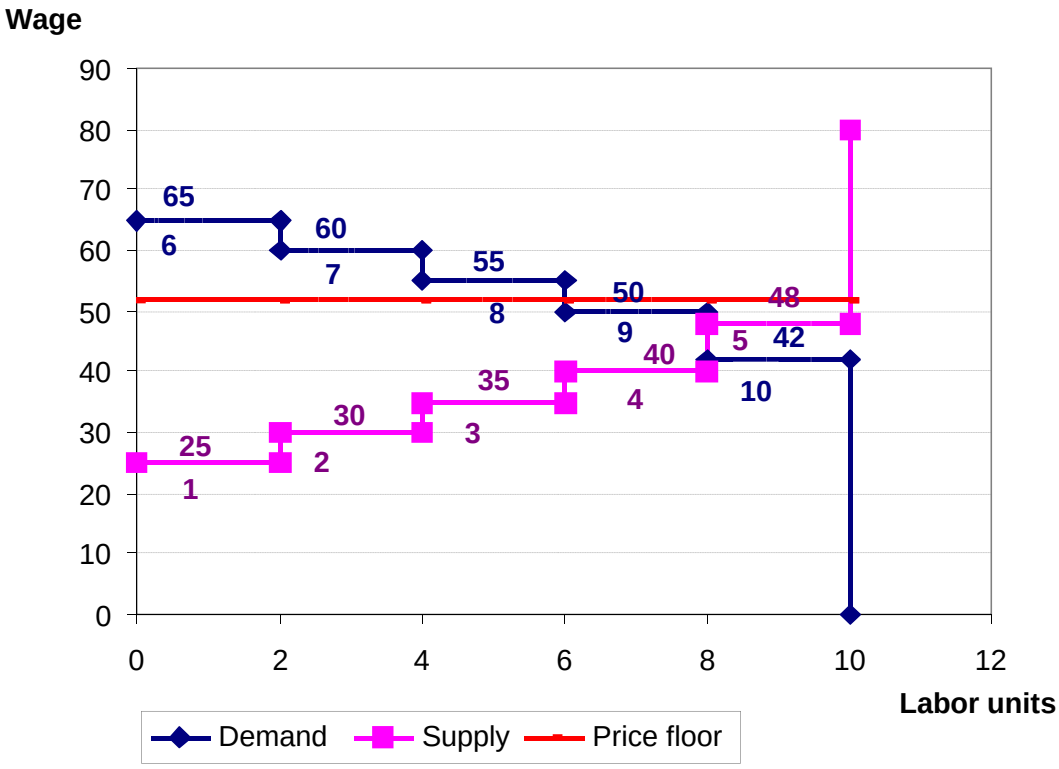
The latter interaction effect is illustrated in Figures 2–3 for the case of the Full mandate.[5] Figure 2 shows that the non-binding minimum wage of 40 does not affect the market outcome, which remains the same as under the Full mandate with no wage regulation. However, the binding minimum wage of 52, as in Figure 3, does not allow the wages to adjust downward to account for the cost of health insurance provision, thus creating excess supply of labor and causing unemployment. This illustrates that a minimum wage increase under the full insurance mandate may distort efficiency even further compared to the case when the minimum wage were not binding.

[5]In both Figures 2-3, demand for labor is constructed using firm insurance-adjusted marginal revenues, and the supply of labor is constructed using worker insurance-adjusted disutilities of labor. See Appendix A in Supplementary Materials for details.



In the graph above firms revenues and worker labor costs are insurance-adjusted. Numbers 1 though 5 indicate workers and numbers 6 through 10 indicate firms. Workers 1 through 4 sell their labor to firms 6 through 9, all with insurance. Worker 5 and Firm 10 do not trade.

Figure 2: Mandate-constrained market outcome with a non-binding minimum wage



In the graph above firms revenues and worker labor costs are insurance-adjusted. Numbers 1 though 5 indicate workers and numbers 6 through 10 indicate firms. Workers 1 through 5 sell their labor to firms 6 through 8 all with insurance. Firms 9 and 10 do not trade in the market. Any two of the five workers are not unemployed (excess supply of labor is 4 units).

Figure 3: Mandate-constrained market outcome with a binding minimum wage

Five treatments were implemented: NB (No mandate, wage floor Below the equilibrium), FB (Full mandate, wage floor Below the equilibrium), NA (No mandate, wage floor Above the equilibrium), PA (Partial mandate, wage floor Above the equilibrium) and FA (Full mandate, wage floor Above the equilibrium). Under each treatment, the buyers (firms) and sellers (workers) traded in up to four concurrent double auction markets for units of a fictitious good (labor), with or without "service" (insurance). The markets differed in the way the units and the service were traded: Market A: separate units, no service (part-time employment with no insurance); Market B: separate units, with service (part-time employment with insurance); Market C: packages of 2 units, no service (full-time employment with no insurance); Market D: packages of 2 units, with service (full-time employment with insurance). The No mandate treatments (NA, NB) had all markets in operation. Under the Partial mandate treatment (PA) there was no market C, and a sellers in market A was prohibited to sell two units to the same buyer. In the Full mandate treatments (FA, FB) market C was also absent, and a seller had to trade the first unit in market B to be able to trade the second unit in market A. In all treatments a seller could sell at most one unit in market B, i.e., a seller could benefit from the service only once in a period.

Predictions for the equilibrium trades and wage ranges by treatment and market are given in Table 2, with the corresponding derivations outlined in the Supplementary Appendices A, B and C.

In equilibrium, all workers employed with insurance are paid a lower per unit wage than the workers employed without insurance. These equilibrium wages support efficient (for the No mandate with the minimum wage Below the equilibrium), or mandate-constrained-efficient (for the Full mandate with the minimum wage Below the equilibrium) allocations.

Treatment	Employed workers	Markets in which workers trade	Equilibrium Prices (Wages)		
			Market	Price Range	Price relations
No Mandate, Min Wage 40 (NB)	1, 2	2-unit package in D	Market D*	84-96	Pd = 2Pa - 32
	3, 4	2-unit package in C or two separate units in A	Market A	58-64	Pc = 2Pa
			Market C	116-128	
Full Mandate, Min Wage 40 (FB)	Three of any 1,2,3,4,5	2-unit package in D	Market D**	84-96	
No Mandate, Min Wage 52 (NA)	1, 2	2 separate units in A or 2-unit package in C	Market A	58-66	
	3, 4		Market C	116-132	Pc = 2Pa
Partial Mandate, Min Wage 52 (PA)	1, 2	2 separate units with two different firms in A	Market A	58-66	
	3, 4				
Full Mandate, Min Wage 52 (FA)	Three of any 1,2,3,4,5	2-unit package in D	Market D**	104	

*Because of the minimum wage constraint, no trades are predicted to occur in market B. Hence, there are no price prediction for market B.

