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Abstract

Over the past decades several governments have implemented similar labor reforms by increasing the flexibility of hiring unskilled temporary workers, but leaving the skilled workers under the protection of the indefinite-term contract. This paper argues that this type of partial reform may lead to dampened effects and unintended consequences. To assess this argument, I examine and compare the effects of two different types of partial reform in the context of the framework of Hopenhayn and Rogerson (1993). In addition to workers' heterogeneity in skill, my model considers the search frictions and workers' decision on labor market participation. The numerical results indicate that reducing the employment protection legislation (EPL) on unskilled workers brings about small effects on improving output, productivity, and welfare, though reducing the income inequality. In comparison, reducing the EPL of skilled workers significantly improves the conditions of macroeconomic aggregates.

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1 Introduction

Policymakers have been viewing liberalizing the labor market—through easing the use of temporary contracts or reducing the employment protection legislation (EPL)—as the panacea to improve labor market performance and revive macroeconomic activities. By reducing firms' labor adjustment cost, this type of policy reform encourages firms to hire new workers, even in the face of uncertainty; on the other hand, it also induces firms to fire unneeded workers, allowing production factors to be allocated more efficiently. The overall effects lead to a rise in firms' productivity and output.

In theory, there is consensus on the above-mentioned benefits, but in practice, there are doubts about its effectiveness and fairness. When it comes to the practical implementation, the labor reform is usually shaped into a type of partial reform. That is, not all but only a specific group of workers' employment conditions are altered. For instance, as argued in previous studies, there exists discrepancy in the employment conditions of the newly hired workers and currently employed workers. The partial reform leads to a two-tier labor market, which comes with myriad social and economic problems. (Blanchard and Landier (2002), Saint-Paul (2002) and Bentolila *et al.* (2012))

In this study I follow this strand of this study to revisit the question: how good (bad) a partial reform is. In contrast with previous studies, I explore the effects of a skill biased reform, whose influences only placed a specific skill group of workers (for instance, workers with the college degree). For instance, when the government eases the restrictions on the use of temporary contracts, evidence suggest that these temporary contracts are usually used for the employment of unskilled workers. For the skilled workers, however, their employments remain protected by the permanent contracts.[1]

Under this situation, we may have to consider the following possibilities:

1. Since skilled and unskilled workers make different contributions in production, the policy effects of a reform that targets to liberalize the employment of unskilled workers will be different from the policy effects of another policy that targets to skilled workers.

2. Because the influences of on turnovers, flows, and wages across workers' types are different, a policy reform may generate considerable distribution effects.

These concerns imply that a skilled biased partial reform may lead to not only dampened effects but also unintended consequences. To explore this argument, I construct a theoretical

[1]the permanent contracts: the open-ended contracts subject to mandatory payments. Evidence: In Belot *et al.* (2007) Table 1 shows that in most countries the share of temporary jobs among those with a high education is substantially lower than among those with a low education. Other studies include: Gebel and Giesecke (2011)Kahn (2007))

model. Using the calibrated model, I conduct simulations to quantitatively assess the effects of skill-biased partial reforms.

My model is on the basis of the framework developed by Hopenhayn and Rogerson (1993), which provides an environment to study the extent to which the distortions in production in the presence of firing cost. I incorporate workers' heterogeneity by embedding the Krusell *et al.* (2000) style capital-skill complementary production function. This function specifically characterizes the role of each production factors—including skilled and unskilled workers, and two types of capital—and the relationship (substitutability) among them. We can thus explore how the distortion might be amplified (or alleviated) by these factors.

The model considers both the search frictions and workers' labor market participation decision. While the participation decision is often abstracting from the flow approach to modeling labor markets, it is crucial in studying the policy effects on labor market outcomes. As Pries and Rogerson (2009) suggests based on cross country data, that "differences in labor market participation are often larger than differences in unemployment rates". This large difference may be caused by the labor policy. Moreover, by considering labor market participation decision, the model prediction on policy effects precludes the case Ljungqvist (2002) suggests, that those three major frameworks' predictions on the policy effect hinges on each models' assumption on the labor market structure. In my model's setting, the worker's decision on market participation, one of the key element determining the policy effects, are responsive to the equilibrium wage, probability of being dismissed, and the severance payment, all of which are affected by policy.

When using simulations to conduct policy experiment, I consider two types of partial reform: (1)A reform that reduces only firms' firing cost of the unskilled worker, keeping skilled workers' firing cost remaining the same (henceforth, L-reform), and (2)A reform that reduces the firing cost of the skilled worker, keeping unskilled workers' firing cost remaining the same (henceforth, H-reform). In practice, it may be unusual to see a labor reform explicitly aiming at a specific skill group. But a skill biased reform may occur under the influence of labor provision or due to firms' response to the reform. For instance, the temporary contracts are usually restricted to the employment of the young and the long-term unemployed, while a large share of this group members is unskilled. Another situation is that firms tend to use the *inferior* temporary contract, which provides less job security, to hire those less competitive unskilled workers but use the permanent contract for those skilled workers. Thus we can categorize as follows: a policy that eases the use of temporary contract can be regard as an L-reform, while a policy that reduces the employment protection for permanent employees—most likely reduces the skilled workers' firing cost—is equivalent to

an H-reform.[2]

The main findings are as follows: (1) Both reforms increase aggregate output and firms' productivity, due to a more efficient allocations of production factors. More efficient production and less labor adjustment cost also make wages to rise. Since the effects on wages are strong, even though reforms lead to a higher probability of being dismissed, workers' welfare and job participations rate still increase. Moreover, there is an interesting pattern, that both reforms generate the strongest positive effects when the labor market is sclerotic. Those effects, however, are diminishing. The benefits turn to be negligible when the EPL is moderate. (2) Both reforms do not necessarily raise the employment. The combined effects of the increases in workers' labor participate rates and firms' firing rates constitute an interesting equilibrium outcome: In a labor market with strong EPL, the reform tends to increase the aggregate employment; but if the EPL are initially moderate in the labor market, the reform may reduce the aggregate employment. (3) Comparing both reform, I find that the positive effects on output, productivity, employment and welfare of H-reform is more than four times that of the L-reform. On the other hand, because H-reform raises skilled workers' wages, it intensifies the income inequality. And for the same reason, L-reform reduces the income inequality.

