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# Wage Incentive Profiles in Dual Labour Markets

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**Abstract**

We propose a modified version of the Shapiro-Stiglitz's (1984) efficiency wage model by introducing temporary contracts in the standard setup. New theoretical insights emerge on the incentive problem faced by workers and firms. We argue that the existence of temporary contracts broaden the incentive menu available to employers and that the optimal incentive structure can be sustained as an equilibrium outcome only if permanent contracts do not disappear. We also provide an alternative explanation of the wage penalty suffered by temporary workers even if standard models of efficiency wages would predict higher compensations for workers facing a higher job loss risk.

**Keywords:** Dual labour market, efficiency wages, wage differentials.

**JEL Classification Numbers:** J31, J41, J63.

## 1 Introduction

The idea that firms need to elicit effort from workers dates back to Adam Smith since he observed that "the wages of labor are the encouragement of labor which like every

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other human quality improves in proportion to the encouragement it receives: Where wages are high accordingly we shall always find the workmen more active, diligent and expeditious than when they are low" (Smith 1937, p. 81). In this paper, we argue that the existence of temporary contracts broaden the incentive menu available to employers and that the optimal incentive structure can be sustained as an equilibrium outcome only if permanent contracts do not disappear. We also provide an alternative explanation of the wage penalty suffered by temporary workers even if standard models of efficiency wages would predict higher compensations for workers facing a higher job loss risk.

Besides the influential contribution on the alternative explanations of involuntary unemployment (Shapiro and Stiglitz 1984), efficiency wage theories have been proved to be sufficiently flexible to explain several aspects of the labour market. For instance, Bulow and Summers (1986) and Albrecht and Vroman (1992)rationalize the persistence of "good jobs" - offered in the primary sector - and "bad jobs" - offered in the secondary sector - in an equilibrium where equally skilled workers are paid different wages on different jobs. Galdón-Sánchez and Güell (2003) show that in the presence of a double moral hazard problem arising when firing costs must be paid for unfair dismissals, higher severance payments reduces employment. The original model has also been used to provide empirical evidence of the positive relationship between wage premiums and productivity (Cappelli and Chauvin 1991) and between employment protection and worker effort (Ichino and Riphahn 2005). In our case, the efficiency wage approach is a good candidate to explore the incentive mechanism through which fixed-term contracts affect the working of the labour market in terms of wage differentials and the share of flexible contracts in the economy.

The only attempt to introduce fixed-term workers in the standard Shapiro-Stiglitz setup is due to Güell and Mora (2010). The authors show that temporary contracts may actually increase unemployment. This result, though, heavily depends upon the minimum wage to be high enough. As temporary contracts amplify the flow into the labour market, a higher minimum wage raises the value of being unemployed. The only way firms react is to provide greater incentives to avoid shirking, and the level of employment falls. Our analysis differs from this work in several aspects. First, we allow temporary contracts to be either renewed or converted into permanent contracts. Allowing for renewal rates is a non-trivial complication of the model, because workers know that before running into an open-ended job offer they can experience multiple spells of temporary positions. In this way, the incentive problem faced by firms changes dramatically, and so does the equilibrium wages and the unemployment. Second, we endogenously determine optimal conversion and renewal rates without relying on exogenous labour market institutional features. Third, our main interest is

not to compare the equilibrium unemployment arising in the one- and two-tier labour market, but rather to describe some stylized facts presented in the next section. In particular, the model formalizes the use of temporary contracts in an efficiency wage framework in which profit maximizer firms optimally set the share of temporary to permanent workers to satisfy participation and incentive compatible constraints as well as cost minimization. As pointed out by Dolado et al. (2002), several factors may explain the equilibrium ratio of temporary to permanent employees[1]. We argue that this ratio is also linked to the incentive structure arising in a dual labour market. When firms increase their temporary workforce, the ratio of TCs over PCs cannot exceed a given threshold because it would be impossible to provide sufficient incentives to avoid shirking behavior. It follows that, when fixed-term positions can be renewed, converted into permanent positions or ended at will by the employers (while permanent positions last until an exogenous job break-up), the coexistence of both contracts is necessary to have a steady state mass of non-shirking workers who are paid accordingly.

The rest of the paper is organized as follows. Section 2 summarizes some stylized facts of dual labour markets. Section 3 describes the model, while section 4 presents the results. We discuss the economic implications in section 4. Section 5 concludes and sheds light on future research.

# 2 Stylized Facts (in progress)

This section presents some stylized facts of European Labor Markets which are rationalized by the model.

- *Existence of a considerable upward mobility from temporary positions to permanent employment.*

According to the OECD Employment Outlook (2002), between one-third and two-thirds of temporary workers move into a permanent job within a two-year time interval. A natural consequence is that even if in the short run we can observe positive renewal rates, in the long run they must converge to zero.

- *Wages for temporary positions tend to be lower than wages for permanent positions, even after controlling for workers and job characteristics.*

[1]In particular, the authors identify the followings: (i) the elasticity of substitution between temporary and permanent workers; (ii) the relative wage of workers; (iii) the gap in firing costs between contracts; (iv) the difference in hiring costs; (v) the volatility of labour demand along the business cycle; (vi) the average growth rate.

The existence of a wage differential between temporary and permanent workers has been reported for many European Countries. Jimeno and Toharia (1993) find a 9-11% wage gap for the Spanish experience. Blanchard and Landier (2002) conclude that the wage gap has risen from 12% in 1983 to 22.5% in 2000. Hagen (2002) comes to similar conclusions for Germany, even if different methodologies lead to large differences in the magnitude of the wage penalty suffered by temporary workers.