** Because of the minimum wage constraint, no trades are predicted to occur in market B and, consequently, because of the full mandate, in market A. Hence, there are no price prediction for markets A or B.

Table 2: Equilibrium market trades and wage predictions by treatment

Thus, under the non-binding minimum wage ($w_{min} = 40$), workers $1-4$ trade with firms $6-9$ (at different wages, depending on the mandate), resulting in fully efficient outcome, but under the Full mandate, all workers get insurance, although it is inefficient for workers 3 and 4 to do so (Figure 2). The market outcome further departs from efficiency if the minimum wage is Above the equilibrium, i.e., it is binding ($w_{min} = 52$). Under the No mandate and Partial mandate institutions, workers $1-4$ still trade with firms $6-9$, but no insurance is provided (whereas it would be efficient for workers 1 and 2 to get insurance). Under the Partial mandate, employers avoid offering insurance through shifting employment to part-time workers (in market A). The Full mandate institution results in any three of five workers trade with firms $6-8$. Firms $9-10$ are not willing to hire any workers, and any two of five workers are not employed. There is an excess supply of labor and an insufficient demand for labor, resulting in unemployment (Figure 3).

Experimental procedures Experimental procedures were the same as in Sherstyuk et al. (2007). There were ten subjects in each session; half of them were buyers (firms) and half were sellers (workers). The experiment was non-computerized. Experimental instructions and record sheets used by the subjects are included in the Supplementary Materials. Each buyer or seller was assigned values or costs as given in Table 1. The values and costs were kept unchanged until period 5,[6] after which they were rotated once to equalize expected earnings. Trading occurred in a sequence of nine to ten trading periods. Each buyer or seller was allowed to buy or sell in any of the functioning parallel markets, as explained

[6]Assigning traders the same values for a number of periods is commonly used in market experiments to facilitate convergence to equilibrium; see, e.g., Smith (1962).

above. Within each trading period, all bids and asks were placed on the screen using an overhead projector. Each period lasted up to 5 minutes and closed if there was no activity for 20 seconds. Each session lasted for about 2 hours. Subjects were paid in private in cash at the exchange rate of 0.10 US dollars per experimental pesos, plus 5 dollars show-up fee. Individual earnings ranged from US $12 to $35.

3 Results

A total of 160 subjects participated in 16 experimental sessions, all recruited from the student population at a U.S. university. We conducted four independent sessions (groups) for each of the three different treatments with the binding minimum wage of 52 (No mandate NA, Partial mandate PA, and Full mandate FA), and two independent sessions (groups) for each of the treatments with the non-binding minimum wage of 40 (No mandate NB, and Full mandate FB).[7]

Table 3 summarizes the results on labor market efficiency, employment level and structure, and coverage rate among workers, by treatment, and compares them with the theoretical predictions of Section 2. Efficiency is defined in the usual way, as percentage of the actual labor market surplus to the maximal attainable in the absence of regulation. Table 4 lists market prices and the total number of trades, by market.

From Tables 3 and 4, the data fit the equilibrium predictions well overall. On average, the markets efficiency was only 8.48 percentage points below the equilibrium prediction. The

[7]More sessions were conducted under the binding minimum wage treatments, as we expected the non-binding minimum wage case to be similar to the case with no wage rigidities, and the latter was already explored in Sherstyuk et al. (2007).

Policy Alternative		Labor market efficiency, %		Employment, % efficient*		Share of part-time workers out of all workers, %		Coverage rate among employed, %	
		Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual
No mandate, w=40 (NB)	mean (stdv)	100	94.83 (0.76)	100.00	103.75 (1.77)	0-50	16.70 (0.43)	50.00	45.80 (8.91)
Full Mandate, w=40 (FB)	mean (stdv)	89.29	83.68 (2.62)	100.00	100.63 (2.65)	0	5.47 (1.36)	100.00	100 (0.00)
No mandate, w=52 (NA)	mean (stdv)	92.86	87.73 (0.84)	100.00	96.68 (3.27)	0-100	19.55 (16.97)	0.00	6.87 (3.72)
Partial mandate, w=52 (PA)	mean (stdv)	92.86	81.41 (10.75)	100.00	91.41 (12.77)	100.00	71.83 (3.12)	0.00	28.17 (3.11)
Full mandate, w=52 (FA)	mean (stdv)	80.36	68.42 (1.72)	75.00	75.31 (0.63)	0.00	5.77 (4.12)	100.00	100.00 (0.00)

*employment is in percentage to the fully efficient level of four workers

Table 3: Experimental results: summary by treatment

Treatment		Market A		Market B		Market C		Market D	
		Price mean (st.dv.)	No of obs.	Price mean (st.dv.)	No of obs.	Price mean (st.dv.)	No of obs.	Price mean (st.dv.)	No of obs.
No mandate, w=40 (NB)	Theory	58-64		--		116-128		84-96	
	Actual	59.50 (5.39)	26	62.5 (31.81)	2	117.36 (5.46)	33	90.64 (5.24)	36
Full Mandate, w=40 (FB)	Theory	--		--		--		84-96	
	Actual	54.5 (10.34)	4	42.0 (4.47)	5	--	0	88.74 (5.09)	76
No mandate, w=52 (NA)	Theory	58-66		--		116-132		--	
	Actual	60.25 (3.18)	59	53.0 (1.73)	3	122.62 (5.90)	115	105.75 (2.66)	8
Partial mandate, w=52 (PA)	Theory	58-66		--		--		--	
	Actual	62.71 (3.76)	196	--	0	--	0	106.54 (3.68)	41
Full mandate, w=52 (FA)	Theory	--		--		--		104	
	Actual	55.50 (5.17)	6	52.14 (.38)	7	--	0	104.70 (1.81)	114

Market A: Separate units, no insurance. Market B: Separate units, with insurance. Market C: Two-unit package, no insurance. Market D: Two-unit package, with insurance.

Table 4: Market prices (wages) by treatment

	Efficiency			Insurance coverage			Employment		
		Robust			Robust			Robust	
	Coef.	Std. Err.	P>t	Coef.	Std. Err.	P>t	Coef.	Std. Err.	P>t
const	0.9482	*(0.0040)*	0.0000	0.4581	*(0.0467)*	0.0000	4.1500	*(0.0370)*	0.0000
FB	-0.1114	*(0.0143)*	0.0000	0.5491	*(0.0469)*	0.0000	-0.1250	*(0.0667)*	0.0800
NA	-0.0712	*(0.0058)*	0.0000	-0.3890	*(0.0497)*	0.0000	-0.2013	*(0.0707)*	0.0120
PA	-0.1327	*(0.0512)*	0.0200	-0.1777	*(0.0488)*	0.0020	-0.4921	*(0.2464)*	0.0640
FA	-0.2641	*(0.0087)*	0.0000	0.5455	*(0.0468)*	0.0000	-1.1375	*(0.0387)*	0.0000
	Number of obs = 157			Number of obs = 157			Number of obs = 157		
	R-squared = 0.4841			R-squared = 0.8884			R-squared = 0.4580		

Stadard Errors adjusted for 16 clusters in sessionID. Baseline: NB.