These finding concludes two important policy implications. First, a reform is most effective when conducted in a sclerotic labor market caused by strong EPL and high labor firing cost. Second, a H-reform, the reform that aims to reduce skilled workers' firing cost, can lead to stronger favorable effects.

Related literature This study extends the analysis of the literature that explores the effects of a partial labor reform—mostly implemented through the liberalization of temporary contracts. The core idea is that this type of reform divides the labor market into two tiers: the currently employed workers and the newly hired workers. The difference of these two groups lies in the contract type. The focus are mainly centering on the labor market performance and workers welfare. (Saint-Paul (2002), Cahuc and Postel-Vinay (2002), Blanchard and Landier (2002), Belot *et al.* (2007) and Faccini (2014)) Blanchard and Landier (2002) explicitly points out that such partial reform generates perverse effects—higher unemployment rates and lower workers' welfare. This result is mainly caused by the high turn over rates and low payment of entry-level jobs (temporary employment) due to the labor reform.

[2]A good example of H-reform and L-reform is the experiences in Spain during the 80s and 90s. In the 80s, Spanish government initiated a series of policy reforms to liberalize the use of temporary contracts. Bentolila *et al.* (1994) report that unskilled workers are over-represented in this temporary employment. The reform during this period can be regarded as an L-reform. During the 90s, Spanish government conducted another reform, which intends to reduce the temporary employment by reducing the EPL of those permanent employed workers. This reform can regarded as H-reform. (See and Bentolila *et al.* (1994) for detail)

In contrast to these existing theoretical studies, this article provides an alternative view to explore the effects of skill biased labor reform. This perspective is motived by empirical evidence. As reported in several empirical studies, most reforms have generated unbalanced effects on skilled and unskilled workers. (Kahn (2007), Kahn (2010) and Gebel and Giesecke (2011)) Most of the temporary jobs are used to hire the unskilled workers. And as I have concluded from the numerical experiments, there indeed exists large discrepancy between two different types of partial reforms. Moreover, the model implies that most of the existing reforms (the L-reform) would fail to achieve its expected results.

The model's prediction on the negative effects of EPL on productivity is consistent with most of the empirical evidence. (eg:Jahn *et al.* (2012), Cappellari *et al.* (2012), Hirsch and Mueller (2012) total productivity Autor *et al.* (2007)) Regarding the effects of EPL on employment, empirical results are mixed. While our model also shows the possibilities of both positive effects and negative effects. In terms of inequality, our models that H-reform intensifies the inequality. This is consistent with Jahn *et al.* (2012) reported.

The paper is organized as follows: Section 2 describes the model economy and defines the equilibrium. Section 3 describes the calibration procedures, including the way of selecting the parameters. In section 4, I report the simulation results and the policy implications. Section 5 concludes.

2 The model

My model is built on the framework developed by Hopenhayn and Rogerson (1993).[3] The main feature of this class of models is the *resource misallocation* due to the adjustment cost. In the model firms (or establishments) reallocate their employment level in response to the idiosyncratic productivity shock each period. A dismissal cost leads firms to fire or hire less workers than they do in the environment without the dismissal cost, creating distortion in the allocations and reducing efficiency in aggregate level, such as jobs flow, employment, output and labor productivity.

The main concern of this study is to examine the impacts of a partial reform, a reform targeting to liberalizing the employment of a specific type of worker. Thus I incorporate workers' heterogeneity and explicit model their roles in the production. Moreover, to comprehensively look at the policy effects on labor market performance, a worker's decision on labor market participation and the search friction are both considered. For simplicity, we assume the interest rate is exogenously given. I will evaluate the policy effects focus on the stationary equilibrium, where, except for the interest rates, wages, allocations and

[3]My model also extends several settings in Alvarez and Veracierto (2001).

distributions of variables are endogenously determined.

2.1 Workers' problem

The economy is populated by a measure one of workers, categorized by two types: the skilled and the unskilled. The fractions of workers who are skilled ϕ and unskilled $1-\phi$ are exogenously given. Workers are risk neutral, with discount factor equal to β. In addition to skill level, each worker differs in their preference for working, characterized by a parameter b. Time is discrete. A worker's life expectancy is finite. Each period a worker may die with probability θ. Once a worker dies, he will be replaced by another new born worker with identical skill level and preferences.

A worker's objective is to maximize his expected lifetime value, by choosing whether or not to participate in the labor market. If a worker choose not to participate in the labor marker, he will receive b, derived from engaging in non-market activities (such as doing housework, or taking care of children). We assume b is drawn from an uniform distribution between $[0, B_i]$, $i \in [l, h]$. Hereafter the subscript h and l represent for the variables for the skilled and unskilled workers.

The labor markets are segregated by skill level. A worker can only participate in the labor market according to his skill level. For a type i worker ($i \in \{h, l\}$), once deciding to participating in the market, he starts from the unemployed state. Each period an unemployed worker may find a job with probability f_i, an exogenous job finding rate, and being employed. An employed worker receives wage w_i, determined in the market, in each period until separated from the job. A worker may separate from a job for two reasons: (1) he is fired by the firm (2) the firm dies. If fired by the firm, a worker receives a severance payments $\epsilon_i w_i$, representing ϵ_i periods of wage w_i.[4] In the latter situation, a worker receives nothing. After separating from the job, the worker transits to the unemployed state, until receiving another job offer.

A worker's value of being employed J_i and unemployed U_i are given by

$$J_i = w_i + \bar{\beta}\left\{d_e U_i + \kappa_i\left(\epsilon_i w_i + U_i\right) + (1 - d_e - \kappa_i) J_i\right\}, \tag{1}$$

$$U_i = \bar{\beta}\left\{f_i J_i + (1 - f_i) U_i\right\}. \tag{2}$$

where $\bar{\beta} = \beta(1-\theta)$, κ_i is the probability of a worker being fired by the firm and d_e is the probability firm dies. The probability κ_i and d_e will be further explained in firm's problem.