- *The share of temporary contracts over permanent contracts tends to be stable over time.*

Another important finding in the literature of temporary contracts is that there is a substantial stability of the share of temporary workers over permanent workers. Table 1 shows the share of temporary workers over permanent workers for the period 2000-06. Hence a theoretical long run equilibrium must comply with a fixed proportion of temporary workers in the economy.

Table 1: Share of Temporary workers over Permanent workers

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|---|---|
| Austria | 0.082 | 0.075 | 0.079 | 0.081 | 0.102 | 0.103 | 0.100 |
| Belgium | 0.071 | 0.067 | 0.061 | 0.066 | 0.068 | 0.073 | 0.075 |
| Czech Republic | 0.101 | 0.099 | 0.092 | 0.102 | 0.092 | 0.082 | 0.082 |
| Denmark | 0.096 | 0.083 | 0.086 | 0.089 | 0.095 | 0.092 | 0.086 |
| Finland | 0.150 | 0.149 | 0.144 | 0.146 | 0.147 | 0.149 | 0.146 |
| France | 0.171 | 0.158 | 0.142 | 0.137 | 0.140 | 0.153 | 0.154 |
| Germany | 0.143 | 0.139 | 0.134 | 0.138 | 0.145 | 0.169 | 0.173 |
| Greece | 0.129 | 0.126 | 0.117 | 0.108 | 0.117 | 0.112 | 0.100 |
| Hungary | 0.083 | 0.089 | 0.086 | 0.091 | 0.081 | 0.082 | 0.080 |
| Ireland | 0.038 | | 0.047 | 0.046 | 0.038 | 0.032 | 0.030 |
| Italy | 0.096 | 0.089 | 0.092 | 0.090 | 0.110 | 0.117 | 0.126 |
| Luxembourg | 0.027 | 0.038 | 0.042 | 0.025 | 0.042 | 0.052 | 0.060 |
| Netherlands | 0.131 | 0.133 | 0.138 | 0.148 | 0.154 | 0.167 | 0.183 |
| Norway | 0.079 | 0.076 | 0.084 | 0.084 | 0.090 | 0.081 | 0.084 |
| Portugal | 0.228 | 0.232 | 0.248 | 0.235 | 0.230 | 0.230 | 0.243 |
| Spain | 0.440 | 0.428 | 0.426 | 0.427 | 0.440 | 0.463 | 0.471 |
| Sweden | 0.150 | 0.141 | 0.140 | 0.141 | 0.151 | 0.161 | 0.174 |
| Switzerland | 0.118 | 0.121 | 0.134 | 0.133 | 0.134 | 0.144 | 0.151 |
| United Kingdom | 0.063 | 0.063 | 0.060 | 0.057 | 0.058 | 0.056 | 0.055 |

Source: elaboration from OECD data.

- *The majority of newly hired workers enter the labour market through fixed-term positions.*

As pointed out by Cahuc and Postel-Vinay (2002), the majority of new hires is on temporary jobs.

# 3 The Model

## 3.1 The Environment

The economy is populated by $H$ infinitely-lived risk neutral workers identical in their abilities and preferences, and by $N$ profit-maximizer firms sharing the same technology described by the production function $f(eL)$, where $L$ is the labour force at the firm level and $e$ is the effort exerted on the job. Thus, labour is the only input for production. An employer-employee relationship can be regulated either by a fixed-term contract ($t$) or a permanent one ($p$). The former lasts for one period and, at the expiration, it can be converted into a permanent contract with probability $c_p$, renewed as a temporary position with probability $c_t$ or neither of them with probability $1 - c_p - c_t$. Thus, this structure is able to replicate a work life cycle in which workers may reach a stable job after a succession of short-term jobs and unemployment spells.

Workers can either be employed or unemployed. While unemployed workers look for employment opportunities, employed workers produce and do not search on the job. We assume that labour supply is inelastic therefore, since a job opportunity provides almost the utility of an unemployment position, workers will accept opportunity that arises. Utility is linear and is described by the instantaneous utility function $U(w_i, e) = w_i - e$, where $w_i$ is the wage received while holding the $i-th$ contract, $i = \{p, t\}$. In line with Shapiro and Stiglitz (1984), the levels of effort can take only two values, positive and fixed (no-shirking) or null (shirking). In the latter case there is no production. Since all workers are identical, they respond to incentives in the same way and whether or not they shirk depends on the incentives they face. We also assume that workers are equally skilled and aim at maximizing the expected present value of their lifetime utility discounted at the inter-temporal rate $\delta$. Time is continuous[2]. If workers decide to shirk, the effort is null and they gain higher levels of utility while facing a probability $b$ of being caught shirking and then being fired[3]. It follows that, on average, shirkers tend

[2]Allowing for discrete time does not change our results.

[3]Since 1973, the evidence that a large fraction of the U.S. labor force is involved in supervision rather than the direct production of goods and services shows the importance of the monitoring activity. (U.S. Department of Health, Education, and Welfare. Work in America. Task Force Report. Washington, D.C.: U.S. Government Printing Office, 1973.)

to spend more time as unemployed. In addition, while permanent jobs disappear at the exogenous rate $q$, temporary workers become unemployed following the endogenous choice of firms to neither renew the fixed-term contract or convert it into a permanent position[4]. Obviously, both permanent and temporary non-shirking workers enjoy a lower utility with respect to shirkers because of the cost associated to the effort, but have better expectations on their job stability. Moreover, temporary workers also take into account the opportunity of contract renewals and conversions, the probability of which are common knowledge.

