

# Do Wages Compensate for Anticipated Working Time Restrictions? Evidence from Seasonal Employment in Austria \*

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## Abstract

This paper investigates the existence of compensating wage differentials across seasonal and long term jobs which arise due to anticipated working time restrictions. Using longitudinal information from the Austrian administrative records, we derive a definition of seasonality based on observed regularities in employment patterns. As wages change across seasonal and long term jobs for the same individual over time, we can control for individual specific effects and use variation in the starting month of seasonal jobs as an exogenous predictor of anticipated unemployment. We find that employers pay on average a positive wage differential of about 11% for seasonal jobs.

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## I. Introduction

A substantial body of research has examined the existence of compensating wage differentials, which arise when apparently identical workers seem to earn different wage rates across sectors, employers, and even within the same firms. The competitive view sees these differentials as originating from different attributes of the job, which are “offered” by the employer to the workers and whose price is reflected in the wage rate (Rosen, 1986). According to this theory, in equilibrium the forces of competition and worker mobility combine to generate a distribution of wage differentials which compensate workers for accepting different job attributes. In a sample of homogenous workers with identical preferences, these wage differentials will be utility equalizing.

One of the aspects which has been often analyzed in this context is the relationship between wage levels and the likelihood of wage loss. Several studies have examined the compensating wage differentials arising from the risk of work-related accidents (Garen, 1988; Lalive, 2003; Thaler and Rosen, 1975; Viscusi, 1979) and the risk of unemployment (Abowd and Ashenfelter, 1981; Assaad and Tunali, 2002; Hamermesh and Wolfe, 1990; Li, 1986; Topel, 1984). That body of research stresses the importance of *expected* or *anticipated* wage losses, whether these arise from job-related hazards or working hours restrictions.

In this paper we are interested in the relationship between wages and unemployment, where unemployment is seen as a constraint on individual behavior rather than the optimal choice of an intertemporally optimizing agent. This idea has been around at least since Adam Smith’s discussion on the variation in employment among masons and bricklayers.<sup>1</sup> However, although two cen-

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<sup>1</sup>“Employment is much more constant in some trades than in others. In the greater part of manufactures, a journeyman may be pretty sure of employment almost every day in the year that he is able to work. A mason or bricklayer, on the contrary, can work neither in hard frost nor in foul weather, and his employment at all other times depends on the occasional calls of his customers. He is liable, in consequence, to be frequently without any. What he earns, therefore, while he is employed must not only maintain him while he is idle, but make him some compensation for those anxious and desponding moments which the thought of so precarious

turies have passed since the publication of *The Wealth of Nations*, empirical evidence on this issue has been extremely elusive. Studies relying on aggregate data have found a wage premium of about 1%-2% for each point of unemployment (Lillard, 1981; Reza, 1975). By contrast, in the first attempt to use micro data and control for individual unobservables, Abowd and Ashenfelter (1981) and Abowd and Ashenfelter (1984) often found insignificant and sometimes even negative effects.

One of the main problems with the empirical literature to date is that it is rather difficult to distinguish workers affected by anticipated hours restrictions and those who are not. Very often a clear difference can only be established by crude proxies, such as industry affiliation or self-reported definitions related to the type of contract (Moretti, 2000; Murphy and Topel, 1987). Moreover, data are often only available on a cross sectional level and this makes it difficult to control for unobserved person-specific elements, like the taste for more leisure (Assaad and Tunalı, 2002; Hamermesh and Wolfe, 1990; Li, 1986; Topel, 1984).

We approach this problem by using the rich longitudinal information contained in the Austrian social security records to derive a definition of seasonality based on observed individual patterns of employment and unemployment spells. As wage rates vary across seasonal and long term jobs for the same worker, we can adequately control for individual specific effects. We can then relate those changes to variations in working time restrictions, captured by days of unemployment. In order to resolve the potential endogeneity of unemployment with respect to wages we use variation in the starting month of the job as an instrument. The idea is that in an economy characterized by strong seasonal fluctuations in employment, starting a job in different months of the year is a good predictor of anticipated working time restrictions.

Our empirical specification is based on the model developed by Abowd and 

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a situation must sometimes occasion [...]. The high wages of those workmen, therefore, are not so much the recompense of their skill as the compensation for the inconstancy of their employment." Smith (1776), 115-116.

Ashenfelter (1981) in which the compensating wage differential between constrained and unconstrained jobs is seen as a function of the anticipated variation in individual unemployment. Using standard labor supply theory and taking into account the role of the unemployment insurance system, the model suggests that the parameters characterizing the relationship between wages and unemployment can be given an interpretation in terms of the compensated labor supply elasticity and the unemployment benefit replacement ratio.

Our results show that, while the effect of unemployment on the wage rate is negative in a pooled regression, controlling for individual fixed effects and for the endogeneity of unemployment results in a positive impact. According to our estimates, the observed wage differential for seasonal jobs amounts to about 11% percent of the wage in a permanent job and a similar amount is covered by the unemployment insurance system. In other words, employers and workers who operate on the basis of seasonal contracts receive an indirect subsidy from other firms and other workers. This implies an inefficient allocation of labor and calls for the introduction of a system of experience rating.

The paper is organized as follows. Section 2 presents some descriptive evidence on the seasonal variation in employment in Austria and a brief overview of the relevant institutional factors which explain it. Section 3 and 4 introduce the theoretical model and its empirical implementation. Section 5 describes the data, in particular our definition of seasonality, and provides additional insights about our identification strategy. The results are presented in section 6, while the last section concludes.

## **II. Seasonal employment in Austria**

Seasonal variations in employment have been a significant feature of the Austrian labor market for many decades. In the 1950s and 1960s the percentage of male workers employed over the active male population regularly fluctuated

by more than 10 percentage points between the summer peak to the winter trough. By contrast, the 1970s saw a reduction in the amplitude of the seasonal variation as the economy underwent a prolonged boom and reached full employment. More recently, the 1980s and 1990s have seen a resurgence of the seasonal cycle with remarkably regular variation in employment rates of about 5 percentage points as shown in figure 1.

The phenomenon of seasonality observed in Austria is rather atypical for a continental European country. Seasonal employment fluctuations are often observed in economies such as Canada or the Scandinavian countries. Among middle European countries Austria represents a notable exception, as it is characterized by a very high share of seasonal employment with respect to its neighbors (Fischer and Pichelmann, 1991).

To give some idea of the relative magnitude of the seasonal cycle in Austria, figures 2 and 3 plot monthly seasonal employment and its average deviation from a country-specific trend between 2001 to 2004 for Austria, Germany, the USA and Canada. The first graph shows the existence of a regular yearly pattern for all countries. The second graph shows that the average amplitude of the seasonal variation experienced in Austria is very similar to that observed in Canada, i.e. about 5 percentage points from peak to trough. The USA and Germany experience much smaller variations, of about 2 percentage points on average, and in Germany the pattern is clearly different from what we can see elsewhere.

The industries most exposed to seasonal demand variations are construction and tourism and this is accentuated in Austria due to the climatic and geographical conditions. Due to cold weather, almost all activity in construction is shut down during the winter months - roughly between December and February. Outside the bigger cities, tourism is concentrated in the western, alpine regions of Austria where it is characterized by two yearly seasons. The main season

is the skiing season, which occurs during the winter and lasts from December to April, the second - shorter season - occurs during the summer. Given that construction and tourism are relatively important in the Austrian economy, one can expect that their pronounced seasonal fluctuations also affect other industries.<sup>2</sup> Indeed, if we look at employment by industry in figure 4 we find seasonal patterns throughout the economy.

