Employment protection and the stock market: The common shock case

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This paper considers the consequences of employment protection with a fully diversified stock market when firms face a common shock. The analysis focuses on the interaction between employment protection and stock market when wages are sluggish or fixed. We build and calibrate a dynamic model where firms decide upon capital utilization, investment, vacancy posting and lay-offs in order to maximize shareholder value. Public policy, devoted to employment protection, is parametrized through firing costs. Due to the capital and employment irreversibilities, the model has to be solved using numerical techniques. Two series of scenarii are presented, first considering the effect of alternative level of firing costs in a benchmark economy, thus examining interactions between firing cost and successively, *i*) higher market price of risk, *ii*) higher separation rates, *iii*) fixed wages, *iv*) fixed capital utilization.

Keywords : Employment protection institution, matching, stock market

JEL : J.65, J68

Protection de l emploi et marché financier : Le cas d un choc agrégé

Cette étude considère les effets de la protection de l'emploi en présence d'un marché financier complètement diversifié quand les entreprises subissent un choc commun. L'analyse s'attache aux interactions entre protection de l'emploi et marchés financiers quand les salaires sont partiellement ou totalement rigides. On construit, étalonne et résout un modèle dynamique où les firmes décident de l'utilisation du capital, de l'investissement, de l'ouverture d'emplois vacants et de licenciements dans le but de maximiser la valeur actionariale. La politique publique de protection de l'emploi est paramétrisée par le niveau des coûts de licenciements. Etant donné l'irréversibilité des décisions affectant l'investissement et l'emploi, le modèle est résolu au moyen de techniques numériques. Deux types de scénarios sont examinés. On considère d'abord l'effet de différents niveaux des coûts de licenciements dans une économie de référence. On étudie ensuite les interactions des coûts de licenciements avec : 1) un prix plus élevé du risque, 2) des taux de séparation plus forts, 3) un taux d'utilisation du capital fixé, 4) un taux de salaire totalement rigide.

Mots-clés : Appariement, institution, marchés financiers, protection de l'emploi.

JEL : J.65, J68

1 Introduction

There is a growing concern on the institutional framework in which modern market economies are working. Especially, the interaction between labor market institutions and financial market deserves more attention in the recent literature (Blanchard and Wolfers, 2000).

Since Lazear (1990), regulations aiming at employment protection are commonly charged for one part of responsibility for the high levels of European unemployment rates. Alleviating these regulations therefore lies at the forefront of institutional reforms recommended by international organizations as the OECD or the IMF. On the other side, there is a concern from worker unions that return requirements from the stock market exert a higher pressure on firms employment policies, resulting in faster adjustments and a reduced labour hoarding when facing negative shocks.

Following Bertolila and Bertola (1990) and Burda (1992), much work, both theoretical and empirical, has been devoted to the effects of firing costs and other employment protection devices. It is now widely recognized that employment protection generally reduces both firing rates - thus unemployment incidence - and hiring rates - therefore increasing the average duration of unemployment spells (see e.g. Booth 1997). Blanchard and Portugal (2001) find that the -favourable- incidence effect dominates marginally (but not significantly) the duration effect.

Recent contributions generally rest on using some version of the job search or matching paradigm (see e.g. Millard and Mortensen, 1997), successively introducing endogenous separations (Mortensen and Pissarides, 1994), general equilibrium (1994), capital accumulation (Shi and Wen, 1997). Ljungqvist (1999) emphasizes the importance of the wage formation process in shaping the effects of employment protection in matching models. In this literature, employment decisions are modelled as firms responses to idiosynchrastic productivity shocks. Alternatively, some real business cycle models retain the assumption of shocks to the aggregate total factor productivity as the driving force to employment fluctuations (Andolfatto, 1996).

Danthine and Donaldson (2000)[1] provide a stimulating examination of "labor relations and asset returns" within a representative agents perspective. This paper owes much to their impulse, but with three major reformulations. First, Danthine and Donaldson modelize asset pricing in a representative stockholder model while we retain the assumption of a world capital market allowing for full diversification. Next, we consider that firms do not decide

[1] Following the seminal contribution by Danthine, Donaldson and Mehra (1992).

directly their employment level, but only indirectly through firing and posting vacancies. Finally, we consider the effects of shifting employment risk, from workers to the stock market, while Danthine and Donaldson consider the effects of sharing the wage risk at a fixed employment level.

However, a major similarity between the two papers is to work with the representative firm stochastic growth neoclassical model, common to a wide body of literature dealing with business cycle and asset pricing. Consequently, we focus on the responses of firms and the stock market to common shocks, interpretable as phases of the business cycle.

We also introduce endogenous capital utilization as providing an alternative way for firms to adjust their output when employment is no longer flexible.

The remainder of the paper is organized as follows. Section 2 sets up the model, introducing assumptions on technology, the labour market, firm objectives and the stock market. Section 3 deals with calibration and the computation of a benchmark equilibrium. Section 4 considers different levels of firing costs and alternative scenarios in order to elaborate the analysis of interactions between employment protection and others mechanisms or institutions. Section 5 provides a few concluding comments.

2 Firm behavior and the labour market

In order to focus on the interactions between firm behaviour, the labour market and the stock market, we shall disregard households behaviour by considering a small open economy framework and a simplistic labor supply assumption.

2.1 Technology and capital accumulation

The representative firm produces for an international fully competitive good market at a constant price normalized to one. It uses labour and capital at a variable rate. The usual (Greenwood et alii, 1988, Burnside and Eichenbaum, 1996) specification for a production function with a variable capital utilization rate θ writes $y = a_s k^\alpha \theta^\alpha n^{1-\alpha}$, together with a variable rate of depreciation $\delta(\theta) = \dfrac{\theta^{1/\gamma}}{\delta}$ (notice that both δ and γ parameters are taken here as inverses of their usual definition). We adopt the following reformulation of this production function, introducing the user cost or capital used-up in the production as $k_u = \delta(\theta)k = \theta^{1/\gamma}k/\delta$.

$$y = a_s \delta^{\alpha\gamma} k^{\alpha(1-\gamma)} k_u^{\alpha\gamma} N^{1-\alpha} \tag{1}$$

where a_s is the TFP conditional to state s and N the labour effectively used for current period production.

