Employment protection and the market for innovations*

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Abstract

Can employment protection increase innovations and decrease output at the same time? To answer this question we develop an equilibrium matching model with an imperfect labor and innovation market. We calibrate our model to match US labor and product market statistics. We then take the calibrated model, switch on employment protection and show that our comparative static results are in line with the estimated impact of the adoption of wrongful dismissal laws in 13 US states on total factor productivity and innovation found in the literature. Our calibration results suggest that employment protection decreases output and total factor productivity despite the fact that it shifts economic activity towards innovaton.

Keywords: Employment protection, firing costs, innovations, patents, total factor productivity, market imperfections.

JEL-Classifications: J64, J65, O31, O38

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1 Introduction

Job security is among the two most highly ranked job aspects that employed workers in OECD countries are concerned about (see Clark (2005)) and innovations are regarded as one of the most important drivers of economic growth. This opens up the question, whether employment protection and high economic growth are compatible?

Recent theoretical and empirical studies on employment protection have shown that employment protection can increase innovations and investment in firm-specific human capital.[1] This suggests that employment protection and high growth can be achieved at the same time. There is, however, contradicting evidence that shows that employment protection decreases productivity, which questions the positive effect of employment protection on growth.[2] To answer the question whether employment protection accelerates or slows down economic growth, we develop an equilibrium matching model with an imperfect labor and innovation market. We calibrate our model without employment protection to match aggregate US labor and product market statistics as well as aggregate firm exit and entry rates following Shimer (2005) and Kaas and Kircher (2011) . We then take the calibrated model, switch on employment protection and show that our comparative static results are in line with the estimated impact of wrongful dismissal laws on total factor productivity and innovations found by Autor, Kerr, and Kugler (2007) and Acharya, Baghai, and Subramanian (2014) , who exploit the fact that from 1970 to 1999 13 US states introduced wrongful dismissal laws by recognizing the so-called "good-faith" exception to the employment-at-will doctrine. Given that our calibration matches these empirical findings we investigate the equilibrium effect of adopting a wrongful dismissal law on total output

[1] Akerlof (1984) , Soskice (1997) , Zoega and Booth (2003) , Belot, Boone, and Ours (2007) , Pierre and Scarpetta (2004) , Wasmer (2006) and Acharya, Baghai, and Subramanian (2014) among others have shown that employment protection can have positive effects on productivity. The channel is through an increase in job duration, which provides an incentive for workers and firms to invest more in firm-specific capital and innovations.

[2] Negative productivity effects from inefficient labor reallocation have been found by Hopenhayn and Rogerson (1993) , Griliches and Regev (1995) , Olley and Pakes (1996) , Foster, Haltiwanger, and Krizan (2001) , Disney, Haskel, and Heden (2003) , Baldwin and Gu (2006) and Bartelsman, Haltiwanger, and Scarpetta (2009) among others.

and welfare (net output).

We find that the adoption of a wrongful dismissal law decreases total output and welfare despite the fact that the number of innovations increases. The calibrated increase in innovations is in the same range as the increase in patent citations estimated by Acharya, Baghai, and Subramanian (2014) two years after the adoption of wrongful dismissal protection. Our calibration also predicts that total factor productivity decreases, which is consistent with the findings by Autor, Kerr, and Kugler (2007) . How does our model reconcile that total factor productivity decreases while innovations increase? To see this we have to investigate how employment protection affects innovations on the one hand and total factor productivity, i.e., output net of labor and capital input, on the other hand.

The introduction of employment protection implies that firms continue to employ workers even if their productivity has temporarily dropped. This increases labor input although part of it is not productive. This traditional misallocation channel tends to decrease profits, job creation and firm entry. However, the higher cost implied by employment protection also increases firms' willingness to pay for product ideas which allow them to productively reemploy their workers. This increases the price for innovations, which triggers entry of new start-ups and the creation of new innovation establishments. This explains the increase in innovations caused by employment protection. In our calibration the innovation effect dominates the misallocation effect and leads to an increase in the number of establishments. We interprete the increase in the total number of establishments as an increase in captial input. In addition, our model predicts a slight decrease in output for two reasons. First, employment per establishment decreases due to the higher cost for labor caused by employment protection. Second, the imperfections on the innovation market imply that the higher number of innovations cannot be immediately used in production. Thus, the increase in labor and captial input that does not lead to an increase in output can explain the decrease in total factor productivity despite the fact that the number of innovations increases.

We model the innovation market as a matching market where the time to find an appropriate trading partner depends on the number of buyers to sellers in the market, and where prices are negotiated bilaterally. Firms also have the option to do their own research. The decision on whether to do own research or to acquire a new product idea on the innovation market depends on the firm specific innovation cost, which is assumed to be heterogenous across establishments. Firms with high innovation cost will decide to buy new product ideas, firms with low innovation cost will decide to specialize in innovation and sell their product idea, and firms with intermediate innovation cost decide to do their own research.

The innovation market (or market for new product ideas) is thought to encompass the markets for start-up acquisitions, patent licenses, and the internal trade of patents and innovations within large firms. We thereby follow Rhodes-Kropf and Robinson (2008) , who also model the manyfold imperfects on the mergers and acquisitions market as matching frictions. The empirical work on the patent licensing market by Arora and Ceccagnoli (2006) , Fosfuri (2004) and Gambardella, Giuri, and Luzzi (2007) among others also suggests that there are significant transaction costs, which we intend to capture with our matching framework. The market for innovations also includes the internal trade of patents or innovations within large firms, where frictions and inefficiencies are generated by the fight for internal resources as a growing literature shows, e.g. Xuan (2009) , Graham, Harvey, and Puri (2011) and Duchin and Sosyura (2013) .

Our calibration results are also in line with a number of other empirical findings on the same natural experiment in the US. The positive effect of employment protection on the number of establishments is in line with the finding by Acharya, Baghai, and Subramanian (2014) that the adoption of wrongful dismissal laws increases the number of establishments, especially start-ups. At the same time, we find that the number of producing firms decreases, especially those that do their own research if they are without a product idea. This can explain why Autor, Kerr, and Kugler (2007) observe a decrease in the number of entering plants in the manufactoring sector. Autor, Kerr, and Kugler (2007) investigate also the impact of employment protection on a firm's capital and labour input choice. They find that firms located in states that adopted the wrongful dismissal laws increase capital investment and employment, mainly high skilled employment, with the overall effect of a rise in the capital-labor ratio. MacLeod and Nakavachara (2007) , who investigated the same natural experiment, also found a similar increase in high skilled employment. In our model we only have production workers, product ideas and establishments in the aggregate production function. If we assume that high skilled workers generate product ideas with constant returns to scale, then the calibrated increase in the number of establishments that innovate can be interpreted as an increase in high skilled employment. Similarly, if we assume that capital is proportional to the number of establishments in the economy, then the higher number of establishments in the steady state with employment protection can be interpreted as an increase in capital. Our calibration is also consistent with a rise in the capital-labor ratio, if we proxy the capital stock by the number of establishments and labor by production workers. The calibrated decrease in the number of production workers per establishment and the increase in total employment of production workers is also consistent with a higher capital-labor ratio. Our calibration also suggests an increase in total employment, which is consistent with the finding by Autor, Kerr, and Kugler (2007) but contradicts the findings by Autor et al. (2006), who find a negative effect of the so-called "implied contract" exception to the employment at will doctrine on state level employment.

The papers that are theoretically most closely related to ours are Wasmer (2006) and Bartelsman, Gautier, and De Wind (2010) . Both papers investigate the effect of employment protection in an equilibrium matching model to explain differences between the US and Continental Europe. Wasmer (2006) investigates the effect employment protection has on the type of human capital investment undertaken by workers and firms. He shows that a rigid labor market (Europe) creates – through the increase in job duration – an incentive for workers and firms to invest more in firm-specific human capital, while a flexible labor market (US) with high mobility creates incentives only for workers to invest in general human capital. In general the two regimes cannot be Pareto-ranked, since the higher productivity associated with firm-specific human capital might compensate the costs associated with employment protection. Bartelsman, Gautier, and De Wind (2010) consider an equilibrium matching model, where under employment protection firms are less likely to adopt a high-risk and high-return technology and more likely to adopt a low-risk and save technology. They calibrate the model to explain the slowdown in productivity in Europe relative to the US in the mid-1990s. Our paper differs from Wasmer (2006) and Bartelsman, Gautier, and De Wind (2010) , since we focus on the imperfections of the innovation market and its implications for the effect of employment protection on (net) output. We show that the imperfections on the innovation market are able to reconcile the empirical finding that the introduction of employment protection in 13 US states goes along with an increase in innovations and a decrease in total factor productivity.

The paper is structured in a theory part in section 2 and the calibration part in section 3. In the theory section we first present the framework, derive the value functions for workers and firms and present the bargaining setup for the labor and the innovation market (section 2.1 to 2.3). In section 2.4 we derive the vacancy creation and firing conditions, present the wage outcomes, the product idea price and determine the optimal specialization decision of firms. Section 2.5 analyses the steady state flows of firms and workers and section 2.6 presents the equilibrium. In section 2.7 we derive the innovation-, total factor productivity-, and welfare-measures necessary to compare our calibration results with the empirical findings of Autor, Kerr, and Kugler (2007) and Acharya, Baghai, and Subramanian (2014) . Section 3.1 discusses our parameter choices for the calibration and in sections 3.2 and 3.3 we discuss the effects of the introduction of employment protection on innovations, total factor productivity and welfare first without and then with the channel of the innovation market. Section 4 concludes.

2 Theory

2.1 Framework

The model has an infinite horizon, is set in continuous time and concentrates on steady states. All agents are risk neutral and discount the future at rate r. The economy is populated by a unit mass of homogenous workers and an endogenous mass m of establishments.

In the paper we may also refer to an establishment as a firm.

Firms choose to become one of the following types $t \in \{B, R, S\}$. Type S firms innovate, if they do not have a product idea, and once they have generated a product idea, they sell their product idea on the innovation market. Type B firms produce, if they have a product idea, and search on the innovation market for a new product idea, if they are without a product idea. Type R firms produce if they have a product idea and do their own research if they are without a product idea.

Production requires labor and a product idea. The production function is given by $y_i F(N_i) = y_i N^\alpha$, where y_i equals y if firm i possesses a product idea and 0 otherwise. All producing firms produce the same homogenous good with prices normalized to one. Alternatively, we can think of the production function as being the revenue function where each firm sells its product in a monopolistic competitive market.

A producing establishment is assumed to loose its product idea at the exogenous rate δ. Thus, $1/\delta$ can be interpreted as the life-cycle of a product. Once without a product idea the establishment can either decide to do own research, which generates a new product idea at the exogenous rate η at cost k_i, or to acquire a new product idea from a firm that specializes in innovation. The innovation market or market for new product ideas is characterized by matching frictions, with a constant return to scale matching function, which satisfies the usual Inada conditions. The market tightness in the innovation market is defined as the ratio of firms looking for a product idea (B for buyers) to the firms that specialize in innovation and sell their product ideas on the innovation market (S for sellers), i.e., $\varphi = B/S$. Firms that sell their product idea are matched at rate $\varphi g(\varphi)$ with a firm that looks for a product idea and firms that look for a product idea contact a seller at rate $g(\varphi)$. The properties of the matching function are such that the matching probability of a seller (buyer) increases (decreases) with the ratio of buyers to sellers, i.e., $[\varphi g(\varphi)]' > 0$ and $g'(\varphi) < 0$. The product idea price is determined by Nash-Bargaining where β denotes the bargaining power of sellers.

Innovation or research costs are firm (establishment) specific and drawn in the beginning of a firm's life. Formally, we assume that potential firms have to pay a cost F upon entry (sufficiently small to guarantee existence) in order to learn the per period, firm specific innovation cost k_i. The per period cost k_i is drawn randomly from a distribution characterized by the pdf $\gamma(k)$ and the cdf $\Gamma(k)$ on the support $[0, k_{\max}]$. For simplicity, we assume that new firms already obtain a product idea upon paying the entry cost F.

The interaction between the destruction of an establishments and the layoff decision for workers is modelled as follows. Producing firms will only consider laying off workers, if an establishment has no product idea, i.e., if it has been hit by a product idea shock δ. A firm that decides to lay off workers will have to pay firing cost f per worker. Firms can only be destroyed if they are without a product idea. Producing firms ($t = B$ or $t = R$) without a product idea can be hit by a destruction shock at rate λ_d. If workers must be laid off, because a firm is insolvent and destroyed, no firing costs are due. Type $t = S$ firms that specialize in innovation do not employ production workers and are therefore not affected by firing costs. They are hit by a destruction shock at rate λ_s. We assume $\lambda_s < \lambda_d$, in order to ensure that type S and type B and R firms are equally likely to be destroyed. To ensure this we need to assume $\lambda_s < \lambda_d$, because type S firms are on average more often without a product idea and hence vulnerable to a destruction shock as type B and R firms.

The labor market for production workers is also modelled using matching frictions. Firms hire workers by posting vacancies at the per period cost c (sufficiently small to guarantee existence). The matching function for production workers has constant return to scale and satisfies the Inada conditions. The labor market tightness is denoted by $\theta = V/U$, where V equals the number of vacancies created by all establishments and U the number of unemployed workers. The job finding rate of workers is given by $\theta\lambda_m(\theta)$ and the rate at which firms contact workers by $\lambda_m(\theta)$. The properties of the matching function are such that the matching probability of an unemployed worker (vacancy) increases (decreases) with the ratio of vacancies to unemployed, i.e., $[\theta\lambda_m(\theta)]' > 0$ and $\lambda_m'(\theta) < 0$. Wages are negotiated and renegotiated each time when the firm loses and gain a product idea. The bargaining power of workers is denoted by γ. Workers that are unemployed receive unemployment benefits z. Employed workers receive a wage $w^t(y_i, N_i)$, which depends on whether the employer has a product idea, $y_i \in \{0, y\}$, on the marginal product, i.e., on the number of workers employed N_i, and the type t of the firm.

2.2 Value functions

2.2.1 Workers

Workers can only become employed at firms that start production, since firms that specialize in innovation will not be active on the labor market for production workers. Firms that have a product idea will post vacancies and hire unemployed workers. Denote the fraction of vacancies posted by type $t \in \{B, R\}$ firms with product idea status y_i and N_i employed workers by $v^t(y_i, N_i)$. We can therefore write the value of being unemployed as,

$$rU = z + \theta\lambda_m(\theta) \sum_{t\in\{B,R\},y_i\in\{0,y\},N_i} \max\left[v^t(y_i, N_i) W^{O,t}\left(w^{O,t}(y_i, N_i)\right) - U, 0\right], \quad (1)$$

where the value of being employed at a type t firm as an outsider, i.e., as a newly hired worker (indexed by O), at the wage $w^{O,t}(y, N_i)$ is given by,

$$rW^{O,t}\left(w^{O,t}(y, N_i)\right) = w^{O,t}(y, N_i) + \delta\left(\max\left[W^{I,t}\left(w^{I,t}(0, N_i)\right), U\right] - W^{O,t}\left(w^{O,t}(y, N_i)\right)\right). \quad (2)$$

Once a worker is employed he becomes an insider, indexed by I, who is protected by employment protection. The protection through firing costs implies that insiders will receive a higher wage when wages are renegotiated. The value of being employed as an insider at a firm with product idea is given by,

$$rW^{I,t}\left(w^{I,t}(y, N_i)\right) = w^{I,t}(y, N_i) + \delta\left(\max\left[W^{I,t}\left(w^{I,t}(0, N_i)\right), U\right] - W^{I,t}\left(w^{I,t}(y, N_i)\right)\right). \quad (3)$$

The value of being employed depends on whether the surplus of the match is negative, if the firm looses its product idea. If the latter is the case, wage negotiations will fail and the worker will be laid off. However, if the surplus of a match is positive even if a product idea shock hits, wages will be renegotiated and the value of being employed changes to,

$$rW^{I,R}\left(w^{I,R}\left(0,N_i\right)\right)=\begin{cases} w^{I,R}\left(0,N_i\right)+\eta\left(W^{I,R}\left(w^{I,R}\left(y,N_i\right)\right)-W^{I,R}\left(w^{I,R}\left(0,N_i\right)\right)\right) \\ +\lambda_d\left(U-W^{I,R}\left(w^{I,R}\left(0,N_i\right)\right)\right), \quad \text{if} \quad t=R, \end{cases} \tag{4}$$

$$rW^{I,B}\left(w^{I,B}\left(0,N_i\right)\right)=\begin{cases} w^{I,B}\left(0,N_i\right)+g\left(\varphi\right)\left(W^{I,B}\left(w^{I,B}\left(y,N_i\right)\right)-W^{I,B}\left(w^{I,B}\left(0,N_i\right)\right)\right) \\ +\lambda_d\left(U-W^{I,B}\left(w^{I,B}\left(0,N_i\right)\right)\right), \quad \text{if} \quad t=B. \end{cases} \tag{5}$$

The values of being employed at a firm that has no product idea depends on the wage, on whether the firm conducts own research or searches for a product idea in the innovation market, the respective rate with which the firm finds a new product idea, i.e., η for firms that do their own research and $g\left(\varphi\right)$ for firms that buy the product idea in the market for innovation, and on the rate λ_d at which a firm without a product idea becomes insolvent.