Finally, unemployed workers can enter the labour market by receiving either a permanent job offer with probability $a_p$ or a temporary job offer with probability $a_t$[5]. These probabilities will turn out to be endogenous as they both depend on the steady-state equilibrium condition and firms' optimal behavior[6].

## 3.2 Asset Values and No-Shirking Conditions

We first characterize the decision problem faced by permanent workers. As in Shapiro and Stiglitz (1984), imperfect monitoring implies different flow values according to the option of being, respectively, a non-shirker or a shirker. Let $V_p^n$ and $V_p^s$[7] be, respectively, the present discounted value of lifetime utility for a non-shirker and a shirker worker holding a permanent contract. Regular dynamic optimization asserts that treating expected utility as the asset value corresponding to a given state implies that the asset value of both kind of workers equals dividends plus expected capital gains (or losses). Thus:

$$\delta V_p^n = (w_p - e) - q(V_p^n - V_u) \tag{1}$$

and

$$\delta V_p^s = w_p - (q + b)(V_p^s - V_u). \tag{2}$$

To interpret the above equations, note that the shirker receives (current period) utility of $w_p$. If she does not experience an exogenous separation and she is not caught shirking (an event which will occur with probability $(1 - q - b)$, then she will has the

[4]Notice that the positive effort requirement is exogenous (e), as are the Poisson parameters b and q.

[5]We assume that the event of receiving both types of offers has a negligible probability.

[6]It is important to note that the Poisson parameters $a_p$ and $a_t$ are determined in a stationary equilibrium but are exogenous from the individual's point of view.

[7]Since we assume that all firms are the same, the value of utility both for non-shirker and shirker workers does not depend on what employer offer a contract because they set the same wage.

same value in the next period. Also notice that the value of shirking is the same in every period because if it is optimal for the worker to shirk, it continues to be optimal, thus we do not allow for the possibility of worker to change his optimal strategy. On the other hand, if a shirker does experience an exogenous separation or if she is caught shirking (an event which will occur with probability $(q + b)$, then she will suffer a lost given by the difference between the value of being employed and the value of being unemployed. The interpretation of the asset of a non-shirking worker is similar: current period utility is lower (because of the higher effort) as well as the probability of becoming unemployed is lower.

Obviously, workers will choose not to shirk only if the expected lifetime utility of being a non-shirker is no smaller than that of being a shirker. That is, a condition referred to as the no-shirking condition (NSC). Therefore, the problem faced by a firm is to set the wage sufficiently high to deter its workers from shirking. At the same time, there is no need to pay a wage bill above the minimum needed to induce effort. Thus, the firm chooses $w_p$ so that $V_p$ just equal $V_s$, and the minimum rent that workers are willing to accept must satisfy the following no-shirking condition ($NSC_p$):

$$V_p - V_u = \frac{e}{b}. \tag{3}$$

Equation 3 has two important interpretations. On the one hand, it implies that firms set wages high enough so that workers strictly prefer employment to unemployment. Moreover, the size of the rent is increasing in the level of effort and decreasing in the rate at which shirkers are detected and fired. On the other hand, since workers are homogeneous and the value to being unemployed is the same for all workers, there is a unique (lowest) wage satisfying the no-shirking condition. Thus, for a permanent contract firms will pay a wage which is the lowest wage at which the no-shirking condition is satisfied: $w_p = e+\delta V_p+q(V_p-V_u) = e+\delta V_u+\delta(V_p-V_u)+q(V_p-V_u) = e+\delta V_u+\frac{e}{b}(\delta+q)$.

The critical wage is increasing in the level of effort, the value to being unemployed, the probability of an exogenous separation and the discount rate, while is decreasing in the detection probability. The economics behind this result is that the penalty upon shirking, i.e. the asset loss, should be strong enough so as to deter opportunistic behavior. Thus, according to the principal-agent paradigm, firms use monetary incentives scheme in order to avoid opportunistic behaviors.

Moreover, as it will become clear in what follows, since in a one-tier labour market monetary incentives are the solely instruments, in the two-tier system firms use both monetary and non-monetary incentives. Temporary workers could be also encouraged by non-monetary incentives such as the opportunity of a promotion in a permanent position or/and the possibility of a renewal. Therefore, the asset values of temporary positions reflect the instability related to the contract. Indeed, at the contract

expiration, workers can be either laid off or retained by the firm under both type of contracts.

Differently from permanent workers, temporary jobs do not disappear at an exogenous rate[8] thus, temporary workers suffer the lost of the temporary-to-unemployed transition $(V_t - V_u)$ exclusively for firms' inactive behavior. However, they can alternatively enjoy a conversion into a permanent position or a renewal into a temporary contract. In particular, while in case of a conversion workers enjoy the asset difference between a permanent and a temporary positions, when the contract is renewed, even if the asset does not change, workers suffer the lost of opportunity of becoming a permanent worker by receiving direct offers for permanent position[9]. Thus, we quantify the magnitude of this loss with the value of becoming unemployed and enjoy the unemployed-to-permanent job transition $(V_p - V_u)$ conditional on the probability $a_p$[10].

As for permanent workers, temporary workers choose whether or not to shirk. Shirking generates a higher instantaneous utility than non-shirking. On the other hand, the expectation of being employed is shorter for a shirker than for a non-shirker. Specifically, temporary employment gives an instantaneous utility of $w_t$ for a shirker versus $(w_t - e)$ for a non-shirker. Non-shirkers separate from their job only in case of firms' inactive behavior, while shirkers become unemployed either because firms detect them or, if they are not being caught shirking, because of firms' inactive behavior. Note that in case of shirking detection a shirker suffer the lost of the opportunity of a promotion in a permanent position.