The high incidence of seasonal employment in Austria cannot be entirely explained by geographic and climatic circumstances, however. The Austrian institutional setting is thought to play an important role. We therefore present here the main institutional features which contribute to seasonal employment fluctuations: weak firing regulations, an almost universal unemployment insurance system, and the absence of experience rating provisions. Incidentally, we argue that while the OECD draws a picture of Austria as a typical continental European country with a highly regulated labor market, the real picture is much more diverse and shows that in Austria individual employers enjoy a significant bilateral negotiating power (OECD, 2003).

In Austria wages are set by collective agreements stipulated between employers, employee representatives, unions and government officials. While these agreements fix minimum wages at the industry level, employers are still free to negotiate higher wages with individual workers. This means that wages exhibit considerable variation at the firm and individual level, and this is important for our empirical strategy.

The centralized system of bargaining is also thought to encourage adjustments in the form of relatively high job turnover rates (Fischer and Pichelmann, 1991; Hofer et al., 2001; Stiglbauer et al., 2003), which appear to be facilitated by a relatively weak employment protection legislation. Basically, employers can

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<sup>2</sup>According to the Labour Force Survey, in 2001 the share of employment in the construction sector was 8.8% in Austria and 7.9% in the EU-15 as a whole, the corresponding shares in the hotel sector, which is the industry where most tourism workers are classified, were 5.4% and 4.0%.

layoff workers without giving a reason, while workers can appeal against a layoff only if this is “socially unacceptable”, i.e. if it is impossible to find a comparable job in the labor market. As a consequence, only older workers with long firm tenure have a good chance to win an appeal against their employer. Settlements usually result in payments by the firm, not in re-hirings. Moreover, the period of advanced notice for a layoff is 2-3 months for a white collar worker, but usually no longer than 2 weeks for blue collar workers.<sup>3</sup> In general no regulations apply to layoffs in jobs with a duration of less than 6 months, while severance payment rules apply only for job durations above 3 years.

Another important feature of the economy, which is relevant for the purposes of this analysis, is the system of unemployment insurance (UI). In Austria participation in UI is almost universal, that is to say compulsory for all except the self-employed. The system is articulated in the administration of unemployment benefits (Arbeitslosengeld) and, after these expire, unemployment assistance (Notstandshilfe). In order to qualify for unemployment benefits a worker must have been employed for at least 52 weeks in the past two years.<sup>4</sup> The period during which unemployment benefits are paid is 20 or 30 weeks, depending on work experience. The replacement ratio is 55% of net income, which is low by European standards, but becomes potentially higher once family allowances and other benefits are taken into account. After unemployment benefits are exhausted, the worker can apply to receive unemployment assistance, which is means tested and reverts to a subsistence level after 6 further months of unemployment.<sup>5</sup>

The phenomenon of seasonal employment is often discussed in connection with experience rating provisions. In a world without unemployment insurance and

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<sup>3</sup>Thanks to Gerda Heilegger from the Austrian Chamber of Employees helping us with this information.

<sup>4</sup>This requirement is lowered to only 26 weeks within the past year for young people below 25 and for those repeatedly unemployed.

<sup>5</sup>Apart from minor modifications the basic structure of social security system in Austria - as it has been outlined above - has remained unaltered for the period considered here.

low mobility costs, firms that are subject to seasonal demand variations would have to pay wages that are high enough to compensate their workers for the fact that they work only part of the year. In the presence of unemployment insurance, workers employed in seasonal jobs receive compensation when not working thereby reducing the extent to which employers have to pay a wage premium in order to attract them. In order to reduce the extent to which firms (as well as workers) use unemployment insurance to face anticipated rather than unanticipated periods of unemployment, the USA has adopted an experience rating system in which employers are required to pay extra contributions per worker in proportion to their turnover. No such system applies in Austria to date, so that industries which experience periodic and predictable seasonal fluctuations in demand receive an implicit subsidy from other industries.<sup>6</sup>

### **III. A theoretical model of compensating wage differentials**

The importance of the construction and tourism sectors in Austria and the magnitude and regularity of the seasonal cycles clearly suggest that the institutional setting allows some employers to react flexibly to demand conditions. It is therefore possible to think of the Austrian labor market as being characterized by two types of implicit contractual agreements. In the first scenario a worker is employed throughout the entire year, while in the second case the worker is offered a seasonal job and is temporarily dismissed during the off-season to be rehired at a later point in time.

A simple framework to understand a worker's decision to work either in a permanent or a seasonal job is that proposed by Abowd and Ashenfelter (1981).

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<sup>6</sup>The phenomenon is large and difficult to quantify, but it was estimated that in 1993 the direct costs (unemployment insurance and unemployment benefits) amounted to about 250m Euros, while taking into account also social security contributions and payroll taxes not paid brings the total to 290m Euros, almost 0.2% of GDP (Brandel et al., 1994).

Their model shows that the determination of wage rates is linked to anticipated working time constraints through the compensated labor supply elasticity and the unemployment benefit replacement ratio. The model is developed in the context of conventional labor supply theory and can be extended to consider uncertainty over working time restrictions.

Assume we have an economy characterized by two types of jobs: one without constraints on working time and the other with some constraints. In the unconstrained job workers face a fixed wage rate  $w$  and choose the optimal supply of working time  $h^0$ . In the constrained job workers accept a contract which sets the working time at  $\bar{h} < h^0$  and the wage at  $w^*$ . The model is static, there is no substitution over time. If workers are identical in all respects and there are no costs of moving between different jobs, the worker's utility must be the same in these two scenarios. This equilibrium condition implies that in order to make workers indifferent between the two types of jobs a compensating wage differential must be paid in the job with working time restriction.<sup>7</sup>

The equilibrium condition implicitly defines the relationship between the compensating wage differential and the working time restriction imposed by the employer in the constrained job. Abowd and Ashenfelter (1981) derive an approximation which shows that in the presence of working time constraints the competitive wage incorporates a compensating differential which is proportional to the squared difference between  $h^0$  and  $\bar{h}$ :

$$\frac{w^* - w}{w} \sim \frac{1}{2e} \frac{(h^0 - \bar{h})^2}{\bar{h}h^0}. \quad (1)$$

As we can see, the coefficient of proportionality is given by half the inverse of the compensated labor supply elasticity  $e$ . This implies that a greater difficulty in substituting leisure for commodity consumption (lower  $e$ ) results in a higher

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<sup>7</sup>Although we assume here that workers are homogeneous, this is not a necessary feature of the model. Indeed, as we will see below, our empirical strategy allows us to take explicitly into account workers' heterogeneity.

wage differential.<sup>8</sup>

Now assume that there is an unemployment insurance scheme in which benefits cover the wage for a fraction  $\gamma$  of the lost working time  $h^0 - \bar{h}$ . Consequently, total labor income in the constrained job amounts to  $w^*[\bar{h} + \gamma(h^0 - \bar{h})]$  and the wage differential can be approximated by:

$$\frac{w^* - w}{w} \sim -\frac{\gamma(h^0 - \bar{h})}{h^0} + \frac{1}{2e} \left( \frac{h^0 - \bar{h}}{h^0} \right)^2. \quad (2)$$

Under this scenario the compensating wage differential is expressed as a quadratic function of the expected time out of work, as defined by  $(h^0 - \bar{h})/h^0$ . This implies that the compensation can be even negative for a small restriction in working time, particularly if the unemployment insurance covers a high enough fraction of the lost wage and the worker has a high value for the additional leisure.