[4]Technically, this severance payment is a transfer from the government and is financed by a firing tax imposed on firms. This prevents a wage re-negations between firms and workers and the misallocation implied in the model issue will not occur. (See ... for detail)

A worker chooses whether or not to participate in the market by comparing the value from non-market activity $b/(1-\bar{\beta})$ and the expected value derived from labor market U. Therefore, there exits a threshold value b^*, such that a worker decides to participate in the labor market if his utility b is greater than b^*. Solving equation (1) and (2), we obtain

$$b_i^* = (1-\bar{\beta})U = \frac{\bar{\beta} f_i w_i \left(1+\bar{\beta}\kappa_i \epsilon_i\right)}{1-\bar{\beta}+\bar{\beta}(f_i+d_e+\kappa_i)}, \tag{3}$$

A worker's decision rule can be expressed as an indicator function *I(b)*. $I_p(b) = 1$ if $b > b^*$, and $I_p(b) = 0$ otherwise. The proportion of workers who participate in the labor market will be

$$Prob(b < b^*) = \frac{b_i^*}{B_i}. \tag{4}$$

Equation (3) and (4) imply that the job participation rate is increasing in the job finding rate f_i, wage w_i severance payment level ϵ_i, and decreasing in job destruction rate d_i and dismissal rate κ_i .

2.2 Firms' problem

There are a continuum of heterogenous finite-lived firms (establishments) in the markets. All firms follow the production function, as introduced by Krusell *et al.* (2000), which nests three production factors: capital equipment k, skilled worker h and unskilled worker l in a CES functional form, given by

$$F(k,h,l) = A\left\{\left(\mu\left((\lambda k^\rho + (1-\lambda)h^\rho)^{\frac{1}{\rho}}\right)^\sigma + (1-\mu)l^\sigma\right)^{\frac{1}{\sigma}}\right\}^\gamma.$$

Each firm differs in its productivity A. The productivity changes over period, following a first-order Markov process T. We assume $A \in [A_G, A_B, 0]$ and $A_G > A_B > 0$. The A_G and A_B represents a good and a bad state. With probability d_e, the firm fall into the state $A = 0$. The firm dies and all its hired workers become unemployed.

The parameter σ and ρ govern the elasticity of substitution between unskilled worker, capital equipment and labor (σ and $\rho < 1$). The parameter μ and λ governs the income share. The original setup in Krusell *et al.* (2000) incorporates another production factor called the capital structure, and these total four production factors make up a constant returns to scale production function. Unlike Krusell *et al.* (2000) that capital structure can be decided by firms, we assume that the capital structure acting as a fixed cost Ψ that the firm pays for when entering the market. Thus in our case the parameter γ is less than one.

Furthermore, we assume at any point of time, there exists many potential entrants.

Each period firms decide the production factors after observing the shock A. Firms rent the capital equipments in the market with a fixed rental rate $r + \delta$, where r is the interest rate and δ is the depreciation rate.[5] Firms hire skilled and unskilled workers, taking as given the wage rates w_h and w_l. A firm can hire workers up to the amounts it needs before the production starts, although it takes time for a worker to find a job. When firing a worker, firms subject to a firing cost $\epsilon_i w_i$. This $\epsilon_i w_i$ will transfer to the worker as the severance payment. Firms also need to consider that each period a worker may leave the job with exogenous probability θ (due to death). Let h_{-1} and l_{-1} stand for the employment level in the last period and h and l stand for the employment decision in the current period. Then the total cost a firm spends on firing each type of workers (or to speak in a boarder way, adjusting the labor force) D_i can be expressed as,

$$D_h = \epsilon_h w_h \max(0, (1-\theta)h_{-1} - h) + \epsilon_l w_l \max(0, (1-\theta)l_{-1} - l).$$

A firm's problem is to maximize the expected present value of profit streams, given by

$$\begin{aligned} V(A, h_{-1}, l_{-1}) = \max & F(k,h,l) - w_h h - w_l l - D_h(h, l, h_{-1}, l_{-1})_{h,l,k} \\ & -(r+\delta)k + \frac{1}{1+r} EV(A', h, l|A). \end{aligned}$$

It is clear that a firm's decision on $\{k, h, l\}$ are functions of state variables $\{A, h_{-1}, l_{-1}\}$. Three state variables give rise to higher complexity in numerical analysis and difficulty in expiation. Therefore, we simplify the analysis by examining the policy effects of ϵ_i separately. That is, each time we focus on the effects of a change of dismissal cost on one particular kind of labor, given the other dismissal cost be 0. Then we compare the consequences on those variables of interest of these two policies. In the following illustration, we concentrate on the case where the dismissal cost is imposed on the skilled worker h ($\epsilon_h > 0$ and $\epsilon_l = 0$).

If there is no dismissal cost, the firm's problem is static. *i.e.* the state variable h_{-1} has no influence on firm's decision making. The firm simply chooses $\{k, h, l\}$ such that the first order conditions (FOCs) of each factors hold. The firms decision rule is a set of allocations $\{k(A), h(A), l(A)\}$.

When $\epsilon_h > 0$, the firm's employment policy function becomes a kinked function, as described in studies of the labor adjustment cost. (for example, see (Cooper and Willis,

[5]Here we abstract the details of the capital market. However, this can be easily modeled as the following way: there is a competitive capital rental market where capital-rental firms use output goods Y to produce capital equipments K via the production function $K = Y$ and rent for the goods-producing firms. Under the no arbitrage condition, the equilibrium rental rate of capital equals to $r + \delta$.