We assume capital adjustment costs such that the cost of a net increase i, to the capital stock is given as $\psi(i) = i + \chi i^2/2$ with χ a positive parameter[2]. The expression of capital accumulation in standard notations thus reduces to

$$k' = k + i - \Delta \tag{2}$$

with Δ a depreciation shock to be commented later.

By explicitely introducing the used-up capital k_u as a factor of production, this reformulation allows for a straightforward representation of the variable utilization process.

Equation (1) involves the standard representation of the technology shock as a shock to the state conditional TFP. Within this standard representation, a negative shock to a_s would only entail a decrease in the average and marginal productivity of the same magnitude. Assuming a real wage equal to the marginal productivity prior to the shock, the incentive for firms to reduce employment through layoffs is limited, and hardly consistent with the observation of firms incurring firing costs equal to several months of wages in order to immediately reduce employment.

As the introduction of idiosyncratic or reallocation shocks lies beyond our modelling strategy, we rather consider non neutral productivity shocks, which hurt especially one part of the working positions occupied by homogenous workers. The production function (1) is reformulated as

$$y = a_s \delta^{\alpha\gamma} k^{\alpha(1-\gamma)} k_u^{\alpha\gamma} \left(E_s N\right)^{1-\alpha} \tag{3}$$

where the efficient employment is given by the following CES aggregator

$$E_s N = \left(n_0^{-\nu} + A_s \left(N - n_0\right)^{-\nu}\right)^{-\frac{1}{\nu}} \tag{4}$$

the state specific productivity factor only affects $(N - n_0)$, the "fragile" jobs. This specification accounts for the fact that a recession unequally hurts jobs, with some of them unaffected, but others losing much more than the average decline of the productivity.

[2]see Jermann (1998) on the importance of capital adjusment costs for asset pricing.

2.2 The dynamics of employment

The current level of employment is the amount available at the start of the period n, minus the lay-offs f, thus $N = (n - f)$, with $f \geq 0$.

Employment, accounting for lay-offs, decreases according to an exogenous separation process at rate $\lambda > 0$ and increases as the result of new matches $m(v, u)$. Hence we get :

$$n' = (1 - \lambda)(n - f) + m(v, u) \tag{5}$$

New matches, operatives at the next period, are function of the number of vacancies posted in the current period v and the unemployment rate u. In the following, we adopt the specification of the matching function introduced by den Haan et alii (2000)

$$m(v, u) = vu/(v^{\ell} + u^{\ell})^{1/\ell} \tag{6}$$

with ℓ a positive parameter. Labour supply is assumed constant and normalized to one, with the consequence that $u = 1 - N$ at the representative firm equilibrium.

Posting a vacancy involves a fixed cost $c > 0$. The employment protection policy is parametrized through the following cost function of firings

$$\begin{aligned} \phi(f) &= \varphi + \varphi_1 f + \varphi_2 f^2 \ , \quad \text{if } f > 0, \text{ with } \varphi_0, \varphi_1, \varphi_2 \geq 0 \\ &= 0 \qquad\qquad\qquad\quad \text{if } f = 0 \end{aligned} \tag{7}$$

As we do not explicitly consider the situation of workers, it is equivalent for the present problem that $\phi(f)$ consists of severance payments to the fired workers or of taxes.

As we do not either introduce idiosyncratic shocks, all the members of our representative firm will take the same decision, with the consequence that the aggregate (and average) number of vacancies would be zero with a positive probability. To avoid this issue, we assume that every exogenous separation is automatically reposted (as in den Haan et alii, 2000). This assumption determines the "rate of attrition" of employment, defined as the rate of exogenous decrease in n when there is no lay-off ($f = 0$) and vacancies are set at their lower bound v_0, equal to the number of separations reposted. $>$From equation (5) and (6), and the homogeneity of degree one of the matching function, the employment attrition rate writes

$$(n' - n)/n = \lambda - m[\lambda, (1 - n)/n] \tag{8}$$

The value of the attrition rate will be very important for assessing employment protection. If this rate is larger than -or close to- the rate at which firms would wish to downsize their employment level, any policy restraining or precluding lay-offs would be unoperative.

As indicated in the introduction, this paper focuses on the consequences of employment protection as a device of shifting employment risk. Trivially, this problem would not arise with a fully flexible wage, continuously adjusting to its Walrasian full employment level. We would therefore consider as the benchmark case the case of a fixed, unconditional, wage rate set at a level consistent with a plausible average unemployment rate. However, this full rigidity may appear excessive and it is important to assess the interaction of a limited amount of wage flexibility with employment protection.

The wage flexibility is introduced through a wage curve. More precisely, the wage is state dependent, and writes:

$$w(n) = \overline{w}\left(\frac{n}{\overline{n}}\right)^{\eta} \tag{9}$$

where n is the beginning-of-period level of employment (prior to lay-offs), and $\overline{n}$ is the unconditional level of employment. Choosing the unconditional level of employment aims at preventing firms to use current lay-offs as a way to affect the current wage.

2.3 Firms objective and the stock market

The firm decision problems bear on four control variables : gross investment i and capital utilization k_u, together with the number of layoffs f and vacancy posted v. The firm acts at any period in order to maximise its inclusive of dividend value $V(\ )$ for stock holders who have access to a fully diversified world capital market. In order to avoid extra complexities, we consider that firms issue a single security, unleveraged equity, that we will notice thereafter "equity"[3].

The value of dividends in any period is given by the expression

$$\begin{aligned} d(\ ) = {} & (1-\tau_b)[\delta^{\gamma} k^{\alpha(1-\gamma)} k_u^{\alpha\gamma} (E_s(n-f))^{1-\alpha} - (1+\tau_w) w(n)(n-f) \\ & -k_u - cv - \phi(f)] - \psi(i) \end{aligned} \tag{10}$$

[3]The interesting question of how employment protection does affect the interactions between "operational leverage" and financial leverage is thus left for future research.

and the capital and employment dynamics follow respectively from equations (2) and (5).

Remember that the currently employed -and paid- manpower is $(n - f)$. τ_b is the tax rate on current income. Posting and firing costs, as well as capital utilization allowance, are deduced from the corporate income tax base. There is no sign constraint on $d(\ )$, which allows for financing capital and recruiting investment through equity capital. The corporate income tax is assumed symmetrical, with tax credits associated to operational losses.