2.2.2 Firms

Firms that decide not to sell their product idea but to start production choose their labor input by deciding on the number of vacancies V_i^t they want to post and the number of workers they want to lay off L_i^t. The equation governing the change in the number of workers employed at firm i that posts vacancies V_i^t and lays off L_i^t workers is given by,

$$\dot{N}_i^t=\lambda_m\left(\theta\right)V_i^t-L_i^t. \tag{6}$$

Thus, firms only need to post vacancies, if they want to hire new workers (in which case $V_i^t>0$ and $L_i^t=0$). If they want to lay off workers, they will post no vacancies, i.e., $L_i^t>0$ and $V_i^t=0$. Firms that want to start production will hire instantly their optimal number of workers N_i^t, by posting $V_i^t=N_i^t/\lambda_m\left(\theta\right)$ vacancies. If a firm wants to lay off workers, it will either lay off all workers or keep all workers, i.e., $L_i^t\in\{0,N_i^t\}$, since firing costs per worker are constant and the marginal product without a product idea equals zero.

The expected profit of a firm depends on its type $t\in\{S,B,R\}$, on the number of workers it employs N_i^t, on whether it has a product idea $y_i\in\{0,y\}$, and on the innovation cost k_i. We denote the expected profit of an establishment, which has a product idea and

N_i^t workers by $\pi^{O,t}(N_i^t, y_i, k_i)$, where the index O for outsider is used every time the firm has hired new workers. A new firm has to decide which type it wants to be, i.e.,

$$\max_{t\in\{S,B,R\}} \pi^{O,t}\left(N_i^t, y, k_i\right) - \frac{c}{\lambda_m(\theta)} N_i^t,$$

where $cN_i^t/\lambda_m(\theta)$ equals the expected cost of hiring a worker, i.e., the vacancy posting cost c times the number of vacancies it posts $V_i^t = N_i^t/\lambda_m(\theta)$ in order to hire N_i^t workers.

Firms that specialize in innovation will not be active on the labor market for product workers, i.e., $N_i^S = 0$. Thus, labor market conditions only enter the expected profit of a selling firm via the prices it receives for its product ideas. The expected profit of an type S establishment with a product idea that decides to sell its product idea on the innovation market is given by,

$$\begin{aligned} r\pi^S(0, y, k_i) = {}& \varphi g(\varphi) \max\left[E_{N_j}\left[p\left(k_i, N_j^B\right)\right] + \pi^S(0,0,k_i) - \pi^S(0,y,k_i), 0\right] \\ &+ \delta\left(\pi^S(0,0,k_i) - \pi^S(0,y,k_i)\right), \end{aligned} \tag{7}$$

where the price $p\left(k_i, N_j^B\right)$ that is negotiated in the innovation market will depend on the surplus that is generated. The surplus will depend on the innovation cost k_i of the seller and the number of workers employed at the buyer N_j^B. The innovation cost of the buyer does not enter the surplus, since a firm which decided to buy a product idea will also do so in the future, i.e., it will never decide to do own research. Sellers only sell their product idea, if the surplus is positive. The expected profit of a type S firm without a product idea is hence given by,

$$(r + \lambda_s)\pi^S(0,0,k_i) = -k_i + \eta\left(\pi^S(0,y,k_i) - \pi^S(0,0,k_i)\right). \tag{8}$$

The following Bellman equation characterizes the expected profit of a type B or R establishment that possesses a product idea, i.e., $y_i = y$, has innovation cost k_i, and chooses its workforce N_i^t optimally, i.e.,

$$\begin{aligned} r\pi^{h,t}\left(N_i^t, y, k_i\right) = {}& \max_{N_i^t} y\left(N_i^t\right)^\alpha - w^{h,t}\left(y, N_i^t\right)N_i^t \\ &+ \delta\left(\max\left[\pi^{I,t}\left(N_i^t, 0, k_i\right), \pi^{O,t}(0,0,k_i) - fN_i^t\right] - \pi^{h,t}\left(N_i^t, y, k_i\right)\right), \end{aligned} \tag{9}$$

for $t \in \{B, R\}$ and subject to equation (6). Note, that this equation holds for all type B or R firms regardless whether they employ outsiders $h = O$ or with insiders $h = I$. Firms that decide not to layoff their workers once a product idea shock δ hits, i.e., $L_i^t = 0$, can continue without a product idea and renegotiate the wage with their current workforce (insiders), i.e., have a continuation value $\pi^{I,t}\left(N_i^t, 0, k_i\right)$. Firms that decide to layoff their workers, i.e., $L_i^t = N_i^t$, have to continue without workers, which implies a continuation value $\pi^{O,t}\left(0, 0, k_i\right)$ and the payment of fN_i^t of firing costs.

The Bellman equations for a type R firm that decides to do own research if it is without a product idea are given by,

$$(r + \lambda_d)\,\pi^{O,R}\left(0, 0, k_i\right) = -k_i + \eta\left(\pi^{O,R}\left(N_i^R, y, k_i\right) - \frac{c}{\lambda_m(\theta)}N_i^R - \pi^{O,R}\left(0, 0, k_i\right)\right), \tag{10}$$

$$(r + \lambda_d)\,\pi^{I,R}\left(N_i^R, 0, k_i\right) = -w^{I,R}\left(0, N_i^R\right)N_i^R - k_i + \eta\left(\pi^{I,R}\left(N_i^R, y, k_i\right) - \pi^{I,R}\left(N_i^R, 0, k_i\right)\right), \tag{11}$$

with and without laying off workers, respectively. A type B firm that decides to acquire a product idea in case it is without a product idea has the following expected profit,

$$(r + \lambda_d)\,\pi^{O,B}\left(0, 0, k_i\right) = g(\varphi)\int_0^{k_{\max}} \max\left[S^B, 0\right] h\left(k_j\right) dk_j, \tag{12}$$

$$(r + \lambda_d)\,\pi^{I,B}\left(N_i^B, 0, k_i\right) = -w^{I,B}\left(0, N_i^B\right)N_i^B + g(\varphi)\int_0^{k_{\max}} \max\left[S^B, 0\right] h\left(k_j\right) dk_j, \tag{13}$$

with and without laying off workers, respectively, where the surplus for the buyer is given by,

$$S^B = \begin{cases} \pi^{O,B}\left(N_i^B, y, k_i\right) - \frac{c}{\lambda_m(\theta)}N_i^B - \pi^{O,B}\left(0, 0, k_i\right) - p\left(k_j, 0\right) & \text{if } L_i^B = N_i^B, \\ \pi^{I,B}\left(N_i^B, y, k_i\right) - \pi^{I,B}\left(N_i^B, 0, k_i\right) - p\left(k_j, N_i^B\right) & \text{if } L_i^B = 0. \end{cases}$$

The decision whether to do own research or to acquire a product idea depends on the respective success rate η or $g(\varphi)$, the level of innovation cost k_i and the expected price for the product idea. Since a firm can only buy a product idea from those firms that decide to sell their product idea, we denote by $h\left(k_j\right)$ the pdf of those firms that are willing to sell their product idea and that have innovation cost k_j (in equilibrium $h\left(k_j\right) = \gamma\left(k_j\right)/\Gamma\left(k^*\right)$, since all firms with k_j below some threshold k^* prefer to specialize in innovation and are willing to sell their product idea). The maximum operator in the integral guarantees that establishments only buy a product idea, if the surplus is positive.

2.3 Bargaining

2.3.1 Bargaining in the innovation market

The value of an establishment, which decides to acquire the product idea, depends on the number of workers it employs N_i^B, and the value of the establishment, which sells the product idea, on the innovation cost k_j. Thus, the following product idea price solves the Nash-Product, i.e.,

$$\begin{aligned} p\left(k_j, 0\right) = \arg\max_p & \left(\pi^{O,B}\left(N_i^B, y, k_i\right) - \frac{c}{\lambda_m\left(\theta\right)} N_i^B - \pi^{O,B}\left(0, 0, k_i\right) - p\right)^{1-\beta} \\ & \times \left(p + \pi^S\left(0, 0, k_j\right) - \pi^S\left(0, y, k_j\right)\right)^{\beta}, \end{aligned}$$

$$\begin{aligned} p\left(k_j, N_i^B\right) = \arg\max_p & \left(\pi^{I,B}\left(N_i^B, y, k_i\right) - \pi^{I,B}\left(N_i^B, 0, k_i\right) - p\right)^{1-\beta} \\ & \times \left(p + \pi^S\left(0, 0, k_j\right) - \pi^S\left(0, y, k_j\right)\right)^{\beta}, \end{aligned}$$

where the surplus of an establishments that buys a product idea is given by the increase in expected profits from having the product idea minus the price, and the surplus of an establishment that sells the product idea is given by the price plus the loss in expected profit from given up the product idea.

2.3.2 Bargaining in the labor market

Wages in the labor market are also determined by Nash-Bargaining. We assume intra-firm bargaining as in Smith (1999) , and Cahuc and Wasmer (2001) , Cahuc, Marque, and Wasmer (2008) among others. The worker surplus equals the value of being employed minus the outside option of being unemployed. The surplus of the establishment depends on whether it bargains with outsiders (new workers) or with insiders. If a firm is bargaining with outsiders the surplus is given by the marginal value of an additional worker. If an old firm is renegotiating the wage with its current workfore (insiders), then the surplus of continuing the employment relationship is given by the marginal value of an additional worker plus the firing cost f, since a bargaining agreement ensures that the firm does not have to pay the firing cost. The Nash-Product in case a firm negotiates with outsiders and insiders, respectively, are given by,

$$w^{O,t}\left(y_i, N_i^t\right) = \arg\max_w \left(W^{O,t}\left(w\right) - U\right)^{\gamma} \left(\frac{\partial \pi^{O,t}(N_i^t, y_i, k_i)}{\partial N_i^t}\right)^{1-\gamma}, \tag{14}$$

$$w^{I,t}\left(y_i, N_i^t\right) = \arg\max_w \left(W^{I,t}\left(w\right) - U\right)^{\gamma} \left(\frac{\partial \pi^{I,t}(N_i^t, y_i, k_i)}{\partial N_i^t} + f\right)^{1-\gamma}. \tag{15}$$

The bargaining wage $w^t\left(y_i, N_i^t\right)$ will depend on the type $t \in \{B, R\}$ that a firm with innovation cost k_i chooses, on the number of workers it employs N_i^t, and on whether it has a product idea, i.e., $y_i \in \{0, y\}$.

2.4 Optimality conditions

2.4.1 Vacancy creation condition

Type B or R firms will post vacancies until the marginal value of an additional worker equals the expected cost of hiring a worker, i.e.,

$$\frac{\partial \pi^{O,t}\left(N_i^t, y, k_i\right)}{\partial V_i^t} = 0 \Longrightarrow \frac{\partial \pi^{O,t}\left(N_i^t, y, k_i\right)}{\partial N_i^t} = \frac{c}{\lambda_m\left(\theta\right)}. \tag{16}$$

Thus, if the marginal value of an additional worker for a firm that decided to acquire a product idea ($t = B$) is different compared to a firm that does its own research ($t = R$), then also the number of vacancies posted and the number of workers employed are different.

The marginal value of an additional worker for a firm that wants to hire new workers ($h = O$) but with product idea is given by differentiating equation (9). The value depends on whether a firm lays off workers if it is hit by a product idea shock, i.e.,

$$\frac{\partial \pi^{O,t}(N_i^t, y, k_i)}{\partial N_i^t} = \begin{cases} \dfrac{\alpha y \left(N_i^t\right)^{\alpha-1} - w^{O,t}\left(y, N_i^t\right) - \dfrac{\partial w^{O,t}\left(y, N_i^t\right)}{\partial N_i^t} N_i^t + \delta \dfrac{\partial \pi^{I,t}(N_i^t, 0, k_i)}{\partial N_i^t}}{r+\delta} & \text{if } L_i^t = 0, \\[2ex] \dfrac{\alpha y \left(N_i^t\right)^{\alpha-1} - w^{O,t}\left(y, N_i^t\right) - \dfrac{\partial w^{O,t}\left(y, N_i^t\right)}{\partial N_i^t} N_i^t - \delta f}{r+\delta} & \text{if } L_i^t = N_i^t, \end{cases} \tag{17}$$

The third term in the marginal value of an additional worker $\left(\partial w^{O,t}\left(y,N_i^t\right)/\partial N_i^t\right)N_i^t$ captures the fact that each time a new worker is hired wages of all workers are renegotiated and adjusted to the new marginal product.

The marginal values of an additional worker for a firm without a product idea that keeps its workers can be obtained by differentiating equations (11) and (13) and using equation (46) to substitute out the price for a product idea (compare Appendix A.3). The marginal value need not be negative, since there is a chance that the firm obtains a new product idea and starts production. Substituting the vacancy creation condition (16) implies,

$$\frac{\partial \pi^{I,t}\left(N_i^t,0,k_i\right)}{\partial N_i^t}=\begin{cases}\dfrac{\eta}{r+\lambda_d+\eta}\left(\dfrac{c}{\lambda_m\left(\theta\right)}-\gamma f-\dfrac{w^{I,R}\left(0,N_i^R\right)}{\eta}\right) & \text{if } \ t=R,\\ \dfrac{g\left(\varphi\right)}{r+\lambda_d+g\left(\varphi\right)\left(1-\beta\right)}\left(\left(1-\beta\right)\left(\dfrac{c}{\lambda_m\left(\theta\right)}-\gamma f\right)-\dfrac{w^{I,B}\left(0,N_i^B\right)}{g\left(\varphi\right)}\right) & \\ & \text{if } \ t=B.\end{cases}\tag{18}$$

The marginal value of an additional worker is only negative, if the wage payments to workers over the expected duration until it obtains a new product idea, i.e., $1/\eta$ or $1/g\left(\varphi\right)$, are higher than the expected cost of hiring a worker $c/\lambda_m\left(\theta\right)$ minus the part of the firing cost that the firm would have to bear γf if it lays off a worker (or the fraction $\left(1-\beta\right)$ in case of product idea acquisition due to Nash-Bargaining). If hiring costs $c/\lambda_m\left(\theta\right)$ are sufficiently high, the marginal value of an additional worker is positive. However, the first order condition for the optimal number of posted vacancies shows that the vacancy posting costs always exceeds the marginal value of an additional worker without a product idea, i.e.,

$$\frac{\partial \pi^t(N_i^t,0,k_i)}{\partial V_i^t}=\frac{\partial \pi^t(N_i^t,0,k_i)}{\partial N_i^t}\lambda_m\left(\theta\right)-c<0,$$

as one can easily verify by substituting the marginal value of an additional worker using equation (18).