As a second extension to the basic model, let's assume that the working time restriction is not a priori fixed, but there is some uncertainty attached to it. In this case, a risk averse employee asks for an extra compensation for the risk and gets a wage  $w^{**}$ . The actual time worked can be modeled as a random variable  $\tilde{h}$  with  $E(\tilde{h}) = \bar{h}$  and  $V(\tilde{h}) = \sigma^2$ . The additional element contributing to the compensating wage differential is shown to be approximately proportional to the variance of expected unemployment. Formally:

$$\frac{w^{**} - w^*}{w^*} \sim \frac{1}{2} r \frac{\sigma^2}{\bar{h}^2}, \quad (3)$$

where the factor of proportionality is half the coefficient of relative risk aversion  $r$ .

Combining equations (2) and (3) the total compensated wage differential will be expressed as:

$$\frac{w^{**} - w}{w} \sim -\gamma \left( \frac{h^0 - \bar{h}}{h^0} \right) + \frac{1}{2e} \left( \frac{h^0 - \bar{h}}{h^0} \right)^2 + \frac{1}{2} r \frac{\sigma^2}{\bar{h}^2}. \quad (4)$$

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<sup>8</sup>The exact derivations of this and the following results can be found in the Appendix.

This theoretical model implies several predictions. First, the existence of a UI system covers for part of the differential so that at low levels of unemployment the differential can even be negative. Second, because of the quadratic formulation, the compensating wage differential initially decreases and then increases with the amount of working time restrictions. While workers might not care much if they are forced by the employer to spend a few days at home - they collect benefits for a short while and enjoy more leisure time - they will require higher compensation as the constraints become more and more restrictive.

In its original formulation, the model abstracts from the existence of fixed costs of becoming unemployed, like image loss or the costs associated to a new job search. This feature could be easily incorporated in this structure and would determine an additional element of compensation. Including these costs would mitigate the negative wage differential at low values of unemployment, which in turn might make it more difficult to identify the quadratic function form or the turning point. However, it is plausible to assume that fixed costs play a minor role in the Austrian labor market, as we will see that most workers subject to seasonal demand fluctuations are recalled by the same employers.

Although the model in Abowd and Ashenfelter (1981) takes explicitly into account uncertainty in working time restrictions, our empirical specification will not be able to capture this element. This is a potential drawback of our analysis, which could cause an omitted variable bias and affect our main results. Unfortunately we lack a convincing measure of unemployment uncertainty at the individual level and therefore will not be able to take it into account. We can therefore only assume that capital markets in Austria are sufficiently developed for uncertainty on working hours restrictions not to play a major role.

## IV. Empirical application and estimation of the model

We apply the model of working time restrictions and compensated wage differentials to a labor market with permanent jobs and seasonal jobs. We assume that in permanent jobs workers are employed over the entire year and are not subject to anticipated working time constraints, whereas in seasonal jobs workers are only allowed to work for part of the year and are unemployed for the rest of the time. The proportion of time spent in unemployment represents the working time restriction of a seasonal job in this context.

The unit of observation for the empirical analysis is a worker job pair. For worker  $i$  in job  $j$  we observe the log wage  $w_{ij}$ , the job type - seasonal or permanent - along with a the working time restriction or share of time spent in unemployment  $u_{ij}$ , and a set of job and individual specific characteristics  $X_{ij}$ , represented by region, industry, and time dummies. We define seasonal and permanent jobs on the basis of observed regularities in employment patterns. This ensures that “seasonality” is not a characteristic of the individual or of the industry.<sup>9</sup>

The theoretical model we have seen above suggests a nonlinear relationship between wages and the working time restrictions. Therefore we use a semi-parametric specification which we capture in the following model:

$$w_{ij} = g(u_{ij}) + X_{ij}\beta + \alpha_i + \epsilon_{ij}, \quad (5)$$

where  $g$  is an unknown function. Thus, while  $g(u_{ij})$  represents the premium due to working time restrictions, the systematic component of an individual wage is captured by the characteristics  $X_{ij}$  which enter the model linearly. The coefficient vector  $\beta$  measures their influence on the wage rate. We decompose the error term into an individual specific component  $\alpha_i$  reflecting time or job

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<sup>9</sup>The exact way in which these definitions are derived is explained in section A.

invariant differences in taste for consumption and leisure and an idiosyncratic component  $\epsilon_{ij}$ .

The strength of our empirical approach lies in the fact that we observe multiple jobs per worker and that we can distinguish in the data between constrained and unconstrained jobs. Rosen (1974) demonstrates that heterogeneity in preferences among workers and employers leads to sorting of workers with the highest preferences for leisure into firms with the least willingness to compensate for working time constraints in equilibrium. Consequently, cross sectional estimates based on a single job observation per worker will trace a hedonic wage curve and result in estimates that understate the true wage differentials. Longitudinal data allow us instead to identify the effect of working time restrictions on wages even in the presence of heterogeneous preferences using moves between seasonal and permanent jobs for the same individual over time.

An important issue that we still need to address is the potential endogeneity of unemployment in the wage equation. Because of the longitudinal structure of our model we can control for unobserved individual fixed characteristics which could influence both wages and unemployment, but we cannot exclude the presence of other unobserved and time-varying factors which could lead to a non-zero correlation between our measure of working time restriction and the error term. Also, we need to keep in mind that according to the theory what matters in the formulation of the compensating wage differential is not *actual* unemployment, but *anticipated* unemployment. In other words, we need to find an instrument which is able to identify the exogenous variation in unemployment experience and at the same time reflect only the anticipated component of the constraint.

In order to solve this endogeneity problem we adopt an instrumental variable strategy and use the starting month of the job to identify the exogenous variation in individual unemployment experience. The intuition is that since seasons

have typically fixed duration, workers who start a job later in the season will experience a longer period of unemployment with respect to workers who start earlier. Different starting months will therefore be correlated with different average duration of unemployment. Moreover, as the starting month of the job is known to the individual we argue that this instrument is a good predictor of the anticipated component of the individual working time constraint, which is what is important according to the theory.

For the starting month of a job to be a valid instrument of individual unemployment in equation (5) we need to assume that it has no other effect on the wage rate apart from its influence on unemployment duration  $u_{ij}$ . Arguably this is a strong assumption, as it is possible that individuals who start working in different months of the year are systematically different in ways other than their expected unemployment duration. However, we can control for this source of heterogeneity using a fixed-effects estimator.<sup>10</sup>

We extend the model in equation (5) by a linear reduced form equation for  $u_{ij}$ :

$$u_{ij} = X_{ij}\beta + Z_{ij}\gamma + \mu_i + \nu_{ij}. \quad (6)$$

where the  $Z_{ij}$  stands for the starting month of the job, which represents our instrument. The exact way in which this variable is derived is explained in the following section.

