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Skills and the Regulation of Labor

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Keywords: Labor regulation, labor market frictions, skill composition, welfare

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1 Introduction

The question of why standards of living differ significantly across countries remains open in economics. Recent research emphasizes the role of human capital in accounting for these differences (Jones, 2014; Hendricks and Schoellman, 2018). Another influential line of research highlights the importance of how efficiently countries adopt and allocate productive resources, arguing that these factors also contribute to cross-country income disparities (Parente and Prescott, 1994; Restuccia and Rogerson, 2008). In this view, barriers to adoption and sources of allocative inefficiency are often rooted in differences in a country's policy environment and regulatory framework.

In this paper, I study the relationship between the stock of human capital and policy inefficiencies. I begin by documenting the historical evolution of labor regulation and its correlation with the share of skilled workers. Specifically, I show that countries with a larger share of skilled workers observed faster movements toward less stringent labor regulation. I then develop a theoretical framework to explain this relationship: skilled workers are more likely to be harmed by pro-worker regulation, while the effects on unskilled workers depend on the type of regulation in place. Finally, I use an instrumental variable approach to provide causal evidence that a higher share of skilled workers is associated with a faster move toward labor market deregulation in the second half of the twentieth century.

Using cross-country data on labor regulation (Gwartney, Lawson and Hall, 2017) and educational attainment (Lee and Lee, 2016), I show that since the 1970s, the distribution of labor regulation has shifted toward less stringent policies in both developed and developing countries. Importantly, countries with initially larger shares of skilled workers experienced more pronounced moves toward market-oriented labor regulations. This pattern holds across both developed and developing countries and remains evident even when comparing countries with similar initial levels of labor regulation.

Next, I develop a model to identify the winners and losers from increased labor regulation. The model features search frictions and a multi-worker representative firm, following the framework of Acemoglu and Hawkins (2014). It builds on the internal conflict approach of Saint-Paul (1998, 2000), in which skilled workers are indispensable and therefore capture the entire surplus from their match with the representative firm. In contrast, unskilled workers split the surplus with the firm based on their bargaining power. I examine two types of labor regulation: one that increases the cost of posting vacancies, and another that raises the bargaining power of unskilled workers. In the steady state, the effect of these policies on unskilled workers' welfare is ambiguous, as it depends on the balance between short- and long-run effects. Similarly, the impact on skilled workers is mixed and hinges on whether they receive firm dividends, although their wages decline with more stringent regulation due to a reduction in unskilled employment.

To clarify the theoretical relationship, I calibrate the model to match several moments from U.S. data. Numerical exercises show that increases in the cost of posting vacancies reduce the welfare of both skilled and unskilled workers, despite raising unskilled wages. This result reflects the high weight placed on the value of unemployment, which affects even currently employed workers due to an exogenous separation rate. Increases in the bargaining power of unskilled workers, in turn, benefit unskilled workers but further reduce the welfare of skilled workers. Thus, skilled workers lose in both policy scenarios.

Lastly, I estimate the causal relationship between the share of skilled workers and labor regulation, using the epidemiological transition of the mid-twentieth century as an exogenous shock to human capital composition. Acemoglu and Johnson (2007) show that this transition had no significant effect on countries' levels of development but led to increases in population and fertility. Health improvements likely benefited poorer, unskilled individuals disproportionately, leading to higher fertility among this group and, due to intergenerational persistence in educational attainment, a larger share of unskilled workers. This mechanism is studied in detail by Cervellati and Sunde (2015). Using the potential gains from health improvements as an instrument for the share of skilled workers, I find that a higher share of skilled workers is associated with a faster shift toward market-oriented labor regulations. Specifically, an increase in the skilled share equivalent to that experienced by the United States between 1970 and 1990 (17.4%) is associated with a reduction of approximately 2.1 points on a labor regulation index ranging from 0 to 10.

Related Literature This paper relates closely to the literature on the causes of labor regulation. The insider-outsider theory, as developed by Lindbeck and Snower (1988) and Wright (1986), suggests that labor regulation is imposed by incumbent workers to reduce their risk of unemployment, since replacing a worker is costly. Additionally, higher unemployment raises the marginal product of incumbent workers. Saint-Paul (1998) extends this framework by introducing internal conflict between skilled and unskilled workers. While high unemployment among unskilled workers increases the marginal product of incumbent unskilled workers, it simultaneously lowers the marginal product of incumbent skilled workers. Consequently, skilled workers may align with unemployed unskilled workers in favor of less labor market regulation.[1] I extend this model by allowing multiple workers within a firm, which improves its suitability for quantitative analysis, and test this model empirically.

An example of this mechanism is provided by Doepke and Zilibotti (2005), who develop a model in which adult workers oppose child labor because it increases the supply of unskilled labor, thereby driving down their own wages. Building on similar intuition, Acemoglu, Aghion and Violante (2001) and Dinlersoz and Greenwood (2016) argue that the decline in union power can be attributed to skill-biased technological change, which raised the market return to skilled workers. As a result, skilled workers withdrew their support from the unskilled, weakening the coalition that had sustained union strength.

My paper also contributes to the literature on economic growth that seeks to explain the sources of cross-country income disparities. Prior research has emphasized the role of labor market regulation in shaping technology adoption, entrepreneurship, and structural transformation (Parente and Prescott, 1999; Alexopoulos and Villamil, 2014; Donovan and Schoellman, 2023). At the same time, a large body of work highlights the importance of human capital—particularly in the form of education—in accounting for differences in development outcomes (Lucas Jr, 1988; Mankiw, Romer and Weil, 1992; Jones, 2014; Manuelli and Seshadri, 2014; Hendricks and Schoellman,

[1] Boeri, Conde-Ruiz and Galasso (2012) further explore this internal conflict. Another strand of the literature points to long-run determinants of regulation such as legal origins (Botero, Djankov, Porta, Lopez-de Silanes and Shleifer, 2004) and family ties (Alesina, Algan, Cahuc and Giuliano, 2015).

2018). I contribute to this literature by connecting these two drivers of growth, showing that human capital accumulation can lead to a reduction in the strictness of labor regulation. This mechanism resonates with the broader idea, advanced by Nelson and Phelps (1966), that human capital plays a central role in shaping the economic growth, in their case, through the faster technological progress.

The remainder of the paper is organized as follows. In Section 2, I document the evolution of labor regulation during the final decades of the twentieth century. Section 3 presents a theoretical model that identifies the winners and losers from labor market regulation. Section 4 provides the empirical analysis, using causal inference methods to estimate the impact of human capital on labor regulation. Section 5 concludes.

2 Th evolution of labor regulation

In this section, I present evidence that smaller shares of skilled workers in the labor force are associated with stricter labor regulation. Historically, labor relations between employers and workers can be traced back to the age of guilds, when specific laws governed the work of apprentices. However, as noted by Engerman (2003), early labor regulations were often crafted by political elites to protect the interests of employers. For example, in fourteenth-century England, maximum wage laws were introduced in response to a labor shortage following the Black Death (Engerman, 2003, p. 9). Modern labor regulation began to take shape in the nineteenth and twentieth centuries, particularly with laws limiting the working hours of children and women.

The diffusion of labor standards across countries was facilitated by the creation of the International Labor Organization (ILO) in 1919, as an offshoot of the League of Nations, and was further strengthened after World War II. In the decades that followed, particularly during the 1960s and 1970s, many European countries introduced significant changes to labor regulations, often in the context of expanding welfare states and a growing emphasis on wage equality. Italy, for example, experienced a shift in this direction, as illustrated by Siebert (1997, p. 40):

> "Italy followed a similar pattern of more regulated markets in the 1960s and into the 1970s. For example, in 1966, Italy first passed regulations on firing procedures. By

> 1970, following waves of strikes, these regulations were tightened to the point that firing costs were almost infinite. However, as unemployment stayed high in the 1970s, Italy authorized temporary work contracts in 1977, rules that it would liberalize in 1984 and 1987. Layoffs for economic reasons were authorized in 1986, and firing restrictions were eased for large firms in 1991. In 1992, Italy ended its practice of synchronized wage bargaining across sectors of the economy and the indexation of wage adjustments (the *scala mobile*)."