2.4.2 Firing condition

Firms that are hit by a product idea shock δ consider whether or not to lay off workers. Since the marginal value of an additional worker without a product idea is independent of the number of employed workers – as stated in equation (18) – it is optimal for a firm to either keep all its workers, if the surplus is positive, i.e., if the marginal value of a worker plus the firing cost is positive, or to lay off all workers, if the surplus is negative, i.e.,

$$L_i^t = \begin{cases} 0, & \text{if } \dfrac{\partial \pi^{I,t}\left(N_i^t, 0, k_i\right)}{\partial N_i^t} + f \geq 0, \\ N_i^t, & \text{if } \dfrac{\partial \pi^{I,t}\left(N_i^t, 0, k_i\right)}{\partial N_i^t} + f < 0. \end{cases} \tag{19}$$

2.4.3 Wages

Wages are determined by Nash-Bargaining according to the surplus splitting rule (14). All wage equations stated below are derived in Appendix A.1.

We consider first the situation in which workers are not laid off in case the establishment looses its product idea, i.e., $L_i^t = 0$. The wages paid to outsiders and insiders at type R firms that have a product idea, i.e., $y_i = y$, are given by,

$$w^{O,R}\left(y, N_i^R\right) = (1-\gamma)\, z + \gamma\theta c + \gamma \frac{\alpha}{1-\gamma\,(1-\alpha)} y \left(N_i^R\right)^{\alpha-1} - \gamma\delta f, \tag{20}$$

$$w^{I,R}\left(y, N_i^R\right) = (1-\gamma)\, z + \gamma\theta c + \gamma \frac{\alpha}{1-\gamma\,(1-\alpha)} y \left(N_i^R\right)^{\alpha-1} + \gamma r f. \tag{21}$$

Insiders will receive a higher wage than outsiders, because firms' outside option during bargaining is lower once they have to renegotiate with an insider, who is protected by firing costs. Thus, outsiders will receive a lower wage initially in turn for a higher wage later on once their bargaining power as insider has inproved. The respective wages at type B firms include an additional term that accounts for the fact that part of the firm's surplus is going to the seller (type S firm) in the product idea bargaining, i.e.,

$$w^{O,B}\left(y,N_i^B\right)=(1-\gamma)\,z+\gamma\theta c+\gamma\frac{\alpha}{1-\gamma\,(1-\alpha)}y\left(N_i^B\right)^{\alpha-1}-\gamma\delta f \tag{22}$$
$$+\,\delta\beta g\,(\varphi)\,\gamma\frac{g\,(\varphi)\,(1-\beta)\left(\frac{c}{\lambda_m\,(\theta)}-\gamma f\right)-w^{I,B}\left(0,N_i^B\right)}{(r+\lambda_d+g\,(\varphi))\,(r+\lambda_d+g\,(\varphi)\,(1-\beta))},$$

$$w^{I,B}\left(y,N_i^B\right)=(1-\gamma)\,z+\gamma\theta c+\gamma\frac{\alpha}{1-\gamma\,(1-\alpha)}y\left(N_i^B\right)^{\alpha-1}+\gamma rf \tag{23}$$
$$+\,\delta\beta g\,(\varphi)\,\gamma\frac{g\,(\varphi)\,(1-\beta)\left(\frac{c}{\lambda_m\,(\theta)}-\gamma f\right)-w^{I,B}\left(0,N_i^B\right)}{(r+\lambda_d+g\,(\varphi))\,(r+\lambda_d+g\,(\varphi)\,(1-\beta))},$$

Firms without a product idea, i.e., $y_i=0$, that keep their workers, i.e., $L_i^t=0$, pay the following wages,

$$w^{I,R}\left(0,N_i^R\right)=(1-\gamma)\,z+\gamma\theta c+\gamma\,(r+\lambda_d)\,f, \tag{24}$$

$$w^{I,B}\left(0,N_i^B\right)=(1-\gamma)\,z+\gamma\theta c-\beta g\,(\varphi)\,\gamma\left(\frac{c}{\lambda_m\,(\theta)}+(1-\gamma)\,f\right)+\gamma\,(r+\lambda_d)\,f, \tag{25}$$

Thus, a firm that does own research pays a wage $w^{I,R}\left(0,N_i^R\right)$ which equals workers' flow value of being unemployed plus a certain fraction of the firing costs, which reflects the worse ouside option of firms when bargaining with insiders. If workers are employed at a firm that buys product ideas, then part of the surplus that the firm has to paid to the seller of the product idea in the price bargaining process has to be born by its workers.

If firms layoff their workforce in case they are hit by a product idea shock, then workers do not have a chance to renegotiate their wages as insiders. This implies that there will be only one wage, if $L_i^t=N_i^t$. The fact that workers are only paid their outsider wage can also be seen by noting that the workers' value of being employed in equation (2) simplifies, since $\max\left[W^{I,t}\left(w^{I,t}\,(0,N_i)\right),U\right]=U$. The respective wage is therefore given by,

$$w^{O,t}\left(y,N_i^t\right)=(1-\gamma)\,z+\gamma\theta c+\gamma\frac{\alpha}{1-\gamma+\gamma\alpha}y\left(N_i^t\right)^{\alpha-1}-\gamma\delta f,\ \text{ all for }\ t\in\{B,R\}\,. \tag{26}$$

Note, that the wage in this case is independent of the firm's decision of whether to do own research or to buy a product idea, since the vacancy creation conditions and therefore the level of employment are identical.

2.4.4 Product idea prices

The vacancy creation and firing conditions (16) and (19) imply that in a given steady state all establishments that buy product ideas ($t = B$) have either 0 or N_j^B employees. This simplifies the analysis and implies that the expected price for an establishment with innovation cost k_i that sells its product idea is constant and given by $p(k_i, 0)$ or $p\left(k_i, N_j^B\right)$. Since we concentrate on the parameter sets that guarantee the existence of an innovation market, we know that all firms that sell their product idea are also willing to sell to all establishments that want to acquire a product idea, i.e., all matches in the product idea market will generate a positive surplus.

In order to derive a closed form solution for the product idea price we need closed form expressions for the expected profit of firms that sell their product ideas and of firms that buy product ideas. The closed form expressions can be found in Appendix A.4. In order to determine the expected price that firms pay for a product idea, we first focus on the average seller that has innovation cost $\overline{k}$ such that its price equals the expected price, i.e.,

$$p\left(\overline{k}, N_i^B\right) = E_{k_j}\left[p\left(k, N_i^B\right)\right] \text{ or } p\left(\overline{k}, 0\right) = E_{k_j}\left[p\left(k, 0\right)\right].$$

Computing the differences in expected profits using equations (47) to (52) in Appendix A.4 and plugging the results into the innovation price equations (45) and (46) leads to the following expression for the expected product idea price,

$$E_{k_j}\left[p\left(\overline{k}, N_i^B\right)\right] = \frac{K_2\beta\left(r+\lambda_d\right)\left(y\left(N_i^B\right)^{\alpha} - w^B\left(y, N_i^B\right)N_i^B\right) + K_2\beta r w^{I,B}\left(0, N_i^B\right)N_i^B}{K_1K_2 - K_1\left(1-\beta\right)\left(r+\lambda_s\right)\varphi g\left(\varphi\right) - K_2\beta r g\left(\varphi\right)} + \frac{K_1\left(1-\beta\right)r\overline{k}}{K_1K_2 - K_1\left(1-\beta\right)\left(r+\lambda_s\right)\varphi g\left(\varphi\right) - K_2\beta r g\left(\varphi\right)}, \tag{27}$$

$$E_{k_j}\left[p\left(\overline{k}, 0\right)\right] = \frac{K_2\beta\left(r+\lambda_d\right)\left(y\left(N_i^B\right)^{\alpha} - w^{O,B}\left(y, N_i^B\right)N_i^B - \delta f N_i^B - \left(r+\delta\right)\frac{c}{\lambda_m\left(\theta\right)}N_i^B\right)}{K_1K_2 - K_1\left(1-\beta\right)\left(r+\lambda_s\right)\varphi g\left(\varphi\right) - K_2\beta r g\left(\varphi\right)} + \frac{K_1\left(1-\beta\right)r\overline{k}}{K_1K_2 - K_1\left(1-\beta\right)\left(r+\lambda_s\right)\varphi g\left(\varphi\right) - K_2\beta r g\left(\varphi\right)}, \tag{28}$$

where

$$K_1 = (r+\delta)(r+\lambda_d) + rg(\varphi),$$
$$K_2 = (r+\delta+\varphi g(\varphi))(r+\lambda_s) + r\eta.$$

Given the expected price the product idea price $p\left(k_j, N_i^B\right)$ or $p(k_j, 0)$ for a seller with innovation cost k_j is given by substituting the expected price in the respective expected profit functions (47) to (52) in Appendix A.4 and inserting them into the product idea price equations (45) and (46). The explicit formulas for $p\left(k_j, N_i^B\right)$ or $p(k_j, 0)$ are given in Appendix A.4.

2.4.5 Type choice

Given the innovation cost k_i new firms have to decide on their type $t \in \{S, R, B\}$. We concentrate on an equilibrium in which all three types exist. Of course there are parameter values where only S and B type firms exist (for η sufficiently small), and parameter values where only type R firms exist (for η sufficiently high).

Type B firms decide to buy a new product idea if they are hit by a product idea shock. They will thus never innovate. Their expected profit is therefore independent of k_i. The minimum profit that each firm can obtain is hence given by the expected profit of type B firms (before they hire workers), i.e.,

$$\pi^{O,B}\left(N_i^B, y, k_i\right) - \frac{c}{\lambda_m(\theta)} N_i^B,$$

where $\pi^{O,B}\left(N_i^B, y, k_i\right)$ is given by equation (49) or (51) in Appendix A.4 for $L_i^B = 0$ and $L_i^B = N_i^B$, respectively. Type R firms that do their own research if they are hit by a product idea shock have the following expected profit (before they hire workers),

$$\pi^{O,R}\left(N_i^R, y, k_i\right) - \frac{c}{\lambda_m(\theta)} N_i^R,$$

where the closed form expression for $\pi^{O,R}\left(N_i^R, y, k_i\right)$ for firms that keep their workers and for firms that lay off their workers is given in Appendix A.5. Type S firms that only innovate in order to sell their product ideas obtain the expected profit $\pi^S(0, y, k_i)$. In

Appendix A.5 we derive the respective closed form expressions, where we substitute the price $p(k_i, N)$ for the product idea.

Firms that specialize in innovation do more research and their profits are therefore more sensitive to the cost of innovation k_i. In Appendix A.5 we show formally that the expected profit of type $t = S$ firms decreases more in the cost of innovation k_i than the expected profit of type $t = R$ firms, i.e.,

$$\frac{\partial \pi^S(0, y, k_i)}{\partial k_i} < \frac{\partial \pi^{O,R}\left(N_i^R, y, k_i\right)}{\partial k_i} < \frac{\partial \pi^{O,B}\left(N_i^B, y, k_i\right)}{\partial k_i} = 0.$$

Given this single crossing property we can define the innovation cost thresholds k^* and k^{**}. Thus, firms with innovation cost $k_i \in [0, k^*]$ will specialize in innovation, firms with innovation cost $k_i \in (k^*, k^{**})$ will do their own research in case they are without a product idea and will produce otherwise, and firms with innovation cost $k_i \in [k^{**}, k_{\max}]$ will buy a new product idea, if they need one. This also implies that $h(k_i) = \gamma(k_i)/\Gamma(k^*)$. The thresholds are formally defined by the following indifference conditions for type $t = S$ and type $t = R$ firms (thresholds k^*) and type $t = R$ and type $t = B$ firm (thresholds k^{**}) respectively,

$$\pi^S(0, y, k^*) = \pi^{O,R}\left(N_i^R, y, k^*\right) - \frac{c}{\lambda_m(\theta)} N_i^R, \tag{29}$$

$$\pi^{O,R}\left(N_i^R, y, k^{**}\right) - \frac{c}{\lambda_m(\theta)} N_i^R = \pi^{O,B}\left(N_i^B, y, k^{**}\right) - \frac{c}{\lambda_m(\theta)} N_i^B. \tag{30}$$

Note, that the appropriate equation for the expected profit depends on whether or not firms lay off their workers if a product idea shock hits.

2.4.6 Firm entry

The expected profit of a new firm before it draws its innovation cost k_i determines the number m of establishments in the economy. Since the expected profits $\pi^S(0, y, k_i)$ and $\pi^{O,R}\left(N_i^R, y, k_i\right)$ are linear in k_i and $\pi^{O,B}\left(N_i^B, y, k_i\right)$ independent of k_i, we are able to write the expected profit as,

$$
\begin{aligned}
F = & \Gamma\left(k^{*}\right) \pi^{S}\left(0, y, \overline{k}\right) \\
& + \left(\Gamma\left(k^{**}\right) - \Gamma\left(k^{*}\right)\right)\left(\pi^{O,R}\left(N_i^R, y, \overline{\overline{k}}\right) - \frac{c}{\lambda_m\left(\theta\right)} N_i^R\right) \\
& + \left(1 - \Gamma\left(k^{**}\right)\right)\left(\pi^{O,B}\left(N_i^B, y, k_i\right) - \frac{c}{\lambda_m\left(\theta\right)} N_i^B\right),
\end{aligned} \tag{31}
$$

where average innovation cost $\overline{k}$ among firms that sell their product idea (type S) and $\overline{\overline{k}}$ among firms that do their own research if they are hit by a product idea shock are given by,

$$
\overline{k} = \int_0^{k^*} k_i \frac{\gamma\left(k_i\right)}{\Gamma\left(k^*\right)} dk_i \text{ and } \overline{\overline{k}} = \int_{k^*}^{k^{**}} k_i \frac{\gamma\left(k_i\right)}{\Gamma\left(k^{**}\right) - \Gamma\left(k^*\right)} dk_i.
$$

Given the entry cost F, firms will enter until the expected profit is equal to the cost of entry. The number m of establishments is not directly visible in the entry condition (31), but it enters the expected profit indirectly via the labor market tightness θ. The steady state values of the labor market tightness are determined using the steady state flow equations analyzed in the next section.

2.5 Steady state measures

2.5.1 Firm flows and product idea market tightness

We denote the measure of type t firms with N_i^t employed workers and with or without a product idea, i.e., $y_i \in \{0, y\}$, by $m^t\left(y_i, N_i^t\right)$. In total the number of establishments have to sum up to m. Denote the measure of establishments that exit the economy each period by m^e, where the assumptions regarding the destruction of establishments implies,

$$
m^e = \lambda_s m^S\left(0, 0\right) + \lambda_d\left(m^R\left(0, N_i^R\right) + m^B\left(0, N_i^B\right)\right).
$$

In steady state the measure of firms that exit the economy is equal to the measure of new firms that enter, i.e., $m^e = m^n$. The respective measure of establishments evolve according to the difference between in- and outflows, i.e.,

$$\dot{m}^S(0,0) = (\delta + \varphi g(\varphi))\, m^S(y,0) - (\lambda_s + \eta)\, m^S(0,0) \tag{32}$$

$$\dot{m}^S(y,0) = \Gamma(k^*)\, m^n + \eta m^S(0,0) - (\delta + \varphi g(\varphi))\, m^S(y,0) \tag{33}$$

$$\dot{m}^R\left(0,N_i^R\right) = \delta m^R\left(y,N_i^R\right) - (\lambda_d + \eta)\, m^R\left(0,N_i^R\right) \tag{34}$$

$$\dot{m}^R\left(y,N_i^R\right) = (\Gamma(k^{**}) - \Gamma(k^*))\, m^n + \eta m^R\left(0,N_i^R\right) - \delta m^R\left(y,N_i^R\right) \tag{35}$$

$$\dot{m}^B\left(0,N_i^B\right) = \delta m^B\left(y,N_i^B\right) - (\lambda_d + g(\varphi))\, m^B\left(0,N_i^B\right) \tag{36}$$

$$\dot{m}^B\left(y,N_i^B\right) = (1 - \Gamma(k^{**}))\, m^n + g(\varphi)\, m^B\left(0,N_i^B\right) - \delta m^B\left(y,N_i^B\right) \tag{37}$$

We focus on the steady state, where the measures of the different firm types do not change, i.e., $\dot{m}^t\left(y_i, N_i^t\right) = 0$. The above flow equations allow us to write the ratio of the steady state measures of establishments that buy new product ideas $m^B\left(0,N_i^B\right)$ to the measure of establishments that sell new product ideas $m^S(y,0)$ as follows,

$$\varphi = \frac{m^B\left(0,N_i^B\right)}{m^S(y,0)} = \frac{\lambda_s}{\lambda_s+\eta}\frac{\delta+\varphi g(\varphi)}{\lambda_d}\frac{1-\Gamma(k^{**})}{\Gamma(k^*)}. \tag{38}$$

Note, that the Inada conditions guarantee that the RHS of equation (38) increases in φ at a decreasing rate. Since in addition the RHS at $\varphi = 0$ exceeds the LHS, i.e., RHS(0) > 0, equation (38) determines the unique market tightness φ in the product idea market for given innovation cost thresholds k^* and k^{**}, which determine the shares of firms that sell and buy product ideas.

