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COSTLY LABOR ADJUSTMENT:  
GENERAL EQUILIBRIUM EFFECTS OF CHINA'S EMPLOYMENT REGULATIONS

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**ABSTRACT**

This paper studies the employment, productivity and welfare implications of new Chinese labor regulations intended to protect workers' employment conditions. We estimate a general equilibrium model of costly labor adjustment from data prior to the policy. Using the estimated parameters, we study the effects of the interventions. We find that increases in severance payments lead to a sizable increase in firm size, lower aggregate employment, a significant reduction in labor reallocation, an increase in the exit rate and a welfare loss. A policy of credit market liberalization will reduce firm size, increase aggregate employment, increase labor reallocation, wages and welfare. If in place at the time, these frictions would have reduced China's annual growth rate by 1.1 percentage points over the 1998-2007 period.

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# 1 Motivation

The rapid rise of China as a major global economic power is a significant phenomenon. As emphasized by Hsieh and Klenow (2009), the rapid growth in China reflects, in part, the reallocation of factors of production to more productive uses. This reallocation occurred between public and private firms and within these ownership groups. Misallocation due to the presence of publicly owned firms fell during their sample period of 1998 to 2005.<sup>1</sup> This finding is consistent with the evidence presented in Cooper, Gong, and Yan (2013b) that the gap between private and public plants narrowed by 2005-2007.

More recently a countervailing influence has appeared. Along with the rapid growth in China, concerns grew over poor labor conditions, including job security and wage levels.<sup>2</sup> In January 2008, China adopted a new labor law intended to enhance workers' rights. Table 1 in Allard and Garot (2010) compares the scores of different countries on the Employment Protection legislation indicator, which was developed by the OECD to gauge the strictness of labor laws. From this table, the new labor law moves China from a fairly deregulated market to one that could be considered as restrictive as some of the most protective European economies, and much more restrictive than the United States.<sup>3</sup>

While potentially desirable as a device to protect workers, these types of policies can limit reallocation and thus retard economic growth. The gains from reallocation highlighted by Hsieh and Klenow (2009) are at risk due to these types of interventions. The potential effects of these policies on growth in China was a key point in a April 2015 speech by Finance Minister Lou Jiwei at Tsinghua University who said:<sup>4</sup>

The labor law implemented in January 2008 has obvious drawbacks. The drawbacks are mainly due to reduced mobility and flexibility in the labour market. Employees can fire (an) employer, but the employer cannot easily dismiss a worker, ....

Lou compared the reduction in labor market flexibility to the rigidity of labor markets in parts of Europe and Detroit. His comments tied the labor regulations to growth in China, warning of the prospect of China being stuck in a "middle-income trap".

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<sup>1</sup>See the discussion in section VI of Hsieh and Klenow (2009).

<sup>2</sup>These concerns include outright labor abuse. In June 2007, the media reported a labor scandal that kept thousands of labor in slavery in small brick kilns in Shanxi Province, Central China.

<sup>3</sup>In 2012 China ranked first according to the OECD "strictness of employment protection" index. Thanks to one of the referees for bringing this fact to our attention.

<sup>4</sup>For a full version of Lous speech (in Chinese), see: [http://www.sem.tsinghua.edu.cn/portalweb/sem?\\_\\_c=fa1&u=xyywcncn/69292.htm](http://www.sem.tsinghua.edu.cn/portalweb/sem?__c=fa1&u=xyywcncn/69292.htm).

Under the new law, employers are not allowed to unilaterally terminate employees' contracts and requires severance payments for dismissals. The new law also includes restrictions on collective dismissals, which arise when an employer dismisses 10% or more of the work force (or 20 or more employees). A mass layoff can be conducted if the company is experiencing severe financial, production or operation problems or is undergoing a major transformation. Other provisions of the law are detailed below.

To evaluate these policies, we study a general equilibrium model in which households and firms interact in a labor market, constrained by the various components of the new labor law.<sup>5</sup> We estimate both household and plant-level parameters, using observations prior to the labor regulations. For plants, we estimate the revenue function, the driving process for the shocks to profitability, the adjustment costs as well as the discount factor.<sup>6</sup> Since there is entry and exit of plants, we also estimate fixed production and entry costs. For households, we estimate the disutility from work. The estimation uses the allocation of a stationary general equilibrium as a basis for inference.

The estimates of structural parameters from the model are used for the policy analysis. The policies we consider include: (i) the increase of fixed firing costs, (ii) increased costs of varying worker hours (overtime provisions), (iii) increases in severance pay and (iv) increases in social security payments. We study how these policy interventions influence steady state levels of firm size, employment, worker reallocation, aggregate productivity and welfare.<sup>7</sup>

We supplement the consideration of labor market interventions with an analysis of credit market interventions. In the same speech as quoted above, Finance Minister Lou said:

In implementing these reforms, two issues must be handled with care. First, deleveraging and liberalizing the capital market by introducing more means of financing.

In our estimation, and consistent with other studies of capital market frictions in China, private firms tend to discount the future more heavily than public ones.<sup>8</sup> The interaction between labor and credit policies is key: **the response to the labor reforms depends critically on the discount factor of firms.**<sup>9</sup>

A main effect of the interventions on labor demand come through the increased severance payments and the liberalization of capital markets. At given wages, increased severance payments lead

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<sup>5</sup>Our earlier analysis, Cooper, Gong, and Yan (2012) was entirely partial equilibrium in nature.

<sup>6</sup>Relative to Hsieh and Klenow (2009), the contribution is to make the adjustment frictions explicit, the analysis dynamic and to study an equilibrium outcome.

<sup>7</sup>Throughout we distinguish the effects of the policy on average firm size and total employment, i.e. the equilibrium participation rate of the representative household.

<sup>8</sup>This comparison and a discussion of related literature is contained in Cooper, Gong, and Yan (2013b).

<sup>9</sup>In a model with labor and financial market search, Petrosky-Nadeau and Wasmer (2013) emphasize this interaction as well.

to an **increase** in average plant size and a reduction in productivity, since reallocation is more costly. We find that this effect is directly related to our estimated discount factor of about 0.92. With this relatively low discount factor, a plant will expand employment and output in response to a favorable shock and then hold onto these extra workers in bad times due to the higher firing costs. This effect on plant size is muted when capital markets are liberalized and the discount factor rises to 0.95.

The general equilibrium analysis adds entry as well as market clearing wage variations in response to the policy interventions. Relative to the direct effect on labor demand, the increased severance pay has about the same positive impact on firm size while credit market liberalization has a large negative effect on firm size. In addition, the increased severance payments lead to an increase in firm exit rate and a reduction in aggregate employment while credit market liberalization leads to a reduction in firm exit rate and an increase in aggregate employment. In a general equilibrium setting, attempts to increase the social security contributions are offset by equilibrium wage responses, leaving the allocation unchanged.

The general equilibrium model facilitates a welfare analysis of the policies. The 20% increases in severance payments lead to nearly a 3% decline in productivity, a 9% reduction in output and nearly a 6% reduction in welfare. These losses come from the reduction in worker mobility. A 20% increase in the cost of adjusting labor hours reduces productivity by about 4%, output by 17% and welfare by 13%. By limiting the response of hours to shocks, the reallocation of the labor input is hampered. The liberalization of credit market leads, by reducing interest rates, to an output gain of about 43% and significant gains of welfare. Other interventions do not have large welfare effects.

Relative to the experience of China from 1998 to 2007 when, according to Hsieh and Klenow (2009) Chinese growth was facilitated by reallocation, the introduction of labor market protections would have reduced output relative to the baseline by over 10% each year, i.e. a 1.1 percentage points decrease in annual growth over this period.

Further, we study how the economy responds to reallocation shocks, such as a terms of trade shock, with and without the labor regulations. We find that these barriers limit the ability of the economy to exploit the gains associated with a mean preserving spread in productivity across plants.

This is certainly not the first paper to study the effects of labor market interventions. There are a couple of features that make our analysis noteworthy. First, the paper is about labor market interventions in China. While the fact that a communist country finds it necessary to impose labor market protections is of significance, our analysis goes beyond the resulting redistribution effects to focus more on the implications of these policies for productivity. Reallocation has been key

to China's economic success and interventions of this form can lead to output and productivity reductions.

Besides a different focus, this paper combines estimation with policy analysis in a general equilibrium model. The estimation is important since the effects of the policies depend on the underlying parameters of adjustment costs and discount factors. This is particularly noteworthy in understanding the effects of increased severance pay. As we shall see, the estimation uncovers a relatively low value of the discount factor which interacts with the policy effects. Naturally, an increase in severance pay will have two opposing effects. One is to reduce job destruction since it is more expensive to fire workers. The other is to reduce job creation since, given that firing is costly, firms are reluctant to hire workers. The overall effect on firm size is ambiguous. The existing empirical results in the literature are mixed. Building on a partial equilibrium framework, Bentolila and Bertola (1990) claim that firing costs could increase employment by making firms hoard labor. Hopenhayn and Rogerson (1993) develop a general equilibrium model to show that general equilibrium wage adjustments through the labor supply response matters. They find that an increase in firing costs reduces employment. From simulations of our estimated model, firm size grows after an increase in severance pay, a finding attributed to the **estimated** low discount factor.

## 2 China's Labor Policies

China's labor markets and its labor policies have experienced tremendous changes in the last three decades. Prior to the early 1980s, there were few private firms. Nearly all workers worked in the state sector through government assignment. Employment was lifelong, from cradle to grave. Hours variation was minimal. Employment could not be terminated and benefits to employees were secured regardless of their productivity or the firm's profitability. This system was often referred to as the "Iron Rice Bowl".

An initial labor law, effective January 1995, was enacted during China's market transition. The law replaced the Iron Rice Bowl with contract-based employment and the labor market began to substitute for government job assignment. From the perspective of employment protection, the 1995 law was relatively flexible. The provisions were vague and lax. These loosely worded provisions were proposed to release enterprises from the original restrictions, and served to promote business freedom.

The new labor law enacted in 2008 marked a major step in the direction of a rigid labor market in China. These reforms, termed the "Labor Contract Law of the People's Republic of China"

were passed on June 29, 2007 and were effective January 1, 2008.<sup>10</sup> The law requires employers to provide employees with written contracts that contain the term of employment, job description, place of work, working hours, rest and leave periods, wages, social insurance, labor protections, and description of working conditions.

As stated in the first chapter of the law:

Article 1 This Law is formulated to improve the labor contract system, to specify the rights and obligations of the parties to labor contracts, to protect the legitimate rights and interests of workers, and to build and develop harmonious and stable employment relationships.

Article 2 This Law applies to the establishment of labor relationships between, the conclusion of, performance of, amendment of, revocation of and termination of, labor contracts by workers and organizations such as enterprises, individual economic organizations and private non-enterprise units in the People's Republic of China (Employers).