To illustrate this pattern, I use data on labor market regulation from the Fraser Institute's Economic Freedom dataset (Gwartney et al., 2017). Specifically, I focus on the subcomponent "Labor Market Regulation" for the years 1970, 1980, 1990, 2000, and 2010. I construct two samples. The reduced sample includes only countries with complete data for all five periods, resulting in a group of 20 countries—mostly from Western and Northern Europe. The full sample includes all countries with available data from 1990 onward, yielding a total of 45 countries. In the original index, higher values are assigned to countries with less pro-worker (i.e., more market-oriented) regulation.[2] For ease of interpretation, I invert the index so that higher values indicate stricter labor regulation.

As shown in Figure 1A, labor regulation moved toward more market-oriented policies, particularly after the 1990s. However, this period also saw increasing disparity across countries in terms of regulatory strictness. Panel B provides further insight into which countries experienced the most significant regulatory changes. Canada, Japan, New Zealand, and the United Kingdom already had relatively low levels of labor regulation in 1970 and continued to liberalize over the following four decades. Among the countries with stricter labor regulations in the 1970s, the United States, Denmark, and Belgium stand out for their notable improvements. In contrast, countries such as Spain, Greece, Portugal, and Norway exhibited relatively modest gains in their labor regulation index over the same period.

The previous analysis shows that, overall, labor markets have moved toward more pro-market regulation. However, many countries have failed to substantially reform their labor regulations.

[2] To receive high scores in the labor market regulation component, a country must allow market forces to determine wages and hiring/firing conditions and avoid conscription.

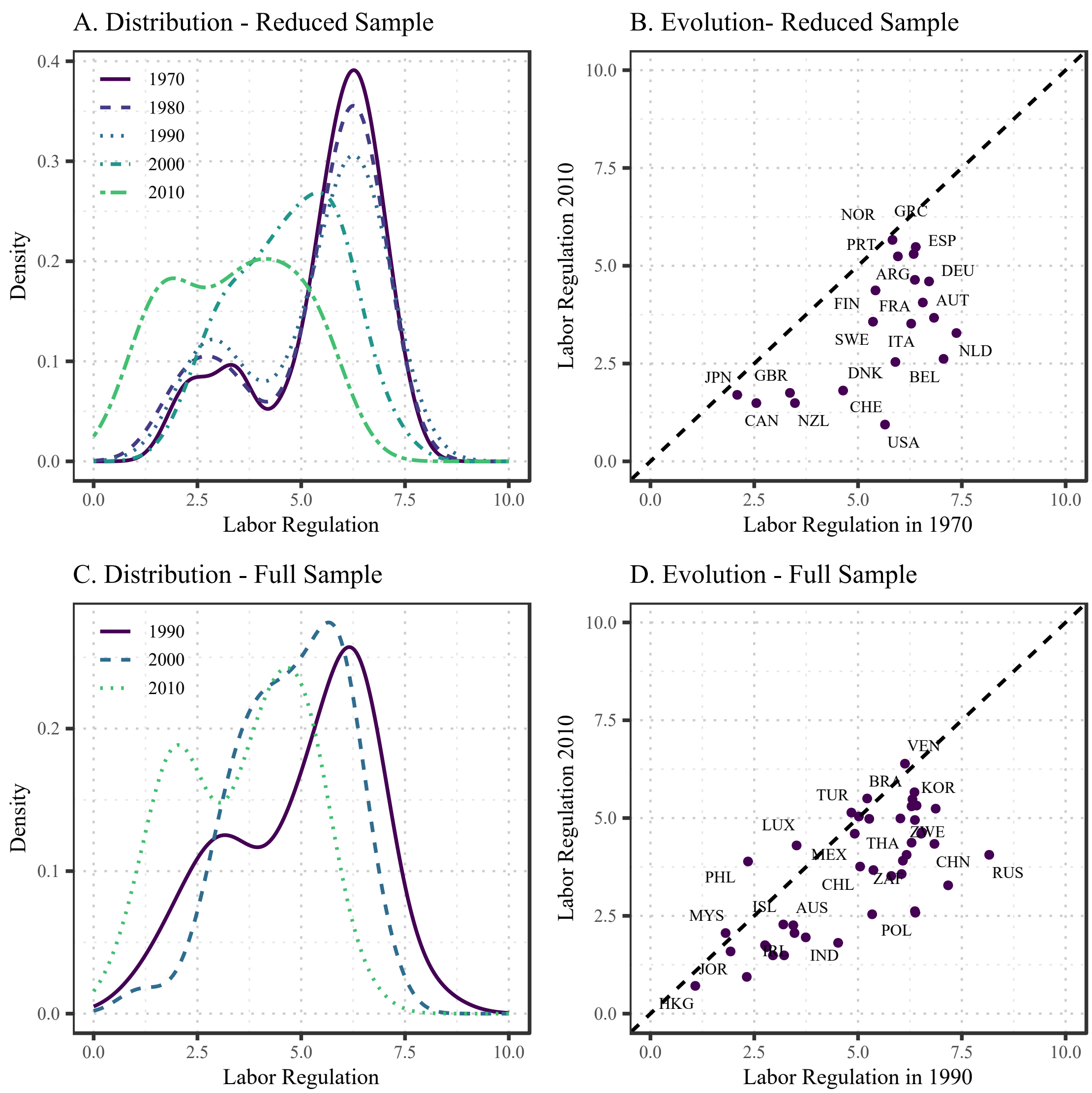

Figure 1: **The evolution of labor regulation after 1970.** *Notes:* The labor regulation index is the sub-topic Labor Market Regulation in the Economic Freedom of the World (Gwartney et al., 2017). Higher values mean more pro-worker regulation.

An open question is whether this trend holds for a broader set of countries, particularly developing economies, which were largely excluded from the earlier analysis. Figure 1C illustrates a general decline in the labor regulation index since the 1990s. Panel D compares the index in 1990 and 2010, revealing that some developing countries, such as Malaysia and India, already had relatively market-oriented labor regulations in both years. Others, like Russia and Bolivia, experienced significant deregulation over the period. In contrast, several developing countries—including Brazil, Mexico, Venezuela, and Turkey—saw little change in their regulation levels and remain among the most restrictive in the distribution.

This paper investigates why some countries fail to reduce the strictness of their labor regulation. Specifically, I examine whether countries with higher shares of skilled labor have a politically weaker working class, making it harder to resist labor market deregulation. To explore this, I compare the evolution of labor regulation between the initial and final periods in the sample with the share of skilled workers in the initial period. I use data from Lee and Lee (2016), measuring the share of skilled workers in 1970 as the proportion of the population aged 25 to 64 with at least completed secondary education.

In Figure 2, I present the correlation between the share of skilled workers in 1970 and the labor regulation index in 2010, focusing on countries with similar levels of regulation at the start of the sample. Specifically, I restrict the sample to countries with a labor regulation index above five in the initial year, capturing the vertical cluster of countries observed in Figure 1. The figure shows that differences in the initial share of high-skilled workers explain a substantial portion of the variation in labor regulation by 2010. Notably, countries with lower shares of skilled workers in 1970 tend to have stricter labor regulations in 2010. In Panel A, the 1970 share of skilled workers explains 48% of the variation in labor regulation in 2010. In the broader sample—where the initial year is 1990—the share of skilled workers explains 25% of the variation in regulation in 2010.