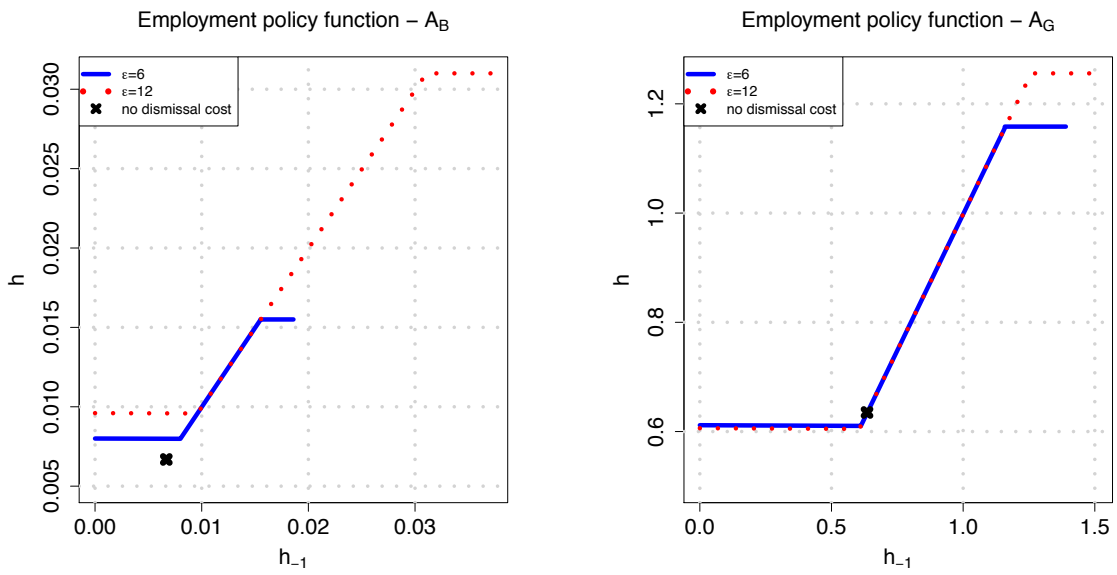

Figure 1: Employment policy function

2009)) In Figure 1 we show some typical shapes for the firm's demand functions for skilled workers h, under different productivityA_B (the left plot) and A_G (the right plot). In each plot, the black cross denotes the firm's choice when there is no dismissal cost, the (blue) real line is the firm's demand function when dismissal cost is low ($\epsilon = 6$) and the (red) dotted line is the firm's demand function when dismissal cost is high ($\epsilon = 12$). We can find the general patterns of a firm's decision: for each productivity A_i, there exists an interval $\left[\underline{h}_{A_i}, \bar{h}_{A_i}\right]$. If h_{-1} lies in this interval, the firm will not do anything. Since a fraction of workers θh_{-1} has left, the employment level is the workers remain staying in the firms $(1-\theta)h_{-1}$. If h_{-1} is more (less) than the upper bound $\bar{h}_{A_i}$ (lower bound $\underline{h}_{A_i}$), then the firm fires (hire) workers up to the upper bound (lower) bound.

This kind of decision rule allow firms to reduce the labor adjustment costs. Firms tend to employ an average level of workers. In each plot the first kink point, located at left bottom side of the figure, indicates the employment level of a firm's just newly entering the market. When facing a high productivity (as shown in the right plot), the firm hires less workers than it does if there is no dismissal cost, denoted by the symbol X. [6] By doing so this firm can reduce the possible dismissal payment if the state changes in the future. The effect gets stronger as the dismissal cost increases. This figure demonstrate how resources might be

[6]We also notice that the firm hires more workers when facing a low productivity shock. But this is driven by different reason: the equilibrium wage is lower under the high adjustment cost. Since firms with low productivity do not need to consider the firing cost, they hire more workers given the low marginal cost of labor.

misallocated in the presence of adjustment cost. Since the choice $h(A, h_{-1})$ enters into the FOCs of other production factors, this decision rule implies that not only h deviates to the *optimal level*, but also other production factors.

2.3 Equilibrium

Firstly, I introduce the measures and conditions required for define the equilibrium.

Free entry condition and the distribution of firms

When a new firm enters the market, it starts with zero employment level, that h_{-1} and l_{-1} equals 0. Assume that the new entry firm's productivity level may be A_G or A_B with equal probability. Thus, the free entry condition can be expressed as,

$$\Psi = V(A_G, 0, 0)\frac{1}{2} + V(A_B, 0, 0)\frac{1}{2}, \tag{5}$$

where the right hand side is the expected value of a newly created firm. Under this condition, in every period there will be M firms entering the market. Let $\Omega(h_{-1}, l_{-1}, A)$ represent the distribution of firms across states. Then, the following condition holds,

$$\Omega(h, l, A^{'}) = \sum_{h=h(h_{-1},l_{-1},A), l=l(h_{-1},l_{-1},A)} \Omega(h_{-1}, l_{-1}, A) Prob(A', A) + \frac{1}{2} M \times I_f(h, l),$$

where $Prob(A', A)$ is the probability of a state A transit to state A', $I_f(h, l)$ is an indicator function, that $I_f(h, l) = 1$ if both h and l are equal to 0, and $I_f(h, l) = 0$ otherwise.

Labor Markets

In equilibrium, the number of employed workers n_i equals the total employments by firms. This relationship can be described by,

$$\begin{aligned} n_h &= \sum_{h_{-1}, l_{-1}} h(h_{-1}, l_{-1}, A)\Omega(h_{-1}, l_{-1}, A) \\ n_l &= \sum_{h_{-1}, l_{-1}} l(h_{-1}, l_{-1}, A)\Omega(h_{-1}, l_{-1}, A) \end{aligned}$$

Let e_i denote the number of workers participating in the labor markets. The value of e_i is determined by the fraction of the labor force i and the fraction of workers participating in

the markets. That is,

$$\begin{aligned} e_h &= \phi Prob(b_h < b_h^*) \quad (6) \\ e_l &= (1-\phi) Prob(b_l < b_l^*) \quad (7) \end{aligned}$$

Let u_i denote the number of unemployed workers. In the equilibrium, the following condition hold for both h and l,

$$e_i = n_i + u_i \quad (8)$$

The unemployments u_h and u_l can be solved by considering the workers flows in the equilibrium. The inflows to unemployments equals the outflows to employments. That is

$$\begin{aligned} (e_i - u_i)s_i &= u_i f_i \\ u_i &= \frac{e_i s_i}{f_i + s_i} \end{aligned} \quad (9)$$

where $s_i = d_e + (1-d_e)\theta + \kappa_i$ is the gross job separation rate. The probability of a worker being fired in the beginning of the period κ_h can be expressed as

$$\kappa_h = \frac{\sum_{h_{-1},l_{-1}} \max\left(0, (1-\theta)h_{-1} - h(h_{-1}, l_{-1}, A)\right) \Omega(h_{-1}, l_{-1}, A)}{\sum_{h_{-1},l_{-1}} (1-\theta) h_{-1} \Omega(h_{-1}, l_{-1}, A)} \quad (10)$$

and κ_l can be defined in the similar way.