The conclusion, performance, amendment, revocation and termination of labor contracts between state authorities, institutions or social organizations and workers with whom they establish employment relationships, shall be subject to this law.

The specifics needed to implement these goals are contained in Chapter IV of the new law. One of the most economically important provisions is the requirement of severance payment upon separation. Before the implementation of the new law, the employer was not required to provide a severance payment if an existing employment contract expired without being renewed. The law stipulates that for lawfully terminated contracts the severance pay is one month's salary for each year of employment, capped at 12 months or 12 times 300% of the local average monthly salary, whichever is bigger. The severance is twice this amount if a contract is terminated unlawfully.

Our estimates of adjustment costs prior to the introduction of the new law includes a significant fixed cost of firing. In our policy analysis we amend the specification of the fixed firing costs from the new law following this provision:

Article 41 If any of the following circumstances make it necessary to reduce the workforce by 20 persons or more, or less than 20 persons but accounting for 10% or more of the total number of employees of the Employer, the Employer may only do so after it has explained the situation to the labor union or to all of its employees 30 days in advance, has considered the opinions of the labor union or the employees, and has submitted its workforce layoff plan to the labor administrative department ...

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<sup>10</sup>This discussion draws on presentation of the new laws at <http://hi.baidu.com/yanyulou/blog/item/1ebba9648ab5f7f3f6365430.html>.

Though the new regulations apply to both private and public firms, we focus on the private plants in our study as they are most likely to be influenced by these new policies. By the end of 2006, 80% of all employees in China had signed labor contracts with their employers. This number is highest in state-owned and state-controlled enterprises, almost 100%, and lowest in private, especially domestic private enterprises.<sup>11</sup> The private plants account for over 75% of total employment.

As with any new regulation, there is the open question of enforcement. One of the most prominent features of the Labor Contract Law is the mandatory requirement of written contracts at the commencement of labor relationship (Article 7) or within one month thereafter (Article 10). Without a written contract, it is difficult for workers to claim legal rights when labor disputes arise. The progress made by the Labor Contract Law is that, it provides penalties for employers who do not sign written contracts with their employees.

There is some evidence that the new regulations have been effective. The Ministry of Human Resources and Social Security of China stated that labor disputes in 2008 rose to 693,000, a near doubling of cases from 2007. From the U.S. Congressional Commission on China, this rapid rate of increase is continuing and that the explosion of disputes is particularly apparent in coastal cities and provinces, including Beijing, Shanghai, Jiangsu, Zhejiang and Guangdong.<sup>12</sup>

To provide further evidence, we conducted an informal survey of plants and the New Labor Contract Law (NLCL).<sup>13</sup> Responses are summarized in Table 1.

Table 1: Survey Responses

	much more difficult	more difficult	no change	easier
NLCL makes recruitment	8	1	3	0
NLCL makes firing	1	7	4	0
NLCL increases average labor cost by	>30%	20 to 30%	10 to 20%	< 10%
Law authorities inspect implementation of NLCL	4	8	0	0
	very strictly	strictly	not strictly	
	5	6	1	

When asked about which provisions of the NLCL affect enterprises most, responses included:

<sup>11</sup>Source: [http://www.ycwb.com/xkb/2006-07/27/content\\_1172744.htm](http://www.ycwb.com/xkb/2006-07/27/content_1172744.htm).

<sup>12</sup>The quote comes from the U.S. Congressional Executive Commission on China, 2009 Annual Report, p. 75., available at <http://www.cecc.gov/>.

<sup>13</sup>Thus far, 12 enterprises replied to the survey, located in 6 provinces: Jiangsu, Shandong, Zhejiang, Henan, Sichuan, and Heilongjiang.



- Enterprises are required to make all employees insured. The base insurance payment increases every year, making the cost of doing business increase every year.
- The minimum wage increases steadily every year.
- Recruitment becomes difficult. In the meantime, labor mobility is very large. The newly hired students cannot and do not want to do hard work.
- The restriction on working hours in New Labor Contract Law imposes huge cost on the apparel industry. The special nature of apparel industry is that the working hours are relatively long; most enterprises export goods to other countries. They have to complete the production in a pressing time, which usually makes employees work extra hours.
- Article 38 where the enterprises are enforced to pay social security insurance for all employees.

Given the size of the survey, the results are only suggestive of the reforms and their enforcement. Yet it does seem that the costs of hiring and firing workers have increased as have labor costs. Moreover, from both the survey and the evidence of labor market strife, the new regulations are being enforced.<sup>14</sup> According to the vice president of the All China Federation of Trade Unions, “Two months after the enactment of the Labor Contract Law, the percentage of workers who have signed labor contracts with their employers has reached 80-90%.”<sup>15</sup>

### 3 Model Economy

We consider the general equilibrium of a large economy composed of households and firms. The main action in the model comes from the dynamic labor demand of the heterogeneous firms.

The households supply labor to firms. The households also own the firms, though the labor supply decisions are made independently of ownership. As detailed below, the households have heterogeneous labor market outcomes. Some are employed, others are not. Among those employed, hours worked may vary across firms.

The analysis is not about these differences in households. While risk sharing opportunities are certainly limited, the effects of the policies we consider are more directly associated with labor demand. Thus, we follow Hopenhayn and Rogerson (1993) and consider a single household within which the risks of these heterogeneous outcomes are shared.

As there are no aggregate shocks in the model, it is relatively straightforward to find a stationary equilibrium. To be clear, in this equilibrium the state of an individual firm is stochastic due to

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<sup>14</sup>Freeman and Li (2013) study the effects of the law on migrant workers and find evidence that these laws are enforced and matter for these workers.

<sup>15</sup>Source: <http://yt.tmjob88.com/ViewArticle.php?id=13920>.

idiosyncratic shocks and differences in employment. Yet, in aggregate, the economy is in a steady state.

### 3.1 Firm Dynamic Optimization

In this section we present the dynamic optimization problem of private plants. The optimization problem is the basis of our estimation using the simulated method of moments approach. The policy changes are then evaluated using the estimated parameters.

The dynamic optimization problem for a privately owned plant builds from the specification in Cooper, Haltiwanger, and Willis (2015) and Cooper, Gong, and Yan (2013b). At a point in time, the plant is in state  $(A, e_{-1})$  where  $A$  is a random variable representing the profitability of the plant and  $e_{-1}$  is the stock of workers employed in the previous period.<sup>16</sup>

At the start of a period, the plant will either continue in operation or exit. As there is no capital, we set the value of exit to 0, assuming that any severance pay requirements are not enforceable on a plant that exits.<sup>17</sup>

$$V(A, e_{-1}) = \max\{V^c(A, e_{-1}), 0\}. \quad (1)$$

Here  $V(A, e_{-1})$  is the state contingent value of the plant and  $V^c(A, e_{-1})$  is the value if it continues in operation, retaining the option of exit in the future.

A continuing plant chooses the number of workers to employ in the current period,  $e$ , along with the hours per worker,  $h$ . These choices are made to maximize the sum of current profits and the discounted expected value of the firm in the next period. Current profits are defined as revenues less compensation paid to workers and less costs of adjusting the workforce.<sup>18</sup>

The value of the continuing plant in state  $(A, e_{-1})$  is given by

$$V^c(A, e_{-1}) = \max_{h,e} R(A, e, h) - e\omega(h) - \omega_0\Gamma - C(e_{-1}, e) + \beta E_{A'|A}V(A', e) \quad (2)$$

for all  $(A, e_{-1})$ . Here  $R(A, e, h)$  is the revenue flow of a plant with  $e$  workers, each working  $h$  hours in profitability state  $A$ . Our analysis assumes that the profitability shock is plant-specific.<sup>19</sup>

The revenue function depends on the product of hours per worker and the number of workers. This function comes from the product of a production function and the demand function facing the plant. Factors of production other than labor, such as capital and energy, are freely adjustable

<sup>16</sup>For this part of the analysis,  $A$  is drawn from a stationary process. We discuss growth in Section 6.

<sup>17</sup>Thanks to Immo Schott for bringing this issue to our attention.

<sup>18</sup>As discussed in the empirical implementation, the data counterpart of this are revenues net of other costs of production.

<sup>19</sup>The model is estimated from cross sectional variation by removing year effects.

within a period. With constant returns to scale and constant elasticity of demand, the revenue function takes the form in (3). The coefficient  $\alpha$  reflects the curvature of the production function along with the elasticity of demand. The parameter  $A$  represents both shifts in the production function of a plant, shifts in factor prices and shifts in the demand for that plant's output:

$$R(A, e, h) = A(eh)^\alpha. \quad (3)$$

In (2), there is a fixed cost of operation, denoted  $\Gamma$ , denominated in units of labor input and thus multiplied by the base wage,  $\omega_0$ . As we observe exit in the data, the presence of  $\Gamma$  will help match that moment. In the policy experiments that follow, the overhead cost will respond to variations in the base wage.

The compensation paid to workers is characterized by

$$e\omega(h) = e(\omega_0 + \omega_1 h^\zeta) \quad (4)$$

so that  $\omega(h)$  stipulates compensation as a function of hours worked. The functional form has a base wage,  $\omega_0$ , and along with a component,  $\omega_1 h^\zeta$ , that is hours dependent. The parameter  $\zeta$  determines the elasticity of compensation with respect to variation in hours.<sup>20</sup>

The dependence of compensation on hours is an important determinant of how the firm varies its labor input in response to a change in profitability. Does the reaction occur through variations in hours or in the number of workers? Though hours are not measured in our data, it is important to include this margin in the model. In theory, one of the effects of an increased firing cost is to reduce the variability of employment and instead to rely on hours variation in response to profitability shocks. In fact, hours variation was historically small in China prior to the reforms in the late 1970s, when almost all enterprises were public. In contrast, a post-reform survey of Chinese households in 2013 shows significant variation in hours over the week and the day. For example, the median days worked per week is 6, but the first quartile of the workers report only 5 days of work and the third quartile report 7 days.<sup>21</sup>

The cost of adjusting the stock of workers is given by  $C(e_{-1}, e)$ . In general, this function captures the various inputs into the process of hiring/firing a worker, including: search, recruitment and training costs. It may contain both convex and non-convex forms of adjustment costs.<sup>22</sup>

<sup>20</sup>When  $\omega_0$  is zero, the elasticity of compensation with respect to hours is  $\zeta$ .

<sup>21</sup>Source: Chinese Household Finance Survey, <http://www.chfsdata.org/default.aspx?cid=7>.

<sup>22</sup>Hamermesh and Pfann (1996) contains a lengthy discussion of adjustment costs models and their interpretation. As in Cooper, Haltiwanger, and Willis (2007), these costs could emerge from search frictions. The Chinese data is not rich enough to permit estimation of an explicit search model. See Krause and Uhlig (2012) as an example of using a search model to study reforms in Germany.