The total value to be maximized in the sum of dividends d and the after distribution price of equity P, thus, at date t,

$$V_t = d_t + P_t$$

As shown by L.P. Hansen and S. Richard (1987), the price P_t of an asset earning an outcome V_{t+1} at date $t + 1$ may be expressed as

$$P_t = E_t(\rho_{t+1}.V_{t+1}) \tag{11}$$

with $E_t(\ )$ the conditional expectation operator and ρ_{t+1} a stochastic discount factor (SDF). Usually, in general equilibrium models, this SDF (or pricing kernel) is equated to the marginal rate of substitution of the representative household [4], which gives the following expression for the equity price

$$P_t = E_t\left(\frac{\beta U'_{c,t+1}}{U'_{c,t}} V_{t+1}\right) \tag{12}$$

Without modelling saving behaviour, we cannot proceed with this expression. It would also be incorrect to assume that the SDF ρ_t follows an exogenous process as that would imply that the valuation process will be unaffected by the risk characteristics of the outcome. So, we consider the following alternative development of P_t, from equation (11).

$$P_t = E_t(\rho_{t+1})E_t(V_{t+1}) + cov_t(\rho_{t+1}, V_{t+1}) \tag{13}$$

where $cov_t(\ )$ stands for the conditional covariance.

A condition similar to (11) holds for an asset of price 1 earning the risk free factor R_f (e.g. Campbell, 1999) assumed to be constant.

$$E_t(\rho_{t+1}, R_f) = 1 \Rightarrow E_t(\rho_{t+1}) = R_f^{-1} \tag{14}$$

[4] Or the average rate of substitution, in case of heteregenous savers (Krusell and Smith, 1997).

The conditional covariance may be developed as the product of conditional correlation coefficient and standard errors, with obvious notations:

$$cov_t(\rho_{t+1}, V_{t+1}) = r_t(\rho_{t+1}V_{t+1})\sigma_t(\rho_{t+1})\sigma_t(V_{t+1})$$

We assume the $r_t(\ )$ correlation coefficient and $\sigma_t(\rho_{t+1})$ to be constant and invariant with respect to the outcome V_t, thus introducing the parameter $b = -r(\rho_t, V_t)\sigma(\rho_t)$ we obtain as the final expression for the market price of equity

$$P_t = \frac{E_t(V_{t+1})}{R_f} - b\sigma_t(V_{t+1}) \tag{15}$$

We retain expression (15) for computational convenience. However, this expression may be further developed to characterize the expected return on equity[5]

$$E_t(R^e_{t+1}) = \frac{E_t(V_{t+1})}{P_t}.$$

>From $\sigma_t(R^e_{t+1}) = \sigma_t(V_{t+1})/P_t$, (13) may be expressed as

$$P_t = \frac{E_t(V_{t+1})}{R_f(1 - b\sigma_t(R^e_{t+1}))} \tag{16}$$

and the relative equity premium writes

$$\frac{E_t(R^e_{t+1}) - R_f}{R_f} = b\sigma_t(R^e_{t+1}) \tag{17}$$

Similarly, we get the Sharpe ratio for equity

$$\frac{E_t(R^e_{t+1}) - R_f}{\sigma_t(R^e_{t+1})} = bR_f$$

The reformulation (15,16) with respect to the initial one (12) simply illustrates the correspondance between the “SDF approach” and the “CAPM” or “beta” method of asset pricing[6].

Notice that the equity premium in this formulation is, as usual, proportional to the conditional standard error of the equity return, measuring a time and state dependant investment risk.

Given this specification, the financial environment in our economy is characterized by two parameters : the risk free factor R_f and the Sharpe ratio, b,

[5] See also Hall (2001), p. 1193) for a similar derivation.

[6] See Campbell and Cochrane (2000), or Jagannathan and Wang (2001) for an empirical comparison of those two approaches.

measuring the "international price of risk". Financial shocks will be modelled as changes affecting these two parameters.

It is now possible to give the firm decision problem its standard recursive formulation, with (s, k, n) the state variables, i, k_u, v and f the control variables

$$V(s,k,n) = \underset{w.r.t.\ i,k_u,v,f}{Max} \left\{ d(i, k_u, v, f \mid s, k, n) + R_f^{-1} E_s V(s', k', n') - b\sigma_t(V(s', k', n')) \right\} \tag{18}$$

submitted to :

i) the state transition equations (2) and (5)

ii) the dividend equation (10)

iii) the inequality constraints $i + k_u \geq 0$, $v \geq v_0(n)$, $f \geq 0$

iv) the transversality conditions

$$\lim_{h\to\infty} E_t \left\{ \left[\Pi_{j=1}^{h} \omega_{t+h} \right] k_{t+h} \right\} = 0$$
$$\lim_{h\to\infty} E_t \left\{ \left[\Pi_{j=1}^{h} \omega_{t+h} \right] n_{t+h} \right\} = 0$$

2.4 The capital utilization decision

We first notice that the optimization problem (18) retains the net investment level i_t as a control variable, thus allowing the capital utilization problem to be separable from the optimal accumulation decision and solved in a first step.

Static first order condition for optimal utilization implies, given the production function (1)

$$\frac{\partial(y - k_u)}{\partial k_u} = \alpha\gamma \frac{y}{k_u} - 1 = 0$$

The optimal solution is to use up at any time the amount ${k_u}^* = \alpha\gamma y$, of capital, i.e. the fraction $(\alpha\gamma)$ of the gross output. So we may proceed further by eliminating k_u from the decision variables and considering the net production function.

$$y^N = y - k_u^* = (1 - \alpha_\gamma) a_s \frac{1}{1 - \alpha_\gamma} \delta \frac{\alpha_\gamma}{1 - a_\gamma} k \frac{\alpha(1 - \gamma)}{(1 - \alpha_\gamma)} N \frac{1 - \alpha}{1 - \alpha_\gamma} \tag{19}$$

This expression for net product is then substituted in the expression of dividends (10) and the value function (18).

3 Model calibration and computation of the benchmark equilibrium

Due to the small open economy assumption, with full goods and capital mobility, an equilibrium in our economy reduces to a solution of the optimal program (18) of the representative firm. Firms behave according to fully rational expectations. In this paper, we consider only the case of constant policies.

3.1 Calibration 1 : technology and the shock process

We retain for the α coefficient of the Cobb-Douglas a value $\alpha = 0.4$, consistent with a 60 % share of wage costs of the gross output. We choose a low value of the depreciation elasticity $\gamma = 0.5$ in order to get a conservative contribution of endogenous utilization. Greenwood et alii (1988), as Burnside and Eichenbaum (1996) calibration would imply values of γ closer to 0.7[7]. The parameter δ in set to 0.025 to get an unconditional expected life of capital of 40 quarters for an average utilization rate $\overline{\theta} = 1$.