[8]While this assumption make our results comparable with respect to the traditional model of efficiency wages, allowing for the same or different break-up rates does not alter our qualitative results.

[9]Economists have recently estimated the utility cost of precarious forms of work by examining the difference in the stated job satisfaction of individuals who are employed in temporary jobs with those who occupy permanent positions. Even thought their study did find evidence that fixed-term contracts are stepping-stones towards permanent jobs (especially for women), Booth et al. (2002) have shown that temporary jobs in the UK are not desirable because they are associated with lower levels of job satisfaction and poorer work-related training. The strong dissatisfaction of temporary workers is also highlighted by Pouliakas and Theodossiou (2005[a]) in the case of Greece. Moreover, Pouliakas and Theodossiou (2005[b]) and Ferrer-i-Carbonell and van-Praag (2006) have embarked on cross-country comparisons to show that the ultimate effect of the type of contract on job satisfaction seems to depend on institutional features of the countries under investigation, which determine the extent to which individuals who work on temporary contracts do so by choice rather than compulsion. In accordance with the practice of a number of psychological experiments (Gilbert, 2006), many papers attempt to obtain a monetary estimate of the extent of the utility loss associated with a move to non-permanent employment, by comparing the premiums of permanent position with those of temporary ones.

[10]Notice that here we do not explicitly formalize the choice of accepting/rejecting an offer, instead it will be taken into account through the fact that only unemployed workers are/can looking for a job. Therefore, since a worker is employed, she or he can not receive new job offers.

Hence, while the term $a_p(V_p^n - V_u)$ represents the value of the opportunity that both type of temporary workers lose when holding a renewed fixed-term contract, the term $c_p(V_p^s - V_t^s)$ represents the value of the opportunity that shirkers lose when they are caught and fired. The former captures the idea of the impact of job instability on individuals' well-being and quality of life compared to those in permanent contracts, while the latter captures the idea that being caught shirking leads to a different asset loss for temporary workers compared to permanent workers.

The asset values for non-shirker and shirker workers holding a temporary contract read, respectively, as follows:

$$\begin{aligned} \delta V_t^n &= (w_t - e) + \\ &- \underbrace{\{(1 - c_t - c_p)\,(V_t^n - V_u)}_{firm's\,inactive\,behavior} \\ &- \underbrace{c_t[(V_t^n - V_t^n)\,\underbrace{-a_p(V_p^n - V_u)}_{loss}]}_{renewal}\,\underbrace{-c_p\left(V_p^n - V_t^n\right)}_{conversion}\} \end{aligned} \tag{4}$$

and

$$\begin{aligned} \delta V_t^s &= w_t - b[(V_t^s - V_u) + c_p(V_p^s - V_t^s)] - q(V_t^s - V_u) + \\ &- (1 - b - q)\,\{(1 - c_t - c_p)\,(V_t^s - V_u) + \\ &- c_t[(V_t^s - V_t^s) - a_p(V_p^s - V_u)] - c_p\left(V_p^s - V_t^s\right)\}. \end{aligned} \tag{5}$$

The fixed-term worker chooses to exert effort if the value of not shirking is at least as large as the value of shirking on that job, and the minimum incentive that temporary workers accept can be found by equating the previous two equations. It can be written as:

$$(V_t - V_u)c_t - a_p(V_p - V_u)c_t + [(V_p - V_u) + (V_p - V_t)]c_p = \tfrac{e}{b} \tag{6}$$

The last equation is the no-shirking condition for temporary workers ($NSC_t$). It states that firms can provide both monetary and non-monetary incentives in order to avoid shirking.

Since agents exhibit a forward looking behavior, they are interested in future wages, but they also know that wages are conditional upon the probability of being a temporary or permanent worker in the next period. Thus, today's wage earners may accept a lower

payment as temporary workers as long as there is a higher probability of becoming a permanent worker. In more detail, the way firms can provide incentives to workers - the LHS of eq. 7 - can be decomposed in three terms. The first two addends tells us that, for a given conversion rate, increasing the renewal rate has two opposite effects. From one side, a greater $c_t$ affects positively the incentive profile because wages for fixed-term positions are weighted more when utility is discounted at its present value. In other words, the more it is likely to be a temporary worker in the next period, the more workers will be interested in higher wages for temporary positions. On the other side, as long as $V_p$ is greater than $V_t$, a higher $c_t$ increases the value of the outside option of entering the labour market as permanent workers from the pool of the unemployed. Intuitively, if workers know that when they accept a temporary contract they will encounter multiple spells of fixed-term positions because of a higher renewal rate, they are giving up the possibility of earning higher wages if they were permanent workers. Moreover, this effect is stronger the higher is the wage differential between permanent and temporary jobs $(V_p - V_t)$. To summarize, the conversion rate acts as an imperfect substitute of wages paid to fixed-term workers. The last term says that firms can encourage workers to put effort by promising them (through $c_p$) a wage as permanent workers, and this incentive is more effective the greater is the wage differential between permanent and temporary workers.