Table 5: Linear regression of efficiency, insurance coverage, and employment on treatment

overwhelming majority of trades took place in the markets where positive volumes of trades were predicted, and the average prices (wages) were within the predicted equilibrium ranges for all of such cases.[8]

The results below address the effect of health insurance and minimum wage regulations on coverage rates, employment structure and labor market efficiency. All experimental results are benchmarked against the qualitative theoretical predictions as discussed in Section 1. To test for statistical significance of differences between treatments, and to compare them with the theoretical predictions, we conduct simple regression analysis of per period efficiencies, employment and insurance coverage on treatment dummies, with standard errors clustered at session level. The results are presented in Table 5. Similarly, Table 6 presents regression results of transaction prices on market dummies, by treatment.

We start with the discussion of the non-binding minimum wage treatments.

Result 1 (No mandate and non-binding minimum wage) *Under No mandate with non-binding minimum wage (NB), employment and insurance coverage were close to the efficient level. Insurance was provided on voluntary basis, and most of the workers who bought insur-*

[8]Overall, the prices (wages) fell within the exact equilibrium range in 65 percent of all transactions.

	NB prices			FB prices			NA prices			PA prices			FA prices		
	Robust			Robust			Robust			Robust			Robust		
	Coef.	Std. Err.	P>t	Coef.	Std. Err.	P>t	Coef.	Std. Err.	P>t	Coef.	Std. Err.	P>t	Coef.	Std. Err.	P>t
constant	59.50	*(0.1563)*	0.002	88.74	*(2.1238)*	0.015	60.25	*(1.1281)*	0.000	62.71	*(1.3819)*	0.000	55.50	*(2.8511)*	0.000
market A				-34.2	*(7.1844)*	0.132									
market B	3.00	*(0.1563)*	0.033	-46.7	*(4.5529)*	0.062	-7.25	*(1.4306)*	0.015				-3.36	*(2.9408)*	0.336
market C	57.86	*(1.1135)*	0.012				62.37	*(1.7397)*	0.000						
market D	31.14	*(2.8782)*	0.059				45.50	*(2.1267)*	0.000	43.85	*(1.4110)*	0.000	49.20	*(2.9774)*	0.000
	Number of obs = 97			Number of obs = 85			Number of obs = 185			Number of obs = 237			Number of obs = 127		
	R-squared = 0.9323			R-squared = 0.8565			R-squared = 0.9718			R-squared = 0.9518			R-squared = 0.9836		

Stdandard Errors adjusted for clusters in sessionID. Baseline: market A (NB, NA, PA, FA treatments); market D (FB treatment).

Table 6: Linear regression of prices (wages) on market, by treatment

ance fully valued it. Prices fully adjusted downwards in the full-time market with insurance as compared to the markets without insurance. Overall, the markets reached close to full efficiency.

Support: Tables 3-4, 5- 6. Under NB treatment, the average employment rate was 103.75% (Table 3), which is slightly above the efficient level ($p = 0.001$, Wald test based on the employment regression given in Table 5); however, in later periods (periods 6–10), employment was at the predicted efficient level of four workers in nine observations out of ten, and was not significantly different from it ($p = 0.2036$).[9] The average coverage rate among employed was 45.80%, and not significantly different from the equilibrium prediction of 50% ($p = 0.3828$, Wald test). Table 7 contains more detailed data on employment and insurance coverage. The table reports that among 4.15 workers employed on average per period, 0.6 workers should have bought insurance but did not buy it, and 0.35 workers bought insurance although they valued it below cost; all others (3.2 workers on average) bought insurance if

[9]The tests of linear hypotheses reported here are Wald tests or t-tests based on the regressions presented in Tables 5- 6, or on analogous regressions with added dummy variables for later periods 6–10.

Treatment	# workers employed*		Share of part-time workers out of all workers, %		Insurance rate among employed, %		# workers who over-insured (compared to equilibrium)		# workers who over-insured (compared to efficiency)		# workers who under-insured (compared to efficiency)	
	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual
NB	4	4.15	0-100	16.7	50	45.25	~	~	0	0.35	2	0.6
FB	4	4.03	0	5.47	100	100	~	~	2	1.75	~	~
NA	4	3.95	0-100	19.55	0	6.6	0	0.28	0	0.03	2	1.87
PA	4	3.66	100	71.83	0	25.72	0	1.08	0	0.22	2	1.28
FA	3	3.01	0	5.77	100	100	~	~	0-2	1.08	~	~

*Number of workers employed is counted based on full-time emloyment: two part-time workers are coutned as one full-time.

Table 7: Employment and Insurance

and only if they fully valued it.

From Table 4, the average per transaction price in market D (full-time labor with insurance) was 90.64 pesos, which is significantly below the average price of 117.36 pesos in market C (full-time labor with no insurance); the full price adjustment hypotheses of $p_D = p_C - 32$ and $p_D = 2p_A - 32$ are both sustained ($p = 0.2055$ and $p = 0.4425$, respectively, Wald tests). The average labor market efficiency was 94.83%, significantly higher than in any other treatment ($p \leq 0.02$, t-tests; see Table 5). □

Result 2 (Full mandate and non-binding minimum wage) *With non-binding minimum wage, the Full mandate (FB) resulted in the efficient employment level, full insurance coverage, but lower market efficiency than under No mandate (NB). Efficiency losses were due to over-insurance.*

Support: Tables 3, 5, 7. Under FB, employment was 100.63% of the efficient level of four workers, and not significantly different from it ($p = 0.6588$, Wald test based on the

employment regression of Table 5). While the coverage rate among employed increased substantially (100% under FB as compared to 45.80% under NB), efficiency decreased from 94.83% under NB to 83.68% under FB. The difference in efficiencies between FB and NB is highly significant ($p < 0.0001$, t-test). From Table 7, under FB, 1.75 among employed workers were over-insured on average per period. □

Results 1 and 2 confirm Prediction 1 of Section 1 that a non-binding minimum wage has no effect on the market outcomes in addition to the health insurance regulation. We also confirm that in the markets with insurance, the prices fully adjust downwards by the cost of providing insurance, so that the insurance cost is ultimately born by workers.[10] These findings on the treatments with a non-binding minimum wage are also consistent with those reported in Sherstyuk et al. (2007) on the markets with no wage rigidities.

We now turn to the analysis of treatments with a binding minimum wage.