The cost of adjustment function is:

$$C(e_{-1}, e) = F^+ + \gamma^+(e - e_{-1}) + \frac{\nu}{2} \left( \frac{e - e_{-1}}{e_{-1}} \right)^2 e_{-1} \quad (5)$$

if there is job creation,  $e > e_{-1}$ . Similarly

$$C(e_{-1}, e) = F^- + \gamma^-(e_{-1} - e) + \frac{\nu}{2} \left( \frac{e - e_{-1}}{e_{-1}} \right)^2 e_{-1} \quad (6)$$

if there is job destruction,  $e < e_{-1}$ . If  $e = e_{-1}$ , so there are no *net* changes in employment, then  $C(e_{-1}, e) \equiv 0$ .

There are three types of adjustment costs, with differences allowed for the job creation and job destruction margins. The first is the traditional quadratic adjustment cost, parameterized by  $\nu$ . A fixed cost of adjustment is parameterized by  $F^-$  and  $F^+$ . Finally, there are linear adjustment costs. The linear firing cost,  $\gamma^-$ , is of particular importance as it captures severance payments. One of the key features of the data is inaction in employment adjustment. The fixed cost and linear costs are each capable of creating inaction.

In addition to the differences in adjustment costs of hiring and firing workers, this study allows a threshold for the non-convex adjustment costs. So, as a leading example, the fixed cost of firing ( $F^-$ ) may apply only if the rate of job destruction exceeds a bound. Through this modification of (6), we are able to capture certain institutional features that may generate nonlinearities in adjustment costs.

Finally, there is the prospect of entry. A new entrant pays a cost  $\kappa$ , denominated in units of labor and multiplied by the base wage,  $\omega_0$ . The entrant then draws a profitability shock and starts operation with the lowest level of employment, denoted  $e_-$ .<sup>23</sup> The free entry condition is

$$E_A V(A, e_-) = \omega_0 \kappa. \quad (7)$$

The value of entry is sensitive to labor costs, so, as in Hopenhayn and Rogerson (1993), the free entry condition will be used to determine wages.

Throughout, we assume that there are no adjustment costs associated with capital. This is, of course, a simplification that allows us to focus on the labor adjustment and the impact of the policies. Cooper, Gong, and Yan (2013b) contains an extensive analysis of the interaction between capital and labor adjustment at these plants and argues that the estimated labor adjustment costs for the private plants are not simply reflecting missing capital adjustment costs.

<sup>23</sup>The employment space has a positive lower bound. An alternative model of entry in which the entrant pays a cost, draws a shock and then can costlessly adjust employment generates very similar general equilibrium implications.

### 3.2 Households

There are numerous agents who supply labor and consume the produced good. The agents have heterogenous outcomes as some are employed and others are not. Further, the amount worked by an agent varies, depending on the productivity of its firm.

Preferences of an individual agent are represented by  $u(c - g(h)) - \xi I(h > 0)$  where  $c$  denotes the consumption of the single good and  $h$  is hours worked. Assume  $u(\cdot)$  is strictly increasing and strictly concave while  $g(\cdot)$  is strictly increasing and strictly convex. In addition, an employed agent suffers a disutility of  $\xi > 0$ , where  $I(h > 0)$  indicates that the agent's working hours are positive.

As in Hopenhayn and Rogerson (1993) these individual agents belong to a large household. Through this household, labor market risks are potentially shared and consumption is reallocated between employed and non-participating household members. In the equilibrium we construct, variations in hours worked across members of the household are compensated by firms so that the household acts to redistribute from its employed members to those not participating in the labor market.

The objective function of the household is:

$$\sum_{i \in emp} u(c^i - g(h^i)) + (1 - N)u(c^{np}) - \xi N \quad (8)$$

where  $N$  is the fraction of agents in the household currently employed, the remainder are non-participants. The first sum is over the agents, indexed by  $i$ , who are employed:  $i \in emp$ .

The budget constraint of the household is given by:

$$\sum_{i \in emp} c^i + (1 - N)c^{np} = \sum_{i \in emp} \omega(h^i) + (1 - N)\omega^{np} + \Pi + T \quad (9)$$

where  $\omega(h^i)$  is the compensation paid to a worker supplying  $h^i$  hours. Total consumption is funded from a number of sources. The first is the total earning of employed agents, including compensation for excessive hours. This is supplemented by welfare payments, denoted  $(1 - N)\omega^{np}$ , to the household from the government or severance payments paid by the firm to the government which flow to the members of the household who are not participating.<sup>24</sup>

The household owns the firms and hence gets profits of  $\Pi$ . In the event there is unemployment insurance and other welfare payments funded by the government, the household may incur some tax obligations. Further the household may receive transfers from the government for employment at public firms. These transfers net of taxes are denoted  $T$ . This household acts competitively.

<sup>24</sup>As emphasized to us by our referees, the model does not distinguish unemployment from non-participation.

The household's optimal allocation equates the marginal utility of consumption across all of its members, both employed and non-participants:  $u'(c^{np}) = u'(c^i - g(h^i))$  so that  $c^i - g(h^i) = c^{np} \equiv \bar{c}$  for all  $i \in emp$ . In this way, workers are exactly compensated for the disutility of working at a particular firm. The level of consumption of employed and non-participating household members is determined directly from the budget constraint:

$$\bar{c} = \sum_{i \in emp} [\omega(h^i) - g(h^i)] + (1 - N)\omega^{np} + \Pi + T. \quad (10)$$

Given the compensation function and its redistribution between members, the household chooses the fraction of its members who will work. At the margin, the household is indifferent with respect to the hours worked of an additional worker. Thus the fraction of household members working is determined from the first order condition of  $\omega_0(1 - \phi)u'(\bar{c}) = \xi$ , where  $\phi \equiv \omega^{np}/\omega_0$  is the fraction of the base wage received by a household member who is not participating.<sup>25</sup>

Household members working at publicly owned firms in China are not modeled. The focus on private sector employment is consistent with the view expressed earlier that the new labor regulations mainly impacted private firms. Yet public sector employment is nearly 25%. We adopt a segmented markets view in which wages and employment at jobs at state-owned enterprises and other public firms are determined separately from private labor markets.<sup>26</sup> The income from public employment is contained in transfer net of taxes,  $T$ . The marginal condition on labor supply comes from the market for labor exchange with private firms, given employment and wage income with public firms.

### 3.3 Stationary Equilibrium

A stationary equilibrium is a compensation function  $\omega(h)$ , state contingent employment and hours,  $(e(A, e_{-1}), h(A, e_{-1}))$  and a participation rate  $N$ , such that: (i) the free entry condition holds, (ii) the labor market clears and (iii) households and plants act optimally.

Assume the household's disutility of work takes a particular form,  $g(h) = \omega_1 h^\zeta$ . To construct an equilibrium, set  $\omega(h) = \omega_0 + g(h)$  so that  $\omega(h) = \omega_0 + \omega_1 h^\zeta$  as in (4). With this construction, the effects of hours variation on household utility are fully compensated by the firm leaving workers indifferent with respect to hours supplied.<sup>27</sup> Consequently, hours will be unilaterally determined by

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<sup>25</sup>With workers compensated for the disutility of work, the marginal gain to working is  $\omega_0(1 - \phi)$ .

<sup>26</sup>Démurger, Li, and Yang (2012) study changes in public-private sector earnings differentials for local residents in urban China between 2002 and 2007. They find that although earnings gaps between ownership decreased during this period, segmentation remained important. Job tenure remained higher at the state-owned enterprises.

<sup>27</sup>There are many ways to decentralize these trades. These include *ex post* markets for workers at different levels of

plants' demand.

Since the expected profits of an entrant depends inversely on the base wage,  $\omega_0$ , given an entry cost, the free entry condition determines the base wage. The equilibrium level of employment is determined by labor supply. Given the base wage, the equilibrium participation rate comes from finding the  $N$  such that  $\omega_0(1 - \phi)u'(\bar{c}) = \xi$  holds. The dependence of  $\bar{c}$  on  $N$  comes from the household budget constraint (10).

## 4 Estimation

The estimation of parameters for plants and households is a necessary component for the policy analysis. The procedure uses information prior to the introduction of the policies to estimate underlying parameters. Evaluating the effects of the policies pursued by the Chinese government is impossible without a structural model. Thus the estimation component is key to the policy analysis.

### 4.1 Data and Moments

The data used in this study and in Cooper, Gong, and Yan (2013b) are from Annual Surveys of Industrial Production (1998-2007), conducted by the National Bureau of Statistics (NBS) of China. The panel used in that study includes all private plants with more than five million Yuan in revenue. Private plants are identified through ownership shares.

Data moments used in the estimation are reported in the first row of Table 2. All moments except the exit rate are computed from a balanced panel of private plants in operation during the period 2005-2007.

There are a couple of key features of the data which are important in the estimation. The first is inaction: about 35% of the observations entail essentially no net change in the number of workers.<sup>28</sup> The second is the presence of significantly large employment changes. Over 20% of the observations entail job creation in excess of 20% of the workforce and over 10% have job destruction in excess of 20% of the plant work force. Yet, about 22% of the observations have job creation or job destruction rates less than 10% (in absolute value). As discussed further below, these moments are key to the estimation of the parameters of adjustment costs which, in turn, are important for analyzing policy effects.

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hours and an *ex ante* contracting model where the labor contract sets the compensation function and state contingent hours so that worker utility is the same regardless of hours worked. All of these decentralize the planner's allocation of risk and hours across plants.

<sup>28</sup>Importantly, we observe only net flows, not gross hires and fires.

Table 2: Moments for Plants

	std(r/e)	sc	JC30	JC1020	JC10	0	JD10	JD1020	JD30	xrate	$\hat{\alpha}$	$\hat{\rho}$	$\hat{\sigma}$
<b>Data</b>	0.988	0.914	0.158	0.075	0.122	0.349	0.103	0.053	0.058	0.071	0.700	0.867	0.882
Base	0.901	0.963	0.081	0.074	0.128	0.424	0.098	0.056	0.043	0.058	0.935	0.721	0.927

In this table,  $\text{std}(r/e)$  is the standard deviation of the log of revenue per worker,  $sc$  is the serial correlation in employment,  $JC30$  is a job creation rate in excess of 30%,  $JC1020$  is a job creation rate between 10% and 20% and  $JC10$  is a job creation rate greater than 0 and less than 10%. The job destruction (JD) moments are defined symmetrically. The entries are the fractions of observations with these rates of job creation and job destruction. “xrate” is the average exit rate. The last three moments are the OLS estimates of the curvature of the revenue function,  $\hat{\alpha}$ , the serial correlation of the residual from the regression,  $\hat{\rho}$ , and the standard deviation of this residual,  $\hat{\sigma}$ .