The data presented above provides suggestive evidence of a connection between the share of skilled workers and the strictness of labor regulation. In the following section, I develop a formal theoretical framework that links the share of skilled workers to political support for labor regulation.

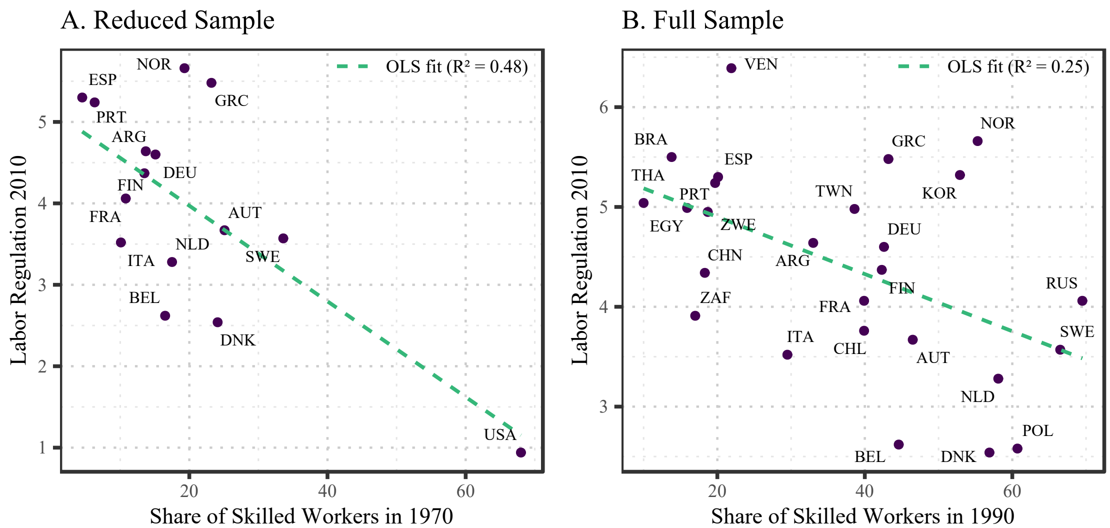

Figure 2: **Initial share of skilled workers and labor regulation index.** *Notes:* Sample of countries with labor regulation index above 5. Share of skilled workers are defined as the share of individuals between 25 and 65 years of age with at least secondary education from Lee and Lee (2016). The labor regulation index is the sub-topic Labor Market Regulation in the Economic Freedom of the World (Gwartney et al., 2017). Higher values mean more pro-worker regulation.

I then extend the empirical analysis to examine the causal relationship between these two variables.

3 Winner and losers from labor regulation

The economy consists of a continuum of risk-neutral workers of measure one, who are heterogeneous with respect to their skills. A share χ of the population is skilled, while the remaining share $n = 1-\chi$ is unskilled. A representative firm combines skilled labor (h) and unskilled labor (ℓ) to produce a final good using a constant returns to scale production function $f(h,\ell)$. The function f is continuous, strictly increasing, and strictly concave in both arguments, and satisfies the standard Inada conditions. In addition, the following assumptions are imposed:

Assumption 1. *The production function $f(\cdot,\cdot)$ satisfies the following additional conditions, where subscripts denote partial derivatives:*

1. $\lim_{\ell\to 0} \ell^{-\frac{1}{\varphi}+1} \int_0^{\ell} \lambda^{\frac{1}{\varphi}-1} f_\ell(h,\lambda)d\lambda = 0$;

2. $f_\ell(h,\ell) - f_{\ell h}(h,\ell)h$ *is strictly decreasing in* ℓ;

3. $\lim_{\ell\to 0}\left[f_\ell(h,\ell) - f_{\ell h}(h,\ell)h\right] > 0$.

Following Saint-Paul (1998, 2000), I assume that skilled workers possess unique abilities that allow them to capture all the incremental surplus generated from their match with the firm. Consistent with a competitive market, the firm takes skilled workers' wages, denoted by x, as given, and there is full employment of skilled labor, so $h = \chi$. In contrast, the market for unskilled workers features search frictions following the framework of Mortensen and Pissarides (1994). To hire unskilled workers, the firm posts vacancies v at a cost $c(v)$, where $c(\cdot)$ is continuous, strictly increasing, and strictly convex, with the property that $\lim_{v\to 0} c_v(v) = 0$. Vacancies are converted into employment according to a matching function $m(v,u)$, which exhibits constant returns to scale and takes the number of vacancies v and unemployed workers u as inputs. This function is continuous, strictly increasing, strictly concave, and bounded above in both arguments. Given constant returns to scale, the rate at which a vacancy is filled is defined as $q(\theta) := m(u,v)/v = m(1/\theta,1)$, and the rate at which an unemployed worker is matched with a vacancy is $p(\theta) := m(u,v)/u = m(1,\theta)$, where $\theta := v/u$ is the market tightness, taken as given by the firm. Wages paid to unskilled workers, w, are determined through a bargaining process described by Stole and Zwiebel (1996) and discussed below.

The representative firm employs h skilled workers and ℓ unskilled workers, earning a period profit given by $\pi(h,\ell) = f(h,\ell) - x(h,\ell)h - w(h,\ell)\ell$. The firm's value is defined as

$$\mathcal{J}(h,\ell) = \pi(h,\ell) + \max_{v\geq 0}\{-c(v) + \beta\mathcal{J}(h',\ell')\} \quad \text{suject to} \quad \ell' = (1-\delta)\ell + vq(\theta), \tag{1}$$

where y' denotes the future value of variable y, δ is the exogenous separation rate, and β is the discount factor. The value of an unskilled worker employed in a firm with h skilled and ℓ unskilled workers is given by

$$\mathcal{V}(h,j) = w(h,\ell) + \delta\beta\mathcal{U}' + (1-\delta)\beta\mathcal{V}(h',\ell'), \tag{2}$$

where the value of unemployment is given by

$$\mathcal{U} = b + p(\theta)\beta\mathcal{V}(h', \ell') + (1 - p(\theta))\beta\mathcal{U}', \tag{3}$$

where b denotes the home production value enjoyed by unskilled workers while unemployed, which they consume entirely.

Given the value functions, I define the surplus of an incremental match in a firm with h skilled workers and ℓ unskilled workers as $S(h, \ell) = \mathcal{J}_\ell(h, \ell) + \mathcal{V}(h, \ell) - \mathcal{U}$. The bargaining solution allocates a share φ of this surplus to the unskilled worker and the remaining share $1 - \varphi$ to the firm, where $\varphi \in (0, 1)$ represents the bargaining power of workers. Consequently, wages satisfy the condition

$$\varphi\mathcal{J}_\ell(h, \ell) = (1 - \varphi)(\mathcal{V}(h, \ell) - \mathcal{U}),$$

which together with the optimal vacancy posting condition

$$c_v(v) = \beta q(\theta)\mathcal{J}_\ell(h', \ell'), \tag{4}$$

imply the following proposition.