With above equilibrium conditions, the stationary competitive equilibrium can be defined as follows: there exit (1) a set of time invariant variables: employments n_i, unemployments u_i, the workers who participate in the markets e_i and number of new entry firms M, (2) a set of decision rules $\{k(A, h_{-1}, l_{-1}), h(A, h_{-1}, l_{-1}), l(A, h_{-1}, l_{-1}), I_h(b), I_l(b)\}$, (3) a set of prices $\{w_h, w_l\}$, and (4) a time invariant distribution of firms $\Omega(h_{-1}, l_{-1}, A)$, such that the following conditions hold.

1. Given prices, the policy functions $\{k(A, h_{-1}, l_{-1}), h(A, h_{-1}, l_{-1}), l(A, h_{-1}, l_{-1})\}$ solve each firm's problem.

2. Given prices, the decision rule $I_i(b)$ solves workers problem

3. The time invariant measures and variables $\Omega(h_{-1}, l_{-1}, A)$, n_i, u_i, e_i are consistent with firms' and workers' decision rules.

4. Market clearing condition (8) holds.

3 Quantitive analysis

I choose the U.S. economy statistics as the calibration targets. Although we are interested in the implications of labor reforms that usually conducted in European countries, it is easier to calibrate the model parameters in a *laissez-faire* benchmark economy, and the U.S economy is the most closer to this case.

I choose the model period to be one month. There three groups of parameters. First group contains parameters whose values can be directly followed from the existing literature. Table 1 reports the values and sources of these parameters. I set the interest rate equal to 0.0033, which yields 4% a year. The discount factor β is 0.9967, allowing the condition $\beta(1+r)=1$ holds. I use the elasticity parameters in production function, including $\rho = -0.495$, $\sigma = 0.401$, capital structure's share of income $1-\gamma = 0.117$ and annual depreciation rate of capital equipment $\delta = 0.125$ estimated by Krusell *et al.* (2000); I use the monthly job finding rate for skilled workers and unskilled workers are the estimates reported in Hagedorn *et al.* (2010).[7] Using the CPS 2012 and the education based classification, I compute the fraction of skilled worker $\phi = 0.415$, and the labor force participation rates of the skilled and unskilled workers.[8] The labor force participation rates allow us to pin down B_h and B_l, the parameters associated with the distribution of utility derived from non-market activities.

The second group are parameters in the transition matrix T and $[A_G, A_B, 0]$. Suppose T follows the form

$$T = \begin{bmatrix} \rho_a & 1-\rho_a-\pi_d & \pi_d \\ 1-\rho_a-\pi_d & \rho_a & \pi_d \\ 0 & 0 & 1 \end{bmatrix},$$

where π_d id the firm's death rate the ρ_a is the persistence parameter. I normalize $A_B = 1$, and use the following three observations reported (Davis and Haltiwanger, 1992) to pin down A_G, ρ_a and π_d :

In a year,

1. 2% of the firms die.
2. The job creation rate is 9.2%
3. 80% of the newly created jobs are from the existing firms.

I obtain $A_B = 1.7037$, $d_e = 0.0018$ and $\rho_a = 0.9917$. Noted that, since the model period is one month, to compute the moments in our model comparable with the data report, I

[7] These estimates are obtained using the CPS data, based on Shimer (2012) two state model.

[8] The skilled workers includes the individuals in the following education attainment group: associate's degree, bachelor's degree, master's degree, professional degree, and doctoral degree.

Table 1: Parameters value

Parameter	meaning	Value	Source and Target
r	Real interest rate	0.0033	Annual interest rate 4%
β	Discount factor	0.9967	$\beta = 1/(1+r)$
$1-\gamma$	Share of capital structure	0.117	Krusell *et al.* (2000)
ρ	Elasticity of substitution between k and l	-0.495	Krusell *et al.* (2000)
σ	Elasticity of substitution between k and h	0.401	Krusell *et al.* (2000)
δ	Depreciation rate	0.0125/12	Krusell *et al.* (2000)
f_h	Job finding rate of skilled worker	0.3618	Hagedorn *et al.* (2010)
f_l	Job finding rate of unskilled worker	0.4185	Hagedorn *et al.* (2010)
ϕ	Fraction of labor in skilled sector	0.415	CPS 2012
d_e	workers' death rate	0.0021	40 years working periods
B_h	Upper bound of h's non-employment utility	4.091	h's job participation rate 0.75
B_l	Upper bound of l's non-employment utility	3.047	l's job participation rate 0.51

simulate model for 12 periods and calculate these moments. For instance, when calculating the newly crated jobs, I sum up all the jobs created by firms who exist in the first period and still survive after 12 periods. (This parameters are independent of the values reported in the first group. So when conducting the sensitive analysis by adjusting ρ or σ, I can still keep these values.)

The last group the parameters in the production function governing the shares $\{\mu, \lambda\}$ of income contributed by each factor. Having the parameter pinned downed in the previous steps, together with the two conditions: (1) the labor share of output 70% and the wage ratio between skilled and unskilled worker 1.9846 solve $\lambda = 0.778$ and $\mu = 0.521$.

4 Results and discussion

The simulations focus on the effect of a decrease in ϵ_h and ϵ_l, representing a policy intended to increase labor market flexibility. I examine the responses of the economy to two types of reform: A H-reform and a L-reform. H-reform represents a reduction of firing cost of high skilled workers (ϵ_h), while L-reforms represents a reduction of firing cost of high skilled workers (ϵ_l).