Included in the moments are the OLS estimates of the curvature of the revenue function as a function of employment as well as estimates of the stochastic process of the profitability shock.<sup>29</sup> These estimates are summarized as the last three elements in Table 2.

To be clear, these OLS estimates are not taken to be estimates of the structural parameters for two reasons. First, the OLS procedure, of course, does not control for the response of firm size to profitability shocks, thus biasing the estimate of  $\alpha$  upwards. Second, the revenue function in our model depends on hours as well as plant-level employment. Yet, hours are not measured in our data set. This will create additional bias in the estimates. As we shall see, the structural analogues of these parameters are quite different from the OLS estimates, indicative of the bias in the OLS regressions.

The model we estimate includes exit, at an average annual rate of 7.1%. The exit is induced, in part, by the overhead cost,  $\Gamma$ , but is also influenced by the discount factor,  $\beta$ . The exit rate is matched using the unbalanced panel. Following the procedures used in the creation of the data moments, a balanced panel is selected from the simulated unbalanced panel to match the moments in Table 2.

## 4.2 Procedure

The estimation procedure finds parameters to match moments using Simulated Method of Moments (SMM). The main challenge to the estimation is to match these prominent features of the data shown in Table 2. In particular some form of nonlinear adjustment costs are needed to produce this high level of inaction in employment adjustment. That same type of non-convexity can produce observations in the tails of the distribution. A major difficulty arises in matching the relatively

<sup>29</sup>This estimation conditions on year, industry, and province.



small job destruction and job creation rates since models with non-convex adjustment costs alone will usually not imply these small adjustments. Our specification of adjustment costs allows for the non-convexity to appear after a threshold of adjustment.

In addition, these moments indicate asymmetry in the distribution of firm-level employment changes. Thus our model allows for asymmetries in adjustment costs.

#### 4.2.1 Parameter Estimates

The parameters estimated by SMM are  $\Theta \equiv (\zeta, \nu, F^+, F^-, \gamma^+, \gamma^-, \beta, \Gamma, \alpha, \rho, \sigma)$ . This approach finds the vector of structural parameters,  $\Theta$ , to minimize the weighted difference between simulated and actual data moments:

$$\mathcal{L}(\Theta) \equiv (M^d - M^s(\Theta))W(M^d - M^s(\Theta))'. \quad (11)$$

There are 13 moments used to estimate the 11 parameters. So the model is slightly over identified.

The estimation method starts by solving the dynamic programming problem in (2) for a given value of  $\Theta$ . The decision rules are calculated as part of this solution. Shocks to profitability are then drawn in a manner consistent with  $(\rho, \sigma)$  in  $\Theta$ . Given these shocks and the decision rules at the plant level, a simulated panel data set is created and the simulated moments are calculated. The weighting matrix,  $W$ , is obtained by inverting an estimate of the variance/covariance matrix obtained from bootstrapping the data.

Table 2 indicates the moments used in the estimation.<sup>30</sup> The moments were intended to capture variations in the data needed to estimate key parameters that in turn, determine the effects of the policies on target variables, such as firm size, aggregate employment and productivity.

Of course, there is not a one-to-one mapping from moments to parameters: i.e. generally the simulated moments depend on all the parameters. The Appendix of Cooper, Gong, and Yan (2013a) includes a table summarizing the effects of small variations in parameter values on the simulated moments. This provides information on the nature of the identification. These responses underlie the standard errors for the estimated model, presented in Table 3.

The cross sectional distribution of employment adjustment (job destruction and creation) is informative about the various adjustment costs. The serial correlation of employment,  $sc$ , is particularly responsive to the quadratic adjustment cost parameter. The standard deviation of the log of revenue per worker,  $std(r/e)$ , is included to capture the role of employment adjustment relative

<sup>30</sup>These moments differ from those used in Cooper, Gong, and Yan (2013b) for a few reasons. First and foremost, this model includes an exit choice and thus adds an exit rate moment and a cost of operation to the vector of parameters. Second, the balanced panel was created for this analysis after the data was trimmed, not before. Therefore, the parameter estimates are slightly different as well.

to (unobserved) adjustments in hours worked. The curvature of the compensation function is identified from the standard deviation of the log of revenue per worker.<sup>31</sup> An increase in  $\zeta$  will lead to a larger variation in employment relative to hours and thus a reduction in this moment. Variations in  $\beta$  influence all the moments, particularly the standard deviation of the log of revenue per worker. When, for example,  $\beta$  is low, the future gains from firm-level employment adjustment are more heavily discounted and so the plant relies more on adjusting hours.

As noted earlier, the estimation includes the curvature of the revenue function,  $\alpha$ , as well as the parameters of the stochastic profitability process. While these parameters are directly linked to their counterparts in the OLS reduced-form regression, variations in these parameters also influence other aspects of dynamic labor demand. A decision on inaction in firm-level employment adjustment, for example, depends on the serial correlation of the shock. Likewise, large employment adjustments reflect realizations of relatively large, persistent profitability shocks.

#### 4.2.2 Other Parameters

With  $g(h) = \omega_1 h^\zeta$ , the estimate of  $\zeta$  is informative about household preferences. The other parameters of the compensation function,  $(\omega_0, \omega_1)$  are chosen to match the size distribution of plants and average hours per week of 40.<sup>32</sup>

The estimation finds parameters of the plant's revenue and cost of adjustment functions as well as other parameters to minimize the distance between simulated and data moments. This inference is based on the dynamic labor demand of plants within a general equilibrium. Once the estimation is completed, the estimates determine the cost of entry and household disutility,  $(\kappa, \xi)$ , through the equilibrium conditions.

First, the expected value to an entrant is determined in the solution of the plant dynamic optimization problem as  $E_A V(A, e_-)$  where  $e_-$  is the minimal level of employment and thus the level employment for an entrant. The cost of entry,  $\kappa$ , is set equal to this expected value of entry.<sup>33</sup>

Second, the disutility of employment  $\xi$ , is inferred from the household participation decision condition:  $\omega_0(1 - \phi)u'(\bar{c}) = \xi$ . In equilibrium, the household level of consumption  $\bar{c}$ , is determined by (10).<sup>34</sup> In China, the subsistence payments through the welfare system amount to about 30%

<sup>31</sup>We do not have direct information on hours in the data set.

<sup>32</sup>The calibration of these parameters is done outside of the SMM loop in order to establish the employment state space for the dynamic programming problem. In the baseline estimation, the range of plants by employment is [48, 1622] compared to a range in the data of [13, 1996]. This parameterization leads to an average plant that is larger than in the data.

<sup>33</sup>This approach follows Hopenhayn and Rogerson (1993).

<sup>34</sup>To determine  $\bar{c}$ , we set the participation rate at 75.10% to match the mean of labor participation rates (% of total population ages 15+) in China of 75.30 as of 2005, 75.10 as of 2006, and 74.90 as of 2007. These participation rate comes from the Mundi Index: <http://www.indexmundi.com/facts/china/labor-participation-rate>. For

of the base wage. Thus we set  $\phi = 0.30$ . Further, we assume log utility. With these inputs and estimated structural parameters, we can calculate  $\xi = 0.21$  with the baseline parameters.

### 4.3 Results

The parameter estimates are given in the first row of Table 3, along with their standard errors. Here the fixed costs of hiring and firing are in terms of average revenues. The moments for this estimated model are those reported in Table 2.

An important parameter is the estimated linear firing costs,  $\gamma^- = 0.1755$ . This is about 61% of annual average compensation paid to a worker.<sup>35</sup>

The estimated discount factor of 0.9223 is low relative to the discount factor of 0.95 assumed in many macroeconomic models. It is noteworthy that this estimated discount factor is consistent with capital market imperfections associated with private plants in China.<sup>36</sup>

The estimated fixed hiring costs were essentially zero and the linear hiring costs are small.<sup>37</sup> In fact, the estimation allows for negative hiring costs, which could be interpreted as political hiring bonuses. The presence of firing costs is important for explaining the asymmetry in the data between large labor adjustments, i.e. the nearly 16% frequency of job creation in excess of 30% relative to only 6% of job destruction in excess of 30%. The low discount factor, as explained further below, implies that hiring and firing costs are distinct.

Parameter estimates for other cases are presented in the Appendix of Cooper, Gong, and Yan (2013a).<sup>38</sup> The model with fixed and linear costs fit the data moments better than models with just hiring costs or quadratic adjustment costs alone. Accordingly, we refer to the estimates in the first row of Table 3 as the “base”.

Though the simulated moments in Table 2 appear close to the data, the difference is statistically significant. That is, the value from (11) is  $45.57 \times 10^3$  so that the hypothesis that  $\mathcal{L}(\Theta) = 0$  is soundly rejected. Given the large number of plant year observations, the moments are tightly estimated and thus the elements of the weighting matrix  $W$  are very big. Thus the  $\mathcal{L}(\Theta)$  is large though the estimated model succeeds in matching key aspects of the data.

The moments for the baseline parameters are indicated in Table 2. The estimated model does

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the policy experiments, the participation rate adjusts for fixed  $\xi$  and is determined by (10).

<sup>35</sup>This is calculated in the simulated data from the ratio of the estimate of  $\gamma^-$  to the mean wage, including compensation for extra hours, received per worker.

<sup>36</sup>See the discussion and references in Song, Storesletten, and Zilibotti (2011).

<sup>37</sup>As noted earlier, the model allows thresholds such that the fixed costs apply iff the adjustments exceed the thresholds. For this estimation, a 20% job destruction rate was used as a threshold. The resulting estimates of an essentially zero fixed hiring cost does not depend on this choice.

<sup>38</sup>That Appendix contains other tests of the robustness of our estimation results.

Table 3: Parameters Estimates and Policy Experiments

case	$\zeta$	$\nu$	$F^+$	$F^-$	$\gamma^+$	$\gamma^-$	$\beta$	$\Gamma$	$\alpha$	$\rho$	$\sigma$
base	1.1726	0.2167	-0.001	0.006	0.0209	0.1755	0.9223	1133.89	0.5612	0.9832	2.3196
se	0.002	0.004	0.007	0.003	0.002	0.001	0.003	34.310	0.001	0.000	0.017
fc	1.1726	0.2167	-0.001	<b>0.0072</b>	0.0209	0.1755	0.9223	1133.89	0.5612	0.9832	2.3196
sp	1.1726	0.2167	-0.001	0.006	0.0209	<b>0.2106</b>	0.9223	1133.89	0.5612	0.9832	2.3196
cl	1.1726	0.2167	-0.001	0.006	0.0209	0.1755	<b>0.95</b>	1133.89	0.5612	0.9832	2.3196
cl,sp	1.1726	0.2167	-0.001	0.006	0.0209	<b>0.2106</b>	<b>0.9297</b>	1133.89	0.5612	0.9832	2.3196

Here: (i) base are the baseline estimates, with standard errors (se), (ii) fc is a 20% increase of the fixed cost, (iii) sp increases severance pay by 20%, (iv) cl is credit market liberalization, (v) cl, sp combines an increase in severance pay with credit market liberalization. Additional experiments are discussed in the text. The policy changes are **bold**.

fine with matching the standard deviation of revenue per worker as well as the serial correlation of employment. The model produces a bit too much inaction and does not quite capture the job creation rates over 30%.