Result 3 (No mandate and a binding minimum wage) *The markets under No mandate with a binding minimum wage (NA) resulted in full employment, but lower insurance coverage and lower efficiency than with a non-binding minimum wage (NB). Efficiency losses were due to under-insurance.*

Support: Table 3. Under NA, employment was, on average, 98.68% of the efficient level, indicating no effect of the minimum wages on employment ($p = 0.4085$ for the Wald test of equality between the actual and the efficient employment). However, the average coverage rate was inefficiently low and close to zero: only 6.87% of employed workers were insured, as

[10]From Table 2, under FB treatment, the average price in market D (full-time workers with insurance) was 88.74, which is within the equilibrium price range.

compared to 50% under the efficient outcome; in fact, there were only 11 instances of providing coverage (trades in markets B and D) in all periods and sessions of the NA treatment (39 periods total). The labor market efficiency decreased to 87.73%, a levels significantly below that of 94.83% under NB ($p < 0.0001$, t-test). □

Result 4 (Partial mandate and a binding minimum wage) *As predicted, mandating health insurance for full-time workers but not part-time workers under the binding minimum wage (PA) resulted in full employment, but higher share of part-time workers than under either No mandate (NA) or Full mandate (FA). In contrast to the theoretical prediction, the Partial mandate also led to a higher coverage rate than No mandate, while achieving comparable efficiency. Nevertheless, under-insurance was still significant.*

Support: Tables 3, 5, 7. Under PA, the average employment was 91.41% of the predicted efficient level, and not significantly different from it ($p = 0.1805$, Wald test based on the employment regression of Table 5). The share of part-time workers in the Partial mandate (PA) treatment was 71.83%, as compared to 19.55% under the No mandate (NA), and 5.77% under the Full mandate (FA) with a binding minimum wage. The difference between PA and either NA or FA is highly significant ($p = 0.0143$, Wilcoxon Mann-Whitney (WMW) rank-sum test[11] The average insurance rate among employed workers under PA was 28.17%, as compared to 6.87% under NA (with the same theoretical prediction of 0% for both treatments; $p = 0.0143$ for the difference between PA and NA, WMW test). However, the insurance rate under PA was still far below the efficient level of 50% ($p < 0.0001$, Wald test); from Table 7, last column, an average of 1.28 workers who fully valued insurance did

[11]In the reported WMW tests, session averages are used as units of observation.

not get it since firms could not afford to offer insurance. Regarding efficiency, the average per treatment efficiency was 81.41% for PA compared to 87.73% for NA (with the theoretical prediction of 92.86% for both treatments); the difference between PA and NA is not significant ($p = 0.2483$, Wald test). □

Results 3 and 4 mostly confirm Prediction 2 of Section 1: a binding minimum wage reduces voluntary provision of health insurance by firms, and in the presence of the partial mandate, leads firms to hire part-time workers instead of full-time workers because the former are exempt from the mandate. Efficiency is reduced due to under-insurance. However, curiously, we observe that a significant amount of insurance is still offered under the partial mandate, suggesting that a mandate may increase the saliency of service provision and sometimes make the firms offer the service even at the cost of lowering own profits.

Result 5 (Full mandate and a binding minimum wage) *Full mandate under the binding minimum wage (FA) resulted in full insurance coverage for those employed, but also led to unemployment. Efficiency losses under the Full mandate as compared to No mandate (NA) and the Partial mandate (PA) were significant.*

Support: Table 3, 5, 7. The average number of workers employed under FA was 3.01 (75.31% of the efficient level of 4 workers), as compared to 3.95 under NA (98.68% of the efficient level), and 3.66 under PA (91.41% of the efficient level); the differences between FA and NA, and FA and PA are highly significant ($p < 0.0001$, for the difference between FA and NA, and $p = 0.0183$, for the difference between FA and PA, Wald test). From Table 7, an average of 1.08 employed workers were over-insured, i.e., did not value insurance above its cost. The average efficiency under FA was 68.42%, as compared to 87.73% under NA and

81.41% under PA. Efficiency differences between FA and NA, and between FA and PA, are both highly significant ($p < 0.0001$ for the difference between FA and NA, and $p = 0.0224$ for the difference between FA and PA, Wald test). □

From the above Result 5, Prediction 3 of Section 1 is supported by the data. We further note that for PA and FA treatments, efficiency losses are higher than predicted, and the efficiency deviations from the equilibrium predictions are also higher than in the other treatments (significantly so for FA, $p < 0.01$, Wald test, for pairwise comparisons with other treatments, except for PA). This observation suggests that several binding regulations, when combined, may lead to efficiency distortions larger that those theoretically predicted. A likely reason is that imposition of multiple regulations leads to more errors in subject choices, such as occasional over- and under-insurance by workers, or sub-optimal decisions by firms to offer or not the coverage and to hire in the full-time or part-time market.

4 Discussion

We presented the results of a laboratory experiment that was designed to test the combined effects of wage rigidities and various health insurance regulations. Overall, our experimental data strongly support the theoretical predictions discussed in Section 1, but also provide some behavioral insights not anticipated by the theory.

First, we confirm that non-binding minimum wage regulations do not distort efficiency beyond the levels introduced by health insurance mandates; in the no mandate, non-binding minimum wage treatment, insurance was still offered on a voluntary basis and bought by the workers who valued it above cost, with wages adjusting downwards by the cost of insurance.

Second, we demonstrate that wage rigidities may lead to significant efficiency losses when the minimum wage is binding. Under no mandate on insurance provision, trading in the experimental markets with insurance was fully eliminated under the binding minimum wage, since the cost of health insurance could not be passed over from firms to workers. Thus, binding minimum wages may reduce labor market efficiency and may fully eliminate voluntary provision of health insurance by firms.

Further, we provide evidence on the effect of health insurance regulation on the structure of employment. Under the partial mandate and binding minimum wages, firms switched from full-time to part-time employment when it allowed them to avoid the mandated provision of health insurance, thus significantly increasing the share of part-time workers. This result confirms and reinforces the empirical findings by Thurston (1997) and Buchmueller et al. (2011) on the effect of Hawaii health insurance mandate on the labor market. It also complements the experimental findings by Sherstyuk et al. (2007) who report that the partial mandate under no wage rigidities is likely to increase the share of part-time workers due to the *workers* with low value for insurance switching to part-time employment. In the current study we find, in addition, that hiring workers part-time under a binding minimum wage allows the *firms* not to the offer the costly insurance.

Finally, we demonstrate that when the minimum wage is binding, imposing a full mandate on provision of health insurance may lead to reduced demand for labor and unemployment. The markets under the binding minimum wage and full mandate were characterized by the lowest employment rate and the lowest labor market efficiency among all treatments considered. By comparing the outcomes under FA treatment with those under NA and FB treatments, we demonstrate that health insurance mandates and minimum wage laws,

when combined, may lead to unemployment of low wage workers even when neither of these regulations imposed separately have this effect.