Proposition 1. *If Assumption 1.1 holds, then equilibrium wages are*

$$x(h, \ell) = f_h(h, \ell) - \ell^{-\frac{1}{\varphi}+1} \int_0^\ell \lambda^{\frac{1}{\varphi}-1} f_{\ell h}(h, \lambda) d\lambda \tag{5}$$

$$w(h, \ell) = (1 - \varphi)(\mathcal{U} - \beta\mathcal{U}') + \ell^{-\frac{1}{\varphi}} \int_0^\ell \lambda^{\frac{1}{\varphi}-1} f_\ell(h, \lambda) d\lambda. \tag{6}$$

Proof. See Appendix A. □

Proposition 1 extends Lemma 1 in Acemoglu and Hawkins (2014, p. 594) to a setting with multiple skill types. While the skilled labor market is competitive, skilled workers do not receive their marginal product because the firm internalizes that employing more skilled workers raises unskilled workers' wages.[3] Moreover, Equation (6) aligns with Stole and Zwiebel (1996), showing that unskilled workers' wages are determined by the change in the value of their outside option and their marginal contribution to the firm's value.

Finally, I assume that skilled workers equally share the firm's dividends, so that the value of a skilled worker in a firm with h skilled and ℓ unskilled workers is given by

$$\mathcal{W}(h,\ell) = x(h,\ell) + \mathcal{J}(h,\ell)/h + \beta(\mathcal{W}(h',\ell') - \mathcal{J}(h',\ell')/h'). \tag{7}$$

Equations Equations (1) to (7) fully characterize the dynamic equilibrium with unemployment in this economy. Since the analysis focuses on the steady state, I omit the formal definition of the dynamic equilibrium and instead provide the definition of the steady state equilibrium.

Steady State The steady state is characterized by constant aggregate values of market tightness, θ_{ss}, and the value of unemployment, $\mathcal{U}ss$. In the steady state, the value of employment for an unskilled worker remains constant over time, which implies that labor demand, ℓ_{ss}, is also constant. As a result, wages are constant in steady state. Vacancy posting satisfies the condition $v_{ss} = \delta\ell_{ss}/q(\theta_{ss})$, ensuring that employment levels are stable. This in turn implies that the firm's value remains constant over time, and so does the value of skilled workers.

Definition 1. *A steady state equilibrium with unemployment is a set of endogenous aggregate variables* $\{\theta_{ss}, \mathcal{U}_{ss}, v_{ss}, h_{ss}, \ell_{ss}\}$, *a set of wage functions* $\{w_{ss}, x_{ss}\}$, *and set of values functions* $\{\mathcal{J}_{ss}, \mathcal{V}_{ss}, \mathcal{W}_{ss}\}$ *such that*

1. *Skilled labor market clearing implies* $h_{ss} = \chi$;
2. *Given* $\theta_{ss} := v_{ss}/u_{ss}$ *and* $v_{ss} = \delta\ell_{ss}/q(\theta_{ss})$, *the equilibrium unemployment rate is given by* $u_{ss} = \delta n/(p(\theta_{ss}) + \delta)$ *and implies* $\ell_{ss} = p(\theta_{ss})n/(\delta + p(\theta_{ss}))$;

[3] Whether or not this cost is paid by the firm or skilled workers is a modelling choice. In this case, it is inconsequential since skilled workers receive the firm's dividends.

3. *Given θ_{ss} and v_{ss}, the steady state value of unemployment is*

$$\mathcal{U}_{ss} = \frac{b}{1-\beta} + \frac{1}{1-\beta}\frac{\varphi}{1-\varphi}\frac{p(\theta_{ss})}{\beta q(\theta_{ss})}c_v(v_{ss}); \tag{8}$$

4. *Given the set of endogenous aggregate variables, the steady state wages are defined by Equations (5) and (6) with $h = h_{ss}$, $\ell = \ell_{ss}$ and $\mathcal{U} = \mathcal{U}' = \mathcal{U}_{ss}$;*

5. *Given the set of endogenous aggregate variables and wage functions, the set of value functions satisfy*

$$\begin{aligned}(1-\beta)\mathcal{J}_{ss}(h_{ss},\ell_{ss}) &= f(h_{ss},\ell_{ss}) - x(h_{ss},\ell_{ss})h_{ss} - w(h_{ss},\ell_{ss})\ell_{ss} - c(v_{ss})\\ (1-\beta(1-\delta))\mathcal{V}_{ss}(h_{ss},\ell_{ss}) &= w_{ss}(h_s s,\ell_{ss}) + \delta\beta\mathcal{U}_{ss}\\ (1-\beta)\mathcal{W}_{ss}(h_{ss},\ell_{ss}) &= x_{ss}(h_{ss},\ell_{ss}) + (1-\beta)\mathcal{J}_{ss}(h_{ss},\ell_{ss})/h_{ss};\end{aligned}$$

6. *Given θ_{ss}, v_{ss} and $\mathcal{J}_{ss}$, optimal vacancy posting condition Equation (4) holds and can be written as*

$$\pi_\ell(h_{ss},\ell_{ss}) = \frac{(1-\beta(1-\delta))}{\beta}\frac{c_v(v_{ss})}{q(\theta_{ss})}. \tag{9}$$

The computation of the steady state equilibrium involves finding the value of θ_{ss} that satisfies Equation (9), noting that both ℓ_{ss} and v_{ss} are functions of θ_{ss}, and that skilled employment is exogenously given by $h_{ss} = \chi$.

Proposition 2. *If Assumption 1 holds, then a steady state exists and is unique.*

Proof. See Appendix A. □

Definition 1 merits a brief discussion. Throughout the analysis, I consider two types of labor regulation: one that increases the cost of posting vacancies $c(\cdot)$, and another that raises the bargaining power of unskilled workers φ. First, note that condition 2 in Definition 1 implies that both employment ℓ_{ss} and vacancies v_{ss} increase with market tightness θ_{ss}. According to Equation (9), an increase in the cost of posting vacancies leads to a lower steady-state market tightness.[4] The effect of this change on the value of unemployment is ambiguous: a larger pool of unemployed workers and fewer vacancies reduce the probability of matching, but at the same time, the lower market tightness may reduce vacancy posting costs, thereby increasing firm profits and potentially raising the surplus shared with employed workers. This ambiguity carries over to the wages and value of unskilled workers. In contrast, the wage of skilled workers unambiguously decreases due to the lower demand for unskilled labor, which reduces their marginal product. However, because the effect on firm value is ambiguous, the overall impact on the value of skilled workers remains uncertain.

Similarly, an increase in the bargaining power of unskilled workers raises their outside option and negotiated wages, which in turn leads to higher unemployment and lower market tightness in the steady state. As discussed above, the resulting decrease in market tightness has an ambiguous effect on the welfare of both skilled and unskilled workers. Therefore, the qualitative analysis of the model does not allow us to clearly identify winners and losers from stricter labor regulation. In the next section, I calibrate the model to quantify these effects and determine which groups benefit or are harmed under relevant parameter values.

Numerical Analysis To quantify the model, I assume a constant elasticity of substitution production function

$$f(h, \ell) = z[\gamma h^{\rho} + (1-\gamma)\ell^{\rho}]^{\frac{1}{\rho}}, \tag{10}$$

where $0 < \rho < 1$ determines the elasticity of substitution $\sigma = 1/(1-\rho)$ and the positivity restriction is imposed to ensure that the inputs are substitutes. Following Acemoglu and Hawkins (2014), I assume

$$c(v) = 0.5\tau v^2,$$

[4]The proof of Proposition 2 in Appendix A shows that $q(\theta_{ss})\pi_{\ell}(h_{ss}, \ell_{ss})$ is strictly decreasing in θ_{ss}.

where τ is the exogenous cost of posting a vacancy. Finally, I follow the literature on search frictions setting

$$m(u, v) = \zeta u^{\eta} v^{1-\eta}.$$

Proposition 3. *The production function (10) satisfies Assumption 1*

Proof. See Appendix A. □

The quantification of the model assumes a model period of one month and defines skilled workers as college graduates. I set the monthly discount factor $\beta = 0.997$, which is consistent with an annual interest rate of 4%. The production function parameter $\rho = 0.3827$, consistent with an aggregate elasticity of substitution between college and high-school equivalents equal to 1.64, as estimated by Autor, Katz and Kearney (2008). The elasticity of substitution in the matching function η and workers' bargaining power φ are both set to 0.72, following Shimer (2005). As in Acemoglu and Hawkins (2014), I set the present value of $b/(1 - \beta)$ to 40% of the steady state value of unemployment. The monthly separation rate of unskilled workers is set to $\delta = 0.032$, following Wolcott (2021). The efficiency of the matching function $\zeta = 0.5635$ is calibrated to match an average historical unemployment rate of non-college graduates of 3.6% in the US, and the relative productivity of college graduates $\gamma = 0.73$ is chosen to match a college wage premium of 1.97, consistent with Acemoglu and Autor (2011). The share of skilled workers is set to $h = 0.33$, reflecting the share of college graduates in the US labor force in 2007. Finally, productivity is set to $z = 3.467$ and the exogenous cost of posting a vacancy to $\tau = 6.462$, in order to normalize the steady state market tightness to one and $(1 - \beta)\mathcal{U} = 1$.