The most straightforward way to correct for endogeneity in a semi-parametric model with additive errors is via a control function using a two-step estimation procedure (Blundell and Powell, 2003). In the first step we estimate the reduced form equation (6) with a linear fixed effects estimator. In the second stage we include a flexible function  $k$  of the estimated reduced form residuals  $\hat{r}_{ij} = \hat{\mu}_i + \hat{\nu}_{ij}$

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<sup>10</sup>The validity of this strategy impinges on the assumption that moves between permanent and seasonal jobs are exogenous. We have no evidence to offer on this point, but this might not be a serious concern as we observe a relatively large number of transitions between permanent and seasonal jobs and viceversa (see section 5.2).

into the structural equation and estimate the following specification:

$$w_{ij} = g(u_{ij}) + k(\hat{r}_{ij}) + X_{ij}\beta + \alpha_i + \epsilon_{ij}. \quad (7)$$

Newey et al. (1999) propose a series estimator to approximate the unknown functional forms of  $g$  and  $k$ . The advantages of this estimator are its computational convenience and high efficiency in imposing additivity. Specifically, we use polynomial functions to approximate  $g$  and  $k$ . To determine the optimal degree of the polynomials we increase the number of exponential terms and check the sensitivity of the results to this choice.

## V. Data

We use longitudinal information on a random sample of workers drawn from the Austrian social security records during the years 1984-2001. The social security authority collects detailed information on all workers in Austria, with the exception of the self-employed, and tenured civil servants. The data contains information on the individual's labor market status in employment, unemployment, and various other qualifications on a daily basis. Wage information is provided per year and per employer. The information in the administrative records is very precise, because the main reason for its collection is to verify pension claims. The limitations of the data are that wages are top-coded and that there is no information on working time.

We restrict the sample to male, Austrian, blue collar workers, born between 1941 and 1978 (in 2001 workers are 23 to 60 years old). We select this group of workers because Austrian workers are better covered by the unemployment insurance system. Seasonal firms often hire foreign workers with temporary working permits, e.g. in agriculture and tourism. These workers are not comparable to workers living in Austria throughout the year. Also, among male

blue collar workers the share of seasonal employment is especially high. In addition, the share of part time work among prime age males is very low, which is important as we cannot control for exact working hours. Finally, blue collar wages are usually below the top-coding threshold<sup>11</sup> and blue collar jobs are typically not subject to fringe benefits.<sup>12</sup>

The full line in figure 5 plots weekly employment over active population for the sample. We find the same regular pattern as in the aggregate figure 1. Figure 6 presents employment by worker type. The graph makes it clear that seasonality affects employment of blue collar workers most. Similarly to figure 4, we find seasonal employment fluctuations in all industries in the sample (data not shown). Therefore, our analysis will not be restricted to a specific group of industries.

### A. Seasonal jobs and working time restrictions

The precise information on timing and the longitudinal nature of the data allow us to identify *seasonal* jobs from individual patterns of employment over time and to distinguish them from long term employment or *permanent* jobs. We start out with a definition of seasonal and permanent jobs based on the observed employment patterns and then explain how the main variables that enter the empirical model in equations (5) and (7) are derived from this definition.

The basic building block for the definition is an employment spell. For individuals in employment we can track the employers by an employer identifier. Consequently, an employment spell is defined by an uninterrupted sequence of days employed with the same employer. The idea is to look at durations and annual regularities of employment spells over an individual's experience and to

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<sup>11</sup>In our sample we observe a share of 0.05% top-coded wages. Moreover, since the upper ceiling for unemployment benefits depends on the upper earnings limit for social security contributions, we can ignore both these problems.

<sup>12</sup>Since all workers in the social security database are covered by the government pension system, employer provided retirement pensions are virtually non-existent.

associate permanent employment with long term jobs and seasonal employment with regular changes between employment and non-employment.<sup>13</sup>

By construction, a permanent job is an employment spell with a minimum duration of 11 months. Among the remaining, shorter employment spells we focus on spells lasting at least 2 months. Two or more employment spells which end at about the same time in consecutive calendar years define a seasonal job. To be specific, we allow for a three months window at the end dates of a spell. Figure 7 illustrates the definition by way of an example. The individual in the top graph is only employed during the summer months in the first three years. In each of these years, the employment spells end at about the same time. Hence we consider all of them as seasonal job  $S1$ . From the fourth year onwards the individual is employed continuously with the same employer and thus holds a permanent job  $P$ .

This concept looks straightforward. In the data, however, we often observe that during years in which an individual holds a seasonal job, this seasonal job is not their only source of employment. Note that we restrict the minimum duration of an employment spell in seasonal jobs to be 2 months, so there is potentially plenty of time during the year to hold other jobs. It may be the case that an individual holds 2 seasonal jobs in the same year, say a summer job and a winter job. An example is given in the second graph in figure 7. For this individual we observe three jobs:  $S1$  and  $S2$  are seasonal jobs,  $P$  is a permanent job.

In other cases we cannot detect any regular pattern in the extra employment spells in years characterized by seasonal jobs. The last graph in figure 7 demonstrates this. Here the individual holds a seasonal job  $S1$  during the first three years, and a permanent job  $P$  later on. The employment spell  $A$ , starting at the end of the second year, is not part of any regular pattern of spells. We will focus our analysis exclusively on seasonal and permanent jobs, and will not

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<sup>13</sup>This approach to define seasonality is similar to de Raaf et al. (2003).

consider *alternative* short term employment spells as separate job observations. However, they do play a role in our model, as will become clear below.

The measure of working time restriction in seasonal jobs is motivated by both the theoretical model and the data. In the model the working time restriction represents the period during which the employee is not working because of an imposed constraint which the employer is willing to compensate. In the data we see that workers who are employed in seasonal jobs and therefore subject to a working time constraint have other employment opportunities during the remaining part of the year (either another seasonal job or an alternative job). It seems plausible that both the employer and the worker are aware of these other employment opportunities, so that the employer might only be willing to compensate for the actual time the worker spends in unemployment. Following these considerations, we define the working time restriction as the proportion of the year spent in unemployment rather than non-employment.<sup>14</sup>

To calculate the measure of unemployment for seasonal jobs we also need to define starting and ending dates for the jobs. Calendar years seem unsuitable for seasonal jobs starting in the middle of the year, so we use the earliest starting month of all employment spells belonging to the same seasonal job to construct a “seasonal year”. Having defined the starting month of the seasonal job in this way, we calculate the yearly share of unemployment from this date onwards.<sup>15</sup> The same definition of starting month is used for the instrumental variable in equation(7).

According to the definitions, the minimum duration of a seasonal job is 2 years and very often also permanent jobs extend over more than one year. Wages are available on a yearly basis for each employer and we can calculate a yearly

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<sup>14</sup>In the administrative registers unemployment is defined by either the receipt of unemployment benefits or by being registered as actively looking for work with the public employment office. This also corresponds to the official definition of unemployment used in the aggregate labor market statistics.

<sup>15</sup>Suppose an individual is in a seasonal job which started with an employment spell in April 1997, and that the following spells start in March 1998 and April 1999. For this job we calculate yearly measures of unemployment from March 1997 onwards.

unemployment or working time restriction measure with the method described above. Consequently, we have in general more than one measure of wage and the working time restriction for each job. In the empirical analysis we use wage and unemployment information from the observation in the second year.<sup>16</sup> This is because first-year wages appear to be more noisy than wages in subsequent years, while second-year wages are a better representation of the typical wage in a permanent or a seasonal job.<sup>17</sup>

## B. The incidence of seasonality in our sample

To see what the effect of our definition of seasonal jobs is in practice, we plot the ratio of employed over active population for all but the seasonal workers, as a dashed line in figure 5. Excluding seasonality according to our definition reduces the yearly employment variation by two thirds. This means that our definition takes a conservative point of view but it clearly captures the phenomenon. Some of the seasonal demand variation is still reflected in the short employment spells without a regular pattern.