2.5.2 Worker flows and labor market tightness

We denote the measure of employed workers by l and the measure of unemployed workers by u. Unemployment evolves according to the difference between inflows and outflows, i.e.,

$$\dot{u} = \begin{cases} \theta\lambda_m(\theta)\, u - \lambda_d\left(m^B\left(0,N_i^B\right)N_i^B + m^R\left(0,N_i^R\right)N_i^R\right) & \text{if } L_i^t = 0, \\ \theta\lambda_m(\theta)\, u - \delta\left(m^B\left(y,N_i^B\right)N_i^B + m^R\left(y,N_i^R\right)N_i^R\right) & \text{if } L_i^t = N_i^t. \end{cases} \tag{39}$$

If all firms keep their workers in case they are hit by a product idea shock the inflow into unemployment is given by the rate λ_d at which producing firms without a product idea are destroyed times the number of workers that are employed at these firms, i.e.,

$m^B\left(0, N_i^B\right) N_i^B + m^R\left(0, N_i^R\right) N_i^R$. If all firms lay off their workers in case they are hit by a product idea shock the inflow into unemployment is given by the rate δ at which a productivity shock hits times the number of workers employed at producing firms with a product idea, i.e., $m^B\left(y, N_i^B\right) N_i^B + m^R\left(y, N_i^R\right) N_i^R$.

In the Appendix A.6 we use the firm level flow equations (32) to (37) to write employment under the different scenarios as a function of m, the number of firms in the economy. This allows us to write the labor market tightness θ as a function of the number of workers employed at type B and R establishments, i.e., N_i^B and N_i^R, as well as of the variables $\{\varphi, k^*, k^{**}, m\}$, i.e.,

$$\left(\frac{1}{\varphi} + \frac{\delta + \varphi g(\varphi)}{(\lambda_s + \eta)\varphi} + \frac{\delta + \lambda_d + g(\varphi)}{\delta} + \frac{\delta + \lambda_d + \eta}{\delta} \frac{\Gamma(k^{**}) - \Gamma(k^*)}{1 - \Gamma(k^{**})}\right) \frac{1}{m} \tag{40}$$

$$= \begin{cases} \left(\frac{\lambda_d}{\delta} \frac{\delta + \theta\lambda_m(\theta)}{\theta\lambda_m(\theta)} + \frac{\delta + g(\varphi)}{\delta}\right) N_i^B \\ + \left(\frac{\lambda_d}{\delta} \frac{\delta + \theta\lambda_m(\theta)}{\theta\lambda_m(\theta)} + \frac{\delta + \eta}{\delta}\right) \frac{\Gamma(k^{**}) - \Gamma(k^*)}{1 - \Gamma(k^{**})} N_i^R \text{ if } L_i^t = 0, \\ \\ \frac{\delta + \theta\lambda_m(\theta)}{\theta\lambda_m(\theta)} \left(\frac{\lambda_d + g(\varphi)}{\delta} N_i^B + \frac{\Gamma(k^{**}) - \Gamma(k^*)}{1 - \Gamma(k^{**})} \frac{\lambda_d + \eta}{\delta} N_i^R\right) \text{ if } L_i^t = N_i^t, \end{cases}$$

where we differentiate between the two cases where all firms keep their workers and all firms lay off their workers in case a product idea shock hits. The cases where either only type B or only type R firms lay off workers are described in Appendix A.6.

2.6 Equilibrium

An equilibrium is characterized by the market tightness in the product idea and the labor market, the layoff decision of type B and R establishments L_i^B and L_i^R, the threshold values k^* and k^{**} of the innovation cost k_i that determine the fraction of type S, B, and R establishments and the number of active firms in the economy, i.e., by the set of variables $\left\{\varphi, \theta, L_i^B, L_i^R, k^*, k^{**}, m\right\}$.

The innovation market tightness φ is determined by equation (38). Comparative statics using the implicit function theorem implies that the innovation market tightness φ decreases with both innovation cost thresholds k^* and k^{**}, since in the case of k^* more establishments decide to specialize in innovation and in case of k^{**} less establishments decide to buy a new product idea if they are hit by a product idea shock.

The layoff decision for firm types B and R are given by substituting the respective values of an additional worker into the firing condition (19). Workers are laid off, i.e., $L_i^t = N_i^t$, if the marginal value of continuing an employment relationship plus the firing cost is negative, i.e., if and only if,

$$\frac{g(\varphi)(1-\beta)\left(\frac{c}{\lambda_m(\theta)} - \gamma f\right) - w^{I,B}\left(0, N_i^B\right)}{\left(r + \lambda_d + g(\varphi)(1-\beta)\right)} + f < 0,$$

$$\frac{\eta\left(\frac{c}{\lambda_m(\theta)} - \gamma f\right) - w^{I,R}\left(0, N_i^R\right)}{\left(r + \lambda_d + \eta\right)} + f < 0,$$

Bargaining wages are given in equations (20) to (25) for workers with and without product ideas, if all firms keep their workers in case a product idea shock hits, and in equation (26), if workers are laid off once a product idea shock hits. The vacancy creation conditions for type R and B firms that do not lay off workers, if they lose their product idea, i.e., if $L_i^t = 0$, are given by substituting the respective values of an additional worker $\partial\pi^{O,t}\left(N_i^t, y, k_i\right)/\partial N_i^t$ of firms without workers into the general vacancy creation condition (16), i.e.,

$$\frac{c}{\lambda_m(\theta)} = \begin{cases} \frac{(r+\lambda_d+\eta)}{(r+\delta)(r+\lambda_d)+r\eta}\frac{(1-\gamma)\alpha}{1-\gamma(1-\alpha)}y\left(N_i^R\right)^{\alpha-1} \\ -\frac{(r+\delta+\lambda_d+\eta)\left((1-\gamma)z+\gamma\theta c\right)}{(r+\delta)(r+\lambda_d)+r\eta}, \text{ for } t = R, \\ \frac{C_2}{C_1}\frac{(1-\gamma)\alpha}{1-\gamma(1-\alpha)}y\left(N_i^B\right)^{\alpha-1} + \frac{\delta g(\varphi)\beta(1-\gamma)\beta g(\varphi)\gamma}{C_1}(1-\gamma)f \\ -\frac{C_2 + \left(r+\lambda_d+g(\varphi)-\gamma\beta g(\varphi)\right)\delta}{C_1}\left((1-\gamma)z+\gamma\theta c\right), \text{ for } t = B, \end{cases}$$

where

$$C_1 = C_2(r+\delta) - \left(r+\lambda_d+g(\varphi)-\gamma\beta g(\varphi)\right)\delta\left(1-(1-\gamma)\beta\right)g(\varphi),$$
$$C_2 = \left(r+\lambda_d+g(\varphi)\right)\left(r+\lambda_d+g(\varphi)(1-\beta)\right).$$

The vacancy creation condition, if firms lay off their workforce, i.e., if $L_i^t = N_i^t$, once they are hit by a product idea shock is given by,

$$\frac{c}{\lambda_m(\theta)} = \frac{\frac{(1-\gamma)\alpha}{1-\gamma+\gamma\alpha} y \left(N_i^t\right)^{\alpha-1} - (1-\gamma) z - \gamma\theta c - (1-\gamma)\delta f}{r+\delta},$$

All vacancy creation curves determine the number of employed workers as a decreasing function of the labor market tightness, i.e., $N_i^t(\theta)$ with $\partial N_i^t(\theta)/\partial\theta < 0$. Substituting the respective functions $N_i^t(\theta)$ into the steady state equation (40) determines the labor market tightness as a function of $\left\{\varphi, L_i^B, L_i^R, k^*, k^{**}, m\right\}$. The property $\partial N_i^t(\theta)/\partial\theta < 0$ guarantees together with $\partial\theta\left(N_i^R, N_i^B\right)/\partial N_i^t > 0$ that the equilibrium market tightness is unique for a given set of variables $\left\{\varphi, L_i^B, L_i^R, k^*, k^{**}, m\right\}$. The comparative static result that a higher number of firms m leads to a higher labor market tightness θ ensures that the free entry condition (31) is well defined.

The innovation cost thresholds k^* and k^{**} are determined by comparing the expected profits of the different types of firms as defined in equations (29) and (30). The single crossing property of the expected profits guarantees a unique pair of innovation cost thresholds k^* and k^{**} for a given set of variables $\{\varphi, \theta, m\}$. Thus, firms with low innovation costs specialize in innovation, firms with high innovation cost buy new product ideas if they are hit by a product idea shock and firms with medium innovation costs do own research, if they loose their product idea.

The final equation that determines the number of establishments m in equilibrium is the free entry condition (31), where the number of establishments enters indirectly via the labor market tightness θ. A higher number of firms m increases ceteris paribus the labor market tightness θ. A higher labor market tightness increases the recruitment cost of workers and decreases thus the expected profit of type B and R firms. Thus, the free entry condition is decreasing in the number of firms.

2.7 Comparative statics

In this section we derive the main measures that we need in order to compare our calibration results with the empiricial findings of Autor, Kerr, and Kugler (2007) and Acharya, Baghai, and Subramanian (2014) .

Acharya, Baghai, and Subramanian (2014) find that the number of patents and patent citations increases with the adoption of the wrongful dismissal law. The number of patents and patent citations in our framework is measured by the number of product ideas created each period, i.e.,

$$I = m^e + \eta \left(m^R(0, N_i^R) + m^S(0,0) \right) \tag{41}$$

In our model there are two ways in which new product ideas are created, at firm entry and by doing own research. All firms that enter the economy, i.e., m^e, are assumed to obtain a new product idea after paying the entry cost F. Existing firms without a product idea that either decided to specialize in innovation ($m^S(0,0)$) or to do own research if they are hit by a product idea shock ($m^R(0, N_i^R)$) obtain a new product idea at the research success rate η.

Autor, Kerr, and Kugler (2007) show that total factor productivity decreases after the introduction of employment protection. In our model output is produced by production workers at producing firms, i.e., total output is given by,

$$Y = m^R \left(y, N_i^R \right) y \left(N_i^R \right)^{\alpha} + m^B \left(y, N_i^B \right) y \left(N_i^B \right)^{\alpha}. \tag{42}$$

In order to be able to derive a measure for total factor productivity, we follow the empirical approach and define total factor productivity as the residual from the production function with different factor inputs. The natural candidates for inputs in our model are the number of production workers,

$$L = \begin{cases} \left(m^R \left(y, N_i^R \right) + m^R \left(0, N_i^R \right) \right) N_i^R + \left(m^B \left(y, N_i^B \right) + m^B \left(0, N_i^B \right) \right) N_i^B \text{ if } L_i^t = 0, \\ m^R \left(y, N_i^R \right) N_i^R + m^B \left(y, N_i^B \right) N_i^B \text{ if } L_i^t = N_i^t, \end{cases} \tag{43}$$

which we interpret as labor input, and the number of firms in the economy, which we interpret as capital (or skilled labor), i.e., $K = m$. Following the empirical literature and assuming that the production of total output in our model can be approximated by a Cobb-Douglas type production function with labor L and capital K as inputs, total factor productivity is defined as,

$$TFP = \log(Y) - \widehat{\beta}_0 - \widehat{\beta}_L \log(L) - \widehat{\beta}_K \log(K).$$

where $\widehat{\beta}_L$ and $\widehat{\beta}_K$ are the output elasticities of labor and capital, respectively. Instead of estimating these elasticities, we can calculate them using our formula for total output (42), i.e.,

$$\widehat{\beta}_L = \frac{\partial Y}{\partial L}\frac{L}{Y} = \sum_{t\in\{R,B\}} \left(m^t(y,N_i^t)\alpha y(N_i^t)^{\alpha-1}\frac{m^t(y,N_i^t)N_i^t}{L}\right)\frac{L}{Y},$$
$$\widehat{\beta}_K = \frac{\partial Y}{\partial K}\frac{K}{Y} = \sum_{t\in\{R,B\}} \left(m^t(y,N_i^t)\frac{m^t(y,N_i^t)}{m}y(N_i^t)^{\alpha}\right)\frac{L}{Y},$$

where a marginal increase in labor L increases the number of workers employed at producing firms by $m^t(y,N_i^t)N_i^t/L$ and similarly a marginal increase in capital K increases the number of producing firms by $m^t(y,N_i^t)/m$. In empirical applications these elasticities are estimated to be constant before and after the introduction of employment protection. We will therefore provide two versions of total factor productivity. In the first version we keep the elasticities $\widehat{\beta}_L$ and $\widehat{\beta}_K$ at the values based on the calibration before the introduction of employment protection and in the second version at the values based on the calibration after the introduction of employment protection.

Given our calibration we can investigate the equilibrium effect of introducing employment protection on welfare. Welfare in our model is equal to net output, i.e.,

$$W = Y - m^e F - c\theta u - m^S(0,0)\,\overline{k} - m^R\left(0,N_i^R\right)\overline{\overline{k}}. \tag{44}$$

To obtain net output we need to subtract form total output Y entry costs m^eF, vacancy creation costs $c\theta u$ $(= vc)$, innovation costs of firms that specialize in innovation $m^S(0,0)\,\overline{k}$, and innovation costs of firms that do their own research $m^R\left(0,N_i^R\right)\overline{\overline{k}}$.

3 Calibration

In this section we show that our model is able to reconcile the empirical findings that the introduction of wrongful dismissal laws in the US decreased total factor productivity as shown by Autor, Kerr, and Kugler (2007) and increased the number of patents as shown by Acharya, Baghai, and Subramanian (2014) . Moreover, we then use our calibration to investigate the equilibrium effect of adopting a wrongful dismissal law on total output and welfare (net output).

3.1 Baseline calibration

3.1.1 Parameters and targets

The model comprises of 17 exogenous parameters (see Table 1). In the calibration we choose the time period to represent one quarter and set the quarterly discount rate to $r = 0.012$ (equivalent to an annual discount factor of 0.953).

The parameters to target aggregate labor market statistics are taken from Shimer (2005) and Kaas and Kircher (2011) . We use a standard Cobb-Douglas type matching function, i.e., $M(U, V) = \kappa_l U^{\psi} V^{1-\psi}$. Like Shimer (2005) we target a mean labor market tightness of 1 and a job finding rate $\theta\lambda_m(\theta)$ of 1.36. To do so we set the labor market matching efficiency parameter to $\kappa_l = 1.36$, the matching elasticity on the labor market ψ at the value 0.72 and the vacancy posting costs to $c = 0.142$. Workers' bargaining power γ is set at the same value as the elasticity of the labor market matching function ψ. Since Shimer (2005) has only single worker firms, we follow Kaas and Kircher (2011) to specify the parameters of the production function for large firms. We normalize the productivity parameter to $y = 1$ and set the labor elasticity parameter of the production function α equal to the labor share of 0.7. Bauer and Lingens (2013) , who also calibrate a matching model with large firms, take a value of 0.8 for the labor elasticity parameter. They motivate their choice by targeting realistic mark-up values. Taking a value of 0.8 instead of 0.7 for labor elasticity would change our results quantitatively but not qualitatively. Following Shimer (2005) we set the value of leisure z such that it is consistent with a value of leisure to labor income ratio of roughly 40%. Since labor income in our baseline calibration without employment protection is equal to 0.65, we set $z = 0.25$.