Summing up, the lowest incentive compatible wage for temporary workers is: $w_t = e + \delta V_t - (1 - c_p)(V_p - V_t) = e + \delta V_u + \delta(V_t - V_u) - (1 - c_p)(V_p - V_t) = w_p - \frac{e}{b}q - \delta(V_p - V_t) - (1 - c_p)(V_p - V_t)$. In particular, by comparing the wage of permanent and temporary workers, we observe that the latter reflects both the absence of an exogenous separation rate $(q)$ and the difference between the value of a permanent position with respect to the temporary one by keeping into account two scaling factors, the odds of not obtaining a conversion $(1 - c_p)$ and the intertemporal discount rate $(\delta)$. The next two equations give us the difference between the value of permanent and temporary contracts and the difference between the latter and the value of being unemployed:

$$(V_p - V_t) = \frac{e}{b}\frac{(1 - c_p - c_t + c_t a_p)}{(c_p - c_t)} \tag{7}$$

and

$$(V_t - V_u) = \frac{e}{b}\frac{(2c_p - c_t a_p - 1)}{(c_p - c_t)}. \tag{8}$$

Workers who accept temporary or permanent jobs enjoy the asset change because they move away from the unemployed stock. In what follows, we assume that un-

employed workers enter the labour market either through temporary or permanent contracts. Thus, the value of being unemployed reads as follows:

$$\delta V_u = a_p \left(V_p - V_u\right) + a_t[(V_t - V_u) + (V_p - V_t)c_p], \tag{9}$$

where $a_t$ and $a_p$ are the (endogenous) arrival rates, respectively, of temporary and permanent jobs. Workers who accept a job put value to the asset change they experience. In particular, those who accept a temporary contract also put value both to the opportunity of becoming a permanent worker with probability $c_p$ and to the event of contract renewal with probability $c_t$[11].

## 3.3 Wages, Participation Constraints and Optimal Renewal and Conversion Rates

We now derive the incentive compatible wage structure arising in the two-tier system when firms optimally set renewal and conversion rates. First, notice that the condition under which permanent workers decide not to shirk ($NSC_p$) coincides with the their participation constraint. Thus, they strictly prefer employment to unemployment obtaining a rent which firms can not modify because the size of this rent depends exogenously both on the level of the effort and the detection technology, i.e.: given a strictly positive rent, workers are always willing to accept a permanent contract.

Differently by looking at equation 8, we notice that the rent can be driven to zero when firms set the optimal values of the conversion and renewal rate. In the two-tier system, firms can deter shirking of temporary workers even by paying to them a null premium (corresponding to the reservation utility of being unemployed) but allowing for the opportunity of a promotion in a permanent position and/or the possibility of a renewal. This means that:

$$\frac{e\left(2c_p - 1 - c_t a_p\right)}{b\left(c_p - c_t\right)} = 0. \tag{10}$$

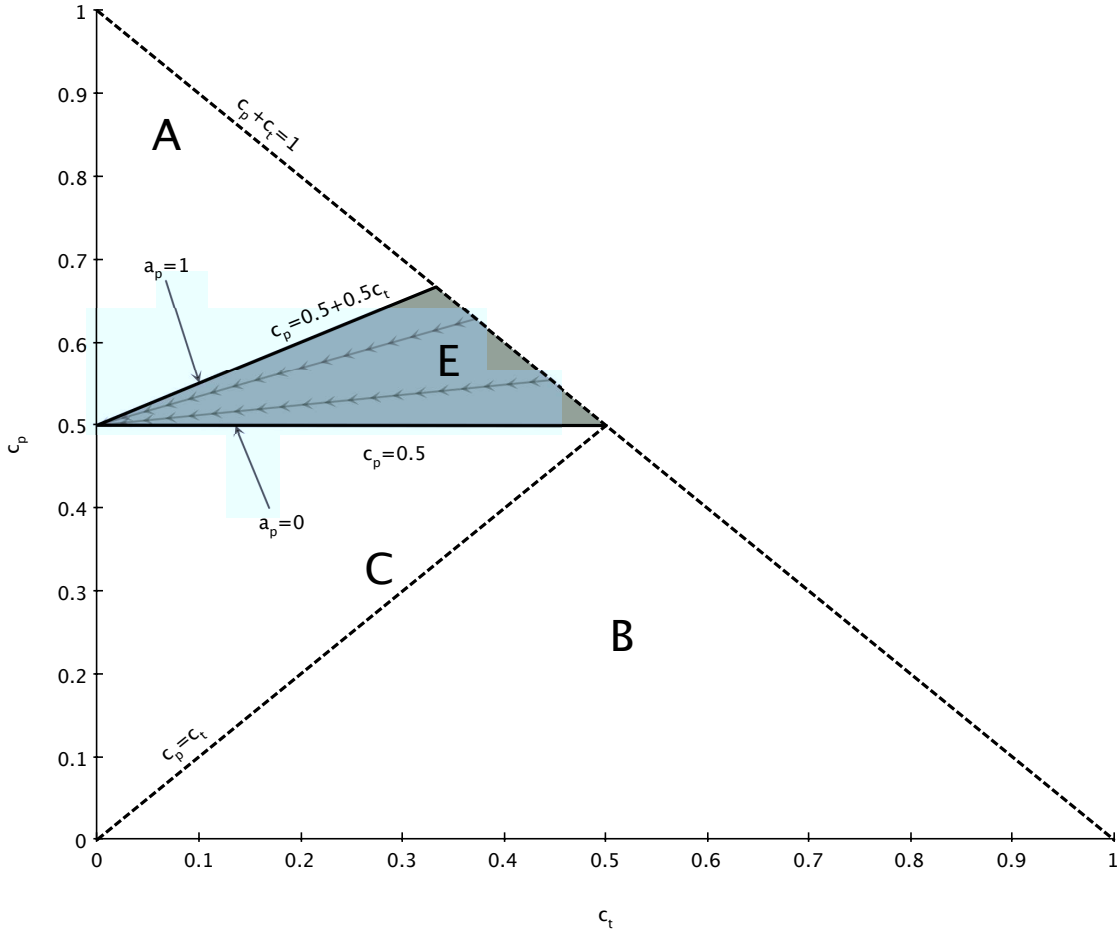
The space of all the possible solution candidates is characterized by the following conditions:

$$\begin{cases} c_p = \frac{1}{2} + \frac{1}{2} c_t a_p \\ 0 < c_t + c_p \leq 1 \end{cases} . \tag{11}$$

Figure 1 plots a graphical representation of the problem.