As noted earlier, one of the challenges for models of adjustment costs is to capture the intermediate adjustments along with the inaction and bursts of job creation and destruction. The model does match the intermediate levels of job destruction because the fixed cost of firing applies for job destruction in excess of 20%. There are essentially no hiring costs so that low job creation rates are not difficult to match. The inaction is a consequence of the linear firing costs.

One of the interesting features of the estimation results is that the asymmetric adjustment costs are able to reproduce the more symmetric distribution of job creation and destruction rates. That is, though our findings indicate the significance of firing costs, the model is still capable of matching the moments of job creation. This is partly due to the fact that hiring decisions are influenced by the prospects of firing and thus the costs associated with job destruction.

## 5 Policy Implications

We use the estimated model to study the effects of recent job protection measures. It is not possible to accurately incorporate all elements of the policy measures into our analysis. Instead, we use the policy measures as motivation for changes in various parameters. The results are indicative of the direction and magnitude of responses to these policy actions.

To do so requires us to solve for the general equilibrium of the model for given policies. As in Hopenhayn and Rogerson (1993) this reduces to two conditions: (i) free entry and (ii) labor market

clearing. Policy will influence the base wage through the effects of the interventions on the value of entry so that the free entry condition holds given the estimated value of  $\kappa$ . At the estimated  $\Theta$ , the elasticity of the value of entry with respect to the base wage is about 0.7: so there is sufficient sensitivity of this value to determine the base wage in equilibrium.

The response of the base wage to interventions also reflects the effect of the policies on the value of participating to ensure labor market clearing given the estimated disutility of employment,  $\xi$ . The effect of the labor market policies on the participation rate comes from the household budget constraint in equilibrium expressed in equation (10) and the household labor supply condition,  $\omega_0(1 - \phi)u'(\bar{c}) = \xi$ . The policy interventions will impact  $\bar{c}$  directly through net revenue and also through variations in  $\omega_0$ .

## 5.1 Policies

Here is how we go from the presentation of the Chinese policies in section 2 to changes in parameter values. These changes are summarized by the various rows of Table 3.

There are two experiments associated with changes in the fixed firing cost. One interpretation of this parameter is that it reflects administrative and political costs of large job destruction. One policy experiment, labeled “fc”, increases this fixed cost by 20%. A second, labeled “fc(10)” assumes that this fixed cost applied for job destruction above 10% rather than the 20% found in the estimation. As noted earlier, labor disputes have risen sharply under the new law, leading to increased costs of firing workers.

The policy measures include the extension and enforcement of severance pay provisions. We model this as a 20% increase in the linear firing costs. As noted earlier, the estimated linear firing cost could be interpreted as severance payment of about 7 months of average annual wages. This experiment, labeled “sp” amounts to an increase in severance pay to cover an additional 6 weeks of average wages. The main effect is on employment through the increased firing costs of a firm. As explained further below, the household participation rate responds as well.

The estimated discount factor is considerably lower than the commonly parameterized value of  $\beta$  in dynamic general equilibrium models. One interpretation, discussed in more detail in Cooper, Gong, and Yan (2013b), is that the estimated discount factor reflects capital market imperfections. The treatment labeled “cl” increases the discount factor to 0.95. This partly reflects the ongoing discussion in China, noted by Finance Minister Lou, about opening access to credit markets.

It is of interest to combine the experiments of increasing severance pay with capital market liberalization. Further, as we shall see, the effects of the policy depend on the firm’s discount factor. This experiment is labeled “cl,sp”. Here the discount factor is set at 0.9297 for reasons

discussed below.

There is an experiment associated with a 20% increase in social security payments modeled as an increase in the base wage,  $\omega_0$ . This case is labeled “ss”. This experiment captures the increased social security insurance contributions and the principle of equal pay for equal work by Article 11. Under the new law, the employer is required to contribute to the social benefits of workers on contracts.

In our model, the government receives these social security transfers from the firm. In equilibrium, these policies can influence the base wage and thus the participation decision of the household.

The enforcement of overtime provisions means that hours variation is more costly. The treatment labeled “he” increases the component of compensation associated with hours,  $\omega_1$ , by 20%.

## 5.2 Employment Effects

Table 4 summarizes the implications of the policies on plant size and productivity. The policies are listed as rows. The first two columns report average employment level, where the average is both across plants and time.<sup>39</sup> Under the heading “part.” are partial equilibrium results in which the base wage is held fixed and there is no entry nor exit. The impact of endogenous wages on entry and exit is brought out in the general equilibrium analysis, labeled “gen.”.

### 5.2.1 Labor Demand Shifts

The partial equilibrium exercise is useful for understanding the direct effect of the policies on labor demand.<sup>40</sup> Relative to the baseline, there are relatively large employment effects for variations in severance pay, credit liberalization, increases in the social security payments and the cost of varying hours. The other policy interventions, particularly the changes in the fixed cost of firing, do relatively little to labor demand.

In partial equilibrium, an increase in severance pay, the “sp” experiment leads to a 6.7% increase in employment. An increase in linear firing cost is naturally going to have two effects. One is to reduce job destruction since it is more expensive to fire workers. But, this increased cost of firing means that firms are reluctant to hire workers. Which effect dominates is not clear. Hopenhayn and Rogerson (1993) find that an increase in linear firing costs reduces employment while Bentolila and Bertola (1990) find that employment rises when firing costs increase.

<sup>39</sup>We are looking at the moments produced from a stationary allocation in which entry and exit rates balance, given the base wage.

<sup>40</sup>Cooper, Gong, and Yan (2013a) provides more details and additional exercises.

Table 4: Policy Experiments: Employment and Productivity

Policy	Employment		Productivity					
	part.	gen.	reall.	$E(p_t)$	$cov(A_{it}, s_{it})$	$E_t(std_i(arpl_{it}))$	$cov(e_{it}, arpl_{it})$	$cov(A_{it}, arpl_{it})$
base	714.56	714.56	0.098	2.724	0.724	0.683	166.234	0.782
no ac	728.76	728.76	0.486	3.525	1.700	0.000	-0.000	-0.000
fc	714.79	714.80	0.098	2.723	0.724	0.683	166.116	0.782
sp	762.05	763.85	0.078	2.644	0.620	0.690	160.047	0.809
cl	520.62	465.05	0.133	2.853	1.015	0.801	164.929	0.869
cl,sp	713.00	682.92	0.119	2.794	0.933	0.823	167.14	0.915
fc(10)	715.26	715.33	0.098	2.721	0.721	0.683	166.78	0.783
ss	652.38	714.56	0.098	2.724	0.724	0.683	166.234	0.782
he	687.27	765.40	0.073	2.616	0.597	0.594	132.779	0.698

For the employment numbers,  $E(e)$  is the mean establishment size for the partial (part.) and general (gen.) equilibrium models. For productivity, “reall.” is the mean level of reallocation, defined as the sum of job creation and job destruction. Further,  $E(p_t) \equiv E(A_{it} \times shr_{it})$  is the time-series average of the product of the profitability shock and the establishment employment share,  $cov(A_{it}, shr_{it})$  is the time-series average covariance between the profitability shock and the employment share,  $E_t(std_i(arpl_{it}))$  is the time-series average standard deviation of the average revenue product of labor,  $cov(e_{it}, arpl_{it})$  is the time-series average covariance of employment and the average revenue product of labor at the establishment and  $cov(A_{it}, arpl_{it})$  is the time-series average covariance of the profitability shock and the average revenue product of labor at the establishment.

In our model, we can trace this employment enhancing effect of an increase in linear firing costs to the high discount rate of private plants. From simulated data, when the firing cost is increased, plants experiencing relative low profitability realizations do not fire workers while those with relatively high profitability expand. The overall effect is an expansion of employment. This asymmetric response is driven by the low discount factor so that job creation responds to the current shock and the future prospects of costly job destruction are given less weight.

This point drives the effects on employment of credit liberalization, the “cl” experiment. When the discount factor rises to 0.95, employment falls since plants incorporate into hiring decisions a higher present value of firing costs.

The “cl, sp” experiment combines the “sp” treatment with a particular value of the discount factor. The idea was to illustrate the combined effect by finding the discount factor such that the employment enhancing effects of “sp” were offset. An increase of  $\beta$  from the baseline value of 0.9223 to a value of 0.9297 is sufficient to offset the employment enhancement of the increased severance pay. For the 20% increase in severance pay, if borrowing rate were lower so that  $\beta$  exceeded 0.9297, the employment would decrease rather than increase in the “sp” experiment. This experiment is also indicative of the extreme sensitivity of average employment to the discount factor.

Large employment effects arise from variations in required social security payments by employers

that are equivalent to policy induced variations in the base wage, the “ss” experiment. The 20% increase in the social security payments is associated with an employment reduction of nearly 9%: the elasticity of labor demand is about  $-0.43$ . Likewise, the employment effects of overtime provision, the “he” experiment which increases the cost of hours variation, reduces employment.

### 5.2.2 General Equilibrium Response

Comparing the partial and general equilibrium employment effects in Table 4, there are a couple of key differences brought about by the adjustment of wages. The magnitude of the equilibrium wage adjustments are shown in the first column of Table 5. Recall that the base wage influences the cost of workers directly but also impacts both the overhead and entry costs.

The “sp” experiment leads to an increase in employment in the general equilibrium model as it did in the partial equilibrium model. As seen in Table 5, increasing severance pay has a small effect on base wages.

In contrast, the adverse employment effect of the “cl” experiment is even larger in the general equilibrium model. From Table 5, this is due to the higher wages created by the increase in the firm discount factor from  $\beta = 0.9223$  to  $0.95$ .

For the “ss” experiment, the increase in the mandated social security payment is offset in the general equilibrium model leading to no change in the base wage, which is the total payment from the firm to the worker. In this way, there are no employment effects relative to the baseline. If the authorities act to prevent adjustments in wages in response to the policy, then the partial equilibrium results may be a better guide to the effects of the increase in these payments.

Finally, the reduced base wage in the “he” experiment leads to an increase in employment that actually exceeds the baseline. Here the general equilibrium response offsets the partial equilibrium effects.

The remaining columns of Table 5 summarize other policy effects. The participation rate indicates the labor supply of the household or aggregate employment. The exit margin is indicated by the fraction of plants exiting, “exit rate”, and the consequent job destruction, “JD exit”. The level of output is shown as is household welfare, computed as  $\ln(\bar{c}) - \xi N$  using the estimated  $\xi$ .