This is even more convincingly shown in figure 8, which gives the share of employed over active population in three job categories by week of the year: permanent, seasonal, and the residual category of jobs for which neither definition applies. The variation over the year is largest in seasonal jobs, where employment peaks during the summer months and is lowest in February. We also see lower employment ratios during the winter for the alternative jobs, but there is no variation in employment over the year for permanent employment.

In the empirical fixed effects analysis we consider all individuals who hold at least two jobs (about 75% of the total sample). In addition, we restrict the

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<sup>16</sup>For a small number of permanent jobs we only have one observation, so we take this.

<sup>17</sup>Note that our definition also avoids a direct mechanical link between the unemployment variable and the starting month variable for individual  $i$  in job  $j$ , as the starting month refers to the earliest start of any of the seasonal employment spells in the job and our measure of unemployment refers to the share of unemployment in the second year of the job.

analysis to seasonal jobs with an average yearly employment of 180 days, to ensure eligibility for UI benefits. Table VII. presents the basic summary statistics of our sample. In total we observe 24,516 jobs, of which 21% are seasonal jobs. Our definition only restricts the duration and ending dates of seasonal employment spells, not the employer. Still, we find a high recall rate to the same employer among seasonal jobs; the share of seasonal jobs with recall is 64%.

In about half of the seasonal jobs we find an extra employment spell (i.e. an additional spell apart from the main seasonal spell) during the year. In some cases the pattern reveals that the individual alternates between summer and winter seasonal jobs, like in graph 2 of figure 7. Specifically, these patterns constitute about 13% of the total number of seasonal jobs. Most of the cases are, therefore, just irregular extra employment spells, like in the example drawn in graph 3 of figure 7, for which no clear pattern can be identified.

Looking at individuals instead of jobs, we see that our sample consists of 7,908 workers and that on average we observe 3 jobs per individual. As we consider only blue collar males, the share of workers holding at least one seasonal job is particularly high, about 42%. We also observe a high number of workers who transit between seasonal and permanent employment, about 38% of the whole sample. This figure is important for the identification of wage differences between seasonal and permanent jobs. Transitions occur in both directions, from seasonal to permanent jobs and the other way round, although the frequency of transitions from seasonal to permanent jobs is a bit higher, perhaps indicating a form of career advancement through time.

Table VII. reports summary statistics by industry, region and starting month of the job. The industries with the highest number of job observations are manufacturing and construction. As we expected, most of the seasonal jobs are concentrated in the construction and hotel industries, which together account

for almost 60% of the seasonal observations. But we find seasonality in every industry and this justifies our choice of not restricting the analysis to a few of them.

Seasonality also varies with the region. Especially in the Alpine parts (Salzburg, Tirol, Carinthia) of the country, which rely heavily on the hotel industry, we observe a high share of seasonal employment. The two different seasonal cycles are clearly marked by the starting month of job spells. Seasonal jobs typically start in the spring (March - May) or in December when the winter season takes off. For permanent jobs, on the other hand, the distribution of the starting month of the spell is fairly even throughout the year with some peaks in January, March and April.

Figure 9 plots the histogram of the percentage of unemployment of seasonal jobs in our sample. We note that some fraction of seasonal workers experience almost no unemployment. For them, transitions between short seasonal spells occur rather quickly. The rest of the distribution peaks at an unemployment share of 20%, or 2.5 months per year. The distribution of unemployment in the data, and especially the fact that we observe most of the variation in unemployment for values between 1 and 4 months implies that it may be difficult to identify the effects of working time constraints of just a few weeks in the empirical estimation.

Table VII. gives summary statistics for wages and unemployment for seasonal and permanent jobs. Workers in seasonal jobs experience on average 70 days of unemployment per year. For permanent workers we also see some unemployment due to switching jobs or losing a job unexpectedly, but here unemployment accounts for only 9 days a year. We also see that on average seasonal jobs pay a gross wage of about 1,900 Euros per month, while permanent jobs average about 1,967 Euros.<sup>18</sup> Thus, seasonal jobs pay about 3.4% less than permanent jobs. This makes it clear that in order to find support for the existence of a

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<sup>18</sup>Wages are measured as gross monthly wages deflated to 1995 Euros.

compensating wage differential it is essential to control for individual and job specific characteristics.

Figure 10 plots the mean wage differentials over time for the different industries. We find the largest negative differentials in agriculture and manufacturing, followed by services and transport. Interestingly, the differential is almost zero in the construction and even positive in the hotel industry. As we saw in table VII., these are exactly the industries where the largest fraction of seasonal employment is concentrated.

### C. The identification strategy

Table VII. has shown that in the data there is considerable variation in starting months between seasonal and permanent jobs, but also within seasonal jobs. Our strategy is to use this variation to predict working time restrictions across all types of jobs. As we have also seen that different industries and regions are affected differently by seasonality, we can expect to increase efficiency by using interactions between starting month and industry or region indicators as additional instruments. The full set of interacted categories results in a large set of excluded exogenous variables ( $7 \text{ industries} * 12 \text{ starting months} + 7 \text{ regions} * 12 \text{ starting months} = 168 \text{ instruments}$ ).

We first use the full set of instruments to predict the exogenous and anticipated variation in unemployment across all types of jobs, without explicitly distinguishing between permanent and seasonal employment spells. To avoid potential problems arising from a model with many instruments (Hansen et al., 2005), we examine some cuts on the number of different categories considered. So, for example, we exclude region and starting month interactions, or aggregate some of the starting months together.

As an alternative approach of dealing with the many instruments, we use a three-step estimation strategy. In the first step we estimate the probability of

being in a seasonal job as compared to a permanent job using year, region, and industry indicators and the full set of instruments: starting month dummies and their interactions with industry and region dummies. This probability is estimated via a probit model which results in a remarkably good fit with a Pseudo R-squared of 0.16. In the second step we estimate equation (6) using the predicted probability of holding a job and its square obtained from step one as instrumental variables  $Z$ . The third step consists of a wage equation (7) which is estimated using actual unemployment and the residual from the second step. The advantage of this procedure is that instead of using the full set of starting months and their interactions with industries and regions, we collapse all the variation into a single continuous variable thus reducing the dimensionality of the instrument set.<sup>19</sup>

We can use the one-dimensional instrument derived from the 3-step procedure in a graphical argument for the validity of our instrumental variables strategy. The top graph in Figure 11 plots the relationship between the predicted probability of being in a seasonal job and the observed share of unemployment for seasonal jobs. It shows a clear positive relationship, indicating that a higher probability of being in a seasonal job - as predicted by the starting month of the job plus the various interactions - is also related to higher unemployment. Next, we plot the average wage in seasonal jobs against the predicted probability of being in a seasonal job in the bottom graph. We can clearly see that a higher probability of being in a seasonal job is related to higher wages. The IV coefficient estimate is related to the ratio of the slopes in both graphs, thus we will expect a positive effect of unemployment on the wage differential in the IV estimation results.