The simulation begins with a highly protected labor market, characterized by a large ϵ ($\epsilon = 20$). Then I examine the responses of variables of interest as ϵ declines, representing the liberalization of labor market. Notice that, when a H-reform is conducted, the other labor market (unskilled workers' market) is assumed to be perfectly flexible. The same assumption applies to L-reform.

Figure 2 to 4 display the results for the rage where ϵ decreases from 20 to 0. In each figure, the y axis represents the percentage deviation to *laissez-faire* steady state $\epsilon_i = 0$. The real blue line represents results of H-reform, and the dotted black line represents the results of L-reform.

4.1 Main results

Figure 2 displays the responses of macroeconomic aggregates. The figure shows that output and labor productivity (calculated by $y/(h+l)$) increases as ϵ declines. To reduce ϵ_h from 20 to 0 induce the labor productivity to rise by 1.2 % and output by 1.9%. The explanation for this is the resource misallocation led by the adjustment cost (severance payment). As shown in Figure 1, firms tend to maintain employment staying at an *average* level to prevent a future adjustment cost. When adjustment cost is high, such tendency gets stronger, leading to a larger deviation to the *optimal* employment level. Less efficient production leads to lower profit, implying less active firms in the market (as shown in the plot with title M). Moreover, since some proportions of output spent for the adjustment cost, resulting smaller share to pay for workers and capital, workers' wages and capital employment all declines (as shown in the plots W_h, W_l and capital). When market turns to be more flexible, $i.e.\epsilon$ decreases, all the distortions mentioned above decline. I also note that the marginal benefit from reducing ϵ is diminishing. In particular, except for the wages, the effects turn to be very small when ϵ is smaller than 10.

One clear pattern for all the plots in Figure 2, that the responses to H-reform are much larger than the responses to L-reform. For output and productivity, by reducing each ϵ from 20 to 0 , the benefit from H-refrom is around four times higher than that from L-reform. The economic force at work is clear: that the magnitude of a firm' misallocation on the employment in response to its firing cost, causing a efficiency and output loss, is proportional to the marginal contribution of this resource. The difference of responses to ϵ_h and ϵ_l is driven by the productivity difference of workers' skill. ($i.e$ the contribution on produciton)

Figure 3 displays the responses of labor market performance to the partial reforms. We first note that the separation rates rise as ϵ declines. The changes in the separation rates is governed by a firm's decision on firing κ. We have learnt that firms is more willing to adjust employment, including firing workers in the downturn, when ϵ is small, and his explains the observed pattern. The two plots in the second row show that the probability of a worker to choose to participate in the labor market increases as ϵ declines. As noted in Eq. (4), this probability is increasing with wage w and severance payments ϵ, decreasing with the

firing rate κ. When ϵ is large, in the range [10,20], the effects of the rise of wage dominates. As ϵ move to the moderate range, $[0, 10]$, the effects of the rise in separation rate and the decline in severance payments becomes stronger. In particular, it is shown in the response of unskilled workers' participation rate declines, though a small level, as ϵ shifts from 10 to 0.

The equilibrium employment is the consequence of the workers' decisions on labor market participation and the firms' firing decision. The former governs the ins of workers to the employment while the latter determines the outs. Some interesting findings are (1) An L-reform reduces the employment of unskilled workers but raises the employment of skilled workers. Both impacts are small, less than 0.1%. (2) When an H-reform is conducted in a very rigid labor market $\epsilon \in [10, 20]$, the employment of skilled workers largely rises; while the reform slightly lowers the employment in a moderate protected market $\epsilon \in [0, 10]$ (3) The effects of H-reform is much stronger than L-reform. In particular, a partial reform intending to liberalize the labor market of the skilled workers causes even large impacts on rising the employment of unskilled workers.

Figure (4) shows the consequences of labor reforms on various welfare indexes. The two plots in the first row shows the effects of reform on a worker's value in the unemployment state U. The value U is one suitable measure of welfare, since it represents the threshold for individuals to decide whether to participate in the labor market, indicating the average lifetime value staying in the labor market. The responses of U indicate that the a partial reforms on the skilled worker can improve all workers welfare. The reason is identical to the responses of labor market participation rate, that the policy improves the production efficiency, raising the wages paid to workers and the value staying in the labor market.

The remaining two plots in the Figure (4) show the responses of income inequality, measured by GINI coefficient, and the responses of the ratio of employment between l and h. The impacts on inequality come from two sources: the wage gap and the relative proportions between these two types of workers. We have learnt that when ϵ_h declines, skilled workers' wage largely increases, so as the wages gap. Meanwhile, firms rises their demand for the relative cheaper unskilled workers as substitutes, increasing the relative size of the poor in the economy. Both forces intensify the income inequality, as we see in the plot. The same explanation can be applied to the partial reform on the unskilled worker reducing the income inequality: wage gap and the size of the poor both declines. This is the only significant and positive effects brought by this partial reform.

4.2 Robustness check

To check the robustness of the results, I conduct three additional experiments: (1) To fix agents's labor force participation rate (2) To assume the job finding rate to be convex to firm's hiring. (3) To change the capital-skill complementarity property in the production function.[9] The responses of policy on productivity and output are quantitatively similar to the baseline case, the response on the use of production factors, prices and inequality is qualitatively consistent to the baseline case. These experiments support the conclusion drawn from the baseline simulation.

5 Conclusion

I constructed a model to evaluate the policy effects of partial reforms on macroeconomic aggregates. The partial reform refers to those labor reforms that intend to increase the labor market flexibility, implicitly and unintentionally targeting to a specific labor market compose by unskilled workers, perhaps due to the political concern. The numerical results indicate that this kind of partial reform can only give rise to limited improvements on the output, labor productivity, labor force participation rate and workers' welfare, though it does effectively reduce the income inequality, by rising unskilled workers' wage. In comparison, if the partial reform can instead aim at the skilled worker, the resulting effect is much larger, and consistent with the policymaker's intension. This conclusion is in line with several previous studies, for instance Blanchard and Landier (2002) and Bentolila and Bertola (1990); Bentolila *et al.* (2012), that "a partial reform may be a very poor substitute for broader reform", even though the focus of this study look at different perspective. Another implication drawn by our simulation is that a reform attains the strongest effects when the labor market is extremely rigid. Moreover, the effects diminishes and turns to be negligible quickly.