The first numerical exercise analyzes the response of each worker type's welfare to changes in the exogenous cost of posting a vacancy, τ. Figure 3 shows that the welfare of both worker types declines as τ increases, although the decline in skilled workers' welfare is much smaller compared to that of unskilled workers. The value of the firm increases due to higher profits driven by a larger pool of unemployed workers. Doubling the cost of posting a vacancy raises equilibrium unemployment by approximately 0.5 percentage points. The resulting decrease in unskilled employment reduces unskilled wages, offsetting the increase in firm value. Notably, unskilled wages rise despite a decline in the outside option, as their average marginal product increases.

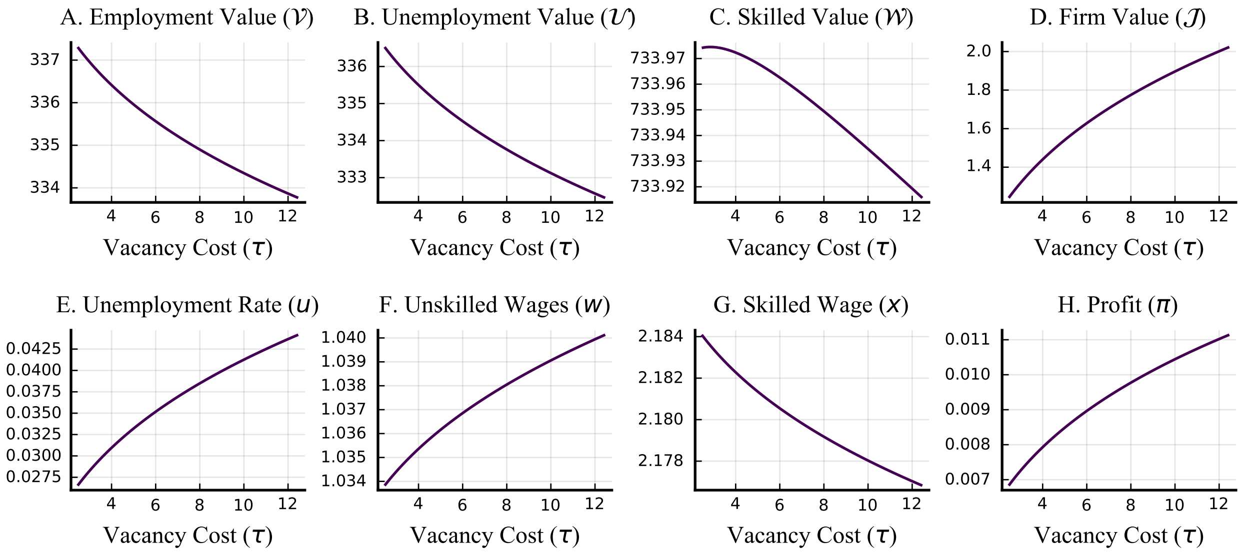

Figure 3: **Response of steady state variables to changes in the exogenous cost of posting a vacancy.**

It is important to note that unskilled employed workers experience a welfare loss as τ increases, due to the reduced value of unemployment, which outweighs the gain in wages. This effect arises from the interaction between the separation rate and the discount factor. When the probability of becoming unemployed is lower or when workers discount the future more heavily, wages play a larger role in determining the welfare of unskilled workers.

Figure 4 shows the response of the same variables to changes in the bargaining power φ. The variables are much more sensitive to changes in φ. An increase in φ from 0.72 to 0.8 raises the unemployment rate by 0.4 percentage points. The values of both employed and unemployed unskilled workers increase by about 6.9%, since, once again, the probability of being unemployed outweighs current wages. In contrast, the firm's value decreases due to lower profits resulting from higher wages. This effect, combined with the reduction in skilled labor wages, causes the value of skilled workers to decrease by 6.5%.

Overall, the analysis above suggests that identifying winners and losers from labor regulation depends critically on the type of regulation considered. Labor regulations that increase workers'

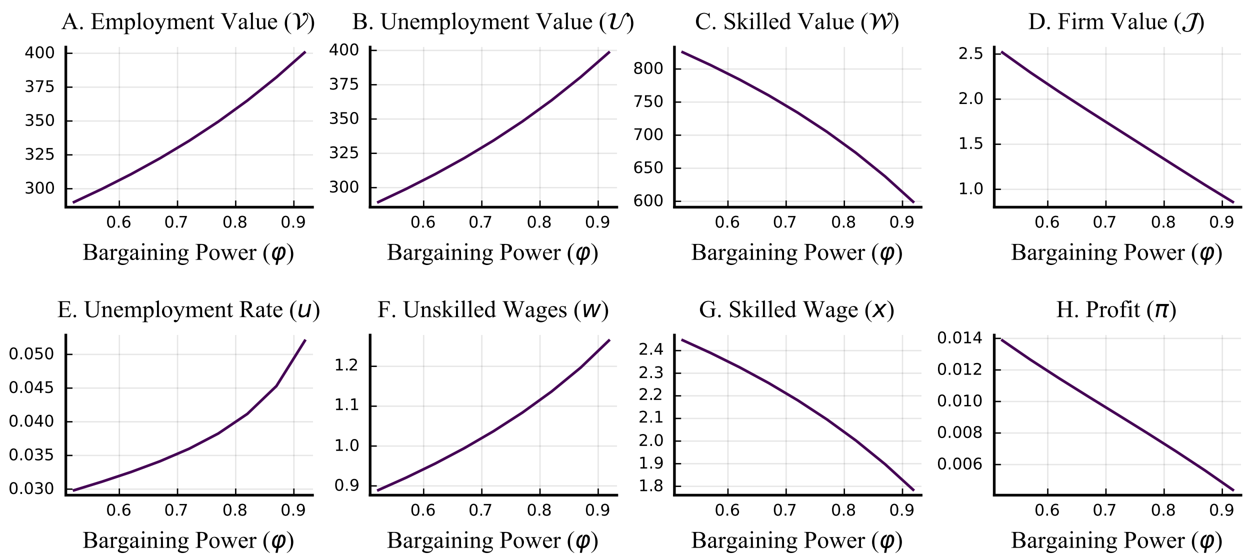

Figure 4: **Response of steady state variables to changes in the unskilled workers bargaining power.**

bargaining power—such as laws enabling union organization—provide greater benefits to unskilled workers but impose larger costs on skilled workers. Importantly, even unskilled workers can be harmed by labor regulations that raise hiring costs, despite experiencing higher wages. Another key insight from the numerical exercise is that, in the steady state, the welfare of employed unskilled workers is largely driven by their risk of becoming unemployed. This raises the important question of how much individuals weigh long-run outcomes when deciding on labor regulation.