Finally, we consider a specification of the model which takes into account the probability that an individual can find some other employment during the off-season. Using the above three-step estimation procedure, we predict the prob-

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<sup>19</sup>A similar three-step approach is used in Fortin (2006). The main difference is that her model does not consider nonlinearities. We take this aspect into account by correcting the standard errors of our estimates through a bootstrapping procedure.

ability of having an alternative employment spell during the year (apart from the seasonal employment spell) with the full set of instruments. We then include both the predicted probability of having a seasonal job and the predicted probability of having an alternative job in  $Z$  to predict variation in individual unemployment rates in step 2 and analyze its effect on wages in step 3.

## VI. Estimation results

The series estimation procedure with polynomial approximations for the unknown functional forms proposed by Newey et al. (1999) suggests to include exponential terms of increasing order in the model and to determine the optimal polynomial degree. We check the sensitivity of the results to inclusion of higher order terms by plotting the functional form relationship between log wages and unemployment.

Panels A, B, and C in table VII. show the results for specifications that are linear, quadratic, and cubic in unemployment, respectively. Comparing results across the three panels, we find little evidence for a nonlinear relationship between wages and unemployment in seasonal jobs. For illustration, figure 12 plots the functional form relationship between the unemployment and the wage differential for several models. We also experimented with polynomials of higher order than those reported in the table, but plots of the basic functional form relationship show almost no deviation from the linear model. So we will discuss the different model specifications in Panel A, which are all linear in unemployment.

All the models presented include year, region, and industry dummies as additional regressor variables  $X_{ij}$ . Column 1 in table VII. presents the results from a pooled OLS regression. What we find replicates the negative wage differential between seasonal and permanent jobs that we saw in the descriptive statistics in table VII. and figure 10. It turns out to be important to control for

individual specific effects, however. In the fixed effects model in column 2 the differential has vanished. Individual specific differences in the taste for leisure and consumption seem to wipe out the negative differential in the raw data.

The wage differential for seasonal jobs becomes positive once we control for the endogeneity of unemployment. The remaining columns in table VII. present results for different sets of instrumental variables. The control function approach treats the endogeneity like an omitted variable problem. If we consider only starting months dummies we obtain a positive but not significant effect of unemployment on wages. On the other hand, if we consider as instruments also the interaction of industries and starting months dummies we obtain a positive and significant relationship between wages and working time restrictions. In all models that use starting months and industries interactions the coefficient on unemployment is significant and so is the coefficient on the first stage residual.

Applying the three-step estimation procedure, the specifications in models 5 and 6 use the predicted probability to get a seasonal job and the predicted probability of holding an alternative job as a way to collapse the information in the full set of instruments. This appears to be a more efficient strategy which yields even higher coefficient estimates, and relatively lower standard errors.<sup>20</sup>

We have seen in figure 10 that the only industry where the raw wage differential between seasonal and permanent jobs is positive is the hotel industry. One might argue that overtime pay is the driving factor for the positive wage differential in this industry. This would imply that our instrumentation strategy is invalid, because starting months closer to the peak of the tourism season result in higher overtime. If this is the case the starting month has a direct impact on the wage and not only via the compensation for unemployment.

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<sup>20</sup>As a further check we estimated the linear IV specifications using a LIML estimator. In the presence of weak instruments instrumental variable estimates are biased towards OLS, while LIML is median unbiased. We find that the LIML estimates are generally very close to the IV results and this suggests that weak instruments may not represent a major problem in our case. Results are available on request.

As a robustness check, we estimate all models for the sample excluding the hotel industry. The results are shown in table VII. Because of the reduced sample we get slightly smaller coefficients for all models, but the main picture is unchanged. Hence, we feel confident to rule out overtime pay as the reason for a positive wage differential in seasonal jobs.

Given these results, it is important to ask how our empirical evidence relates to the theoretical model in section III. Abowd and Ashenfelter (1981) approximate the relationship between the wage differential and the working time restriction by a quadratic function, which allows to separately identify the replacement ratio in the UI system  $\gamma$  and the compensated labor supply elasticity  $e$ , (as well as the coefficient of relative risk aversion  $r$ ). Our empirical results clearly favor a linear relationship between log wages and unemployment.

We can think of the following explanations. First, we have observed that the distribution of unemployment in the data is concentrated between 1 and 4 months, i.e. between 8% and 33% of the year, which makes it difficult to identify effects of low unemployment rates on the wage differential. This is because under realistic assumptions about the structural parameters ( $e = 0.15$  and  $\gamma = 0.55$ ) the compensating wage differential would reach its negative minimum when unemployment is about 5%, and we have relatively few observations in that range so that it might be impossible in our data to distinguish a quadratic from a linear functional form.

A second argument, which we already briefly mentioned, is that the Abowd and Ashenfelter (1981) model abstracts from fixed costs of becoming unemployed. Introducing fixed costs into the model would make the function almost linear at low values of unemployment. The third point is that our data do not provide a convincing measure for the variance in the working time constraint. Therefore we did not explicitly control for uncertainty in the working time restriction, like the Abowd and Ashenfelter (1981) model does. This could have induced

an omitted variable bias in our estimation.

To get an estimate of the compensating labor supply elasticity implied by our model, we can compare the slopes of equation (3) and of one of our linear model estimates at the mean value of unemployment for seasonal jobs. Suppose we consider model 5 as our reference model and take  $\beta = 0.56$ , then we can derive the value of  $e$  from the identity  $\beta = -\gamma + \frac{1}{2e}\bar{u}$ , where  $\bar{u}$  is the average unemployment rate for seasonal jobs (about 20%), and  $\gamma$  is set to 0.55. This calculation implies that the compensated labor supply elasticity is about 0.18, which is comparable to conventional estimates. Also, we see that the average compensating differential paid by the employer is about 11% ( $0.56 \cdot 0.20$ ), and an approximately equal amount is covered by the Austrian UI system ( $\gamma = 0.55$ ). In other words, the employer's compensation would have to be twice as high in the absence of UI benefits.

## VII. Conclusions

In this paper we examine the existence of compensating wage differentials due to employer-determined working time restrictions which arise in the context of seasonal employment fluctuations in Austria. The specification of the model is based on the theoretical construct elaborated in Abowd and Ashenfelter (1981), which links the compensating wage differential to variation in individual unemployment through the effect of the unemployment insurance system and the compensated labor supply elasticity.

Previous attempts to quantify the effect of anticipated working time restrictions on wages rely on a worker's industry affiliation or his self-reported contract (Moretti, 2000; Murphy and Topel, 1987), and are often based on cross-sectional data (Assaad and Tunalı, 2002; Hamermesh and Wolfe, 1990; Li, 1986; Topel, 1984). This makes it difficult to distinguish industry and individual effects from the true effect of the working time constraints.

In contrast with the previous literature, we derive a flexible definition of working time constraints which does not rely on industry or individual-specific characteristics. In order to do so we use the longitudinal information collected by the Austrian social security records and exploit the pattern of employment and unemployment spells observed for the same individual over time.