The current model has been simplified in several dimensions, so that there exists several potential extensions. For instance, one may attempt to explore the partial effects under the environment both firing costs are imposed on skilled and unskilled workers. (*i.e.* a complete sclerotic labor market). Another extension is to relax the assumption on the exogenous job finding rate. Given that a high protection reduces firm's hiring, it is nature to think the protections may also lower the job finding rate. This perspective has not well captured in the current model, but may provide a more comprehensive understudying of the impact of policy reforms on labor market performance.

[9]The results of these experiment do not report here.

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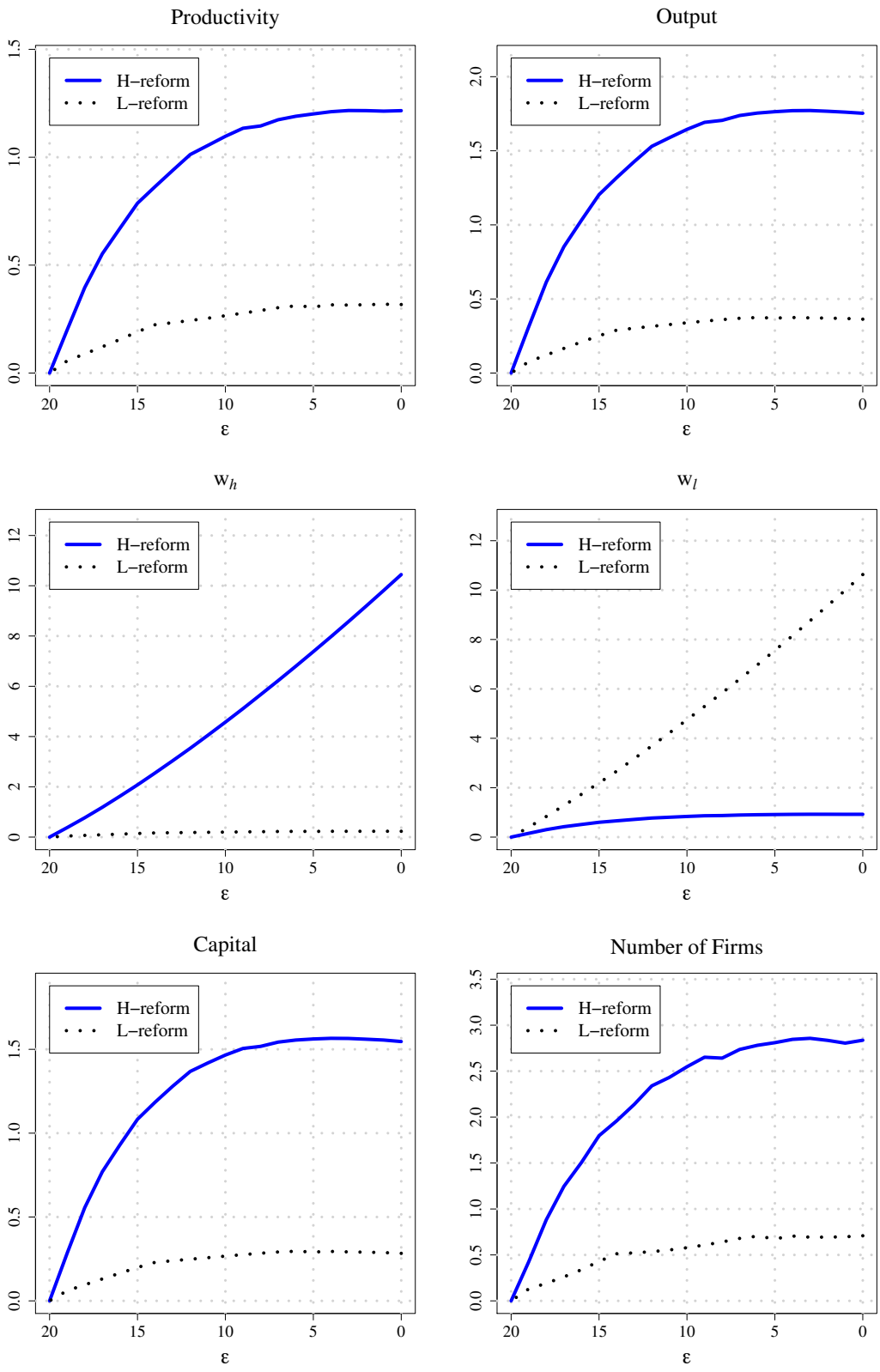