The elasticity of wage with respect to employment in the wage curve (9) is set at 0.3. The productivity process is calibrated through parameters of the CES aggregator (4). We assume $\nu = 0.75$, hence an elasticity of substitution between the protected jobs n_0 and the "fragile" ones $\sigma = 4$. The number of the protected jobs in the labour force $n_0 = 0.56$, thus leaving $N - n_0 = 0.34$ fragile jobs when unemployment stands at its benchmark equilibrium level of 10%. The specific productivity factor A_s follows a two states Markovian process with conditional values $(0.9, 0.63)$. The higher value (0.9) is taken in order to ensure that firms always saturate the protected jobs n_0. A low level of 0.63 means that the recession entails a 30% decrease of the productivity of fragile jobs. At the benchmark level of N and n_0, this shock is equivalent to a 10.1% decrease in the TFP. The transition probabilities are fixed at $\pi_{11} = 15/16$ and $\pi_{22} = 7/8$ consistent with an expected duration of expansion (high productivity) states of four years, and a 2-year average duration of recession.

Δ_t is introduced in equation (2) as a depreciation shock. However, we do not specify Δ as a distinct and symmetric shock as Ambler and Paquet (1994). Δ_t is assumed to be asymmetric, involving an exceptional depreciation at the outset of a recession. Such a shock is rationalizable as the

[7] respectively 1/1.34 and 1/1.42.

downturn actually implies an accelerated depreciation of some capacities. Its purpose in the model is to introduce an extra source of risk, especially aiming at a more balanced level of risk between expansion and recession. Without this shock, the level of risk in recession would roughly be the double of the expansion level, a feature definitely not consistent with the data. We retain a low, or conservative, calibration of $\Delta = 0.0125$, that is half of the unconditional quarterly rate of depreciation.

3.2 Calibration 2 : job flows and asset market

Job separation in the model come from two sources : exogenous separations and lay-offs. The exogenous separation rate λ is important in our story as it determines the lower bound v_0 of vacancies and the employment attrition rate. Bertola and Rogerson (1997) found for an analogue of our λ in France a (yearly) value of 13.2%. However, a high value of λ would imply a large attrition rate with the consequence than unemployment in recession may rise quickly even without firings. We thus retain for our baseline calibration a lower value $\lambda = 0.025$ (quarterly rate), leaving as the matter of an alternative scenario the case of a larger λ. The baseline $\lambda = 0.025$ would imply, according to equation (8), an attrition rate of 0.25% at a 10 % unemployment level. This mean that unemployment may increase by 0.22 point within a year without any lay-off.

The value of ℓ in the matching function (6) is set at 1.3 following den Haan et alii (2000).

The calibration of stock pricing is done in two steps : first, the Sharpe ratio b is set at 0.223, consistently with Campbell (1999)[8]. Then, the value of the risk free factor R_f is set at 1.0177 in order to get an average return on equity of 7.83 % per year, consistent with international data[9].

The tax ratio on corporate income is set to 0.2, a level lower than its nominal value in France, but not than the realized ex post average.

[8]see Harvey (1991) for an extensive discussion of the world price of covariance risk. Phelps and Zoega (2001) examine the empirical relations between unemployment and the share prices. Lettau and Uhlig (2002) obtain a value of 0.27 for the Sharpe ratio. This higher value will be retained in our "high cost of risk scenario".

[9]The process of calibrating R^e may only be approximative as the model R^e stands for an unleveraged equity return, while international comparisons bear on leveraged equity returns (e.g. Campbell, 1999).

3.3 Solution techniques

The optimization problem of the representative firm (16) entails three state variables, the exogenously given total factor productivity a_s and the endogenous capital k and employment n levels. It is solved using a discrete state space method, involving value function iteration.

For a given wage rate $\overline{w}$, the algorithm consists in finding a fixed point for a polynomial approximation of the conditional variance $\sigma(s, k, u) = \Gamma_s(k, u)$. The different steps are the following :

i) Guess a polynomial approximation $\Gamma_s(k, u)$.

ii) Given $\Gamma_s(k, u)$, compute the value functions and the policy rules over a grid $(k_{\text{inf}}, k_{\text{sup}}) \times (u_{\text{inf}}, u_{\text{sup}}) \times \{a_\ell, a_k\}$. Iterate until 2 consecutive value functions are close enough.

iii) Given the value functions, compute the conditional variances over the grid.

iv) Simulate over 501.000 periods the path of the economy. Discard the first 1.000 realizations. This defines the ergodic set and provides with the various distributions of interest.

v) Estimate the conditional parameters of $\Gamma_s(k, u)$ over the ergodic set. If the newly estimated parameters are equal to those of step 1, stop. Otherwise, update the parameters and go back to step 2.

During the calibrating process, we determine the value for $\overline{w}$ such that the unconditional unemployment rate equal 10 %. To this end, we use an adapted version of the secant algorithm.

3.4 The benchmark equilibrium

With the values of the technical and behavioral parameters previously indicated, setting the employment protection parameters is the last step required to fully characterize the conditions of the benchmark equilibrium. We choose as baseline a "low protection" rule with $\varphi_0 = 0$, $\varphi_1 = 0.25, \varphi_2 = 80$.

Iterating for this rule from an initial guess of the $\overline{w}$, we first compute as previously indicated the wage rate consistent with an unconditional unemployment rate of 0.10, with the result $\overline{w} = 2.2175$ to be imposed in the various alternative fixed wage scenarios. In this baseline economy the average unemployment rate rises from 8.71 % in expansion to 12.04 % in recession. We also compute a measure of unemployment duration defined as the inverse of the probability of leaving unemployment $Du = u/m(v, u)$. We find an unconditional duration of 4.43 quarters, with 3.49 quarters in expansion and 5.95 in recession, which is not at odd with the French experience[10]. We also notice that the average return on equity does not fluctuate much, around an average 7.83 %. From an recession level of 7.78, the return on equity rises to 7.86 in expansion. Recall indeed that (i) other things being equal, recessions are more risky than expansion because the probability of a new shock is higher but also that (ii) the risk of having in the near future its capital depreciated is mostly perceived during expansions. This difference in returns on equity is small, to be compared with the low values for the equity premium obtained in standard representative shareholder models (Mehra, 2001).