Since the Austrian labor market is characterized by significant seasonal variation in employment, our data provides a natural way to define anticipated working time restrictions. Specifically, we consider regular patterns of short employment spells as a seasonal job, i.e. a job subject to working time constraints, and compare wage rates between seasonal and permanent jobs as well as within different seasonal jobs in order to identify the effect of working time restrictions on the compensating differential. Our measure for working time restrictions is based on the yearly rate of unemployment observed over seasonal and permanent jobs. Since seasonal jobs are not identified by industries, or individuals, or by specific periods of the year, we can exploit a large amount of variation in the data and try to disentangle the effect of restrictions on working time from other observed and unobservable characteristics of the job or the individual.

The raw sample means show that seasonal jobs pay on average 3.4% lower wages than permanent jobs, and a pooled regression of wages onto worker and job characteristics reveals a significant and negative effect of individual yearly unemployment rates. Controlling for individual fixed effects immediately wipes out this negative differential, however. Since individual unobservables are unlikely to account for all the potential problems of endogeneity of unemployment rates with respect to wages, we also implement an IV strategy. Using variation in the starting month of the job as our instrument we predict the anticipated and exogenous variation in the working time constraint and analyze its effect on the compensating wage differential. Here the results show a positive and significant effect of unemployment on wages of about half a percentage point

for each percentage point of unemployment.

These results are important in that they highlight the value of longitudinal information in this context as well as the value of adopting a very flexible definition of working time restrictions. Our empirical strategy is also successful in identifying the presence of a positive compensating wage differential due to anticipated working time restrictions, so that our results are broadly in line with the main theoretical prediction in Abowd and Ashenfelter (1981).

This analysis leads to important policy recommendations. In particular, the implied observed wage differential for seasonal jobs amounts to about 11% of the wage in a permanent job calculated at the average rate of unemployment in seasonal jobs. Implicitly the model indicates that unemployment insurance covers about the same amount. This means that employers (and workers) who operate on the basis of seasonal contracts receive an indirect subsidy to face anticipated rather than unanticipated employment fluctuations. A straightforward consequence of this system of incentives would seem to be an inefficient allocation of labor and would justify the introduction of experience rating provisions.

## Appendix

This section contains the derivations of the results for the theoretical model in section III. This mostly follows the theoretical appendix in Abowd and Ashenfelter (1984).

Consider an economy characterized by two types of jobs. In the unconstrained job the worker chooses the optimal amount of hours given the prevailing wage rate. In the constrained job, the worker is offered a fixed wage and a fixed number of working hours. In the first case the optimal labor supply  $h^0(w, p, y)$  and commodity demand  $x^0(w, p, y)$  depend on the wage rate  $w$ , prices  $p$ , and non

labor income  $y$ . The indirect or maximum utility achieved is given by  $V(w, p, y)$ . In the constrained job, the worker faces a working time constraint given by  $\bar{h} < h^0$ . In this case the worker supplies  $\bar{h}$  time units and demands commodities  $x^*(\bar{h}, p, w\bar{h} + y)$ . The associated indirect utility is given by  $V^*(\bar{h}, p, w\bar{h} + y)$ . This level of utility will in general be lower than  $V(w, p, y)$ .

To make the worker indifferent between both types of jobs the wage in the constrained job has to be adjusted to satisfy the equilibrium condition:

$$V^*(\bar{h}, p, w^*\bar{h} + y) = V(w, p, y), \quad (8)$$

which implicitly defines the compensating wage differential  $\frac{w^* - w}{w}$ .

To derive an approximation for the wage differential we have to make some assumptions about the workers' utility function. Assume that  $U(x, T - h)$  is a strictly quasi-concave, 2 times continuously differentiable utility function, and that  $T$  is the maximum amount of time available. Further, consider a linear budget constraint  $px = wh + y$  and define the minimum expenditure function as:

$$R(w, p, u^0) = \min_{x, h} px - wh \text{ such that } U(x, T - h) \geq u^0, 0 < h < T. \quad (9)$$

The minimum expenditure function determines the non labor income needed to achieve the utility level  $u^0$  given  $w$  and  $p$ .

In the constrained job, where  $\bar{h}$  is fixed, the worker faces a similar minimization problem:

$$R^*(\bar{h}, p, u^0) = \min_x px \text{ such that } U(x, T - \bar{h}) \geq u^0. \quad (10)$$

We can rewrite this as:

$$R^*(\bar{h}, p, u^0) - w^*\bar{h} = \min_x px - w^*\bar{h} \text{ such that } U(x, T - \bar{h}) \geq u^0, \quad (11)$$

and formulate the equilibrium condition as:

$$R^*(\bar{h}, p, u^0) - w^*\bar{h} = R(w, p, u^0). \quad (12)$$

The intuition is to hold the budget constraint fixed at the level  $y$  of non-labor income and to increase its slope, until the budget line intersects with the indifference curve level  $u^0$  at the value  $T - \bar{h}$ , as we can see in figure 13.

We also consider some auxiliary results. By the envelope theorem we know that  $R_1(w, p, u^0) = -h^0(w, p, y)$ . Evaluating equation (12) at  $\bar{h} = h^0(w, p, y)$  gives the following identity in  $w$ :

$$R^*(h^0(w, p, y), p, u^0) - wh^0(w, p, y) = R(w, p, u^0) \quad (13)$$

Differentiating this expression with respect to  $w$ , we have:

$$\begin{aligned} R_1^* \frac{\partial h^0}{\partial w} - h^0 - w \frac{\partial h^0}{\partial w} &= \frac{\partial R}{\partial w}, \\ R_1^* \frac{\partial h^0}{\partial w} &= w \frac{\partial h^0}{\partial w}, \\ R_1^*(h^0(w, p, y), p, u^0) &= w, \end{aligned} \quad (14)$$

and:

$$\begin{aligned} R_{11}^* \frac{\partial h^0}{\partial w} &= 1, \\ R_{11}^* &= \frac{1}{\frac{\partial h^0}{\partial w}}. \end{aligned} \quad (15)$$

We can use these results in a second order Taylor expansion of  $R^*(\bar{h}, p, u^0)$  around  $h^0$ :

$$\begin{aligned} R^*(\bar{h}, p, u^0) &\sim R^*(h^0(w, p, y), p, u^0) + (\bar{h} - h^0)R_1^*(h^0(w, p, y), p, u^0) + \\ &\quad \frac{1}{2}(\bar{h} - h^0)^2 R_{11}^*(h^0(w, p, y), p, u^0) \\ &= R(w, p, u^0) + wh^0 + (\bar{h} - h^0)w + \frac{1}{2}(\bar{h} - h^0)^2 \frac{1}{\frac{\partial h^0}{\partial w}}. \end{aligned} \quad (16)$$

This gives us:

$$R^*(\bar{h}, p, u^0) - w^*\bar{h} \sim R(w, p, u^0) - \bar{h}(w^* - w) + \frac{1}{2}(\bar{h} - h^0)^2 \frac{1}{\frac{\partial h^0}{\partial w}}. \quad (17)$$

Using the equilibrium condition (12) we can rewrite (17) to get an expression for the wage differential:

$$\begin{aligned} \bar{h}(w^* - w) &\sim \frac{1}{2}(h^0 - \bar{h})^2 \left( \frac{1}{\frac{\partial h^0}{\partial w}} \frac{1}{h^0} \right) \frac{w}{h^0}, \\ \frac{w^* - w}{w} &\sim \frac{1}{2} \frac{(h^0 - \bar{h})^2}{\bar{h}h^0} \frac{1}{e}. \end{aligned} \quad (18)$$

Equation (18) shows that the compensating wage differential is proportional to the squared expected time out of work, as defined by  $(h^0 - \bar{h})/h^0$ . The factor of proportionality is given by half the inverse of the compensated labor supply elasticity,  $e$ . Therefore, the more inelastic the labor supply, the greater the compensating wage differential for any given level of anticipated unemployment.