Figure 2: Responses of partial reform for macroeconomic aggregates

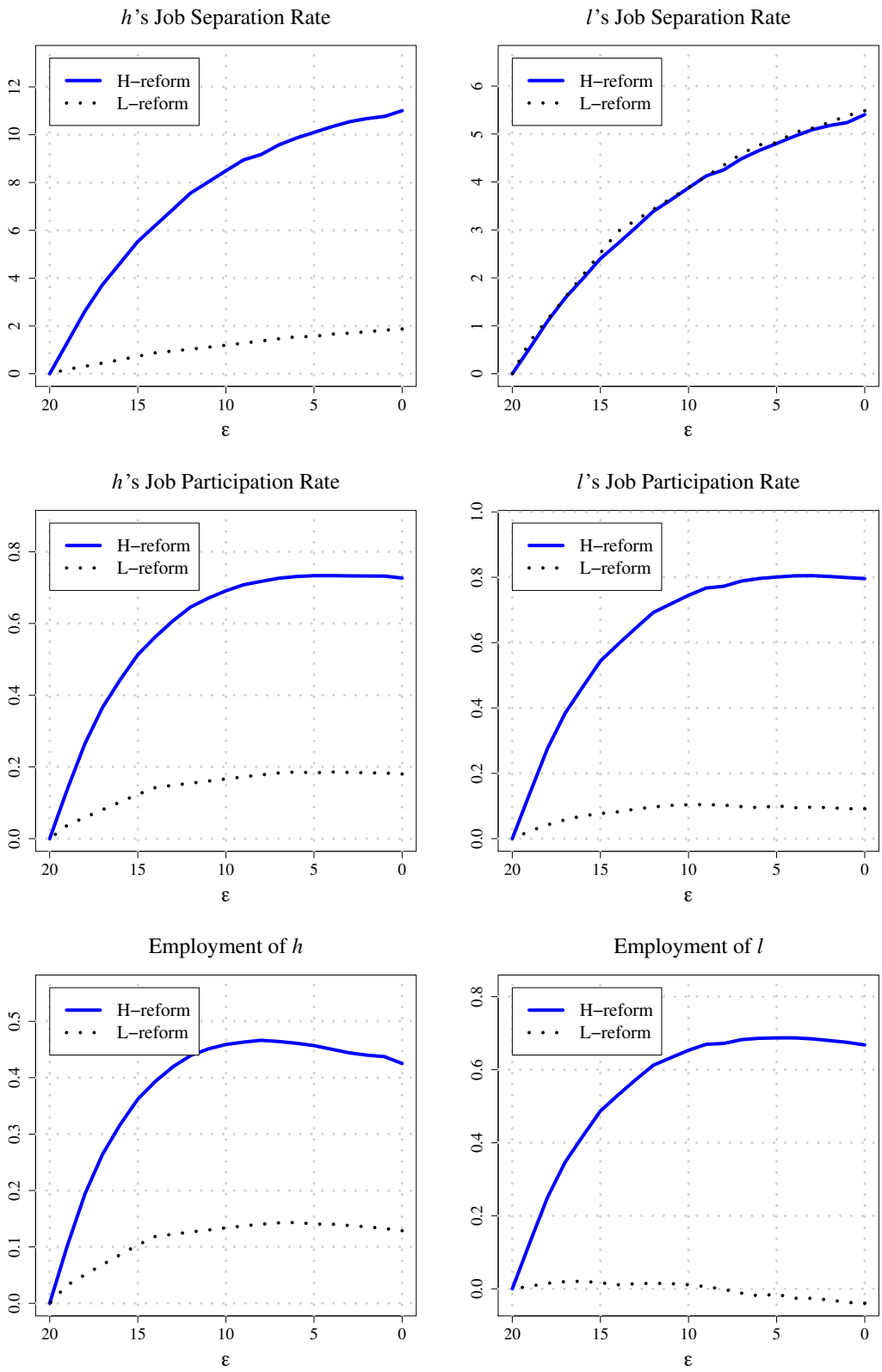

Figure 3: Responses of partial reform for workers

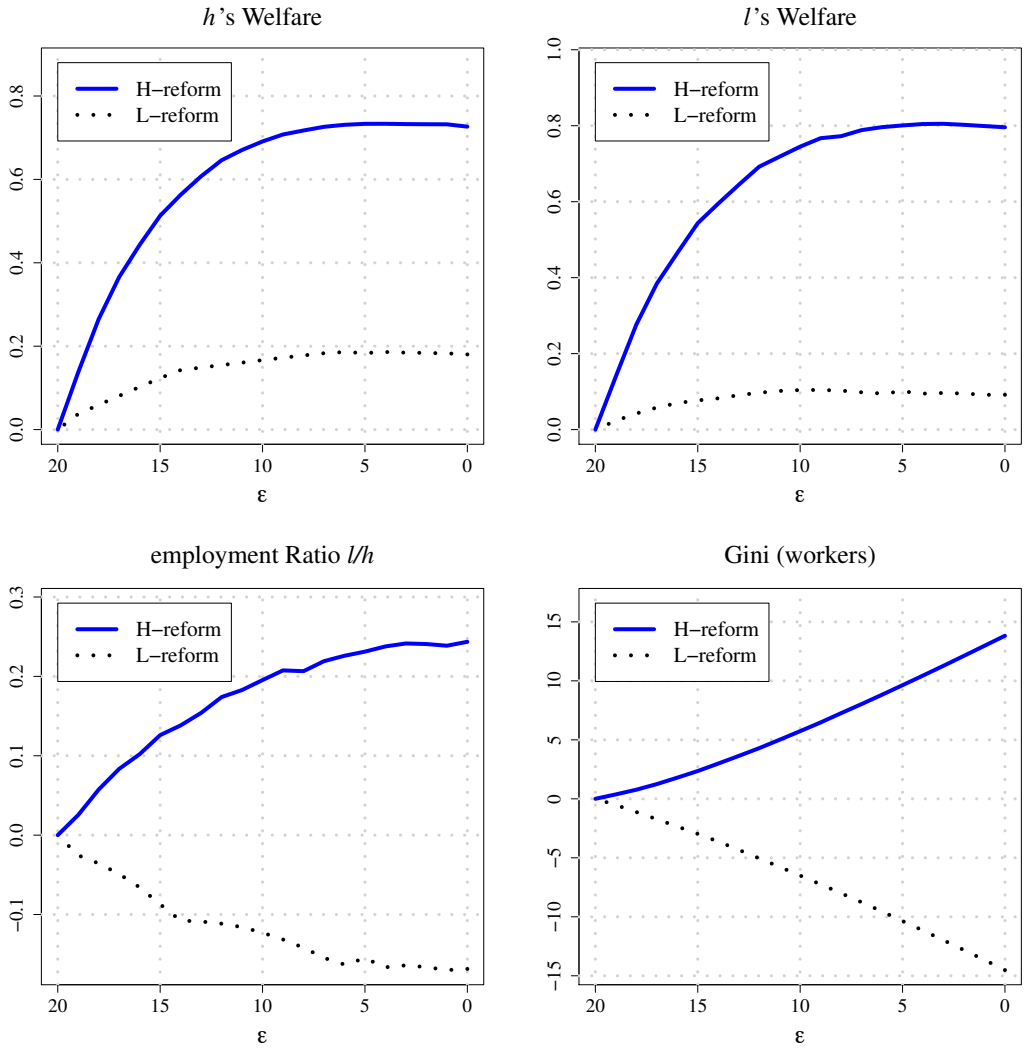

Figure 4: Responses of partial reform for welfare indicators