There were three distinct sources of efficiency losses in our experiment: (1) efficiency distortions due to wage controls; (2) efficiency distortions due to health insurance regulations (employer mandates); and (3) behavioral imperfections, such as trading by extra-marginal workers and firms, over-insurance and under-insurance. Our results strongly suggest that, overall, regulatory distortions outweighed the behavioral imperfections (decision errors), thus providing a strong and convincing demonstration of the likely effect of the wage and health insurance regulations on the labor market outcomes. Further, we observe that multiple regulations are also likely to result in more decision errors, thus leading to efficiency distortions larger than theoretically predicted.

One finding that departs from the theoretical prediction concerns the effect of the partial mandate. We found that the partial mandate with a binding minimum wage resulted in a significantly higher insurance coverage as compared to no mandate, with no significant losses in efficiency. This is likely due to behavioral factors, where the presence of a mandate makes people more likely to offer, and to consider buying, the insurance. It is possible, however, that such tendency would be eliminated with more experienced traders, as offering health insurance in this setting is too costly for the firms.

As discussed in Section 1, an important limitation of our analysis is that we assume no externalities: all benefits from health insurance are private, with no public benefits. This is a strong assumption, and one may find efficiency gains from wider insurance coverage if the public benefits of the coverage are taken into account. Further, we do not consider the problem of adverse selection that exists in markets with voluntary health insurance provision.

This problem is often argued to be a fundamental reason for government intervention in insurance markets (Einav and Finkelstein 2011). Therefore, one should not seek direct policy implications from our conclusions. Likewise, our findings should not be interpreted as evidence against wider health insurance coverage, as proposed under the current health care reform, which puts an emphasis on "individual" health insurance mandate. Exploring the effects of individual insurance mandate on the labor market is a promising avenue for future experimental research.

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Supplementary Materials

Appendix A: Formal Model

There are N workers, $i = 1, .., N$, and M firms, $j = 1, .., M$. Each worker i is characterized by a constant marginal disutility of labor e_i, and a fixed lump-sum private benefit b_i from health insurance coverage. If worker i supplies x_{ij} units of labor to firm j, is paid a per unit wage $w_{ij} \geq 0$, and firm j provides the share y_{ij} of his health insurance benefits, then this worker's utility from employment at this firm is given by $((w_{ij} - e_i)x_{ij} + b_i y_{ij})$. Assuming the worker may work for more than one firm, his total utility from employment is:

$$U_i = \sum_j ((w_{ij} - e_i)x_{ij} + b_i y_{ij}). \tag{1}$$

Suppose that each worker can supply up to $\bar{x}^w$ units of labor (the same for all workers). Then feasibility requires that $x_{ij} \geq 0, \sum_j x_{ij} \leq \bar{x}^w, y_{ij} \geq 0, \sum_j y_{ij} \leq 1$. Further, assume that health insurance is traded as a discrete good: $y_{ij} \in \{0, 1\}$ for all i, j. Finally, we constrain our attention to employer-provided health insurance, which implies that if $x_{ij} = 0$, then $y_{ij} = 0$.

Each firm j receives a constant marginal revenue v_j from each unit of labor hired, and it can hire a maximum of $\bar{x}^f$ units of labor (for technological reasons, or due to capacity constraints); this capacity constraint is the same for all firms. The cost of providing insurance for the firm is c_j per worker; for simplicity, we assume that this cost does not depend on the total number of workers insured and it does not vary across firms, $c_j = c$. Firm j total profit from employment is then given by

$$\pi_j = \sum_i ((v_j - w_{ij})x_{ij} - cy_{ij}), \tag{2}$$

with $\sum_i x_{ij} \leq \bar{x}^f$.

A labor market outcome is efficient if the allocation of workers across firms and the health insurance coverage matrices $\{x_{ij}\}, \{y_{ij}\}$ maximize the total surplus in the labor market, which is

$$S = \sum_{ij} ((v_j - e_i)x_{ij} + \sum_{ij} (b_i - c)y_{ij}. \tag{3}$$

Efficiency prescribes that workers who fully value insurance (i.e., value it above the cost of its provision by firms) buy insurance, while others who under-value insurance do not buy it. For each worker i, define insurance-benefit-adjusted cost of worker labor as

$$\widetilde{e}_i = \min\{e_i, e_i - \frac{b_i - c}{\bar{x}^w}\}. \tag{4}$$

Then an allocation of workers across firms is efficient only if it maximizes:

$$\widetilde{S} = \sum_{ij}(v_j - \widetilde{e}_i)x_{ij}. \tag{5}$$

If health insurance is mandated for all employed workers, then a firm's mandate-adjusted per unit revenue from employment is $(v_j - c/\bar{x}^w)$, and a worker's disutility of labor net of insurance benefit is $(e_i - b_i/\bar{x}^w)$. Let $\widetilde{\widetilde{e}}_i$ denote cost of worker labor adjusted for mandated health insurance:

$$\widetilde{\widetilde{e}}_i = e_i - \frac{b_i - c}{\bar{x}^w} \geq \widetilde{e}_i. \tag{6}$$

The mandate-constrained efficient allocation of workers across firms maximizes

$$\widetilde{\widetilde{S}} = \sum_{ij}(v_j - \frac{c}{\bar{x}^w}) - (e_i - \frac{b_i}{\bar{x}^w}))x_{ij} = \sum_{ij}(v_j - \widetilde{\widetilde{e}}_i)x_{ij}. \tag{7}$$

It is then obvious that the full health insurance mandate may reduce labor market efficiency.

In the numerical example discussed in Section 2, there are $M = 5$ firms and $N = 5$ workers in this model, and $\bar{x}^w = \bar{x}^f = 2$. Without regulation, as can be inferred from parameter values given in Table 1 (in the main text) and expression 5 above, efficiency dictates that workers 1-4 should sell their labor to firms 6-9, and workers 1 and 2 should get insurance, while workers 3 and 4 should stay uninsured. The labor market surplus achieved at the fully efficient allocation is $\tilde{S} = 224$. If, however, insurance is mandated for all workers, then insurance-adjusted disutility of labor rises for workers 3 and 4. Although the composition of the employed workers remains unchanged, from expression 7, the mandate-constrained labor market surplus decreases to $\tilde{\tilde{S}} = 200$. On the other hand, if insurance is mandated to full-time workers, but not part-time workers (partial mandate), then efficiency can be restored if workers 3 and 4, who under-value insurance, take two part-time jobs instead of one full-time job, and thus avoid the wage reduction due to the mandated benefit.

Now consider the effects of minimum wages. The non-binding minimum wage of 40 does not affect the market outcome, and the mandate-constrained labor market surplus stays at $\widetilde{\widetilde{S}}_{40} = 200$, as under the full mandate with no wage regulation (Figure 2 in the main text). However, the binding minimum wage of 52 creates excess supply of labor causing unemployment (Figure 3 in the main text), and the surplus decreases further to $\widetilde{\widetilde{S}}_{52} = 180$.