We assume that research costs are uniformly distributed between zero and one. The support of the research cost distribution is chosen such that the threshold values for the investment cost can be directly used to obtain the shares of the respective firm types. Using the uniform distribution on the zero-one support implies a R&D expenditure to GDP ratio of around 0.012, a value that is of the same magnitude as the 2% of GDP reported in Eurostat (2011) for private sector R&D expenditure in the US. The product idea shock rate δ is calibrated in order to reflect average product life-cycle length. Magnier, Kalaitzandonakes, and Miller (2010) find that on average products last for about 2.5 years, implying $\delta = 0.1$. In order to obtain a value for the research success rate η we use a result by Griffin (2002) , who finds that the ratio of product life cycle length to the time to market for the development of a new product is 3.56 in almost all industries (i.e., the product life cycle length and the time to market are extremely highly correlated across industries with $\rho = 0.99$). Given the ratio of product life cycle length to the time to market of 3.56 we set the research success rate at $\eta = 0.356$.

There is less information in the literature that we can use in order to pin down the parameters for the innovation market. We also use a Cobb-Douglas type matching functions for the innovation market, i.e., $P(S,B) = \kappa_p(S)^{\nu}B^{1-\nu}$. We set the exponent of the innovation market matching function to $\nu = 0.5$ in order to derive an explicit expression for the innovation market tightness, which is done to reduce the computer capacity necessary to solve the model numerically. The bargaining power of firms that sell their product ideas in the innovation market is also chosen to equal $\beta = 0.5$. We choose a matching efficiency in the innovation market of $\kappa_p = 0.2$ in order to obtain an innovation acquisition rate $g(\varphi)$ that is of roughly the same magnitude as the research success rate η for firms that do their own research.

Firing costs $f = 0.75$ are chosen to equal 3.5 month of production in the calibration with employment protection and zero otherwise. According to Bartelsman, Gautier, and De Wind (2010) this value is at the upper end for the US labor market on average, but given the fact that only 13 US states have adopted the "good-faith" exception, the value $f = 0.75$ seem appropriate for those US states that have introduced this exception.

The establishment level destruction rates λ_d and λ_s are chosen such that the average life expectancy of establishments lies somewhere around 50 quarters, which is taken from Burns (2010) . We set the destruction shock of producing establishments to be much larger than the destruction shock of establishments that specialize in innovation, i.e., $\lambda_d = 0.25$ and $\lambda_s = 0.01$, since establishments that specialize in innovation are more often without a product idea as producing establishments (because they sell their product ideas in the innovation market). The resulting average life expectancy of establishments that specialize in innovation is then ten times larger than the average life expectancy of producing establishments, which can be justified by the fact that innovation establishments consist of high skilled jobs, which are less likely to be destroyed.

Finally we set entry costs to $F = 3$, which leads to firm-level employment at producing firms of 2.6 production workers. Since we do not include non-production workers we have chosen a value that is significantly small than the average US establishment size of around 4.18 employees (production and non-production workers) documented by US-Census (2008) .

Table 1 – Exogenous parameters values

Parameter	**Value**	**Source / Target**
δ	0.100	Target: Average product cycle length, see Magnier, Kalaitzandonakes, and Miller (2010).
λ_d	0.250	Target: Average firm life expectancy of 50 quarters, see Burns (2010)
λ_s	0.010	Set to equal $25\lambda_d = \lambda_s$.
η	0.356	Set to equal the ratio of average product life cycle length to time to market of 3.56, see Griffin (2002).
y	1.000	Normalisation
α	0.700	Set to equal the labor share, see Kaas and Kircher (2011).
ψ	0.720	Target: Labor market tightness of 1 and job-finding rate of 1.36, see Shimer (2005).
κ_l	1.360	Target: Labor market tightness of 1 and job-finding rate of 1.36, see Shimer (2005).
ν	0.500	Set due to computational constraints.
κ_p	0.200	Set to get a product idea finding rate of $g(\varphi) = \eta$.
γ	0.720	Set to equal the elasticity of the labor market matching function, see Shimer (2005).
β	0.500	Set to equal the elasticity of the innovation market matching function.
z	0.250	Set to equal 40% of mean labor income, see Shimer (2005).
c	0.142	Target: Labor market tightness of 1 and job-finding rate of 1.36, see Shimer (2005).
r	0.012	Compare Shimer (2005).
f	0.260	Set to equal one month of production, see Bartelsman, Gautier, and De Wind (2010).
F	3.000	Target: Average establishment size of 4.18 workers. see US-Census (2008)

3.1.2 Baseline calibration of the US economy

The first column of Table 2 below shows the baseline calibration of the US economy without employment protection. Given the normalization of the number of workers in the economy and the productivity parameter to one, total output without employment protection is equal to 0.698 and welfare (net output) to 0.636. The total measure of innovations per quarter of 0.048 consist of the innovations done by firms, which are temporarily without a product idea and which do their own research 0.033 (innovations within), and firms, which enter the economy 0.015 (innovations upon entry). The private sector R&D expenditure to GDP ratio of 0.012 can equivalently be divided into R&D expenditures of firms that do their own research 0.008, if they are without a product idea, and into R&D expenditures of firms that enter the economy 0.004 (under the assumption that the expenditure on R&D of entering firms – as part of the entry cost F – is on average the same as the R&D expenditure of firms that do their own research). Firms that acquire a product idea are willing to pay on average 1.039, which is about one third of the entry cost F, which equals the capital cost to set up a firm.

In steady state the free entry condition ensures that average expected profits exactly offset entry costs F. This pins down the number of establishments in the economy at $m = 0.614$, out of which 0.355 are actually producing. The remaining establishments either conduct own research 0.092 or search for a trading partner in the innovation market 0.167. The number of producing establishments 0.355 combined with the firm-level employment of 2.626 workers determine the production workers' employment rate of 0.932. The unemployment rate among production workers is respectively given by 0.068.

3.2 Introducing employment protection

In order to shed light on the interaction of employment protection and innovation we first keep the product idea price fixed at the level without employment protection. Later, we endogenize the price for product ideas to demonstrate the role of the innovation market.

3.2.1 Fixed product idea price

Table 2 compares the baseline model without employment protection with a situation in which employment protection is in place. However, the average product idea price is kept constant at 1.039, the level in the baseline calibration. In order to understand the effect on profits, we first kept the number of firms in the economy constant at 0.614. This is shown in the second column of Table 2.

Table 2 – Results: Employment protection with fixed idea price

Variable	**Baseline without EPL**	**With EPL m-fixed**	**With EPL m-flexible**
Total output (Y)	0.698	0.644	0.624
Welfare (W)	0.636	0.591	0.575
Total factor productivity (before)	0.138	0.093	0.139
Capital / labor ratio	0.659	0.630	0.555
Total innovations (I)	0.048	0.048	0.043
Total R&D costs / GDP	0.012	0.012	0.012
Innovation market tightness (φ)	0.304	0.290	0.317
Product idea finding rate ($g(\varphi)$)	0.363	0.372	0.355
Product idea price (p)	1.039	1.039	1.039
Unemployment rate (u)	0.068	0.026	0.027
Labor market tightness (θ)	1.029	0.893	0.846
Job finding rate ($\theta g(\theta)$)	1.371	1.317	1.298
Job destruction rate	0.100	0.035	0.035
Firm-level employment			
Type R firms (N_i^R)	2.626	2.387	2.642
Type B firms (N_i^B)	2.626	2.418	2.640
Total number of firms (m)	0.614	0.614	0.540
Producing firms	0.355	0.348	0.316
Firms with employment	0.355	0.405	0.370
Average firm destruction rate	0.025	0.024	0.025
Average profit	3.002	2.787	3.007

The introduction of employment protection implies that firms continue to employ their workers, if they are hit by a product idea shock. This increases the number of establishments with employment by 14%. Although there are more firms, which employ workers, the number of producing firms decreases, because keeping and paying unproductive workers decreases profits, especially profits of producing firms, and makes it more attractive to specialize in innovation. Higher labor costs also imply that firm-level employment drops on average by 8.5%. Both negative effects in the number of producing firms and firm-level employment lead to a drop in total output and welfare by about 7% to 8%. The increase in the number of workers employed (partly unproductive) and the decrease in output imply a decrease in total factor productivity from 0.138 to 0.093.

The unemployment rate falls because job destruction decreases far more heavily than job creation, because under employment protection not only firms with a product idea but also firms without a product idea employ workers. The drop in the unemployment rate shown in the second column does not yet take the negative effect of employment protection on firm entry and the respective negative effect on vacancy creation into account.

The adoption of employment protection laws decreases average profits by roughly 8% and implies that the total number of firms in the economy with employment protection decreases by about 12%. This can be seen by looking at the third column of Table 2, which keeps the product idea prices constant, but allows for adjustment of the number of establishments. The number of innovations also decreases with the number of firms by about 9%. Total factor productivity recovers to the initial level, since the lower number of firms, which is thought to proxy lower capital input in our framework, is able to explain the decrease in output and welfare of roughly 10% due to the introduction of employment protection.

Thus, without the innovation market channel (flexible product idea price) our model is not able to replicate the empirical findings by Acharya, Baghai, and Subramanian (2014) , who find a positive effect of employment protection on the number of patents and an increase in the number of establishments. Furthermore, our model would also not be able to explain the results of Autor, Kerr, and Kugler (2007) , who find that employment protection leads firms to employ more capital and shift labor towards more high skilled labor – which in our model would imply an increase in the total number of firms in the economy.

3.2.2 Endogenous product idea price

Until now we fixed the product idea price at its baseline value in order to disentangle the innovation market effect from the conventional profit depressing effects of employment protection. We now compare the baseline calibration with the model with employment protection under flexible product idea prices. Again, the second column of Table 3 keeps the number of firms in the economy at the baseline calibration level in order to understand the effects of employment protection on profits.

The introduction of employment protection increases labor cost during the period in which a firm is without a product idea. This increases the willingness of producing firms without a product idea to pay for innovations. This implies a huge increase in the price for a product idea from 1.039 in the baseline calibration to 1.516. This increases the profits of firms that specialize in innovation relative to the profit of producing firms. The associated shift in the composition of firms increases the number of within innovations, i.e., the innovations that are done by firms without a product idea, by around 12%. The total number of innovations does not change, however, since we keep the number of firms fixed, which implies that we exclude all innovations that are attached to the entry of new firms.[3]

The change in the composition of firms mainly increases the number of firms that want to sell a product idea and decreases the number of producing firms from 0.355 to 0.299. Although the reduction in the number of producing firms leads to lower hiring costs (as mirrored by the lower labor market tightness), higher profits and thus to an increase in firm-level and total employment, total production decreases by around 11.5% due to the dominant shift in the composition of firms. Welfare shrinks accordingly by around 10%.

In stark contrast to the calibration in Table 2 with fixed product idea prices, average profits increase by around 14%. This triggers firm entry and increases in the number of establishments in the new steady state from 0.614 to 0.714. The increase in the number of establishments of around 15% is somewhat larger in size than the 8.7% to 12.4%

[3]As $\lambda_s \leq \lambda_d$ the change in the composition of firms towards more sellers leads to less exits per and accordingly to less entries per period.

Table 3 – Results: Employment protection with endogenous idea price

Variable	Baseline without EPL	With EPL m-fixed	With EPL m-flexible
Total output (Y)	0.698	0.618	0.647
Welfare (W)	0.636	0.573	0.598
Total factor productivity (before)	0.138	0.073	-0.010
Capital / labor ratio	0.659	0.629	0.731
Total innovations (I)	0.048	0.048	0.057
Total R&D costs / GDP	0.012	0.012	0.013
Innovation market tightness (φ)	0.304	0.172	0.179
Product idea finding rate ($g(\varphi)$)	0.363	0.482	0.473
Product idea price (p)	1.039	1.516	1.376
Unemployment rate (u)	0.068	0.024	0.023
Labor market tightness (θ)	1.029	0.812	0.880
Job finding rate ($\theta g(\theta)$)	1.371	1.283	1.323
Job destruction rate	0.100	0.031	0.032
Firm-level employment			
Type R firms (N_i^R)	2.626	2.849	2.450
Type B firms (N_i^B)	2.626	2.988	2.553
Total number of firms (m)	0.614	0.614	0.714
Producing firms	0.355	0.289	0.337
Firms with employment	0.355	0.330	0.385
Average firm destruction rate	0.025	0.018	0.018
Average profit	3.002	3.466	3.001

estimated by Acharya, Baghai, and Subramanian (2014) . The increase in the number of establishments in our model can also be interpreted as an increase in capital and employment of high skilled labor, which is observed by Autor, Kerr, and Kugler (2007) as a firm response to the introduction of employment protection.

The increase in the total number of firms has a counteracting effect on the average product idea price, which decreases from 1.516 in the calibration with the fixed number of firms to 1.376. However, the above mentioned shift in the composition of firms towards a higher fraction of firms that specialize in innovation is still present and leads in combination with the innovations generated by newly created firms to an increase in total innovations of around 18.8%. This is equal to the upper bound estimate by Acharya, Baghai, and Subramanian (2014) , which lies between 12.2% and 18.8%. The larger number of available product ideas increases the product idea finding rate $g(\varphi)$ by 30%.

The higher number of firms m and the higher product idea finding rate dampen the decrease in the number of producing firms. Thus, the decrease in firm-level employment of around 5% on average is primarily responsible for the decline in output, which drops by 7.3%, and the fall in welfare (net output), which decreases by 6.0%. Since the decrease in output cannot be explained by the decrease captial, which is measured by the number of firms, and labor total factor productivity inevitable decreases from 0.138 to -0.010, which confirms qualitatively the effect found by Autor, Kerr, and Kugler (2007) . The decrease in firm-level employment of production workers and the increase in the total number of firms is also in line with the increase in the capital-labor ratio observed by Autor, Kerr, and Kugler (2007) .

4 Conclusion

The model can explain the counter intuitive empirical finding that employment protection increases innovations and at the same time lowers total factor productivity. Firing costs that prevent that workers are laid off increase the cost keeping unproductive workers and thus increases firms' willingness to pay for product ideas. This increases the price for innovations and triggers entry of new firms, especially new start-ups and innovation. Thus, although more resources are allocated to innovative purposes, search frictions on the product idea market cause innovations to remain partly unproductive. This together with the shift in the firm composition away from producing towards innovating firms leads to less output. The fall in output that goes along with an increase in employment (although partly unproductive) and an increase in captial (number of firms) can on the aggregate level only result in a decrease in total factor productivity. Thus, an increase in innovation and a decrease in total factor productivity are competible, if one allows for frictions in the labor and the innovation market.