[11] Notice that the value of a renewal is related to a null asset change.

Figure 1: Minimum incentive space



Given $a_p$, the set of combinations of $c_t$ and $c_p$ for which $V_t - V_u = 0$ is one of the lines in the "E" area. The "A" and "B" areas identify all combinations of $c_t$ and $c_p$ for which, respectively, $c_p < c_t$ and $c_p > c_t$. In both areas, firms deter shirking by paying a premium over the reservation utility ($V_t - V_u > 0$). Differently, the levels of $c_t$ and $c_p$ in the "C" area are the combinations for which workers strictly prefer unemployment to temporary positions ($V_t - V_u < 0$)[12].

For a given renewal rate $c_t$ in the "E" area, the optimal conversion rate is increasing in the arrival rate of permanent positions. A higher $a_p$ increases the asset loss of becoming a permanent worker when unemployed and it must be compensated with a higher expectation for temporary workers to be converted into permanent ones, thus $c_p$ must be higher. In other words, the employer rewards the lower utility with a higher opportunity of a promotion in a permanent position. Also, a higher $a_p$ means that even if a temporary worker is caught shirking and is fired, she faces a higher opportunity to find a permanent job from the unemployment stock. Obviously, the reduction on the risk of unemployment should be offset with the promise of a higher $c_p$.

Notice that for a given $a_p$, the optimal conversion rate is increasing in the level of the renewal rate. The interpretation is straightforward. In a two-tier labour market, a higher $c_t$ means more stability for workers holding a temporary contract. This reduces the fraction of temporary workers who are laid off by the firm $(1 - c_p - c_t)$ and the number of unemployed is lower. Since it is easier for unemployed workers to find either permanent or temporary jobs, firms prevent shirking by offering a higher $c_p$. Also notice that when firms never offer permanent contracts to the unemployed ($a_p = 0$), at least one-half of temporary contracts must be converted into permanent positions in order to elicit workers' effort independently from the renewal rate. To sum up, in the "E" area the efficiency wages are:

$$\begin{cases} w_p = e + \delta V_u + \frac{e}{b}(q + \delta) \\ w_t = e + \delta V_u + \frac{e}{b}(1 - c_p) \end{cases} . \tag{12}$$

Using Eq. 12 and 9, we can write an explicit solution for the wage incentive structure. In particular, the efficiency wage for permanent workers reads as follows:

$$w_p \;\; = \;\; e + \frac{e}{b}(a_p + \delta + q) + \frac{e}{b} a_t (\frac{1}{2} + \frac{1}{2} a_p c_t). \tag{13}$$

It is easy to notice that when $a_t = 0$, the efficiency wage is the same as in Shapiro-Stiglitz, because the market collapses to the one tier system and no temporary positions

[12]This area includes the cases for which the renewal and conversion rates are the same ($c_t = c_p$) where no finite wages exist to simultaneously deter shirking and satisfy the participation constraint.

are available.

The efficiency wage for temporary workers is:

$$w_t \quad = e + \tfrac{e}{b}(a_p(1 + \tfrac{1}{2}c_t) - \tfrac{1}{2}) + \tfrac{e}{b}a_t(\tfrac{1}{2} + \tfrac{1}{2}a_p c_t). \tag{14}$$

In Shapiro-Stiglitz the only alternative to employment is unemployment, differently, in our model the penalty for being caught and fired can be interpreted instead as the utility loss associated with not having a permanent position. Since an unemployed worker is indifferent between holding a temporary job and remaining unemployed, the introduction of fixed-term contract has no effect on the no-shirking condition for permanent workers (3), which is always equal to $e/b$. Nevertheless, the level of their efficiency wage is higher because they can also find a job as temporary workers. On the other hand, the efficiency wage for temporary workers reflect two penalties. The first is that of becoming unemployed because of the firm's inactive behavior. The second is due to the fact that it is not possible to get a permanent job through $a_p$ in case of contract renewal.

Even in the presence of equally productive workers, the existence of dual labor markets implies that firms find optimal to pay a wage differential in favor of permanent workers. As long as $w_p > w_t$, firms can use the conversion rate as an optimal policy to avoid shirking of workers and, simultaneously, firms can use the renewal rate in order to minimize wages both for permanent and temporary workers. Once the no-shirking conditions are satisfied, an extra-dollar paid to workers would not produce any benefit to the firm, but would result in higher costs. It is straightforward to show that both kinds of efficiency wages are increasing in the level of the renewal rate, therefore firms set the optimal level of $c_t$ in order to minimize production costs. It turns out that firms set $c_t = 0$ while the optimal level of the conversion rate is $c_p = \frac{1}{2}$ . Finally, the optimal efficiency wages for permanent and temporary workers are:

$$\begin{cases} w_p = e + \frac{e}{b}(a_p + \delta + q) + \frac{1}{2}\frac{e}{b}a_t \\ w_t = e - \frac{1}{2}\frac{e}{b} + \frac{1}{2}a_p + \frac{1}{2}\frac{e}{b}a_t \end{cases} . \tag{15}$$