Appendix B: Equilibrium per unit wages in markets with a non-binding minimum wage

[NB] No Mandate and Non-binding Minimum Wage, $w_{min} = 40$

Regulatory constraints set by price floor of 40 yields additional constraints:

$$p_A \geq 40; \tag{8}$$

$$p_C \geq 80; \tag{9}$$

$$p_D \geq 80; \tag{10}$$

Workers 1 and 2 are willing to participate in market D. They prefer selling two units in market D than two units in C market, or two separate units in A market, or one unit in market A:

$$p_D + b_i - 2e_i \geq p_C - 2e_i, \qquad i = 1, 2; \tag{11}$$

$$p_D + b_i - 2e_i \geq 2p_A - 2e_i, \qquad i = 1, 2; \tag{12}$$

$$p_D + b_i - 2e_i \geq p_A - e_i, \qquad i = 1, 2; \tag{13}$$

$$p_D + b_i - 2e_i \geq 0, \qquad i = 1, 2; \tag{14}$$

Workers $3 - 4$ are indifferent between selling a package in market C, or two units in A. They prefer to sell in C that to sell in D, or one unit in A, or not to sell at all:

$$p_C - 2e_i = 2p_A - 2e_i, \qquad i = 3, 4; \tag{15}$$

$$p_C - 2e_i \geq p_D + b_i - 2e_i, \qquad i = 3, 4; \tag{16}$$

$$p_C - 2e_i \geq p_A - e_i, \qquad i = 3, 4; \tag{17}$$

$$p_C - 2e_i \geq 0, \qquad i = 3, 4; \tag{18}$$

Worker 5 prefers not to sell at all than to sell in any of the markets:

$$0 \geq p_A - e_5; \tag{19}$$

$$0 \geq p_C - 2e_5; \tag{20}$$

$$0 \geq p_D + b_5 - 2e_5; \tag{21}$$

$$0 \geq 2p_A - 2e_5; \tag{22}$$

Firms $6-9$ are willing to buy in any of the three markets, and are indifferent between buying in C, or D, or two units in A:

$$v_i - p_A \geq 0, \qquad i = 6, ..., 9; \tag{23}$$

$$2(v_i - p_A) \geq 0, \qquad i = 6, .., 9; \tag{24}$$

$$2v_i - p_C \geq 0, \qquad i = 6, .., 9; \tag{25}$$

$$2v_i - p_D - c \geq 0, \qquad i = 6, .., 9; \tag{26}$$

$$2v_i - p_C = 2v_i - p_D - c, \qquad i = 6, .., 9; \tag{27}$$

$$2(v_i - p_A) = 2v_i - p_C, \qquad i = 6, .., 9; \tag{28}$$

$$2(v_i - p_A) = 2v_i - p_D - c, \qquad i = 6, .., 9; \tag{29}$$

Firm 10 prefers not to buy at all, than to buy in any of the markets:

$$0 \geq v_5 - p_A; \tag{30}$$

$$0 \geq 2v_5 - p_C; \tag{31}$$

$$0 \geq 2v_5 - p_D - c; \tag{32}$$

$$0 \geq 2(v_5 - p_A); \tag{33}$$

The above constraints and the parameter values from Table 1 result the equilibrium prices (wages) in the three markets:

$$p_A = p_C/2; \tag{34}$$

$$p_C = p_D + 32; \tag{35}$$

$$58 \leq p_A \leq 64; \tag{36}$$

$$116 \leq p_C \leq 128; \tag{37}$$

$$84 \leq p_D \leq 96; \tag{38}$$

[FB] Full Mandate and Non-binding Minimum Wage, $w_{min} = 40$

$$p_D + b_i - 2e_i \geq 0, \qquad i = 1, .., 4; \tag{39}$$

$$0 \geq p_D + b_5 - 2e_5; \tag{40}$$

$$2v_i - p_D - c \geq 0, \qquad i = 6, .., 9; \tag{41}$$

$$0 \geq 2v_{10} - p_D - c. \tag{42}$$

The regulatory constraint is given by:

$$p_D \geq 80 \tag{43}$$

Combining the above equations and the parameter values from Table 1 we obtain that the equilibrium price for the market D is given by:

$$84 \leq p_D \leq 96 \tag{44}$$

Appendix C: Equilibrium per unit wages in markets with a binding minimum wage

[NA] No Mandate and Binding Minimum Wage, $w_{min} = 52$

The regulatory constraints set by price floor of about 52 yields additional constraints:

$$p_A \geq 52; \tag{45}$$

$$p_C \geq 104; \tag{46}$$

$$p_D \geq 104. \tag{47}$$

Worker 1 and 2 are willing to participate in market D. They prefer selling two units in market D than two units in C market, or two separate units in A market, or one unit in market A:

$$p_D + b_i - 2e_i \geq p_C - 2e_i, \qquad i = 1, 2; \tag{48}$$

$$p_D + b_i - 2e_i \geq 2p_A - 2e_i, \qquad i = 1, 2; \tag{49}$$

$$p_D + b_i - 2e_i \geq p_A - e_i, \qquad i = 1, 2; \tag{50}$$

$$p_D + b_i - 2e_i \geq 0, \qquad i = 1, 2; \tag{51}$$

Worker 3 and 4 are indifferent between selling a package in market C, or two units in A. They prefer to sell in C that to sell in D, or one unit in A, or not to sell at all:

$$p_C - 2e_i = 2p_A - 2e_i, \qquad i = 3, 4; \tag{52}$$

$$p_C - 2e_i \geq p_D + b_i - 2e_i, \qquad i = 3, 4; \tag{53}$$

$$p_C - 2e_i \geq p_A - e_i, \qquad i = 3, 4; \tag{54}$$

$$p_C - 2e_i \geq 0, \qquad i = 3, 4; \tag{55}$$

Worker 5 prefers not to sell at all than to sell in any of the markets:

$$0 \geq p_A - e_5; \tag{56}$$

$$0 \geq p_C - 2e_5; \tag{57}$$

$$0 \geq p_D + b_5 - 2e_5; \tag{58}$$

$$0 \geq 2p_A - 2e_5; \tag{59}$$

Firms $6 - 9$ are willing to buy in any of the three markets, and are indifferent between buying in C, or two units in A:

$$v_i - p_A \geq 0, \qquad i = 6, ..., 9; \tag{60}$$

$$2(v_i - p_A) \geq 0, \qquad i = 6, .., 9; \tag{61}$$

$$2v_i - p_C \geq 0, \qquad i = 6, .., 9; \tag{62}$$

$$2(v_i - p_A) = 2v_i - p_C, \qquad i = 6, .., 9; \tag{63}$$

Firm 10 prefers not to buy at all, than to buy in any of the markets:

$$0 \geq v_5 - p_A; \tag{64}$$

$$0 \geq 2v_5 - p_C; \tag{65}$$

$$0 \geq 2(v_5 - p_A); \tag{66}$$

The above constraints and the parameter values from Table 1 result in the following equilibrium prices (wages) in two markets:

$$p_A = p_C/2; \tag{67}$$

$$58 \leq p_A \leq 66; \tag{68}$$

$$116 \leq p_C \leq 132; \tag{69}$$

[FA] Full Mandate and Binding Minimum Wage, $w_{min} = 52$

Firms $6 - 8$ are willing to trade with any of five workers in D market. Firms 9 and 10 prefer not to buy at all than to buy in the market:

$$p_D + b_i - 2e_i \geq 0, \qquad i = 1, ..., 5; \tag{70}$$

$$2v_i - p_D - c \geq 0, \qquad i = 6, ..., 8; \tag{71}$$

$$0 \geq 2v_i - p_D - c, \qquad i = 9, 10; \tag{72}$$

The regulatory constraint is given by:

$$p_D \geq 104. \tag{73}$$

Combining the above equations and the parameter values from Table 1 we obtain that the unique equilibrium price for the market D is given by:

$$p_D = 104. \tag{74}$$

APPENDIX D

Instructions
(NB)

General Information

This is an experiment in the economics of market decision making. Based on your decisions in this experiment, you can earn a significant amount of money that will be paid to you IN CASH at the end of the experiment. During the experiment all units of account will be in experimental pesos. At the end of the experiment the amount of experimental pesos that you earn will be converted into dollars at the conversion rate of ___dollars per pesos. Your earnings plus a lump sum amount of 5 dollars will be paid to you in private.

From this point onwards you are NOT allowed to communicate with any other participant except according to the rules specified below. If you have any questions raise your hand and we will answer your questions in private. From this point onwards, you will be referred to by your participant number. You are participant number_____.

In this experiment we are going to conduct a market in which some of you will be buyers and some of you will be sellers of a fictitious good. Participants 1 through 5 will be sellers and participants 6 through 10 will be buyers. Attached to the instructions you will find a sheet labeled "Seller" or "Buyer", which describes the value to you of any decisions you might make. YOU ARE NOT TO REVEAL THIS INFORMATION TO ANYONE. It is your own private information.

Trading will occur in a sequence of market days, or trading periods. In each period, each buyer is free to buy, and each seller is free to sell, up to two units of the good. Units of the good can be traded separately or in packages of 2 units. In addition, each seller may request, and each buyer may offer, to provide a fictitious service in exchange for the good(s). There will be four separate markets depending on how the goods are traded:

Market A: separate units, no service;
Market B: separate units, with service;
Market C: packages of 2 units, no service;
Market D: packages of 2 units, with service.

Trading in each period will close after 5 minutes or when there is no activity for 20 seconds (whichever occurs first). At the end of every period you will be required to record your earnings for that period on your record sheet to be described below. This procedure will repeat for a number of periods.

Specific Instructions for Buyers

During each period you are free to buy up to two units of the good from any seller or sellers in any of the markets A, B, C or D. For each unit you buy, you will receive a *resale value*, which is listed in row I of your record sheet. You may buy units of the good separately (in markets A and B), or in a package (in markets C or D). In addition, you may offer to provide a fictitious service to sellers, which costs you the amount listed in row III of your record sheet. Your earnings from a purchase (which are yours to keep) equal to the difference between the resale values of the units sold and the purchase price you paid, minus the cost of service if you provide it.

Your Earnings = Resale Value – Price – Cost of Service if Provided

Your total earnings in a period equal the sum of the earnings from all of the units that you purchase in that period. (All the numbers used in the examples below are hypothetical.)

Example 1: Suppose, for example, that your resale value for each of the two units of the good is 65, and the cost of providing service to sellers is 30. Suppose you buy one unit in Market A (separate units, no service) for 50 pesos and another unit in Market B (separate units, with service) for 40. Then your earnings are:

Earnings [Market A, one unit, no service] = 65 – 50 = 15
Earnings [Market B, one unit, with service] = 65 – 40 – 30 = –5
Total earnings = 15 – 5 = 10

Example 2: Suppose, instead of the above, that you buy both units as a package in Market D (2-unit package, with service) for 80 pesos. Then your earnings are:

Earnings [Market D, package, with service] = 2*65 – 80 – 30 = 130 – 80 – 30 = 20

Remember, you can buy no more than 2 units in total per period. You can buy two units in Market B, but you will have to pay the cost of providing the service for each of the units.

Specific Instructors for Sellers

During each period you are free to sell up to two units of the good to any buyer or buyers in any of the markets A, B, C or D. For each unit that you sell you will receive the unit's price minus your *production cost*, which is listed in row II of your record sheet. You may sell units of the good separately (in markets A and B), or as a package (in markets C or D). In addition, you may request to receive a fictitious service from buyers. If you obtain the service you will receive an extra pay, listed in row III of your record sheet. You can only receive one extra pay per period. Therefore, if you sell one unit in market B (separate units, with service) you cannot sell another unit in market B; you can only sell your second unit in market A (separate units, no service). Your earnings from a sale (which are yours to keep) equal to the difference between the price you receive for the unit and production cost, plus the extra pay from service if you receive it.

Your Earnings = Price – Production Cost + Pay from Service if Received

Your total earnings in a period equal the sum of the earnings from all of the units that you sell in that period. (All the numbers used in the examples below are hypothetical.)

Examples 3: Suppose, for example, that your production cost for each of the two units of the good is 30, and the extra pay from receiving service from a buyer is 20. Suppose you sell one unit in Market A (separate units, no service) for 45 and one unit in Market B (separate units, with service) for 50. Then your earnings are:

Earnings [Market A, one unit, no service] = 45 – 30 = 15

Earnings [Market B, one unit, with service] = 50 – 30 + 20 = 40

Total Earnings = 15 + 40 = 55

Example 4: Suppose, instead of the above, that you sell both units as a package in Market C (2-unit package, no service) for 95 pesos. Then your earnings are:

Earnings [Market C, package, no service] = 95 – 2*30 = 95 – 60 = 35

Remember, you can sell no more than 2 units in total per period. Also note, you cannot sell 2 units in Market B.

Market Organization

The market for this good is organized as follows. During each trade period each buyer is free to buy up to 2 units and each seller is free to sell up to 2 units of the good. Any buyer (seller) is free at any time during the period to raise his hand and make a verbal bid (ask) to buy (sell) a unit or units of the good in any of the markets A, B, C or D. The buyer (seller) must specify which market he will buy (sell) the unit(s) in and at (for) what price. **Buyers and sellers may name any price except for the following constraint. Price in markets A and B must be no lower than 40 pesos, and prices in markets C and D must be no lower than 80 pesos.**

For instance, if buyer 7 wishes to buy a unit in Market A (separate units, no service) for 55 pesos, he should call out "Market A, buyer 7 bids 55". If seller 3 wishes to sell a 2-unit package in Market D (2-unit package, with service) for 105 pesos, he should call out "Market D, seller 3 asks 105". The price in markets A and B is the price per unit, while the price in markets C and D is the price for the 2-unit package.