While this benchmark equilibrium delivers a sensible quantitative view of an European labour market like the French one, one may be surprised by the calibration of the firing costs.

Actual firing costs depend on many parameters as the nature of the contract, the conditions of the lay off, the size of the firm, etc ... However they are probably closer to 2 quarters of wages than to the low values introduced in the model. Clearly such values would preclude any lay off in the model economy. Remember than a recession basically entails a drop of productivity by 10% of the average thus implying that the marginal worker costs to the firm roughly 10% of his wage (in excess of his productivity). Further, due to attrition, excess labor would be gradually eliminated. This implies that firing cost equalling a small fraction of the quarterly wage would be enough to deter firms from firing. This is why, in the low protection case, the marginal cost of firings is around a quarter, that is, half its actual value. We thus prefer to focus on relative levels of firing costs rather than on their absolute levels.

4 Alternative scenarios

Given our baseline low protection economy taken as a benchmark, we may now consider alternative scenarii illustrative of the effect of employment protection and their interaction with some institutional or behavioral features.

[10]see e.g. Blanchard and Portugal (2001), and OECD (1999).

4.1 Different levels of protection in the baseline economy

We consider three alternative schemes of employment protection in the baseline economy. A "high protection", case consists of an increase in firing costs parameters φ_1 from 0.25 to 0.75 and φ_2 from 80 to 240. As a consequence, the marginal cost of $f = 0.005$, i.e. firing roughly 0.45 % of the employed labor force within a quarter, increases from 1.05 to 3.15. All other parameters, as the wage rate $\overline{w}$, are left unchanged.

Results of this increased employment protection are presented on the second line on table 1. This policy succeeds in reducing unconditional unemployment by half a point. As we could expect, raising firing costs reduces the gap of unemployment rates between the two states : it slightly increases unemployment in expansion (0.09 point) and significantly reduces it in recession (1.4 points). The unemployment duration evolves in a similar fashion. It appears that the equity returns are rather unsensitive to this policy change.

We further consider two extreme scenarii one with no protection (zero firing costs) and other without lay offs (very large firing costs). Effects are in line with the one previously discussed. Precluding lay offs reduces the unconditional unemployment rate to 9.44 %, while suppressing firing costs increases it to 11.13 %. The effects are even larger in recession, with an average unemployment rate of 15.36 in the employment-flexible economy but a mere 10.52 in the no lay-off economy. Again, the same comparison applies for the unemployment durations. Contrary to the *a priori* intuition, the risk shifting effects of employment protection are not visible on the equity returns.

Figure 11 plots the fluctuations in unemployment for the 3 following economies : low protection, no firings and no protection. By using an identical set of realizations for the random shocks for these three simulations, the comparison is straightforward, since economies are hit by TFP shocks at the same time. It clearly appears that employment protection reduces the range on unemployment rates. Figures 2 and 4, which plot the unconditional distribution of the unemployment rate, confirm this impression : the distribution is much more concentrated when employment protection is high.

The overall favourable effects of employment protection in this model may be explained by the interaction of a concentration effect and a duration effect. Due to the common shock assumption, firings occur at the onset of a recession. As the pattern of hirings is less responsive to change in employment protection, the average episode of unemployment is longer the more flexible is the labor market regulation.

4.2 Financial shocks : a higher price of risk

As is well known, a small open economy is very sensitive to international financial conditions. Changes in the world price of risk affect our model economy along two dimensions : first, they act as financial shocks, and secondly they are likely to alter the cost of adjusments. As our model economy is very sensitive to the required return on equity, we consider two different financial scenarios. First, we assume a 20 % increase in the Sharpe ratio measuring the world price of risk (from 0.223 to 0.268 following Lettau and Uhlig, 2001) compensated by a decrease in the risk-free in order to maintain the *ex ante* overall cost of capital. In the second scenario, we consider an uncompensated increase in the cost of risk of the same magnitude, thus implying an ex ante increase in the rate of return of 11.2 basis points.

Employment is found very sensitive to these financial shocks. Average unemployment increases (from 10% in the benchmark) to 11.89 in the compensated shock case and to 12.52 in the uncompensated case. The increase in good state unemployment by 2.4 points (in the uncompensated case) is especially noticeable. Imposing a high job protection is quite ineffective to reduce this unemployment effect of financial shocks, an important result as the union support for more employment protection is often motivated by the necessity to compensate a stronger pressure from capital markets through higher profitability requirements.

In the uncompensated shock case, the ex post increase in the return on equity is small (10 basis points). The difference (1.12 basis point) between this ex post increase and the ex ante one results from an endogenous reduction of the standard deviation of returns.

4.3 A high turnover economy

The high turnover economy is characterized by a larger autonomous separation rate λ, set at 3 % instead of 2.5 % in the baseline scenario. With the same -low-level of protection, the unconditional unemployment rate increases by 0.57 points. It is worth to notice that unemployment duration follows the opposed pattern. Indeed, for a given unemployment rate, a higher turnover implies more hirings, and therefore a higher exit rate out of unemployment. With higher job protection, the unconditional unemployment rate drops down 0.39 points. During recessions, the unemployment rate is 0.9 point lower than with a low job protection. This reduction is smaller than in the baseline (1.4 point), since the increase in turnover induces an increase in the attrition rate. Since the latter is a costless substitute for firings, it follows that firings are less frequent, and therefore that employment protection is less effective. Figures 5 and 6 are consistent with these results. The distributions of unemployment rates seem quite similar, apart for high levels of unemployment, where the frequency is higher in the low protection case.

A larger turnover has no effects on the risk and return characteristics of the economy.

4.4 The fixed wage case

To assess how the wage flexibility makes it easier for firms to keep high employment during recessions, we have also computed the equilibrium of an economy similar in every respect, apart from the wage, assumed here to be constant. We therefore have first recalibrated the level of the constant wage to obtain an unconditional level of unemployment of 10% in the low protection case.