4 Empirical evidence

Sections 2 and 3 provide suggestive evidence and theoretical foundations linking labor regulation to the share of skilled workers in the economy. However, establishing a causal interpretation of this relationship requires further analysis. While Figure 2 reveals a strong positive correlation between the share of skilled workers and the strictness of labor regulation, this association may be driven by omitted factors such as the level of economic development or institutional quality—despite the reduced sample being restricted to a relatively homogeneous set of countries.

One possible approach would be to extend the quantification of the model and examine whether it can replicate the patterns observed in Figure 2. However, I refrain from pursuing this path for two reasons. First, there is no straightforward way to link the model's labor regulation parameters to the labor regulation index used in Gwartney et al. (2017). Second, and more importantly, a rigorous model of how societies determine the level of labor regulation is necessary. Such a model would require strong assumptions about the aggregation of individual preferences and the trade-offs between long- and short-run benefits in the political process of voting or lobbying for labor regulation, which are crucial for a meaningful quantitative analysis.

Instead, I pursue the causal estimation of the proposed relationship using an instrumental variable approach. I exploit the effects of the epidemiological transition, as studied by Acemoglu and Johnson (2007), on the share of skilled workers. Specifically, countries that experienced larger mortality reductions during the transition tended to have slower increases in the share of skilled workers afterward. This relationship was also examined in Cervellati and Sunde (2015).

My goal is to estimate α_2 in the following linear regression model:

$$\text{Labor Regulation}_{i,t} = \alpha_0 + \alpha_1 \text{Labor Regulation}_{i,t-1} + \alpha_2 \text{Share of Skilled Workers}_{i,t-1} + \varepsilon_{i,t}, \quad (11)$$

where i indexes countries and t indexes time periods. The error term $\varepsilon_{i,t}$ is likely correlated with the share of skilled workers, making the OLS estimator of α_2 biased. Below I discuss the Two-Stage Least Squares (2SLS) estimation. The reduced-form theory behind the regression equation assumes that labor regulation is somewhat persistent, depending on the coefficient α_1, and that it depends on the lagged values of the share of skilled workers. Implicitly, this setting assumes that the change in labor regulation depends on the initial share of skilled workers, considering that regulatory changes do not take place continuously over time.

Health Shocks and the Share of Skilled Workers Improvement in life expectancy is a well-documented fact of the twentieth century. Important medical innovations in the 1940s played a crucial role in the eradication of many diseases worldwide (Acemoglu and Johnson, 2007). Nonetheless, these improvements were heterogeneous across countries, depending on the levels and causes of mortality prior to the health interventions. I use the same variable proposed by Acemoglu and Johnson (2007) as an instrument for improvements in health, namely, the *predicted mortality* defined as

$$M_{i,t}^{I} = \sum_{d \in \mathcal{D}} \left[(1 - I_{d,t}) M_{di,1940} + I_{dt} M_{dF,t} \right],$$

where $\mathcal{D}$ is the set of 15 killer diseases whose treatments improved after the 1940s.[5] The term $M_{di,1940}$ is the mortality from disease d in country i in year 1940, $I_{d,t}$ is a binary variable that takes value one if there was a medical intervention for disease d and $M_{dF,t}$ is the mortality from disease d in the "frontier" country, i.e., the country with lower mortality from that disease

The connection between health improvements and the share of skilled workers finds support in the literature since these improvements did not spread evenly among populations. Individuals with higher education levels were more likely to provide healthy environments and afford treatment for their children (Castelló-Climent and Doménech, 2008). Therefore, individuals in households with less educated mothers must have experienced higher increases in survival rates. As stressed by Doepke (2005), extended versions of Barro and Becker (1989) predict that increases in survival rates lead to increases in the number of surviving children. Consequently, given that low-skilled parents are less likely to educate their offspring (Kremer and Chen, 2002; Moav, 2005), countries that experienced higher improvements in life expectancy should have a higher share of low-skilled individuals.

Figure 5 speaks to this point. It shows that countries that benefited the most from mortality reductions — measured by larger reductions in predicted mortality — between 1940 and 1980 experienced lower increases in the share of skilled workers during the same period. Moreover, the R^2 of this relationship is 0.18. Since this relationship was previously studied by Cervellati and Sunde (2015), I do not present complete regression tables here, except for the first-stage regressions in Appendix B.

However, I extend the previous results found in the literature to investigate the dynamics of the

[5] The diseases are tuberculosis, malaria, pneumonia, influenza, cholera, typhoid, smallpox, whooping cough, measles, diphtheria, scarlet fever, yellow fever, plague, typhus fever, and dysentery/diarrhea-related diseases. See Acemoglu and Johnson (2007) for details.

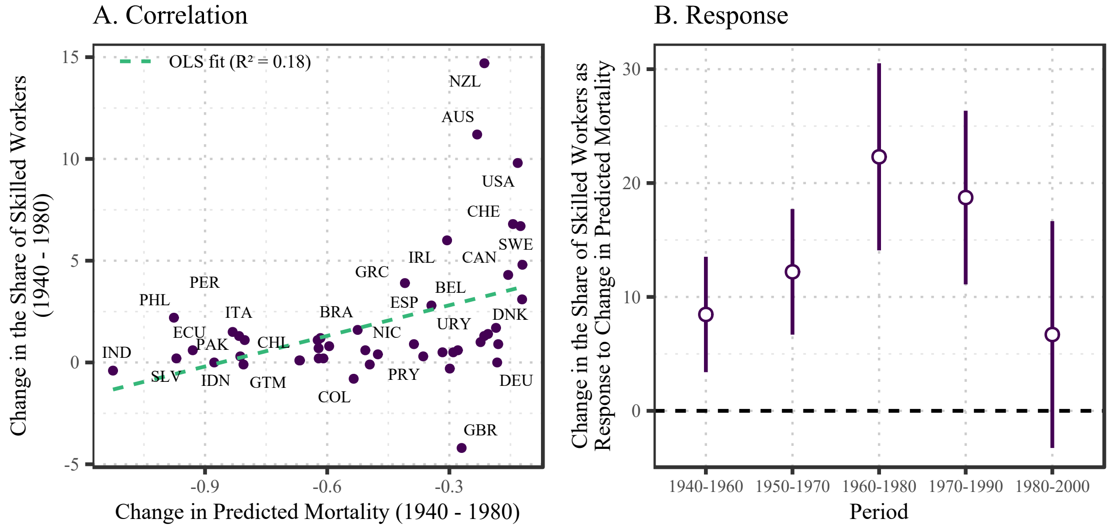

Figure 5: **Health improvements and change in the share of skilled workers.** Share of skilled workers are defined as the share of individuals between 25 and 65 years of age with at least secondary education from Lee and Lee (2016). Predicted mortality is defined as in Acemoglu and Johnson (2007).

effect of health improvements on the share of skilled workers. Specifically, I restrict attention to the change in predicted mortality from 1940 to 1960 and observe its effect on the change in the share of skilled workers during successive 20-year intervals between 1940 and 2000. The estimated coefficients together with 95% confidence intervals are presented in Figure 5B. Recall that a smaller change in predicted mortality corresponds to greater health benefits. Although the coefficients are positive and statistically significant in the first two 20-year intervals (1940–1960 and 1950–1970), the effect is much larger in the third interval (1960–1980). This is expected because the connection between health improvements and the share of skilled workers likely operates through higher fertility of unskilled workers, meaning it takes a couple of decades for these newborn cohorts to enter the labor market. In the subsequent decades, the effect weakens, and in the final interval (1980–2000), it is no longer statistically significant.