## 3.4 Firms' behavior

Assume that firms are homogeneous and each of the N firms seeks to maximize their profits. While there are many economic explanations that justify the heterogeneity of productivity, we prefer to impose that workers are equally productive. In this way, we are confident that our results do not depend upon any over-imposed economic structure. We assume a production function $f(eL)$ where each unit of labour produces a constant

fraction of output ($f^{'} = ey$) and is paid the incentive compatible wage, $w_i$. The instantaneous value of profits concerning a position filled either with a temporary or a permanent worker are, respectively, $\pi_t = ey - w_t$ and $\pi_p = ey - w_p$, where the output price is normalized to one. It follows that each firm, which employs both temporary and permanent workers, enjoys total profits described by the following formula[13]:

$$\Pi = l_t \pi_t + l_p \pi_p. \tag{16}$$

Since the firm's decision at any date affect profits only at that date, there is no need to analyze the present value of profits. Moreover, firms optimally choose both the overall number of workers ($L$) and the composition of their labour force in terms of temporary and permanent workers ($l_t + l_p = L$).

Since permanent workers must be paid more than temporary ones and workers are equally productive, firms always prefer to hire the latter than the former. It follows that the endogenous arrival rate for permanent position is set to zero. Figure 2 plots isoquants (black lines) and isocosts (red lines). Obviously, the latter have a lower (negative) slope than the isoquants. Therefore, each level of production could be achieved at lower costs by hiring exclusively workers under fixed-terms contract[14]. However as seen in the previous section, firms must guarantee a positive conversion rate in order to elicit workers' effort and to satisfy the participation constraint for temporary workers. Moreover, in equilibrium expectations should be satisfied and therefore each firm converts a fraction of temporary workers into permanent positions, $c_p = \frac{1}{2}$. Thus, given the optimal conversion rate (the arrival rate for permanent positions) and by considering the exogenous separation rate ($q$) from permanent jobs, in a steady-state equilibrium, the ratio between the number of permanent and temporary workers employed by a firm is constant and equals:

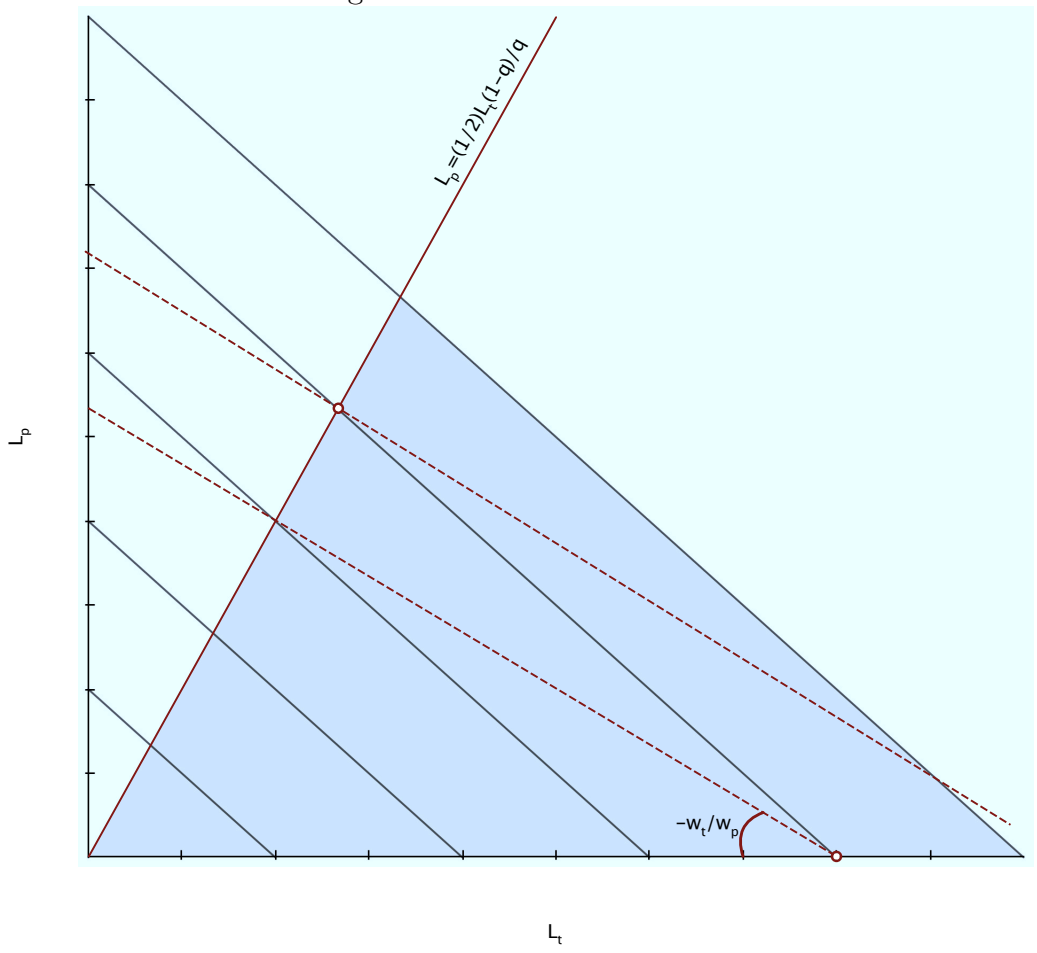
$$\frac{l_p}{l_t} = (\frac{1}{2})(\frac{1}{q}). \tag{17}$$

In other words, firms maintain the minimum number of permanent contracts in order to hire workers under fixed-terms contracts and take advantage of paying them lower wages. The increasing line in 2 shows this production expansion path. For each level of output, the combination of permanent and temporary workers that minimize the production costs is the set of intersection points between the production expansion path and the isoquants. Note that a higher level of $q$ while does not alter the wage of

[13]We also assume that the marginal product of labour ($ey$) exceeds the costs of exerting effort ($e$) or, alternatively that $y > 1$.