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Appendix

A Derivations in section 2

A.1 Wage equations

Let us first consider the wages paid in type R firms. Wage bargaining according to equations (14) and (15) implies the following surplus splitting rule for outsiders in firms with a product idea, for insiders in firms with a product idea and for insiders in firms without a product idea,

$$(1-\gamma)\left(W^{O,R}\left(w^{O,R}\left(y,N_i^R\right)\right)-U\right)=\gamma\left(\frac{\partial\pi^{O,R}(N_i^R,y,k_i)}{\partial N_i^R}\right),$$
$$(1-\gamma)\left(W^{I,R}\left(w^{I,R}\left(y,N_i^R\right)\right)-U\right)=\gamma\left(\frac{\partial\pi^{I,R}(N_i^R,y,k_i)}{\partial N_i^R}+f\right),$$
$$(1-\gamma)\left(W^{I,R}\left(w^{I,R}\left(0,N_i^R\right)\right)-U\right)=\gamma\left(\frac{\partial\pi^{I,R}(N_i^R,0,k_i)}{\partial N_i^R}+f\right),$$

, where firms only have to pay firing costs f, if they do not continue to employ an insider. Subsititung the marginal value of a worker in the respective situation from equations (17) and (18), i.e.,

$$\frac{\partial \pi^{O,R}(N_i^R,y,k_i)}{\partial N_i^R} = \frac{\alpha y \left(N_i^R\right)^{\alpha-1} - w^{O,R}\left(y,N_i^R\right) - \frac{\partial w^{O,R}\left(y,N_i^R\right)}{\partial N_i^R}N_i^R + \delta\frac{\partial \pi^{I,R}(N_i^R,0,k_i)}{\partial N_i^R}}{(r+\delta)},$$

$$\frac{\partial \pi^{I,R}(N_i^R,y,k_i)}{\partial N_i^R} = \frac{\alpha y \left(N_i^R\right)^{\alpha-1} - w^{I,R}\left(y,N_i^R\right) - \frac{\partial w^{I,R}\left(y,N_i^R\right)}{\partial N_i^R}N_i^R + \delta\frac{\partial \pi^{I,R}(N_i^R,0,k_i)}{\partial N_i^R}}{(r+\delta)},$$

$$\frac{\partial \pi^{I,R}(N_i^R,0,k_i)}{\partial N_i^R} = \frac{-w^{I,R}\left(0,N_i^R\right) - \frac{\partial w^{I,R}\left(0,N_i^R\right)}{\partial N_i^R}N_i^R + \eta\frac{\partial \pi^{I,R}(N_i^R,y,k_i)}{\partial N_i^R}}{(r+\lambda_d+\eta)},$$

and the workers' surplus from employment using equations (2) and (4), i.e.,

$$\left[W^{O,R}\left(w^{O,R}\left(y,N_i^R\right)\right) - U\right] = \frac{w^{O,R}\left(y,N_i^R\right) - rU + \delta\left[W^{I,R}\left(w^R\left(0,N_i\right)\right) - U\right]}{(r+\delta)},$$

$$\left[W^{I,R}\left(w^{I,R}\left(y,N_i^R\right)\right) - U\right] = \frac{w^{I,R}\left(y,N_i^R\right) - rU + \delta\left[W^{I,R}\left(w^R\left(0,N_i\right)\right) - U\right]}{(r+\delta)},$$

$$\left[W^{I,R}\left(w^{I,R}\left(0,N_i^R\right)\right) - U\right] = \frac{w^{I,R}\left(0,N_i\right) - rU + \eta\left[W^{I,R}\left(w^{i,R}\left(y,N_i\right)\right) - U\right]}{(r+\eta+\lambda_d)},$$

and rearranging using again the surplus splitting rules in the equations above and leads to the following differential wage equations,

$$w^{O,R}\left(y,N_i^R\right) = (1-\gamma)\,rU + \gamma\left(\alpha y\left(N_i^R\right)^{\alpha-1} - \frac{\partial w^{O,R}\left(y,N_i^R\right)}{\partial N_i^R}N_i^R\right) - \gamma\delta f,$$

$$w^{I,R}\left(y,N_i^R\right) = (1-\gamma)\,rU + \gamma\left(\alpha y\left(N_i^R\right)^{\alpha-1} - \frac{\partial w^{I,R}\left(y,N_i^R\right)}{\partial N_i^R}N_i^R\right) + \gamma r f,$$

$$w^{I,R}\left(0,N_i^R\right) = (1-\gamma)\,rU - \gamma\frac{\partial w^{I,R}\left(0,N_i^R\right)}{\partial N_i^R}N_i^R + \gamma\left(r+\lambda_d\right)f,$$

Solving the differential equations for $w^{O,R}\left(y,N_i^R\right)$ and $w^{I,R}\left(y,N_i^R\right)$ following Cahuc and Wasmer (2001) and Cahuc, Marque, and Wasmer (2008) gives the wage equations in section 2.4.3, where we substituted the value of being unemployed by $(1-\gamma)\,rU = (1-\gamma)\,z + \gamma\theta c$. The differential wage equation for $w^{I,R}\left(0,N_i\right)$ is independent of N_i^R and is therefore given by setting $\partial w^{I,R}\left(0,N_i^R\right)/\partial N_i^R = 0$.

Now consider wages paid by type B firms. The surplus splitting rules are given by,

$$(1-\gamma)\left(W^{O,B}\left(w^{O,B}\left(y,N_i^B\right)\right)-U\right)=\gamma\left(\frac{\partial\pi^{O,B}(N_i^B,y,k_i)}{\partial N_i^B}\right),$$
$$(1-\gamma)\left(W^{I,B}\left(w^{I,B}\left(y,N_i^B\right)\right)-U\right)=\gamma\left(\frac{\partial\pi^{I,B}(N_i^B,y,k_i)}{\partial N_i^B}+f\right),$$
$$(1-\gamma)\left(W^{I,B}\left(w^{I,B}\left(0,N_i^B\right)\right)-U\right)=\gamma\frac{r+\lambda_d+g\left(\varphi\right)\left(1-\beta\right)}{r+\lambda_d+g\left(\varphi\right)}\left(\frac{\partial\pi^{I,B}(N_i^B,0,k_i)}{\partial N_i^B}+f\right),$$

where the surplus splitting rule for the case without a product idea takes into account that product idea price bargaining implies that part of the marginal value of continuing the employment relationship (the fraction β) is going to the seller. This causes the additional term in the last equation. The marginal values of employing a worker are given by,

$$\frac{\partial\pi^{O,B}(N_i^B,y,k_i)}{\partial N_i^B}=\frac{\alpha y\left(N_i^B\right)^{\alpha-1}-w^{O,B}\left(y,N_i^B\right)-\frac{\partial w^{O,B}\left(y,N_i^B\right)}{\partial N_i^B}N_i^B+\delta\frac{\partial\pi^{I,B}(N_i^B,0,k_i)}{\partial N_i^B}}{(r+\delta)},$$
$$\frac{\partial\pi^{I,B}(N_i^B,y,k_i)}{\partial N_i^B}=\frac{\alpha y\left(N_i^B\right)^{\alpha-1}-w^{I,B}\left(y,N_i^B\right)-\frac{\partial w^{I,B}\left(y,N_i^B\right)}{\partial N_i^B}N_i^B+\delta\frac{\partial\pi^{I,B}(N_i^B,0,k_i)}{\partial N_i^B}}{(r+\delta)},$$
$$\frac{\partial\pi^{I,B}(N_i^B,0,k_i)}{\partial N_i^B}=\frac{-w^{I,B}\left(0,N_i^B\right)-\frac{\partial w^{I,B}\left(0,N_i^B\right)}{\partial N_i^B}N_i^B+g\left(\varphi\right)\left(1-\beta\right)\frac{\partial\pi^{I,B}(N_i^B,y,k_i)}{\partial N_i^B}}{\left(r+\lambda_d+g\left(\varphi\right)\left(1-\beta\right)\right)},$$

and the workers' surplus from employment by,

$$\left[W^{O,B}\left(w^{O,B}\left(y,N_i^B\right)\right)-U\right]=\frac{w^{O,B}\left(y,N_i^B\right)-rU+\delta\left[W^{I,B}\left(w^{I,B}\left(0,N_i^B\right)\right)-U\right]}{(r+\delta)},$$
$$\left[W^{I,B}\left(w^{I,B}\left(y,N_i^B\right)\right)-U\right]=\frac{w^{I,B}\left(y,N_i^B\right)-rU+\delta\left[W^{I,B}\left(w^{I,B}\left(0,N_i^B\right)\right)-U\right]}{(r+\delta)},$$
$$\left[W^{I,B}\left(w^{I,B}\left(0,N_i^B\right)\right)-U\right]=\frac{w^{I,B}\left(0,N_i^B\right)-rU+g\left(\varphi\right)\left[W^{I,B}\left(w^{I,B}\left(y,N_i\right)\right)-U\right]}{\left(r+\lambda_d+g\left(\varphi\right)\right)}.$$

Substituting implies the following differential wage equations,

$$
\begin{aligned}
w^{O,B}\left(y,N_i^B\right) &= (1-\gamma)\,rU + \gamma\alpha y\left(N_i^B\right)^{\alpha-1} - \gamma\frac{\partial w^{O,B}\left(y,N_i^B\right)}{\partial N_i^B}N_i^B - \delta\gamma f \\
&\quad + \delta\frac{\beta g\left(\varphi\right)}{r+\lambda_d+g\left(\varphi\right)}\gamma\left(\frac{\partial\pi^{I,B}(N_i^B,0,k_i)}{\partial N_i^B}+f\right), \\
w^{I,B}\left(y,N_i^B\right) &= (1-\gamma)\,rU + \gamma\alpha y\left(N_i^B\right)^{\alpha-1} - \gamma\frac{\partial w^{I,B}\left(y,N_i^B\right)}{\partial N_i^B}N_i^B + \gamma r f \\
&\quad + \delta\frac{g\left(\varphi\right)\beta}{r+\lambda_d+g\left(\varphi\right)}\gamma\left(\frac{\partial\pi^{I,B}(N_i^B,0,k_i)}{\partial N_i^B}+f\right), \\
w^{I,B}\left(0,N_i^B\right) &= (1-\gamma)\,rU - \gamma\frac{\partial w^{I,B}\left(0,N_i^B\right)}{\partial N_i^B}N_i^B + \gamma\left(r+\lambda_d\right)f \\
&\quad - \beta g\left(\varphi\right)\gamma\left(\frac{\partial\pi^{I,B}(N_i^B,y,k_i)}{\partial N_i^B}+f\right),
\end{aligned}
$$

where the last term in each line, i.e., a fraction of firms' surplus, appears due to the product idea price bargaining. Since wages of outsiders and insiders at a firm with a product idea only differ in a constant, we know that the $\partial w^{O,B}\left(y,N_i^B\right)/\partial N_i^B = \partial w^{I,B}\left(y,N_i^B\right)/\partial N_i^B$. This allows us to write the differences in the wages between ousiders and insiders as,

$$
w^{I,B}\left(y,N_i^B\right) - w^{O,B}\left(y,N_i^B\right) = \gamma\left(r+\delta\right)f.
$$

Substituting allows us to write the difference in the marginal values of employing an outsider and an insider as,

$$
\frac{\partial\pi^{O,B}(N_i^B,y,k_i)}{\partial N_i^B} - \frac{\partial\pi^{I,B}(N_i^B,y,k_i)}{\partial N_i^B} = \frac{w^{I,B}\left(y,N_i^B\right) - w^{O,B}\left(y,N_i^B\right)}{\left(r+\delta\right)} = \gamma f.
$$

Given the vacancy creation condition, we can write the marginal value of employing an insider as

$$
\frac{\partial\pi^{I,B}(N_i^B,y,k_i)}{\partial N_i^B} = \frac{\partial\pi^{O,B}(N_i^B,y,k_i)}{\partial N_i^B} - \gamma f = \frac{c}{\lambda_m\left(\theta\right)} - \gamma f.
$$

This allows us to determine the wage for an insider at a firm without a product idea,

$$
w^{I,B}\left(0,N_i^B\right) = (1-\gamma)\,rU + \gamma\left(r+\lambda_d\right)f - \beta g\left(\varphi\right)\gamma\left(\frac{c}{\lambda_m\left(\theta\right)} + (1-\gamma)\,f\right)
$$

where we used the fact that the differential equation is independent of N_i^B.

Substituting implies that the marginal value of employing an insider without a product idea is independent of the number of employed workers, i.e.,

$$\frac{\partial \pi^{I,B}(N_i^B, 0, k_i)}{\partial N_i^B} = \frac{g(\varphi)(1-\beta)\left(\frac{c}{\lambda_m(\theta)} - \gamma f\right) - w^{I,B}\left(0, N_i^B\right)}{(r + \lambda_d + g(\varphi)(1-\beta))}.$$

This allows us to write the wage equation for an outsider and an insider at a firm with product idea implies,

$$\begin{aligned} w^{O,B}\left(y, N_i^B\right) &= (1-\gamma) rU + \gamma \frac{\alpha}{1-\gamma(1-\alpha)} y \left(N_i^B\right)^{\alpha-1} - \delta\gamma f \\ &\quad + \delta\beta g(\varphi)\gamma \frac{g(\varphi)(1-\beta)\left(\frac{c}{\lambda_m(\theta)} - \gamma f\right) - w^{I,B}\left(0, N_i^B\right)}{(r + \lambda_d + g(\varphi))(r + \lambda_d + g(\varphi)(1-\beta))}, \\ w^{I,B}\left(y, N_i^B\right) &= (1-\gamma) rU + \gamma \frac{\alpha}{1-\gamma(1-\alpha)} y \left(N_i^B\right)^{\alpha-1} + \gamma r f \\ &\quad + \delta\beta g(\varphi)\gamma \frac{g(\varphi)(1-\beta)\left(\frac{c}{\lambda_m(\theta)} - \gamma f\right) - w^{I,B}\left(0, N_i^B\right)}{(r + \lambda_d + g(\varphi))(r + \lambda_d + g(\varphi)(1-\beta))}, \end{aligned}$$

Substituting the value of being unemployed by $(1-\gamma) rU = (1-\gamma) z + \gamma\theta c$ gives the wage equation in section 2.4.3.

A.2 Firing conditions

The firing conditions for type R and type B firms are given by,

$$\frac{\partial \pi^{I,R}(N_i^R, 0, k_i)}{\partial N_i^R} + f < 0, \text{ and } \frac{\partial \pi^{I,B}(N_i^B, 0, k_i)}{\partial N_i^B} + f < 0.$$

Using the respective marginal values of a worker from section A.1 and the fact that,

$$\frac{\partial \pi^{O,t}(N_i^t, y, k_i)}{\partial N_i^t} - \frac{\partial \pi^{I,t}(N_i^t, y, k_i)}{\partial N_i^t} = \frac{w^{I,t}(y, N_i^t) - w^{O,t}(y, N_i^t)}{(r+\delta)} = \gamma f,$$

and that the vacancy creation condition,

$$\frac{\partial \pi^{O,t}(N_i^t, y, k_i)}{\partial N_i^t} = \frac{c}{\lambda_m(\theta)},$$

gives the firing conditions in section 2.6.

A.3 Vacancy creation conditions

Using the respective marginal values of a worker from section A.1 and the fact that,

$$\frac{\partial \pi^{O,t}(N_i^t, y, k_i)}{\partial N_i^t} - \frac{\partial \pi^{I,t}(N_i^t, y, k_i)}{\partial N_i^t} = \frac{w^{I,t}\left(y, N_i^t\right) - w^{O,t}\left(y, N_i^t\right)}{(r+\delta)} = \gamma f,$$

where

$$\begin{aligned}
\frac{\partial \pi^{I,R}(N_i^R, y, k_i)}{\partial N_i^R} &= \frac{\frac{(1-\gamma)\alpha}{1-\gamma(1-\alpha)} y \left(N_i^R\right)^{\alpha-1} - (1-\gamma) rU - \gamma r f + \delta \frac{\partial \pi^{I,R}(N_i^R, 0, k_i)}{\partial N_i^R}}{(r+\delta)} \\
&= \frac{\frac{(1-\gamma)\alpha}{1-\gamma(1-\alpha)} y \left(N_i^R\right)^{\alpha-1} - (1-\gamma) rU - \gamma r f}{(r+\delta)} \\
&+ \frac{\delta}{(r+\delta)} \frac{\eta \left(\frac{c}{\lambda_m(\theta)} + (1-\gamma) f\right) - w^{I,R}\left(0, N_i^R\right) - \eta f}{(r+\lambda_d+\eta)} \\
&= \frac{\frac{(1-\gamma)\alpha}{1-\gamma(1-\alpha)} y \left(N_i^R\right)^{\alpha-1} - (1-\gamma) rU - \gamma r f}{(r+\delta)} \\
&+ \frac{\delta}{(r+\delta)} \frac{\eta \frac{c}{\lambda_m(\theta)} - (1-\gamma) rU - \gamma (r+\lambda_d+\eta) f}{(r+\lambda_d+\eta)}
\end{aligned}$$