Of these experiments, credit liberalization has a large influence on these other aspects of the equilibrium outcome. The increase in the discount factor (lower interest rate) increases the base wage as well as average output (and consumption) and the participation rate is higher to maintain the household first-order condition for  $N$ . Note too that for this experiment, the exit rate and job destruction rates from exit are lower as firms are more forward looking. Further household welfare is increased.



Table 5: General Equilibrium Effects: Alternative Policies

policy	$w_0$	$\bar{w}(h)$	part. rate	E(e)	exit rate	JD exit	output	welfare
base	0.0850	0.5085	0.7510	714.56	0.0583	0.0174	0.6789	-1.4440
fc	0.0850	0.5084	0.7512	714.80	0.0583	0.0174	0.6789	-1.4441
sp	0.0848	0.4953	0.7120	763.85	0.0601	0.0208	0.6167	-1.5266
cl	0.1046	0.6383	0.8991	465.05	0.0515	0.0105	0.9738	-1.2677
cl,sp	0.0894	0.5283	0.7217	682.92	0.0583	0.0185	0.6667	-1.4766
fc(10)	0.0849	0.5077	0.7518	715.33	0.0583	0.0174	0.6789	-1.4442
ss	0.0850	0.5085	0.7510	714.56	0.0583	0.0174	0.6789	-1.4440
he	0.0713	0.4179	0.7772	765.40	0.0602	0.0214	0.5665	-1.6249

In this table,  $\bar{w}(h)$  is the average compensation paid to a worker across firms; part. rate is the participation rate; exit rate is the fraction of plants exiting and JD exit is the job destruction rate from exit; E(e) is the mean establishment size; “output” is net revenue per capita, i.e., revenue excluding fixed and quadratic adjustment costs, entry cost and operation cost. Welfare is  $\ln(\bar{c}) - \xi N$  using the estimated  $\xi$ .

The participation rate is noticeably lower in the “sp” experiment. In this experiment, the increased severance pay is treated as a transfer from firms to the government. The additional revenues could either be used to supplement the payments to non-participants or to reduce the lump sum tax on households. For the results presented here, the transfer to non-participants, denoted  $\phi$  in the household first-order condition, increases by 20%. This creates a disincentive to work so that, relative to the baseline, the participation rate is lower. The alternative with  $\phi$  constant would increase the participation rate relative to the baseline since the reduced output (and consumption) increases the marginal return to working.

Except for the “cl” case, all of the other interventions reduce welfare, particularly the “he” and “sp” interventions. They do so by limiting reallocation (strictly in some cases) and then lowering productivity relative to the baseline.

There are no risk sharing gains from these interventions. As noted earlier, the labor market outcome shields workers from risk over hours and the household redistributes across its members. Thus the analysis highlights the costs of the intervention from frictions in reallocation. Given the attention to output and productivity by policymakers in China, the focus on the output effects of the interventions is not misplaced.

### 5.3 Productivity Effects

Hsieh and Klenow (2009), Song, Storesletten, and Zilibotti (2011) and Deng, Haltiwanger, McGuckin, Xu, Liu, and Liu (December 2007) have chronicled the importance of reallocation for productivity in China. Those studies focus on the period of transformation during the 1990s and the 2000s. Our

focus, in contrast, is with the productivity implications of policy interventions. These effects arise in two principal ways. First, the policies may introduce barriers to labor mobility. This additional friction in the reallocation process can have aggregate productivity implications. Second, these policies may influence the continuation decisions of plants. The second panel in Table 4 summarizes the effects of the policy interventions on productivity. The column labels “real.” reports job reallocation rates for the simulated data. The flows are calculated from the simulated data using the same definitions as in, for example, Foster, Haltiwanger, and Kim (2006). The rates are thus weighted by plant size. As there are no aggregate shocks, the average job creation and destruction rates are equal to one-half of the reallocation rate.

We study a couple of measures of the misallocation of labor on productivity. For this discussion, it is useful to think of a large economy producing a single product with differences in productivity across plants. In this way, the reallocation is linked to total output rather than its composition.

Let  $s_{it} \equiv \frac{e_{it}}{\sum_j e_{jt}}$  be the share of employment at establishment  $i$  in period  $t$ . Then the weighted profitability in period  $t$  is given by  $p_t \equiv E(A_{it} \times s_{it})$ . As in Olley and Pakes (1996), interpret  $p_t$  as aggregate productivity and decompose it as:

$$p_t = \bar{p}_t + cov(A_{it}, s_{it}) \quad (12)$$

where  $\bar{p}$  is the unweighted mean of  $A_{it}$ . For our analysis,  $\bar{p}_t$  is effectively constant as there are no aggregate shocks and the number of plants is large.

Returning to the questions posed in the introduction, this analysis provides insights into the productivity effects of the interventions. The average weighted profitability shock,  $E_t(p_t)$ , as well as the covariance of the time-series average of the employment share and the profitability shock,  $cov(A_{it}, s_{it})$  are shown in the first two columns under productivity in Table 4. The mean of weighted profitability as well as the covariance are highest in the frictionless (“no ac”) case. Both of these terms are lower when frictions are present, indicating the misallocation of labor across establishments. Relative to the baseline, productivity losses are largest in the “sp” experiment alone and when this policy is combined with credit market liberalization. **The loss in productivity due to the increased severance pay is about 3%.**

It is also useful to study the distribution of the average revenue product of labor, denoted  $arpl_{it}$ . In a frictionless world, the distribution of the marginal revenue product of labor and thus, using our model, the average revenue product of labor is degenerate. This is seen by the “no ac” row in Table 4. But frictions in labor adjustment change this distribution and its covariance with employment and profitability.

As a basis of comparison, according to our estimates, eliminating existing labor market frictions

(i.e. comparing the baseline and no adjustment costs cases) in China would increase productivity by about 30%. This is at the lower end of the interval reported by Hsieh and Klenow (2009) in their characterization of the productivity gains to China from reducing frictions to the US level.

The other rows, including the baseline, do not have a zero standard deviation of  $arpl_{it}$  nor zero covariances. These are all indicative of productivity gains to reallocation, reflecting the frictions to labor reallocation. These frictions are significantly higher in the “sp” and “cl,sp” cases. Note too that this covariance between the shock and the average revenue product of labor is positive indicating that the most profitable plants have higher than average marginal revenue products of labor. Thus, on efficiency grounds, labor should be reallocated to the more profitable plants.

For the “sp” and “he” experiments, which have large employment effects, reallocation is substantially lower, as is mean (weighted) productivity. For these two policy experiments, the covariance between productivity and employment share is lower. The “he” experiment reduces the covariance between employment size and productivity substantially. For these cases, the reduction in the covariance between plant size and productivity implies lower average productivity and hence lower output. And again the “cl” experiment increases employment weighted productivity.

## 5.4 Dynamics

The analysis thus far compares the long-term averages of two regimes. The first is created by the baseline parameter estimates. The second comes from these parameters augmented by the various policy interventions. The results on firm size, productivity and so forth provide guidance as to the long-run impact of these policies.

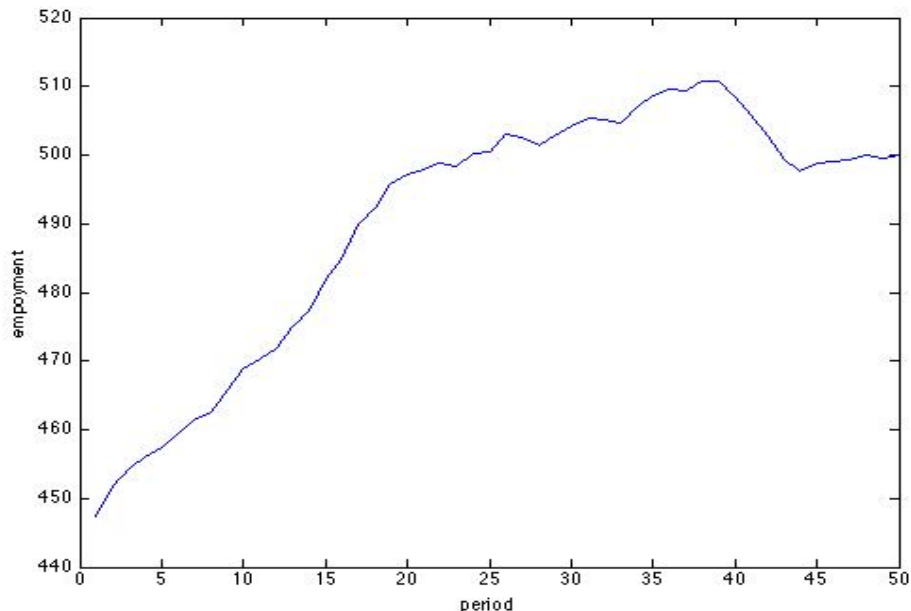
There are transitional effects that arise when the policy is first implemented. Since the increase in severance pay has the large and counterintuitive effects, we focus on the transitional dynamics associated with that policy. To do so, we simulate a panel data set under the baseline parameters. The policy change then occurs, unexpectedly. The policy change is assumed to remain in force.<sup>41</sup>

We trace out the path of average firm size for 50 periods in Figure 1. In contrast to the moments presented in Table 4, the employment size is not for a balanced panel. Instead, employment in Figure 1 is computed from averaging across plants that might subsequently exit. Hence employment is lower in this figure compared to that in Table 4. Wages are held fixed at their baseline since, as shown in Table 5, the base wage does not change across steady states under the “sp” intervention and so is unlikely to change much in the transition.

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<sup>41</sup>Of course one could introduce the policy change itself into the model using a two-state Markov process. The experiment we study is one where the two states are permanent which, by continuity, will be close to the responses when the transitions between states are close to zero.

Figure 1: Mean Employment Transitional Dynamics: Severance Pay Increase



The series come from the “sp” experiment. The policy is introduced permanently in period 0. The figure displays average employment during the transition to the new steady state.

In the initial period, the policy is not in force and the average level of employment is about 445 workers. Average firm size is closer to 500 by the end of the simulation period for the “sp” experiment.

The response to the policy in the first twenty periods is striking. Employment grows rapidly. At the estimated discount factor, plants with positive profitability shocks respond more to the current positive gains of adding workers, discounting the higher future firing costs. Yet those plants with relatively low profitability do not fire due to the higher severance payments. Thus employment increases rapidly when the policy is first introduced.

## 6 Growth and Reallocation: 1998-2007

This section focuses on the interaction of growth and reallocation in China. The first part re-estimates the model over this longer period in which growth in China was heavily influenced by reallocation, as stressed by Hsieh and Klenow (2009). As a counterfactual exercise, we calculate what China’s output would have been had the labor protection policies been imposed in 1998 rather than ten years later.