[14]Also notice that the (negative) slope of the isocosts is decreasing in the level of the exogenous separation rate.

Figure 2: Cost minimization




temporary workers, it reduces both the fraction of permanent workers and their wage, therefore firms produce at lower total costs.

By eq. 17, the number of total workers per firm can be expressed by:

$$L = l_t(1 + \frac{1}{2q}). \tag{18}$$

Therefore, in the steady-state equilibrium, for each temporary worker there must be $\frac{1}{2q}$ permanent workers. Therefore, firm's profits are:

$$\Pi = L\left(ey - (\frac{2q}{2q+1}w_t + \frac{1}{2q+1}w_p)\right).$$

Firms hire workers up to the point where the marginal product of labour equals their overall marginal cost. Thus the condition for the marginal product of labour to equal the wage is:

$$ey = \frac{2q}{2q+1}w_t + \frac{1}{2q+1}w_p. \tag{19}$$

The set of points satisfying 19 is the conventional labour demand curve[15].

It is now convenient to express wages in eq.15 in terms of employment per firm, rather than the rate at which the unemployed workers find a job. Since the economy is in steady-state, flows into and out the stock of unemployment must balance. In equilibrium unemployed workers can receive exclusively temporary contracts. Thus, the flow out of unemployment is given by the arrival rate ($a_t$) times the stock of unemployed workers, $H - NL$ (the difference between the total labour force and the aggregate number of employed workers). The flow into unemployment is made up of permanent workers becoming unemployed at the exogenous separation rate ($q$) and temporary workers becoming unemployed because of firm's inactive behavior at a rate $1 - c_p - c_t$. The equilibrium flow balance is given by:

$$a_t(H - NL) = N(l_p q + l_t(1 - c_t - c_p)). \tag{20}$$

Using equations 17, 18 and 20, the endogenous arrival rate for temporary workers in terms of employment per firms is:

$$a_t = \frac{2(NLq)}{(2q+1)(H - NL)}. \tag{21}$$

Substituting this into eq. 15, the left hand side of eq. 19 gives us the so called incentive curve, i.e. the minimum incentive (average) wage that firms must pay to avoid shirking:

$$w = e + \frac{e}{b}\left(\frac{1}{2q+1}\right)\left(\delta - q + q\frac{H}{H - NL}\right) \tag{22}$$

Eq. 22 can be referred as an effort supply function where there is a positive relationship between the critical average wage and the level of employment. In particular, as the unemployment rate approaches to zero, the critical average wage tends to infinity.

Labour market equilibrium is given by the intersection of the effort supply function and the labour demand. At this point, workers provide effort and firms obtain the labour force ($NL^*$) they want by paying $w_p(NL^*)$ to workers under permanent contract and

[15]In our model, a unit of labour is expressed as a combination of both permanent and temporary workers, thus the average wage is a linear combination of the two efficiency wages.

$w_t(NL^*)$ to workers under fixed-term contract. Differently, a lowering of wages would yield shirking. Thus, firms have an optimal strategy given the preferences of workers.

From the workers' point of view there is involuntary unemployment. While permanent workers strictly prefer working to unemployment, temporary workers, even if they are indifferent between the unemployment and a fixed-term contract, have the incentive of being converted into a permanent position. Therefore, even if each worker would work at a lower wage, it would not be a credible commitment. Thus, given the firms' behavior, the strategy of workers is optimal. Summing up, the equilibrium point where the labour demand and the effort supply function intersect is a Nash equilibrium.

The analytical solutions of the model are:

$$NL^* = H\frac{(2q+1)(y-1)b-\delta}{(2q+1)(y-1)b-\delta+q} \tag{23}$$

$$Nl_t^* = H\frac{(2q+1)(y-1)b-\delta}{(2q+1)(y-1)b-\delta+q} * \frac{2q}{2q+1} \tag{24}$$

$$Nl_p^* = H\frac{(2q+1)(y-1)b-\delta}{(2q+1)(y-1)b-\delta+q} * \frac{1}{2q+1} \tag{25}$$

$$U^* = H\frac{q}{(2q+1)(y-1)b-\delta+q} \tag{26}$$

$$w_p = ey + \frac{e}{b}\left(q + \frac{2q}{2q+1}\delta\right) \tag{27}$$

$$w_t = ey - \frac{1}{2}\frac{e}{b} - \frac{1}{2q+1}\delta \tag{28}$$

# 4 Conclusions

In this article, we have presented a modified version of the Shapiro-Stiglitz's (1984) efficiency wage model by introducing temporary contracts in the standard setup. Consistently with some stylized facts of European Labor Markets, our model is able to describe i) the existence of an upward mobility from temporary positions to permanent employment; ii) the coexistence of temporary and permanent contracts as an equilibrium outcome; iii) a novel reason of the wage differential between permanent and temporary workers.

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