Rearranging and using the fact that

$$\frac{\partial \pi^{O,t}(N_i^t, y, k_i)}{\partial N_i^t} = \frac{\partial \pi^{I,t}(N_i^t, y, k_i)}{\partial N_i^t} + \gamma f = \frac{c}{\lambda_m(\theta)}$$

implies

$$\begin{aligned}
\frac{c}{\lambda_m(\theta)} &= \frac{\frac{(1-\gamma)\alpha}{1-\gamma(1-\alpha)} y \left(N_i^R\right)^{\alpha-1} - (1-\gamma) rU}{(r+\delta)} \\
&+ \frac{\delta}{(r+\delta)} \frac{\eta \frac{c}{\lambda_m(\theta)} - (1-\gamma) rU}{(r+\lambda_d+\eta)} \\
\frac{c}{\lambda_m(\theta)} &= \frac{(r+\lambda_d+\eta) \frac{(1-\gamma)\alpha}{1-\gamma(1-\alpha)} y \left(N_i^R\right)^{\alpha-1} - (r+\delta+\lambda_d+\eta)(1-\gamma) rU}{(r+\delta)(r+\lambda_d) + r\eta}
\end{aligned}$$

Similarly for type B firms, i.e.,

$$\frac{\partial \pi^{I,B}(N_i^B, y, k_i)}{\partial N_i^B} = \frac{\alpha y \left(N_i^B\right)^{\alpha-1} - w^{I,B}\left(y, N_i^B\right) - \dfrac{\partial w^{I,B}\left(y, N_i^B\right)}{\partial N_i^B} N_i^B + \delta \dfrac{\partial \pi^{I,B}(N_i^B, 0, k_i)}{\partial N_i^B}}{(r+\delta)}$$

$$= \frac{\dfrac{(1-\gamma)\alpha}{1-\gamma(1-\alpha)} y \left(N_i^B\right)^{\alpha-1} - (1-\gamma) rU - \gamma(r+\delta) f - \delta(1-\gamma) f}{(r+\delta)}$$

$$+ \frac{\delta}{(r+\delta)} \frac{r+\lambda_d+g(\varphi)-g(\varphi)\gamma\beta}{r+\lambda_d+g(\varphi)} \left(\frac{\partial \pi^{I,B}(N_i^B, 0, k_i)}{\partial N_i^B} + f\right).$$

Using the fact that

$$\frac{\partial \pi^{O,t}(N_i^t, y, k_i)}{\partial N_i^t} = \frac{\partial \pi^{I,t}(N_i^t, y, k_i)}{\partial N_i^t} + \gamma f = \frac{c}{\lambda_m(\theta)},$$

implies

$$\frac{c}{\lambda_m(\theta)} = \frac{\dfrac{(1-\gamma)\alpha}{1-\gamma(1-\alpha)} y \left(N_i^B\right)^{\alpha-1} - (1-\gamma) rU - \delta(1-\gamma) f}{(r+\delta)}$$

$$+ \frac{\delta}{(r+\delta)} \frac{r+\lambda_d+g(\varphi)-g(\varphi)\gamma\beta}{r+\lambda_d+g(\varphi)} \left(\frac{\partial \pi^{I,B}(N_i^B, 0, k_i)}{\partial N_i^B} + f\right),$$

$$\frac{c}{\lambda_m(\theta)} = \frac{\dfrac{(1-\gamma)\alpha}{1-\gamma(1-\alpha)} y \left(N_i^B\right)^{\alpha-1} - (1-\gamma) rU - \delta(1-\gamma) f}{(r+\delta)}$$

$$+ \frac{\delta}{(r+\delta)} \frac{r+\lambda_d+g(\varphi)-g(\varphi)\gamma\beta}{(r+\lambda_d+g(\varphi))} \frac{g(\varphi)(1-(1-\gamma)\beta)\dfrac{c}{\lambda_m(\theta)} - (1-\gamma) rU}{(r+\lambda_d+g(\varphi)(1-\beta))}$$

$$+ \frac{\delta}{(r+\delta)} \frac{r+\lambda_d+g(\varphi)-g(\varphi)\gamma\beta}{r+\lambda_d+g(\varphi)} \frac{r+\lambda_d+g(\varphi)(1-\beta)+g(\varphi)\gamma\beta}{r+\lambda_d+g(\varphi)(1-\beta)} (1-\gamma) f,$$

$$= \frac{\dfrac{(1-\gamma)\alpha}{1-\gamma(1-\alpha)} y \left(N_i^B\right)^{\alpha-1}}{(r+\delta)}$$

$$- \left(1 + \delta \frac{(r+\lambda_d+g(\varphi)-g(\varphi)\gamma\beta)}{(r+\lambda_d+g(\varphi))(r+\lambda_d+g(\varphi)(1-\beta))}\right) \frac{(1-\gamma) rU}{(r+\delta)}$$

$$+ \frac{\delta}{(r+\delta)} \frac{(r+\lambda_d+g(\varphi)-g(\varphi)\gamma\beta) g(\varphi)(1-(1-\gamma)\beta)}{(r+\lambda_d+g(\varphi))(r+\lambda_d+g(\varphi)(1-\beta))} \frac{c}{\lambda_m(\theta)}$$

$$+ \frac{g(\varphi)\beta(1-\gamma) g(\varphi)\gamma\beta}{(r+\lambda_d+g(\varphi))(r+\lambda_d+g(\varphi)(1-\beta))} \frac{\delta}{(r+\delta)} (1-\gamma) f,$$

Rearranging implies,

$$\begin{aligned}\frac{c}{\lambda_m(\theta)} &= \frac{C_2}{C_1}\left(\frac{(1-\gamma)\,\alpha}{1-\gamma(1-\alpha)}y\left(N_i^B\right)^{\alpha-1}-(1-\gamma)\,rU\right)\\ &-\frac{r+\lambda_d+g(\varphi)-g(\varphi)\,\gamma\beta}{C_1}\delta(1-\gamma)\,rU\\ &+\frac{g(\varphi)\,\beta(1-\gamma)\,g(\varphi)\,\gamma\beta}{C_1}\delta(1-\gamma)\,f\end{aligned}$$

with

$$\begin{aligned}C_1 &= C_2(r+\delta)-(r+\lambda_d+g(\varphi)-\gamma\beta g(\varphi))\,\delta(1-(1-\gamma)\,\beta)\,g(\varphi)\\ C_2 &= (r+\lambda_d+g(\varphi))\,(r+\lambda_d+g(\varphi)(1-\beta))\end{aligned}$$

A.4 Product idea price

The product idea price is given by the surplus splitting rule,

$$\begin{aligned}p(k_j,0) = \beta&\left(\pi^{O,B}\left(N_i^B,y,k_i\right)-\frac{c}{\lambda_m(\theta)}N_i^B-\pi^{O,B}(0,0,k_i)\right)\\ &+(1-\beta)\left(\pi^S(0,y,k_j)-\pi^S(0,0,k_j)\right),\end{aligned} \tag{45}$$

$$\begin{aligned}p\left(k_j,N_i^B\right) = \beta&\left(\pi^{I,B}\left(N_i^B,y,k_i\right)-\pi^{I,B}\left(N_i^B,0,k_i\right)\right)\\ &+(1-\beta)\left(\pi^S(0,y,k_j)-\pi^S(0,0,k_j)\right).\end{aligned} \tag{46}$$

The closed form expressions for the expected profit of establishments that sell their product ideas and of establishments that buy product ideas are as follows. Given the fact that the price that an establishment with innovation cost k_i is given by $p(k_i,0)$ or $p\left(k_i,N_j^B\right)$, respectively, and using equations (7) and (8) the expected profit with and without a product idea can be written as,

$$\pi^S(0,y,k_i) = \frac{(r+\lambda_s+\eta)\,\varphi g(\varphi)\,p(k_i,N)-(\delta+\varphi g(\varphi))\,k_i}{r(r+\lambda_s+\eta)+(\delta+\varphi g(\varphi))\,(r+\lambda_s)}, \tag{47}$$

$$\pi^S(0,0,k_i) = \frac{\eta\varphi g(\varphi)\,p(k_i,N)-(r+\delta+\varphi g(\varphi))\,k_i}{r(r+\lambda_s+\eta)+(\delta+\varphi g(\varphi))\,(r+\lambda_s)}. \tag{48}$$

where $N=N_j^B$ if $L_j^B=0$ and $N=0$ if $L_j^B=N_j^B$. Using equations (9) and (13) the expected profit with and without a product idea for establishments that do not lay off their workers if they are hit by a product idea shock can be written as,

$$\pi^{I,B}\left(N_i^B, y, k_i\right) = \frac{\left(r+\lambda_d+g\left(\varphi\right)\right)\left(y\left(N_i^B\right)^\alpha - w^{I,B}\left(y, N_i^B\right)N_i^B\right)}{\left(r+\lambda_d\right)\left(r+\delta\right)+g\left(\varphi\right)r} - \delta\frac{w^{I,B}\left(0, N_i^B\right)N_i^B + g\left(\varphi\right)E_{k_j}\left[p\left(k_j, N_i^B\right)\right]}{\left(r+\lambda_d\right)\left(r+\delta\right)+g\left(\varphi\right)r}, \tag{49}$$

$$\pi^{I,B}\left(N_i^B, 0, k_i\right) = \frac{g\left(\varphi\right)\left(y\left(N_i^B\right)^\alpha - w^{I,B}\left(y, N_i^B\right)N_i^B\right)}{\left(r+\lambda_d\right)\left(r+\delta\right)+g\left(\varphi\right)r} - \left(r+\delta\right)\frac{w^{I,B}\left(0, N_i^B\right)N_i^B + g\left(\varphi\right)E_{k_j}\left[p\left(k_j, N_i^B\right)\right]}{\left(r+\lambda_d\right)\left(r+\delta\right)+g\left(\varphi\right)r}. \tag{50}$$

If workers are laid off in case of a product idea shock, the expected profits with and without a product idea are given by,

$$\pi^{O,B}\left(N_i^B, y, k_i\right) = \frac{\left(r+\lambda_d+g\left(\varphi\right)\right)\left(y\left(N_i^B\right)^\alpha - w^{O,B}\left(y, N_i^B\right)N_i^B - \delta f N_i^B\right)}{\left(r+\lambda_d\right)\left(r+\delta\right)+g\left(\varphi\right)r} - \frac{\delta g\left(\varphi\right)}{\left(r+\lambda_d\right)\left(r+\delta\right)+g\left(\varphi\right)r}\left(\frac{c}{\lambda_m\left(\theta\right)}N_i^B + E_{k_j}\left[p\left(k_j, 0\right)\right]\right), \tag{51}$$

$$\pi^{O,B}\left(0, 0, k_i\right) = \frac{g\left(\varphi\right)\left(y\left(N_i^B\right)^\alpha - w^{O,B}\left(y, N_i^B\right)N_i^B - \delta f N_i^B\right)}{\left(r+\lambda_d\right)\left(r+\delta\right)+g\left(\varphi\right)r} - \frac{\left(r+\delta\right)g\left(\varphi\right)}{\left(r+\lambda_d\right)\left(r+\delta\right)+g\left(\varphi\right)r}\left(\frac{c}{\lambda_m\left(\theta\right)}N_i^B + E_{k_j}\left[p\left(k_j, 0\right)\right]\right). \tag{52}$$

Given the expected price in equation (27) or (28) the product idea price $p\left(k_j, N_i^B\right)$ or $p\left(k_j, 0\right)$ for a seller with innovation cost k_j is given by substituting the expected price in the respective expected profit functions (47) to (52) and inserting them into the product idea price equations (45) and (46). Rearranging implies,

$$p\left(k_j, N_i^B\right) = \frac{K_2\beta\left(r+\lambda_d\right)\left(y\left(N_i^B\right)^\alpha - w^{I,B}\left(y, N_i^B\right)N_i^B\right) + K_2\beta r w^B\left(0, N_i^B\right)N_i^B}{K_1K_2 - K_1\left(1-\beta\right)\left(r+\lambda_s\right)\varphi g\left(\varphi\right)} + \frac{K_1\left(1-\beta\right)rk_j + K_2\beta r g\left(\varphi\right)p\left(\bar{k}, N_i^B\right)}{K_1K_2 - K_1\left(1-\beta\right)\left(r+\lambda_s\right)\varphi g\left(\varphi\right)},$$

$$p\left(k_j, 0\right) = \frac{K_2\beta\left(r+\lambda_d\right)\left(y\left(N_i^B\right)^\alpha - w^{O,B}\left(y, N_i^B\right)N_i^B - \delta f N_i^B - \left(r+\delta\right)\frac{c}{\lambda_m\left(\theta\right)}N_i^B\right)}{K_1K_2 - K_1\left(1-\beta\right)\left(r+\lambda_s\right)\varphi g\left(\varphi\right)} + \frac{K_1\left(1-\beta\right)rk_jK_2 + \beta r g\left(\varphi\right)p\left(\bar{k}, 0\right)}{K_1K_2 - K_1\left(1-\beta\right)\left(r+\lambda_s\right)\varphi g\left(\varphi\right)}.$$

A.5 Type choice

The closed form expression for the expected profit of type R firms is obtained by rearranging equations (9) to (11), i.e.,

$$\pi^{O,R}\left(N_i^R, y, k_i\right) = \begin{cases} \dfrac{(r+\lambda_d+\eta)\left(y\left(N_i^R\right)^{\alpha} - w^{O,R}\left(y, N_i^R\right)N_i^R\right) - \delta k_i}{((r+\lambda_d)(r+\delta)+r\eta)} \\ \qquad -\delta\dfrac{w^{I,R}\left(0, N_i^R\right)N_i^R + \eta\gamma f N_i^R}{((r+\lambda_d)(r+\delta)+r\eta)} \quad \text{if} \quad L_i^R = 0, \\ \dfrac{(r+\lambda_d+\eta)\left(y\left(N_i^R\right)^{\alpha} - w^{O,R}\left(y, N_i^R\right)N_i^R - \delta f N_i^R\right) - \delta k_i}{(r+\lambda_d)(r+\delta)+r\eta} \\ \qquad -\dfrac{\delta\eta}{(r+\lambda_d)(r+\delta)+r\eta}\dfrac{c}{\lambda_m(\theta)}N_i^R \quad \text{if} \quad L_i^R = N_i^R, \end{cases}$$

The expected profit is strictly decreasing in k_i, which makes it less attractive for high innovation cost establishments to do own research if they are hit by a product idea shock.

Type S firms that only innovate in order to sell their product ideas obtain the expected profit $\pi^S(0, y, k_i)$, where substituting the price $p(k_i, N)$ implies,

$$\begin{aligned} \pi^S(0,y,k_i) &= \frac{(r+\lambda_s+\eta)\varphi g(\varphi)\beta(r+\lambda_d)\left(y\left(N_j^B\right)^{\alpha} - w^B\left(y, N_j^B\right)N_j^B\right)}{((r+\lambda_d)(r+\delta)+g(\varphi)r)((r+\lambda_s)(r+\delta+\beta\varphi g(\varphi))+r\eta)} \\ &+ \frac{(r+\lambda_s+\eta)\varphi g(\varphi)\beta\left(rw^B\left(0, N_j^B\right)N_j^B + rg(\varphi)p\left(\overline{k}_i, N_j^B\right)\right)}{((r+\lambda_d)(r+\delta)+g(\varphi)r)((r+\lambda_s)(r+\delta+\beta\varphi g(\varphi))+r\eta)} \\ &- \frac{(\delta+\beta\varphi g(\varphi))}{(r+\lambda_s)(r+\delta+\beta\varphi g(\varphi))+r\eta}k_i \quad \text{if} \quad L_j^B = 0\,, \\ \pi^S(0,y,k_i) &= \frac{(r+\lambda_s+\eta)\varphi g(\varphi)\beta(r+\lambda_d)\left(y\left(N_j^B\right)^{\alpha} - w^B\left(y, N_j^B\right)N_j^B - \delta f N_j^B\right)}{((r+\delta)(r+\lambda_d)+rg(\varphi))((r+\delta)(r+\lambda_s)+\beta\varphi g(\varphi)(r+\lambda_d)+r\eta)} \\ &+ \frac{(r+\lambda_s+\eta)\varphi g(\varphi)\beta\left(-(r+\lambda_d)\left((r+\delta)\dfrac{c}{\lambda_m(\theta)}N_j^B\right) + rg(\varphi)p\left(\overline{k}_j, 0\right)\right)}{((r+\delta)(r+\lambda_d)+rg(\varphi))((r+\delta)(r+\lambda_s)+\beta\varphi g(\varphi)(r+\lambda_d)+r\eta)} \\ &- \frac{(\delta+\beta\varphi g(\varphi))}{(r+\lambda_s)(r+\delta+\beta\varphi g(\varphi))+r\eta}k_i \quad \text{if} \quad L_j^B = N_j^B\,, \end{aligned}$$

The expected profit $\pi^S(0, y, k_i)$ is strictly decreasing in k_i. Comparing how the expected profit of type S and R firms change with the innovation cost k_i reveals,

$$\frac{\partial\pi^{O,R}\left(N_i^R, y, k_i\right)}{\partial k_i} = \frac{\delta}{(r+\lambda_d)(r+\delta)+r\eta} \quad \text{for any } L_i^R.$$

$$
\begin{aligned}
&\frac{\partial \pi^S(0,y,k_i)}{\partial k_i} - \frac{\partial \pi^{O,R}\left(N_i^R,y,k_i\right)}{\partial k_i} \\
&= \frac{\delta}{(r+\delta)(r+\lambda_d+\eta)}\left(1+\frac{\eta\delta}{((r+\lambda_d)(r+\delta)+r\eta)}\right) - \frac{(\delta+\beta\varphi g(\varphi))}{(r+\lambda_s)(r+\delta+\beta\varphi g(\varphi))+r\eta} \\
&= \frac{\delta}{(r+\lambda_d)(r+\delta)+r\eta} - \frac{(\delta+\beta\varphi g(\varphi))}{(r+\lambda_s)(r+\delta+\beta\varphi g(\varphi))+r\eta} \\
&= \frac{(\lambda_s-\lambda_d)(r\delta+\delta)-(r+\lambda_d+\eta)r\beta\varphi g(\varphi)}{((r+\lambda_d)(r+\delta)+r\eta)((r+\lambda_s)(r+\delta+\beta\varphi g(\varphi))+r\eta)} < 0.
\end{aligned}
$$

since $\lambda_s < \lambda_d$ by assumption.