## 6.1 Reestimation

We extend our model to accommodate balanced growth and estimate it using data from 1998-2007. Assume that the efficiency of labor grows at a constant gross rate per year,  $g$ , to capture the growth of human capital or education attainment in China.

Table 6 shows the changes of average employment, revenue and value added for private plants from 1998 to 2007. The average employment decreased 0.94% per year, although plant's average revenue increased significantly. Both revenue and value added grew at an annual rate of around 10.5%. Therefore, we set  $g$  equal to 1.105. Importantly, growth in China was not in terms of larger plants but rather in the number of plants.

Table 6: Average Employment and Revenue: 1998-2007 unbalanced panel

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	Growth Rate
Employment	213	238	222	222	220	221	196	208	199	192	-0.94%
Revenue	46257	49807	54614	52759	56456	64150	58923	68112	87033	108184	10.45%
Value Added	12300	13640	14596	14288	15208	17048	15329	18280	23350	28815	10.52%

Notes: Revenue and added value are in 1,000 RMB and adjusted to 2005 level.

Table 7 shows the moments from 1998-2007 data. Compared to the moments in 2005-2007 data, the longer sample displays a lower inaction rate. The other moments including the exit rate are very close between these two data sets.

Because there is no growth in employment per plant, the moments of employment changes and employment correlations simulated from the model are consistent with data moments.<sup>42</sup> There is no need to detrend these variables.

We construct a balanced growth path where the profitability shock,  $A$ , grows at rate  $g$ . Both revenue and consumption grow at this same rate. Employment and hours do not grow.

The fixed cost of operation and entry cost are denominated in the efficiency units of labor, accordingly. The specification of adjustment costs defined in terms of the number of workers implies the same functional form as above. The discount factor used by the plant is modified in two ways. First, the consumption growth implies that the discount factor becomes  $\frac{\beta}{g}$ . Second, removing growth from the profitability shock implies that  $g$  factors from the value function. As a consequence, the plant continues to discount at rate  $\beta$ .<sup>43</sup> With this construction, the growth rate factors out and the

<sup>42</sup>These moments include the inaction rate, job creation and destruction rates (JC10, JD10, JC1020, JD1020, JC30, JD30), serial correlation in employment (sc).

<sup>43</sup>The plant's exit decision depends on whether the value if it continues in operation is smaller than the value of exit. The value of the continuing plant grows at the rate  $g$ . Because the value of exit is 0, the growth doesn't affect

value of a continuing plant is again given by (2).

The log of revenue per worker can be expressed as

$$\ln\left(\frac{R}{e}\right) = \ln(\tilde{R}) - \ln(e) + t \ln(g) \quad (13)$$

where  $\tilde{R}$  is revenue,  $R$ , taking out growth of  $g^t$ . The standard deviation of the log of revenue per work,  $std(r/e)$ , is generated through two steps to take out of growth. First, we calculate the standard deviation of  $\ln(R/e)$  each year from 1998 to 2007. Second, we calculate the time series average of these standard deviations. Because  $t \ln(g)$  is constant across plants in a given year, the standard deviations calculated in the first step remove the growth effect on revenue per worker. Therefore, the data moment of  $std(r/e)$  is consistent with its model counterpart.

The OLS estimate of the curvature of the revenue function,  $\hat{\alpha}$ , is generated by regressing  $\ln(R) - t \ln(g)$  on employment and a constant, where  $t$  is 0 for year 1998, 1 for year 1999, etc. So, the effects of growth are removed for the moment  $\hat{\alpha}$ . The moments  $\hat{\rho}$  and  $\hat{\sigma}$  characterize the AR(1) process of the residual from the regression. Growth effects have been removed from this residual.

Table 7: Moments for Private Plants:  
2005-2007 Data Compared with 1998-2007 Data

	std(r/e)	sc	JC30	JC1020	JC10	inaction	JD10	JD1020	JD30	xrate	$\hat{\alpha}$	$\hat{\rho}$	$\hat{\sigma}$
<b>2005-2007 data moments and simulated moments</b>													
Data	0.988	0.914	0.158	0.075	0.122	0.349	0.103	0.053	0.058	0.071	0.700	0.867	0.882
Model	0.901	0.963	0.081	0.074	0.128	0.424	0.098	0.056	0.043	0.058	0.935	0.721	0.927
<b>1998-2007 data moments and simulated moments</b>													
Data	1.005	0.879	0.165	0.090	0.127	0.270	0.125	0.079	0.048	0.076	0.766	0.843	0.858
Model	0.777	0.920	0.100	0.110	0.135	0.319	0.093	0.084	0.049	0.075	0.958	0.564	0.791

Notes: std(r/e) is the standard deviation of the log of revenue per worker, sc is the serial correlation in log employment, JC30 is a job creation rate in excess of 30%, JC1020 is a job creation rate between 10% and 20% and JC10 is a job creation rate greater than 0.1% and less than 10%. The job destruction (JD) moments are defined symmetrically. The entries are the fractions of observations with these rates of job creation and job destruction. Inaction is labor growth between -0.1% and 0.1%. "xrate" is the average exit rate. The last three moments are OLS estimates of the curvature of the revenue function,  $\hat{\alpha}$ , the serial correlation of the residual from the regression,  $\hat{\rho}$ , and the standard deviation of this residual,  $\hat{\sigma}$ . The effects of growth have been removed from all moments.

Table 8 presents the parameter estimates. The simulated moments from the model are presented in Table 7. As seen, the estimated parameters are very close to those from 2005-2007 data. Interestingly, the  $\beta$  estimate is about the same as from the 2005-2007 sample.

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the exit decision for the plant.

Table 8: Parameters Estimates

$\zeta$	$\nu$	$F^+$	$F^-$	$\gamma^+$	$\gamma^-$	$\beta$	$\Gamma$	$\alpha$	$\rho$	$\sigma$
<b>Estimates and standard errors from 2005-2007 data</b>										
1.1726	0.2167	-0.001	0.006	0.0209	0.1755	0.9223	1133.89	0.5612	0.9832	2.3196
0.002	0.004	0.007	0.003	0.002	0.001	0.003	34.310	0.001	0.000	0.017
<b>Estimates and standard errors from 1998-2007 data</b>										
1.2904	0.2923	0.0035	0.0164	0.0068	0.1351	0.9233	1410.38	0.5548	0.9762	2.5595
0.037	0.025	0.001	0.009	0.002	0.015	0.007	120.612	0.002	0.001	0.048

Notes: Standard errors are given below the parameter estimates.

## 6.2 Counterfactual

Given the observed experience over the 1998-2007 period, we consider the counterfactual of what productivity in China would have been if the increased severance pay provision had been in force in 1998 rather than 2008. This exercise provides a measure of the cost of this intervention in terms of productivity and output.

To do this, we use the estimates reported in Tables 8 and simulate a panel covering the 1998-2007 period. A counterfactual is created by increasing the linear firing cost by 20% in 1998 and studying the response of the economy in terms of output, productivity and reallocation as a consequence of the increased barriers to labor mobility.<sup>44</sup> Clearly these measures would have reduced productivity in China over this period, the quantitative question is by how much.

Figure 2 illustrates the output cost of the increased firing cost in 1998. Specifically, the figure shows detrended output under the policy. In the absence of the policy, output would remain at the 1998 level throughout the period.

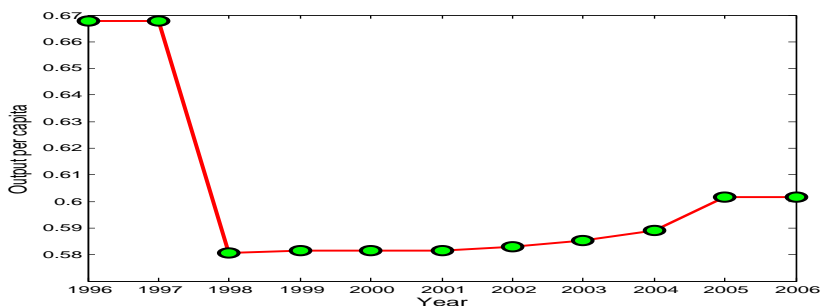
As is clear from the figure, relative to the baseline, output falls by 13% when the policy is introduced. Even after 9 years, output remains over 10% below its 1997 level due to the increased firing costs.

## 7 Response to Reallocation Shocks

The final exercise focuses on the role of the labor law in limiting the response of the Chinese economy to reallocation shocks. From Hsieh and Klenow (2009), the dispersion of total factor productivity, both measured using quantities and revenues, is significantly larger in China than in the US. The

<sup>44</sup>As in Hsieh and Klenow (2009), the frictions to reallocation impact the level but not the underlying growth of output.

Figure 2: Output Response to Policy in 1998



The series comes from simulating the model estimated for the 1998-2007 period, with linear firing costs rising by 20% in 1998.

dispersion fell between 1998 and 2005 but remains substantial.

In fact, the distribution of shocks faced by producers can be influenced by events and policy decisions. Over the recent decade, many events, such as China's WTO entry in 2001, have led to the opening up of the economy. This reduction of trade barriers operates as a reallocation shock as it leads to flows of labor to exporting from non-exporting plants as well as the exit of less productive plants.

The resulting trade opportunities from the reduction of barriers have surely enhanced growth. But at the same time, the Chinese economy has been subject to a wider variety of shocks. The impact of the financial crisis in advanced Western economies on Chinese manufacturing is a leading example.

While trade is a leading source of reallocation shocks, there are certainly others. As emphasized by Bloom (2009) and others, there is significant time series variation in uncertainty, driven in part by variations in the volatility of shocks.

The issue is how the introduction of frictions in the reallocation process influences the response of China to these variations. Instead of studying individual events, we consider the effect of changes in the distribution of profitability shocks on the Chinese economy. In particular, we study the effects of a permanent mean preserving spread in this distribution. The increased dispersion of profitability leads to an increase in output and productivity as resources are shifted to more productive uses.<sup>45</sup> Yet the labor laws, by limiting this reallocation, reduce the productivity gains from increased dispersion.

<sup>45</sup>The uncertainty effects emphasized in Bloom (2009) are not present. The analysis focuses on the gains to greater dispersion in profitability.



Table 9 presents our findings for employment and productivity. The row labeled “base” is the baseline model described above. The row labeled “mps”, i.e. mean preserving spread, takes the baseline and increases the standard deviation of the innovation of the shocks by 20%. This is permanent and known to all agents; i.e. there is no uncertainty added to the analysis, only potential gains to reallocation.

The last two rows add important elements of the labor laws: severance payments and then these payments combined with capital market liberalization. By focusing on these cases, we can see the main forces at work in the interaction between the costs and benefits of reallocation.

Comparing the baseline to the “mps” treatment, the added dispersion increases reallocation by about 49%. Overall productivity,  $E(p_t)$  increases by about 22%. Plant size is lower as (not reported) the base wage is higher in response to the increased value of operating a plant when there is more variance in the shocks.