Two-Stage Least Squares (2SLS) The timing between health improvements and their effects on the share of skilled workers discussed above imply the following first-stage regression:

$$\text{Share of Skilled Workers}_{i,t} = \varsigma_0 + \varsigma_1 \text{Predicted Mortality}_{i,t-1} + \nu_{i,t}, \tag{12}$$

which together with the second stage regression in Equation (11) imply the 2SLS estimator of α_2. The error term is denoted by $\nu_{i,t}$.

Note that we need three time periods to estimate the coefficient. For many countries in the full sample we will have labor regulation information in 1990 and 2010 together with the share of skilled workers in 1990 and the predicted mortality in 1970. Although this is enough, it is not sufficient to obtain within country estimates, which is key to spurge the influence of time-invariant omitted variables from the error term. In this case, I rely on the reduced sample which contain information about regulation in three years 1970, 1990, and 2010.

The causal interpretation of α_2 relies on the two identifying assumptions that predicted mortality is correlated with the share of skilled workers and that it is not correlated with any other omitted variables in $\varepsilon_{i,t}$. The inclusion restriction (the former assumption) holds given our previous discussion about the correlation between health improvement and the share of skilled workers. Moreover, first-stage estimates using the final samples are presented in Table B.1. To argue in favor of the exclusion restriction (the latter assumption), one must ask what other effects the health improvement had. We know from Acemoglu and Johnson (2007) that there was not significant improvement in GDP per capita ruling out development as a confounding factor. Also from Acemoglu and Johnson (2007) we know that population and number of births increased, but that is likely part of the mechanisms I am studying since it leads to the smaller shares of skilled workers. Thus, unless health itself could cause changes in labor regulation, there is no obvious reason to reject the exclusion restriction.

The results are presented in Table 1 for two different measures of skilled labor. In Panel A, I define skilled workers as those who have completed at least secondary education, while in Panel

B, I consider only those who have completed college. Each panel contains four columns. Columns (1) and (2) use the full sample with baseline years 1970 and 1990, respectively. The baseline refers to the year in which the share of skilled workers is measured. Labor regulation is measured 20 years later, and predicted mortality is measured 20 years earlier, as previously discussed. In the full sample, only half of the countries have data for both baseline years; hence, I cannot include fixed effects. Columns (3) and (4) include fixed-effect controls, which reduces the sample to 20 countries. Columns (2) and (4) present 2SLS estimates, using predicted mortality as an instrument for the share of skilled workers.

Table 1: **Skills and labor regulation**

	(1)	(2)	(3)	(4)
Panel A: Secondary Complete				
Dependent Variable: Labor Regulation				
Share of Skilled Workers	-0.0407***	-0.0818***	-0.0752***	-0.1234***
	(0.0066)	(0.0060)	(0.0089)	(0.0155)
Country Fixed Effect			✓	✓
Observations	60	60	40	40
Countries	40	40	20	20
First-Stage F Stat.		83.586		22.518
Panel B: College Complete	(1)	(2)	(3)	(4)
Dependent Variable: Labor Regulation				
Share of Skilled Workers	-0.1318***	-0.3609***	-0.2228***	-0.4091***
	(0.0261)	(0.0329)	(0.0426)	(0.0904)
Country Fixed Effect			✓	✓
Observations	60	60	40	40
Countries	40	40	20	20
First-Stage F Stat.		76.229		19.054

Notes: Robust standard errors are reported in columns (1) and (2) of both panels, while standard errors are clustered at the country level in columns (3) and (4). Panel A defines skilled workers as individuals who have completed at least secondary education, whereas Panel B considers skilled workers to be those who have completed college. All columns control for the initial level of labor regulation. Columns (1) and (2) in both panels include all countries in the sample. Countries in the reduced sample appear twice—once with final labor regulation measured in 2010 and once with final labor regulation measured in 1990. Columns (3) and (4) in both panels include only countries from the reduced sample. Columns (2) and (4) in both panels report 2SLS estimates, using predicted mortality as an instrument for the share of skilled workers. $^{*}p < 0.05,^{**} p < 0.01,^{***} p < 0.001$

Estimations indicate a negative relationship between the share of skilled workers and the strictness of labor regulation corroborating with the correlation depicted in Figure 2. Standard errors are fairly small indicating precise estimates significant at 99.9% confidence interval. The first-stage F statistics are above the common rule-of-thumb of 10 suggesting small bias from the 2SLS estimation. Thus, column (4), which adds fixed effect controls and 2SLS estimation, must deliver more reliable estimates. They show that an increase of 1 percentage point in the share of skilled workers is associated with a decrease of 0.123 in the labor regulation index, which is about 3% of the average regulation index. Thus, a country with an increase in the share of skilled labor from 68% to 85.4%, like the US between 1970 and 1990, could expect a decrease in the labor regulation index of about 2.1. This value is about one third of the magnitude when measuring the share of skilled workers using those with college degree.

The results above suggest that the correlation depicted in Figure 2 and the theory studied in Section 3 find support in the data. Given the losses of skilled workers due to more stringent regulation, they are more likely to support changes in the regulation, moving regulation towards pro-market laws.

5 Conclusion

This paper investigates the heterogeneous effects of labor regulation on different types of workers, emphasizing the role of skill composition in the economy. Through a quantitative model calibrated to U.S. data, I show that increases in labor market frictions, such as higher costs of posting vacancies, disproportionately harm unskilled workers' welfare, mainly due to increased unemployment risk. Conversely, labor regulations that enhance workers' bargaining power tend to benefit unskilled workers but impose costs on skilled workers by reducing firms' profitability and skilled wages. These results underscore the importance of distinguishing between types of labor regulation when evaluating their welfare implications across worker groups.

Building on this theoretical framework, I explore the empirical relationship between labor regulation and the share of skilled workers across countries. Using predicted mortality as an instrument for skill share, I provide evidence that countries with larger share of high-skilled workers tend to have less stringent labor regulations. The instrumental variable approach addresses endogeneity concerns and supports the causal interpretation that changes in labor regulation are related to shifts in the skill composition of the workforce. These findings complement the theory by suggesting that skilled workers, who lose from stricter labor regulation, may be politically motivated to push for more market-friendly reforms.

Appendix A Omitted Proofs

Proposition 1 The proposition states that if $\lim_{\ell\to 0}\ell^{-\frac{1}{\varphi}+1}\int_0^\ell \lambda^{\frac{1}{\varphi}-1}f_\ell(h,\lambda)d\lambda = 0$, then equilibrium wages are

$$x(h,\ell) = f_h(h,\ell) - \ell^{-\frac{1}{\varphi}+1}\int_0^\ell \lambda^{\frac{1}{\varphi}-1}f_{\ell h}(h,\lambda)d\lambda$$
$$w(h,\ell) = (1-\varphi)(\mathcal{U}-\beta\mathcal{U}') + \ell^{-\frac{1}{\varphi}}\int_0^\ell \lambda^{\frac{1}{\varphi}-1}f_\ell(h,\lambda)d\lambda.$$

Proof. Since the choice of h does not require vacancy post, the optimal choice is $\pi_h(h,\ell) = 0$. Moreover, assuming v^* as solution for Equation (4), we can write

$$\mathcal{J}_\ell(h,\ell) = \pi_\ell(h,\ell) + \beta(1-\delta)\mathcal{J}_\ell(h',\ell') + \Big[\beta q(\theta)\mathcal{J}_\ell(h,\ell) - c_v(v^*)\Big]v^*_\ell,$$

where the last term equals zero from Equation (4). The equation above together with Section 3 and Equation (2) implies $\varphi\pi_\ell = (1-\varphi)[w(h,l) - (\mathcal{U}-\beta\mathcal{U}')]$. Thus, the equilibrium wages are the solution to the following uncoupled system of partial differential equations:

$$x(h,\ell) = f_h(h,\ell) - w_h(h,\ell)\ell$$
$$w(h,\ell) + \varphi w_\ell(h,\ell)\ell = \varphi f_\ell(h,\ell) + (1-\varphi)(\mathcal{U}-\beta\mathcal{U}').$$