A.6 Worker flows and labor market tightness

We denote the measure of employed workers by l and the measure of unemployed workers by u. Let us first consider the case when all establishments keep their workers if they are hit by a product idea shock. We can determine the steady state measure of employed workers by equating the in- and outflow from unemployment, i.e.,

$$
\begin{aligned}
\theta\lambda_m(\theta)\,u &= \lambda_d\left(m^B\left(0,N_i^B\right)N_i^B + m^R\left(0,N_i^R\right)N_i^R\right), \\
&= \lambda_d\left(N_i^B + \frac{\Gamma(k^{**})-\Gamma(k^*)}{1-\Gamma(k^{**})}N_i^R\right)m^B\left(0,N_i^B\right).
\end{aligned}
$$

The level of employment l can be obtained by summing over all type B and R establishments, i.e.,

$$
\begin{aligned}
l &= \left(m^B\left(0,N_i^B\right)+m^B\left(y,N_i^B\right)\right)N_i^B + \left(m^R\left(0,N_i^R\right)+m^R\left(y,N_i^R\right)\right)N_i^R, \\
&= \left(\frac{\delta+\lambda_d+g(\varphi)}{\delta}N_i^B + \frac{\delta+\lambda_d+\eta}{\delta}\frac{\Gamma(k^{**})-\Gamma(k^*)}{1-\Gamma(k^{**})}N_i^R\right)m^B\left(0,N_i^B\right),
\end{aligned}
$$

where the flow equations for establishments in equations (32) to (37) imply,

$$
\begin{aligned}
\frac{1}{m^B\left(0,N_i^B\right)} &= \left(\frac{1}{\varphi} + \frac{\delta+\varphi g(\varphi)}{(\lambda_s+\eta)\varphi} + \frac{\delta+\lambda_d+g(\varphi)}{\delta}\right)\frac{1}{m} \\
&\quad + \frac{\delta+\lambda_d+\eta}{\delta}\frac{\Gamma(k^{**})-\Gamma(k^*)}{1-\Gamma(k^{**})}\frac{1}{m}.
\end{aligned} \tag{53}
$$

Using the fact that the number of unemployed and employed workers have to add up to one, i.e., $l = 1-u$, allows us to write the labor market tightness θ as a function of the number of workers employed at type B and R establishments N_i^B and N_i^R, as well as of

$\{\varphi, k^*, k^{**}, m\}$, i.e.,

$$\left(\frac{\lambda_d}{\delta}\frac{\delta+\theta\lambda_m(\theta)}{\theta\lambda_m(\theta)}+\frac{\delta+g(\varphi)}{\delta}\right)N_i^B+\left(\frac{\lambda_d}{\delta}\frac{\delta+\theta\lambda_m(\theta)}{\theta\lambda_m(\theta)}+\frac{\delta+\eta}{\delta}\right)\frac{\Gamma(k^{**})-\Gamma(k^*)}{1-\Gamma(k^{**})}N_i^R$$
$$=\left(\frac{1}{\varphi}+\frac{\delta+\varphi g(\varphi)}{(\lambda_s+\eta)\varphi}+\frac{\delta+\lambda_d+g(\varphi)}{\delta}+\frac{\delta+\lambda_d+\eta}{\delta}\frac{\Gamma(k^{**})-\Gamma(k^*)}{1-\Gamma(k^{**})}\right)\frac{1}{m}, \tag{54}$$

The vacancy creation conditions at type B and R establishments can then be used to substitute out N_i^B and N_i^R to get an equation that solely determines θ as a function of $\{\varphi, k^*, k^{**}, m\}$.

Let us now consider the case when all firms lay off workers if they are hit by a product idea shock. Equating in- and outflow into employment defines steady state employment as,

$$\frac{\theta\lambda_m(\theta)}{\delta+\theta\lambda_m(\theta)}=l=\left(m^B\left(y,N_i^B\right)+m^R\left(y,N_i^R\right)\right)N_i^t,$$
$$=\left(\frac{\lambda_d+g(\varphi)}{\delta}+\frac{\Gamma(k^{**})-\Gamma(k^*)}{1-\Gamma(k^{**})}\frac{\lambda_d+\eta}{\delta}\right)m^B\left(0,N_i^B\right)N_i^t,$$

where $1/m^B\left(0,N_i^B\right)$ is given by equation (53). Substituting $m^B\left(0,N_i^B\right)$ again implies,

$$\left(\frac{1}{\varphi}+\frac{\delta+\varphi g(\varphi)}{(\lambda_s+\eta)\varphi}+\frac{\delta+\lambda_d+g(\varphi)}{\delta}+\frac{\delta+\lambda_d+\eta}{\delta}\frac{\Gamma(k^{**})-\Gamma(k^*)}{1-\Gamma(k^{**})}\right)\frac{1}{m} \tag{55}$$
$$=\left(\frac{\lambda_d+g(\varphi)}{\delta}+\frac{\Gamma(k^{**})-\Gamma(k^*)}{1-\Gamma(k^{**})}\frac{\lambda_d+\eta}{\delta}\right)\frac{\delta+\theta\lambda_m(\theta)}{\theta\lambda_m(\theta)}N_i^t.$$

This again allows us to write the labor market tightness θ as a function of the number of workers N_i^t employed at type B and R establishments with a product idea, as well as $\{\varphi, k^*, k^{**}, m\}$. Again we can use the vacancy creation conditions for productive establishments under $L_i^t = N_i^t$ to substitute out N_i^t.

If only type B or only type R establishments lay off workers, if they are hit by a product idea shock, steady state unemployment and the respective employment level are given by,

$$\theta\lambda_m(\theta)u=\begin{cases}\lambda_d m^B\left(0,N_i^B\right)N_i^B+\delta m^R\left(y,N_i^R\right)N_i^R & \text{if } L_i^B=0 \text{ and } L_i^R=N_i^R,\\ \lambda_d m^R\left(0,N_i^R\right)N_i^R+\delta m^B\left(y,N_i^B\right)N_i^B & \text{if } L_i^B=N_i^B \text{ and } L_i^R=0,\end{cases}$$
$$l=\begin{cases}\left(m^B\left(0,N_i^B\right)+m^B\left(y,N_i^B\right)\right)N_i^B+m^R\left(y,N_i^R\right)N_i^R & \text{if } L_i^B=0 \text{ and } L_i^R=N_i^R,\\ m^B\left(y,N_i^B\right)N_i^B+\left(m^R\left(0,N_i^R\right)+m^R\left(y,N_i^R\right)\right)N_i^R & \text{if } L_i^B=N_i^B \text{ and } L_i^R=0.\end{cases}$$

The flow equations (32) to (37) then determine the respective measures for the number of firms of type B and R. Using the fact that all workers have to add up to one, i.e., $l = 1 - u$, allows us again to write the labor market tightness θ as a function of the number of workers employed at type B and R establishments N_i^B and N_i^R, as well as of $\{\varphi, k^*, k^{**}, m\}$, i.e., for $L_i^B = N_i^B$ and $L_i^R = 0$,

$$\begin{aligned}
&\left(\frac{1}{\varphi} + \frac{\delta + \varphi g(\varphi)}{\varphi(\lambda_s + \eta)} + \frac{\delta + \lambda_d + g(\varphi)}{\delta} + \frac{\delta + \lambda_d + \eta}{\delta} \frac{\Gamma(k^{**}) - \Gamma(k^*)}{1 - \Gamma(k^{**})}\right) \frac{1}{m} \\
&= \left(\frac{\lambda_d + g(\varphi)}{\theta \lambda_m(\theta)} + \frac{\lambda_d + g(\varphi)}{\delta}\right) N_i^B + \left(\frac{\lambda_d}{\theta \lambda_m(\theta)} + \frac{\delta + \lambda_d + \eta}{\delta}\right) \frac{\Gamma(k^{**}) - \Gamma(k^*)}{1 - \Gamma(k^{**})} N_i^R,
\end{aligned} \tag{56}$$

and for $L_i^B = 0$ and $L_i^R = N_i^R$,

$$\begin{aligned}
&\left(\frac{1}{\varphi} + \frac{\delta + \varphi g(\varphi)}{\varphi(\lambda_s + \eta)} + \frac{\delta + \lambda_d + g(\varphi)}{\delta} + \frac{\delta + \lambda_d + \eta}{\delta} \frac{\Gamma(k^{**}) - \Gamma(k^*)}{1 - \Gamma(k^{**})}\right) \frac{1}{m} \\
&= \left(\frac{\lambda_d}{\theta \lambda_m(\theta)} + \frac{\delta + \lambda_d + g(\varphi)}{\delta}\right) N_i^B + \left(\frac{\lambda_d + \eta}{\theta \lambda_m(\theta)} + \frac{\lambda_d + \eta}{\delta}\right) \frac{\Gamma(k^{**}) - \Gamma(k^*)}{1 - \Gamma(k^{**})} N_i^R.
\end{aligned} \tag{57}$$

Keeping the variables $\{\varphi, k^*, k^{**}, m\}$ constant, equations (54) to (57) determine the respective increasing functions of the number of workers employed at the respective establishments, i.e., $\theta\left(N_i^R, N_i^B\right)$ with $\partial\theta\left(N_i^R, N_i^B\right)/\partial N_i^t > 0$.

B Further calibration results

Table 4 – Results: Employment protection with fixed idea price

Variable	**Baseline without EPL**	**With EPL m-fixed**	**With EPL m-flexible**
Total output (Y)	0.698	0.644	0.624
Welfare (W)	0.636	0.591	0.575
Total factor productivity (before)	0.138	0.093	0.139
Total factor productivity (after)	0.040	-0.014	0.017
Total innovations (I)	0.048	0.048	0.043
Within innovations	0.033	0.033	0.029
Entry innovations	0.015	0.015	0.014
Innovation market tightness (φ)	0.304	0.290	0.317
Product idea finding rate ($g(\varphi)$)	0.363	0.372	0.355
Product idea price (p)	1.039	1.039	1.039
Unemployment rate (u)	0.068	0.026	0.027
Vacancies (V)	0.070	0.023	0.023
Labor market tightness (θ)	1.029	0.893	0.846
Job finding rate ($\theta g(\theta)$)	1.371	1.317	1.298
Job destruction rate	0.100	0.035	0.035
Firm-level employment			
Type R firms (N_i^R)	2.626	2.387	2.642
Type B firms (N_i^B)	2.626	2.418	2.640
Wages			
Type R with PI Outsider ($w_i(y, N_i^R)^{O,R}$)	0.656	0.603	0.583
Type B with PI Outsider ($w_i(y, N_i^B)^{O,B}$)	0.656	0.601	0.583
Type R with PI Insider ($w_i(y, N_i^R)^{I,R}$)	0.656	0.663	0.643
Type B with PI Insider ($w_i(y, N_i^B)^{I,B}$)	0.656	0.661	0.643
Type R without PI ($w_i(0, N_i^R)^{I,R}$)		0.303	0.298
Type B without PI ($w_i(0, N_i^B)^{I,B}$)		0.304	0.298
Total number of firms (m)	0.614	0.614	0.540
Producing firms	0.355	0.348	0.316
Type S with idea	0.128	0.134	0.108
Type S without idea	0.073	0.076	0.063
Type R with idea	0.117	0.108	0.108
Type R without idea	0.019	0.018	0.018
Type B with idea	0.238	0.240	0.208
Type B without idea	0.039	0.039	0.034
Average firm destruction rate	0.025	0.024	0.025
Seller - researcher threshold (k^*)	0.048	0.051	0.046
Researcher - buyer threshold (k^{**})	0.365	0.350	0.372
Average profit	3.002	2.787	3.007
Type S firms	4.167	4.047	4.259
Type R firms	3.259	3.025	3.267
Type B firms	2.786	2.579	2.780

Table 5 – Results: Employment protection with endogenous idea price

Variable	**Baseline without EPL**	**With EPL m-fixed**	**With EPL m-flexible**
Total output (Y)	0.698	0.618	0.647
Welfare (W)	0.636	0.576	0.598
Total factor productivity (before)	0.138	0.073	-0.010
Total factor productivity (after)	0.040	-0.038	-0.095
Total innovations (I)	0.048	0.048	0.057
Within innovations	0.033	0.037	0.042
Entry innovations	0.015	0.011	0.015
Innovation market tightness (φ)	0.304	0.172	0.179
Product idea finding rate ($g(\varphi)$)	0.363	0.482	0.473
Product idea price (p)	1.039	1.516	1.376
Unemployment rate (u)	0.068	0.024	0.023
Vacancies (V)	0.070	0.019	0.020
Labor market tightness (θ)	1.029	0.812	0.880
Job finding rate ($\theta g(\theta)$)	1.371	1.283	1.323
Job destruction rate	0.100	0.031	0.032
Firm-level employment			
Type R firms (N_i^R)	2.626	2.849	2.450
Type B firms (N_i^B)	2.626	2.988	2.553
Wages			
Type R with PI Outsider ($w_i(y, N_i^R)^{O,R}$)	0.656	0.569	0.597
Type B with PI Outsider ($w_i(y, N_i^B)^{O,B}$)	0.656	0.563	0.592
Type R with PI Insider ($w_i(y, N_i^R)^{I,R}$)	0.656	0.629	0.658
Type B with PI Insider ($w_i(y, N_i^B)^{I,B}$)	0.656	0.624	0.653
Type R without PI ($w_i(0, N_i^R)^{I,R}$)		0.295	0.302
Type B without PI ($w_i(0, N_i^B)^{I,B}$)		0.243	0.251
Total number of firms (m)	0.614	0.614	0.714
Producing firms	0.355	0.289	0.337
Type S with idea	0.128	0.190	0.219
Type S without idea	0.073	0.095	0.110
Type R with idea	0.117	0.050	0.054
Type R without idea	0.019	0.008	0.009
Type B with idea	0.238	0.239	0.283
Type B without idea	0.039	0.033	0.040
Average firm destruction rate	0.025	0.018	0.018
Seller - researcher threshold (k^*)	0.048	0.085	0.084
Researcher - buyer threshold (k^{**})	0.365	0.268	0.255
Average profit	3.002	3.466	3.001
Type S firms	4.167	4.637	4.269
Type R firms	3.259	3.574	3.170
Type B firms	2.786	3.303	2.792