As could be expected, one of the main difference lies in the variation in unemployment rates between expansions and recessions : it is considerably higher than in the flexible-wage case. With low employment protection, unemployment is 8.12% (resp. 13.07%) in expansions (resp. recessions). This implies a 4.95 points gap, to be compared with a 3.3 point gap in the flexible-wage economy. A high employment protection yields a 0.5 point gain, identical to the previous model. The range of unemployment levels is narrowed, the most significant effect being, like previously, to reduce unemployment during recessions. The two extreme cases (no protection and no firings) are consistent with these remarks : unemployment fluctuations are much greater in the no protection case. We can remark that job protection performs pretty well in stabilizing employment. Indeed, in the no firings economy, the range of unemployment levels is similar to that of the flexible-wage economy.

In terms of financial impact, the returns on equity are quite larger. The equity premium increases by 50% to 84 basis points. However, this increase is quite unaffected by the degree of employment protection. Like Danthine and Donaldson (2000), we find that wage rigidity shifts risk from workers to the stock market.

4.5 Fixed capital utilization

A last exercise is devoted to an examination of the effect of flexible capital utilization. Our initial guess was that a flexible utilization rate provide firms with an alternative way of adjusting output when adjustment through labour is precluded. As to assess this factor, we consider now the fixed utilization case, every other parameter taking its baseline value.

Under the baseline, no protection, regulation, average unemployment is increased by 0.65 point, mainly due to a higher unemployment rate in expansion. Unemployment duration increases consequently, but there is no incidence on risk and required returns.

The "high protection" and "no firings" scenarios are not numerically distinguishable.

The unemployment gain from further protection is noticeable, 1.38 point on average during recessions, while employment duration only marginally increases in expansion. We get no sensible effect of extra protection on returns.

In the no protection case, recession unemployment is larger, but less than in the baseline flexible utilization case. This result confirms that, under the standard Greenwood et alii (1988) specification, the capacity utilization works more as a complement rather than a substitute for labor utilization.

In any phase of the business cycle and with any employment regulation, fixed utilization results in more unemployment, thus expressing the cost for firms of losing a margin of flexibility. However, flexible utilization, contrary to wage flexibility, does not allows firms to reduce risk supported on their operating profits.

5 Concluding remarks

This paper proposes a model allowing for a fully worked-out analysis of the effects of employment protection and financial shocks in a small open economy with an internationally diversified stock market. Using numerical methods, we obtain rational expectation solutions accounting for capital and employment irreversibilities.

Results from diverse exercises deliver several strong, albeit sometimes disturbing, messages. So, we find that :

i) employment is very sensitive to financial shocks, especially an increase in the market price of risk

ii) employment protection is effective to reduce unemployment rate in response to business cycle shocks, but ineffective to preclude the unemployment effect of financial shocks

iii) wage rigidity shifts risk from worker to shareholders

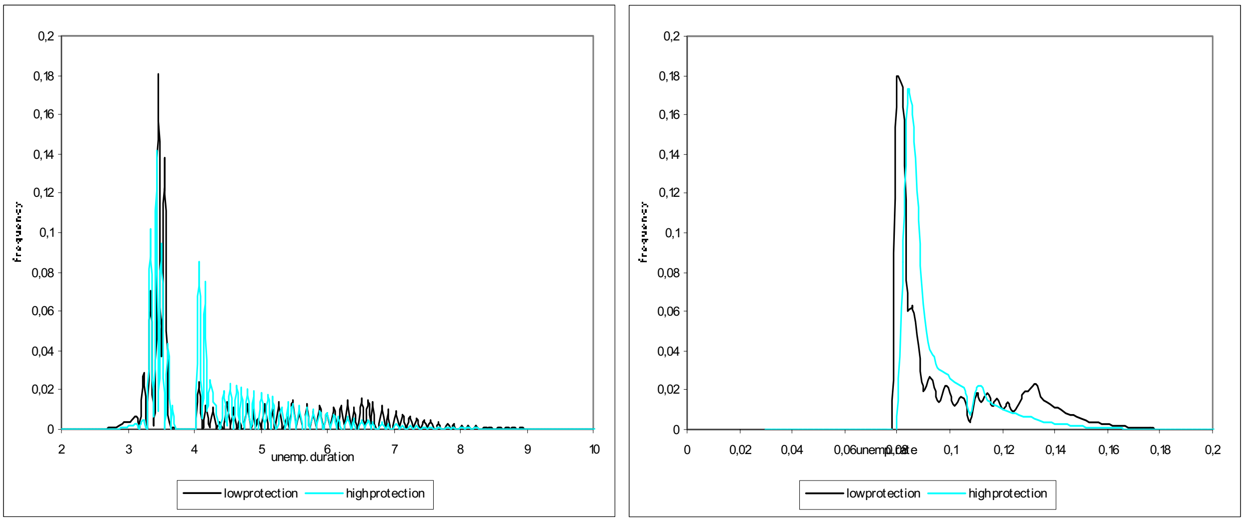
iv) with the standard formulation, capital utilization is a complement to employment, rather than a substitute to employment flexibility

More generally, in this perfect capital mobility model the quantity effects of shocks are large and the asset price effects are of second order of magnitude.

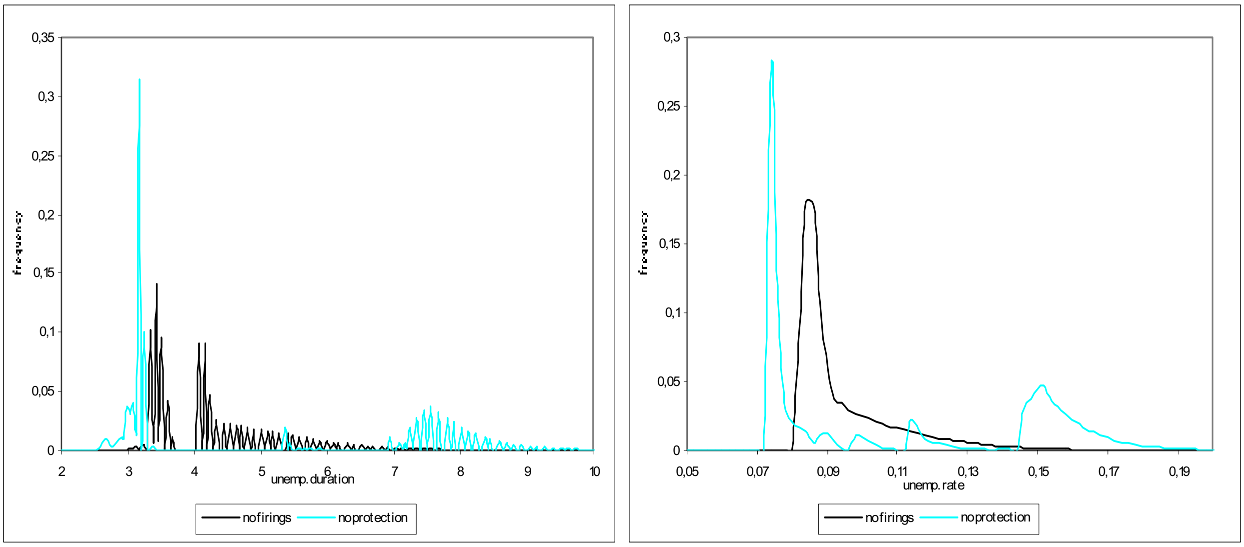
Of course, the limitations of this representative agent model are obvious. We think that three developments are standing as priorities in the research agenda : i) introducing endogenous responses of wages to employment protection, ii) introducing a reallocation issue (Hopenhayn and Rogerson, 1993), iii) comparing the case of a representative shareholder with this model of a world stock market. Beyond these developments, it will remain that coping only with macro -or common- shock allows merely for a very partial view of the issue of labour adjustment and employment protection.