Each new bid (ask) in a given market must be higher (lower) than the highest (lowest) outstanding bid (ask) in that market. For example, if the highest bid in Market A is 55 pesos, any new bids in Market A must be higher than 55. Similarly, if the lowest ask in Market C is currently 180 pesos, any new asks in Market C must be lower than 180. Any buyer (seller) is free at any time to accept an outstanding ask (bid). The buyer (seller) must specify which market he is accepting the ask (bid) in. For example, if buyer 7 wishes to accept the outstanding ask in market B he should calls out "Market B, buyer 7 accepts the ask." If a bid (ask) is accepted a binding contract is closed between the buyer and the seller, and each of them will record the contract price in their record sheet. Any ties in acceptance will be resolved by a random choice of buyer or seller. Buyers (sellers) are free to simultaneously place bids (asks) in as many markets as they wish. However, once a buyer (seller) buys (sells) a unit in markets A or B he can no longer buy (sell) in markets C or D. Consequently, any bids (asks) that the buyer (seller) has in markets C or D will be automatically removed. Once a buyer (seller) buys (sells) 2 units he can no longer participate in the market until the next trading period. You also have the option to record the transactions in each period in the transaction sheet attached.

ARE THERE ANY QUESTIONS?

Please complete the following exercises. Use the tables below to help you solve them.

Exercises for Sellers

Exercise 1: Suppose that a seller sells a unit in Market A (separate units, no service) for 50 pesos and another unit in Market B (separate units, with service) for 50. Assume that the seller's production cost and extra pay from service are 20 and 30 respectively. What are the total earnings of the seller?

Exercise 2: Suppose that a seller sells a 2-unit package in Market D (package, with service) for 90. Assume that the seller's production cost is 35 per unit and his extra pay from service is 44. What are the total earnings of the seller?

Table 1 (Use this table to calculate the earnings for sellers)

	Row		Market A		Market B	Market C	Market D	Total Earnings
Ex. 1	I	*Price*						
	II	*– Cost*	20	20	20	40	40	
	III	*+ Extra Pay*			30		30	
	IV	***= Earnings***						
Ex. 2	I	*Price*						
	II	*– Cost*	35	35	35	70	70	
	III	*+ Extra Pay*			44		44	
	IV	***= Earnings***						

Exercises for Buyers

Exercise 1: Suppose that a buyer purchases one unit in Market A (separate units, no service) for 50 pesos and another unit in Market B (separate units, with service) for 100. The buyer's resale value is 85 per unit and it costs him 40 to provide the service. What are the total earnings of the buyer?

Exercise 2: Suppose that a buyer purchases a 2-unit package in Market D (package, with service) for 90. The buyer's resale value is 65 per unit and it costs him 20 to provide a service. What are the total earnings of the buyer?

Table 2 (Use this table to calculate the earnings for buyers)

	Row		Market A		Market B		Market C	Market D	Total Earnings
Ex. 1	I	*Resale Value*	85	85	85	85	170	170	
	II	*– Price*							
	III	*– Cost of service*			40	40		40	
	IV	***= Earnings***							
Ex. 2	I	*Resale Value*	65	65	65	65	130	130	
	II	*– Price*							
	III	*– Cost of service*			20	20		20	
	IV	***= Earnings***							

ARE THERE ANY QUESTIONS?

Period 0 will be used for practice. It will not count towards your earnings.

Record Sheet (N)

Seller: ID # 1

Period	Row		Market A		Market B	Market C	Market D	Total Earnings
			Unit 1, No Service	Unit 2, No Service	1 Unit, with Service	2 Unit Package, No Service	2 Unit Package, with Service	
0	I	*Price*						
	II	*Cost*	45	45	45	90	90	
	III	+ *Extra Pay*			40		40	
	IV	**= *Earnings***						
1	I	*Price*						
	II	*Cost*	45	45	45	90	90	
	III	+ *Extra Pay*			40		40	
	IV	**= *Earnings***						
2	I	*Price*						
	II	*Cost*	45	45	45	90	90	
	III	+ *Extra Pay*			40		40	
	IV	**= *Earnings***						
3	I	*Price*						
	II	*Cost*	45	45	45	90	90	
	III	+ *Extra Pay*			40		40	
	IV	**= *Earnings***						
4	I	*Price*						
	II	*Cost*	45	45	45	90	90	
	III	+ *Extra Pay*			40		40	
	IV	**= *Earnings***						
5	I	*Price*						
	II	*Cost*	45	45	45	90	90	
	III	+ *Extra Pay*			40		40	
	IV	**= *Earnings***						
6	I	*Price*						
	II	*Cost*	45	45	45	90	90	
	III	+ *Extra Pay*			40		40	
	IV	**= *Earnings***						
7	I	*Price*						
	II	*Cost*	68	68	68	136	136	
	III	+ *Extra Pay*			40		40	
	IV	**= *Earnings***						

Record Sheet Seller: ID # 1								
Period	**Row**		**Market A**		**Market B**	**Market C**	**Market D**	**Total Earnings**
8	I	*Price*						
	II	*Cost*	68	68	68	136	136	
	III	*+ Extra Pay*			40		40	
	IV	***= Earnings***						
9	I	*Price*						
	II	*Cost*	68	68	68	136	136	
	III	*+ Extra Pay*			40		40	
	IV	***= Earnings***						
10	I	*Price*						
	II	*Cost*	68	68	68	136	136	
	III	*+ Extra Pay*			40		40	
	IV	***= Earnings***						
11	I	*Price*						
	II	*Cost*	68	68	68	136	136	
	III	*+ Extra Pay*			40		40	
	IV	*= Earnings*						
12	I	*Price*						
	II	*Cost*	68	68	68	136	136	
	III	*+ Extra Pay*			40		40	
	IV	***= Earnings***						
13	I	*Price*						
	II	*Cost*	68	68	68	136	136	
	III	*+ Extra Pay*			40		40	
	IV	***= Earnings***						
14	I	*Price*						
	II	*Cost*	45	45	45	90	90	
	III	*+ Extra Pay*			40		40	
	IV	***= Earnings***						
15	I	*Price*						
	II	*Cost*	45	45	45	90	90	
	III	*+ Extra Pay*			40		40	
	IV	***= Earnings***						
Cumulative Earnings in Pesos								
Exchange Rate								
Cumulative Earnings in Dollars								

Optional Transactions Sheet (N)

Period	**Market A**			**Market B**			**Market C**			**Market D**		
	Seller	Buyer	Price	Seller	Buyer	Price	Seller	Buyer	Price	Seller	Buyer	Price