Note that the second equation can be rewritten as

$$\frac{\partial(\varphi w\ell^{1/\varphi})}{\partial\ell} = \varphi f_\ell(h,\ell)\ell^{\frac{1}{\varphi}-1} + (1-\varphi)(\mathcal{U}-\beta\mathcal{U}')\ell^{\frac{1}{\varphi}-1},$$

which integrating both sides gives

$$w(h,\ell) = (1-\varphi)(\mathcal{U}-\beta\mathcal{U}') + \ell^{-\frac{1}{\varphi}}\left[\int_0^\ell \lambda^{\frac{1}{\varphi}-1}f_\ell(h,\lambda)d\lambda + \xi\right],$$

where ξ is a constant of integration. If $\lim_{\ell\to 0} w(h,\ell)\ell = 0$, which is satisfied if

$$\lim_{\ell\to 0} \ell^{-\frac{1}{\varphi}+1} \int_0^{\ell} \lambda^{\frac{1}{\varphi}-1} f_\ell(h,\lambda)d\lambda = 0,$$

then $\xi = 0$ and we find Equation (6). Equation (5) is obtained by differentiating Equation (6) with respect to h and substituting into the first equation of the system. □

Proposition 2 The proposition states that the economy has a unique steady state.

Proof. First, I show that the left-hand side of Equation (9) decreases as θ_{ss} increases and goes to infinity as θ_{ss} goes to zero. Use the wages equations Equations (5) and (6), the profit function can be written as

$$\pi_\ell(h_{ss},\ell_{ss}) = (1-\varphi)[\Psi(h_{ss},\ell_{ss}) - (1-\beta)\mathcal{U}_{ss}],$$

where I define

$$\Psi(h_{ss},\ell_{ss}) = \frac{1}{\varphi}\ell_{ss}^{-\frac{1}{\varphi}} \int_0^{\ell_{ss}} \lambda^{\frac{1}{\varphi}-1}[f_\ell(h_{ss},\lambda) - f_{\ell h}(h_{ss},\lambda)h_{ss}]d\lambda.$$

One can show that

$$\Psi_\ell(h_{ss},\ell_{ss}) = \\ \frac{1}{\varphi^2}\ell_{ss}^{-\frac{1}{\varphi}-1} \int_0^{\ell_{ss}} \lambda^{\frac{1}{\varphi}-1}\Big[(f_\ell(h_{ss},\ell_{ss}) - f_{\ell h}(h_{ss},\ell_{ss})h_{ss}) - (f_\ell(h_{ss},\lambda) - f_{\ell h}(h_{ss},\lambda)h_{ss})\Big]d\lambda,$$

is negative as long $f_\ell(h_{ss},\ell) - f_{\ell h}(h_{ss},\ell)h_{ss}$ decreases as ℓ increases and hence $\pi(\cdot,\cdot)$ is strictly concave in the second argument. Moreover, applying L'Hôpital's rule

$$\lim_{\ell_{ss}\to 0} \varphi\Psi(h_{ss},\ell_{ss}) = \lim_{\ell_{ss}\to 0} f_\ell(h_{ss},\ell_{ss}) - f_{\ell h}(h_{ss},\ell_{ss})h_{ss} = \infty,$$

where the second equality holds because $\lim_{\ell_{ss}\to 0} f_{\ell h}(h_{ss},\ell_{ss}) < \infty$. Thus, $\lim_{\ell_{ss}\to 0} \pi(h_{ss},\ell_{ss}) > 0$. Because the relationship between ℓ_{ss} and θ_{ss} is positive, $\pi_\ell(h_{ss},\ell_{ss})$ is strictly decreasing in θ_{ss}.

Moreover, since $\theta_{ss} \to 0$ implies $\ell_{ss} \to 0$, $\pi_\ell(h_{ss}, \ell_{ss}) \to 0$ as $\theta_{ss} \to 0$.

The right-hand side goes to zero as θ_{ss} goes to zero because $\theta_{ss} \to 0$ implies $v_{ss} \to 0$, $\lim_{v\to 0} c_v(v) = 0$ and $q(\theta_{ss})$ is bounded above. Since the relationship between v_{ss} and θ_{ss} is positive and $c(\cdot)$ is strictly convex, the right-hand side of Equation (9) is strictly increasing in θ_{ss}. □

Proposition 3 The proposition states that

$$f(h,\ell) = z[\gamma h^\rho + (1-\gamma)\ell^\rho]^{\frac{1}{\rho}} \quad \text{with} \quad 0 < \rho < 1,$$

satisfies Assumption 1.

Proof. It will be helpful to define

$$\kappa_h := \frac{\gamma h^\rho}{\gamma h^\rho + (1-\gamma)\ell^\rho} \quad \text{and} \quad \kappa_\ell := \frac{(1-\gamma)\ell^\rho}{\gamma h^\rho + (1-\gamma)\ell^\rho},$$

and note that

$$f_h = \kappa_h f/h > 0; f_\ell = \kappa_\ell f/\ell > 0; f_{\ell h} = f_{h\ell} = (1-\rho) f_h f_\ell / f > 0; f_{\ell\ell} = (1-\rho)(1-\kappa_\ell) f_\ell/\ell < 0,$$

where I omit the dependency on h and ℓ to simplify notation.

1. Applying L'Hôpital's rule

$$\lim_{\ell\to 0} \ell^{-\frac{1}{\varphi}+1} \int_0^\ell \lambda^{\frac{1}{\varphi}-1} f_\ell d\lambda = \lim_{\ell\to 0} \frac{\varphi}{1-\varphi} \ell f_\ell = \lim_{\ell\to 0} \frac{\varphi}{1-\varphi} \kappa_\ell f = 0.$$

2. One can show

$$\frac{\partial(f_\ell - f_{\ell h} h)}{\partial \ell} = [1 - (1-\rho)(1-\kappa_\ell) - \rho\kappa_\ell] f_{\ell\ell},$$

which is negative if $\rho > (2\rho - 1)\kappa_\ell$. For $\rho \leq 0.5$ the condition is satisfied since $\kappa_\ell \geq 0$. If $\rho > 0.5$, $\rho < 1$ is a sufficient condition since $\kappa_\ell \leq 1$.

3. Note that

$$\lim_{\ell \to 0} f_\ell - f_{\ell h} h = \lim_{\ell \to 0} (1 - (1-\rho)\kappa_h) f_\ell = \infty.$$

□

Appendix B Omitted Tables

Table B.1: **First-Stage Regression**

	Secondary Complete		College Complete	
	(1)	(2)	(3)	(4)
Dependent Variable: Share of Skilled Workers				
Predicted Mortality	-1.844***	-1.258***	-0.4177***	-0.3793***
	(0.2017)	(0.2650)	(0.0478)	(0.0869)
Country Fixed Effect		✓		✓
Observations	60	40	60	40
Countries	40	20	40	20
First-Stage F Stat.	83.586	22.518	76.229	19.054

Notes: Robust standard errors in columns (1) and (3). Standard errors clustered at the country's level in columns (2) and (4). Columns (1) and (2) define skilled worker as individuals that complete at least the secondary education. Columns (3) and (4) consider skilled workers as individuals the completed college. All columns control for the initial level of labor regulation. ${}^{*}p < 0.05, {}^{**}p < 0.01, {}^{***}p < 0.001$

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