	$\overline{u}$	$\overline{u}^E$	$\overline{u}^R$	$\overline{ud}$	$\overline{ud}^E$	$\overline{ud}^R$	$\overline{RE}$	$\overline{RE}^E$	$\overline{RE}^R$	$\overline{K}$
Baseline										
Low protection	9.99	8.71	12.04	4.43	3.49	5.95	7.83	7.86	7.78	39.98
High protection	9.50	8.80	10.64	4.28	3.68	5.25	7.83	7.85	7.79	40.25
No protection	11.13	8.51	15.36	4.87	3.14	7.65	7.82	7.86	7.75	39.33
No firings	9.44	8.78	10.52	4.26	3.68	5.20	7.83	7.85	7.78	40.29
High turnover										
Low protection	10.57	9.38	12.50	3.98	3.20	5.26	7.82	7.85	7.77	39.70
High protection	10.18	9.31	11.60	3.86	3.23	4.88	7.82	7.85	7.78	39.88
High cost of risk										
- compensated										
Low protection	11.89	10.49	14.15	5.37	4.33	7.04	7.82	7.87	7.76	39.29
High protection	11.75	10.91	13.10	5.37	4.67	6.49	7.83	7.86	7.77	39.49
- uncompensated										
Low protection	12.52	11.10	14.82	5.68	4.61	7.40	7.92	7.96	7.85	38.43
High protection	12.03	11.15	13.45	5.48	4.74	6.67	7.92	7.95	7.86	38.92
Fixed wage										
Low protection	10.01	8.12	13.07	4.40	3.10	6.50	8.11	8.16	8.03	39.69
High protection	9.51	8.39	11.32	4.23	3.37	5.60	8.11	8.15	8.04	40.11
No protection	11.39	7.73	17.28	4.98	2.64	8.74	8.10	8.16	8.01	38.85
No firings	9.14	8.45	10.26	4.10	3.50	5.07	8.11	8.15	8.06	40.37

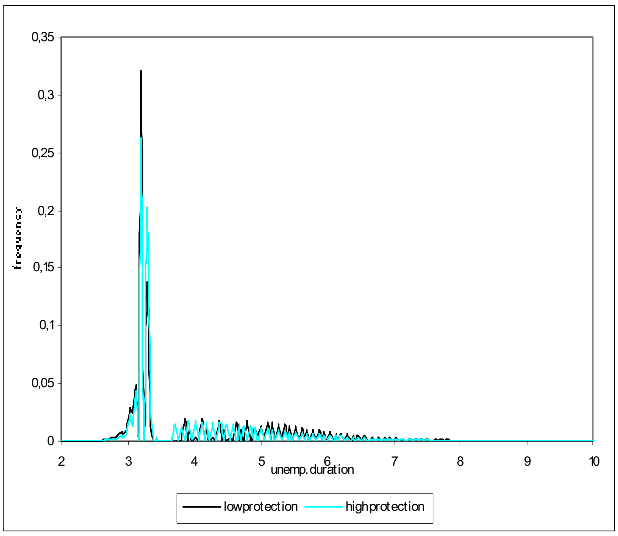
Table 1: Simulation results

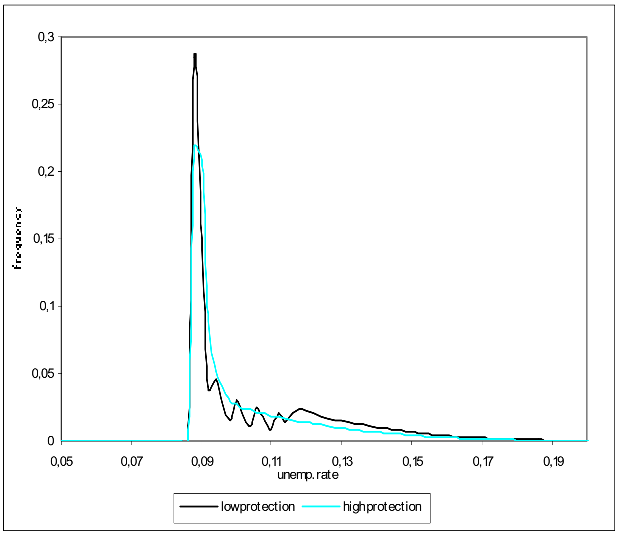


Figures 1 & 2 : Distributions of the unemployment rate and its duration, baseline