The increase in the severance pay reduces the reallocation rate though it remains higher than the baseline. Accordingly the productivity gain from the increased dispersion is not as large.

If the severance pay is coupled by capital market liberalization, then reallocation is again enhanced. In this case, the productivity gains are large. Interestingly, this case has the largest dispersion in the average revenue product of labor, indicating that further gains from reallocation remain.

Table 9: MPS results

Policy	Employment		Productivity				
	$E(e)$	reall.	$E(p_t)$	$cov(A_{it}, s_{it})$	$E_t(std_i(arp;_{it}))$	$cov(e_{it}, arpl_{it})$	$cov(A_{it}, arpl_{it})$
base	714.563	0.098	2.724	0.724	0.683	166.234	0.782
mps	667.599	0.146	3.291	1.20	0.888	258.69	1.199
mps, sp	685.347	0.128	3.207	1.106	0.902	259.76	1.249
mps,sp,cl	504.401	0.163	3.373	1.287	1.056	253.965	1.416

The “mps” treatment increases the standard deviation of the innovation of the shocks by 20%. The row “mps, sp” increases the dispersion as well as introduces linear firing costs. The row “mps,sp,cl” adds credit market liberalization.

## 8 Direct Evidence on Policy Effects

This section presents the evidence of the effects of labor regulations on employment following the implementation of the New Labor Contract Law in January 1, 2008. We analyze data from 2007 and 2008 to evaluate the model’s prediction that plants who discount the future more respond to

the increase in severance pay by increasing employment.

Table 10: Summary of Key Variables: 2007-2008 Data

Variable	Subsample 1		Subsample 2: Private	
	Private	State-Controlled	Domestic	Foreign
1. <i>Sample in 2007</i>				
Mean employment	139.51 (179.51)	560.37 (929.91)	123.93 (131.23)	283.10 (384.29)
Mean wage	18.10 (14.82)	27.30 (22.75)	16.95 (12.88)	29.67 (24.67)
Mean welfare payment	2.08 (3.67)	2.77 (4.91)	1.99 (3.35)	2.92 (5.72)
No. of plants	193,778	16,121	174,813	18,965
2. <i>Sample in 2008, excluding closed plants</i>				
Mean employment	137.96 (169.59)	550.63 (877.22)	122.78 (125.32)	274.08 (354.00)
Mean wage	23.63 (20.56)	32.03 (25.93)	22.37 (18.98)	34.55 (28.84)
Mean welfare payment	2.65 (5.66)	3.51 (6.28)	2.54 (5.48)	3.65 (6.98)
No. of plants	179,780	14,565	161,916	17,864
Exit rate	7.22%	9.65%	7.38%	5.81%

*Notes:* All monetary terms are in 1,000 RMB, deflated to 2007 level. The welfare payment includes health insurance, special contribution award, year-end bonus, subsidies for low income family, etc. Standard errors are given in parentheses.

Of course, in any comparison of 2007 and 2008, it is necessary to control for changes in other economic variables, such as wage changes, to isolate the effects of the policy. The approach studies the behavior of plants with lower discount factors **relative** to those who are less likely to be credit constrained. The estimates reported in Cooper, Gong, and Yan (2013b), which studies both private and public plants, suggest that public plants as well as foreign private plants discount the future much less than domestic private plants.<sup>46</sup> Building on this evidence, we analyze two subsamples categorized by ownership, each consisting of two groups: private plants *vs.* state-controlled firms, and domestic private plants *vs.* foreign private firms.

The hypothesis is that the change in employment induced by the severance pay component of the policy will be larger for plants with lower discount factors, such as domestic private firms. So other changes across these two years would, under this hypothesis, have no effect on differences in behavior between the types of firms.

Table 10 summarizes several key variables in the data, generated from the Annual Survey of Industrial Production. The 2007 survey, used in the estimation, is supplemented by data from

<sup>46</sup>On the differential incidence of credit constraints, also see empirical studies such as Poncet, Steingress, and Vandebussche (2010) and Hale and Long (2010).

2008. We follow the plants in 2007 to 2008. We take account of employment changes at the closed (producers that exited) plants to analyze the overall effect of labor regulations on labor demand.

Table 10 shows that average employment of plants decreased after the implementation of New Labor Contract Law. The average employment, excluding closed plants, decreased slightly, while the average employment for state-controlled plants and foreign plants decreased significantly. In the meantime, there is a large increase in wages paid by private (30%, and 32% for domestic private) firms. The corresponding increase in wages for state-controlled plants and foreign plants is 17% and 16%, respectively. The percentages of welfare payment (e.g. health insurance and bonuses) increase are relatively close, around 27% with domestic private plants having increased most. The exit rate for private plants increased a little, from 7.14% averaging between 2005 and 2007 to 7.22% in 2008.

We use the following reduced form regression model for our estimation:

$$\Delta e_i = \varphi_0 + \varphi_1 HCC_i + \varphi_2 X_i + \varepsilon_i \quad (14)$$

where  $\Delta e_i$  is the change in employment from year 2007 to year 2008 at firm  $i$ ,  $X_i$  is a set of control variables of firm  $i$ , and  $HCC_i$  is a dummy variable that equals 1 if firm  $i$  faces high credit constraint (i.e., belongs to group 1 in Table 10).

Tables 11 and 12 report the estimation results. In Table 11, we restrict our analysis to the set of plants with available employment in both years of 2007 and 2008. In Table 12, we take account of employment changes at the closed plants, setting their employment in 2008 to 0. The model in column (i) does not control for any set of firm characteristics. We introduce set of control variables in the models (ii)-(v): change in wage, change in wage and welfare (i.e. fringe benefits), dummies for industries, and dummies for regions. We do not observe wage and welfare payment data for those closed firm in 2008. To calculate the change of wage (the change of wage and welfare), we set the wage (wage and welfare) in 2008 to the mean wage (wage and welfare) per capita, averaging across all plants that continued in operation in 2008. This mean wage (wage and welfare) proxies for the wage (wage and welfare) of the closed plants.

The estimates in the simple model (i) of Table 11 imply a significant increase in size for private (and domestic private) plants relative to state-controlled plants (and foreign private plants). Taking account of the closed plants, as reported in Table 12, results in a larger increase in labor demand for private plants relative to state-controlled firms. This is because the closed state-controlled plants are much larger than the closed private firms. However, taking account of the closed plants adds little to the amount of increase in employment for domestic private firms. Introducing control variables in models (ii)-(v) implies that the private and state-controlled comparison and the domestic private and foreign comparison are similar, whether or not we exclude the closed plants.

## 9 Conclusion

This paper studies the effects of labor market policies in China on the employment, productivity and welfare. Using a model of dynamic labor demand estimated from moments prior to the introduction of policy measures, we characterize the impact of these new labor regulations.

There are a couple of key findings. First the policy of increased severance payments has a sizable impact on plant size, employment, productivity and welfare. Since we estimate a relatively low discount factor, the increase in severance pay leads to an increase in average firm size. This policy also leads to a higher covariance between productivity and average labor productivity, which is indicative of a less efficient cross-sectional allocation of labor services. This intervention is welfare reducing.

Second, credit market liberalization would induce a reduction in plant size once plants discount future firing costs less heavily. This policy is welfare improving.

The analysis studies the interaction between these interventions. This interaction is important for policymakers to recognize. We find that the plant size increase from a severance pay increase is reduced when this policy is combined with a slight degree of credit market liberalization.

Finally, the job protection measures limit growth and the ability of the Chinese economy to take advantage of shocks to the distribution of productivities. If the job protection measures, particularly the severance pay provision of increasing linear firing costs by 20%, had been enacted in 1998, output would have been lower by 10% a year.

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Table 11: Reduced-Form Estimation Results for Change in Employment, Excluding Closed Plants

Independent variable	Subsample 1					Subsample 2				
	(i)	(ii)	(iii)	(iv)	(v)	(i)	(ii)	(iii)	(iv)	(v)
HCC dummy	9.13 (2.67)	11.58 (3.26)	12.37 (3.28)	16.93 (3.47)	16.20 (3.53)	11.82 (1.30)	14.33 (1.48)	14.65 (1.51)	11.55 (1.43)	11.84 (1.45)
Change in wage <sup>a</sup>	-	0.0016	-	-	-	-	0.0011	-	-	-
Change in wage and welfare <sup>b</sup>	-	(0.0006)	-	-	-	-	(0.0006)	-	-	-
Controls for industry <sup>c</sup>	no	no	no	yes	yes	no	no	0.0011	0.0011	0.0011
Controls for region <sup>d</sup>	no	no	no	no	yes	no	no	(0.0006)	(0.0006)	0.0006

*Notes:* Standard errors are given in parentheses. All models include an unrestricted constant (not reported).

<sup>a</sup> The change in per capita annual wage from year 2007 to 2008.

<sup>b</sup> The change in per capita annual wage plus welfare payment from year 2007 to 2008.

<sup>c</sup> Dummy variables for 519 industries (4-digit) are included.

<sup>d</sup> Dummy variables for 30 provinces are included.

Table 12: Reduced-Form Estimation Results for Change in Employment,  
Setting employment at Closed plants to 0

Independent variable	Subsample 1					Subsample 2				
	(i)	(ii)	(iii)	(iv)	(v)	(i)	(ii)	(iii)	(iv)	(v)
HCC dummy	51.64 (3.81)	55.24 (4.11)	56.25 (4.13)	57.97 (4.37)	58.48 (4.49)	11.74 (1.24)	13.08 (1.36)	13.37 (1.38)	11.54 (1.33)	12.19 (1.35)
Change in wage <sup>a</sup>	-	0.0017	-	-	-	-	0.0012	-	-	-
Change in wage and welfare <sup>b</sup>	-	(0.0007)	-	-	-	-	(0.0007)	-	-	-
Controls for industry <sup>c</sup>	no	no	no	yes	yes	no	no	0.0012	0.0012	0.0012
Controls for region <sup>d</sup>	no	no	no	no	yes	no	no	(0.0005)	(0.0005)	0.0006

*Notes:* Standard errors are given in parentheses. All models include an unrestricted constant (not reported).

<sup>a</sup> The change in per capita annual wage from year 2007 to 2008. For plants closed in 2008, the wage in 2008 is set to the mean annual wage per capita, averaging across all plants which were in operation in 2008.

<sup>b</sup> The change in per capita annual wage plus welfare payment from year 2007 to 2008. For plants closed in 2008, the wage plus welfare in 2008 is set to the mean per capita wage plus welfare payment, averaging across all plants which were in operation in 2008.

<sup>c</sup> Dummy variables for 519 industries (4-digit) are included.

<sup>d</sup> Dummy variables for 30 provinces are included.