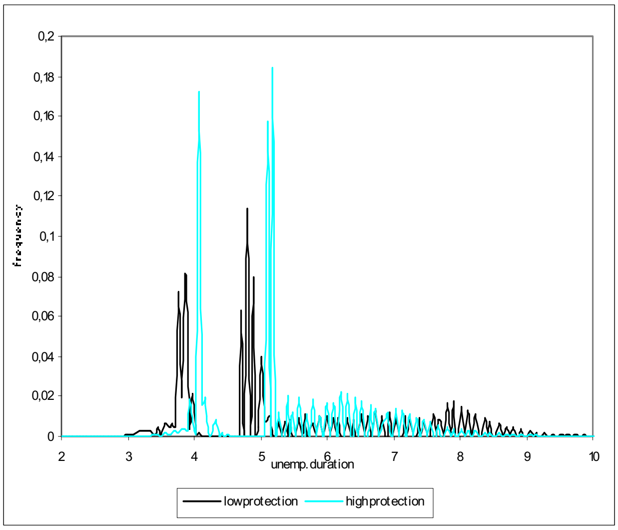


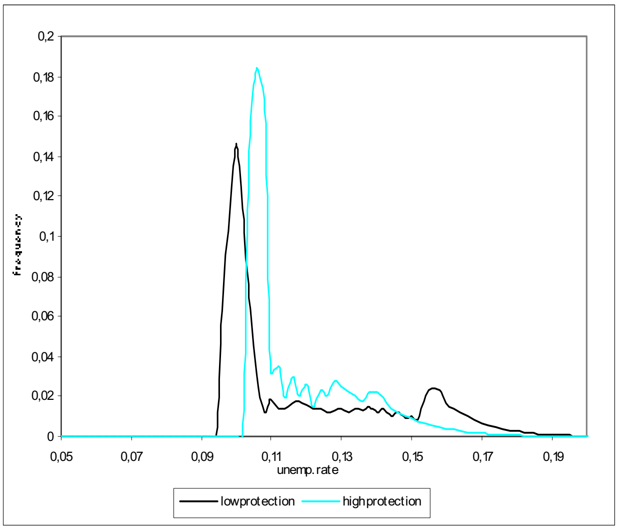
Figures 3 & 4 : Distributions of the unemployment rate and its duration, baseline



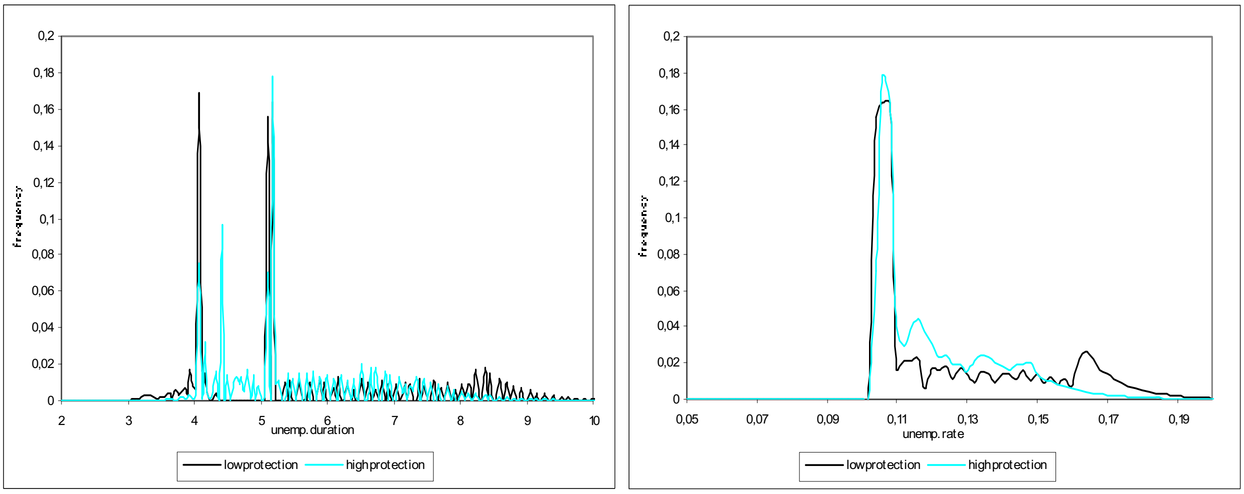


Figures 5 & 6 : Distributions of the unemployment rate and its duration, high turnover





Figures 7 & 8 : Distributions of the unemployment rate and its duration, higher cost of risk (compensated)



Figures 9 & 10 : Distributions of the unemployment rate and its duration, high cost of risk (uncompensated)

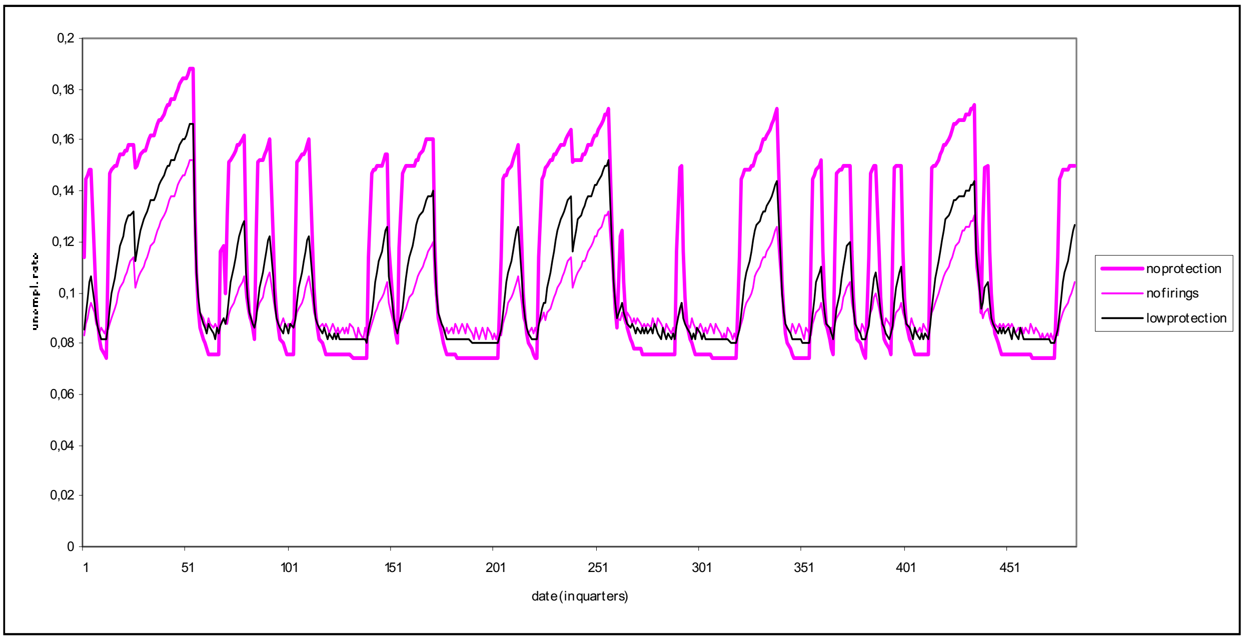


Figure 11: Unemployment rate fluctuations, baseline

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