Next, assume that the worker gets refunded for part of the working time restriction through the UI system, which pays benefits proportional to time out of work  $\gamma w^*(h^0 - \bar{h})$ . In this case the equilibrium condition in equation (11) is given by:

$$R^*(\bar{h}, p, u^0) - w^*\bar{h} - \gamma w^*(h^0 - \bar{h}) = R(w, p, u^0). \quad (19)$$

Using the same Taylor series approximation as before, we get:

$$\begin{aligned} \bar{h}(w^* - w) &\sim \frac{1}{2} \frac{(h^0 - \bar{h})^2}{h^0} \frac{w}{e} - \gamma w^*(h^0 - \bar{h}), \\ \frac{w^* - w}{w} &\sim \frac{1}{2} \frac{(h^0 - \bar{h})^2}{\bar{h}h^0} \frac{1}{e} - \gamma \frac{w^*}{w} \frac{h^0 - \bar{h}}{\bar{h}}, \\ \frac{w^* - w}{w} &\sim \frac{1}{2e} \frac{(h^0 - \bar{h})^2}{\bar{h}[h + \gamma(h^0 - \bar{h})]} - \gamma \frac{h^0 - \bar{h}}{\bar{h} + \gamma(h^0 - \bar{h})}. \end{aligned} \quad (20)$$

Assuming that  $h^0 = \bar{h} + \gamma(h^0 - \bar{h})$ , we get:

$$\frac{w^* - w}{w} \sim \frac{1}{2e} \left( \frac{h^0 - \bar{h}}{h^0} \right)^2 - \gamma \frac{h^0 - \bar{h}}{h^0}. \quad (21)$$

Equation (21) shows that, because of the UI system, the second part of the compensating wage differential falls in proportion to the time spent out of work with the factor of proportionality given by the UI replacement rate. Moreover, we see that the function describing the compensating wage differential is quadratic in expected unemployment.

This model can be extended in order to consider uncertainty. In this case we simply assume the working time constraint  $\tilde{h}$  to be a random variable with mean  $E(\tilde{h}) = \bar{h}$  and variance  $Var(\tilde{h}) = \sigma^2$ . Let's call this parameter vector  $\theta = (\bar{h}, \sigma^2)$ . The indirect utility function will be given by the expected value over the distribution of  $\tilde{h}$ :

$$V^{**}(w^{**}, p, y; \theta) = E(V^*(\tilde{h}, p, w^{**}\tilde{h} + y); \theta). \quad (22)$$

The equilibrium condition now ensures that the indirect utility in a job with a working time constraint and risk is equal to the indirect utility in a job with working time constraint and no risk:

$$V^{**}(w^{**}, p, y; \theta) = V^*(\bar{h}, p, w^*\bar{h} + y) \quad (23)$$

We can get an approximation of the compensating wage differential due to uncertainty,  $\frac{w^{**} - w^*}{w^*}$ , implicitly defined in (23) by expanding the left hand side of the new equilibrium condition according to a Taylor series of order one around  $w^*$ :

$$\begin{aligned} V^*(\bar{h}, p, w^*\bar{h} + y) &\sim V^*(\bar{h}, p, w^{**}\bar{h} + y) + \\ &\quad (w^{**} - w^*)\bar{h}V_3^*(\bar{h}, p, w^{**}\bar{h} + y) \\ &= V^*(\bar{h}, p, w^{**}\bar{h} + y) + \\ &\quad (w^{**} - w^*)\bar{h}U_1(\bar{h}w^{**} + y, T - \bar{h}), \end{aligned} \quad (24)$$

where  $U_1$  is the marginal utility of income. Then we expand the right hand side of (23) into a Taylor series of order two around  $\bar{h}$ :

$$V^{**}(w^{**}, p, y; \theta) \sim V^*(\bar{h}, p, w^{**}\bar{h} + y) + \frac{1}{2}\sigma^2(w^{**2}U_{11} - 2w^{**}U_{12} + U_{22}) \quad (25)$$

Finally, we plug both expansions into equation (23) and get:

$$\frac{w^{**} - w^*}{w^*} \sim \frac{1}{2}r \frac{\sigma^2}{\bar{h}^2}, \quad (26)$$

where  $r$  is the coefficient of relative risk aversion, defined as follows:

$$r = -\frac{\bar{h}(w^{**2}U_{11} - 2w^{**}U_{12} + U_{22})}{w^*U_1}. \quad (27)$$

Therefore, the overall compensating differential can be expressed as:

$$\frac{w^{**} - w}{w} \sim -\gamma \frac{h^0 - \bar{h}}{h^0} + \frac{1}{2e} \left( \frac{h^0 - \bar{h}}{h^0} \right)^2 + \frac{1}{2}r \frac{\sigma^2}{\bar{h}^2}. \quad (28)$$

## References

- Abowd, John M., and Orley Ashenfelter, 1981. Anticipated Unemployment, Temporary Layoffs and Compensating Wage Differentials. In *Studies in Labor Markets*, edited by Sherwin Rosen, Chicago: University of Chicago Press, 141–170.
- , 1984. Compensating Wage and earnings Differentials for employer determined working hours. Working paper 228, Industrial Relation Section Princeton University .
- Assaad, Ragui, and Insan Tunali, 2002. Wage Formation and Recurrent Unemployment. *Labour Economics* 9: 17–61.
- Blundell, Richard, and James L. Powell, 2003. Endogeneity in Nonparametric and Semiparametric Regression Models. In *Advances in Economics and Econometrics*, edited by M Dewatripont, Lars Hansen, and S. J. Turnovsky, Cambridge University Press, 312–357.

- Brandel, Franz, Helmut Hofer, and Karl Pichelmann, 1994. Saisonale Muster von Beschäftigung und Arbeitslosigkeit in Österreich, Materialien zu Wirtschaft und Gesellschaft. Kammer für Arbeiter und Angestellte n. 54.
- Fischer, Georg, and Karl Pichelmann, 1991. Temporary layoff unemployment in Austria: Empirical evidence from administrative data. *Applied Economics* 23: 1447–1452.
- Fortin, Nicole, 2006. Higher Education Policies and the College Wage Premium: Cross-State Evidence from the 1990s. *American Economic Review* 96: 959–987.
- Garen, John, 1988. Compensating Wage Differentials and the Endogeneity of Job Riskiness. *The Review of Economics and Statistics* 70: 9–16.
- Hamermesh, Daniel S., and John R. Wolfe, 1990. Compensating wage differentials and the duration of wage loss. *Journal of Labor Economics* 8: 175–197.
- Hansen, Christian, Jerry Hausman, and Whitney Newey, 2005. Estimation with many Instrumental Variables. *M.I.T.*
- Hofer, Helmut, Karl Pichelmann, and Andreas Schuh, 2001. Price and quantity adjustments in the Austrian labour market. *Applied Economics* 33: 581–592.
- Lalive, Rafael, 2003. Did we Overestimate the Value of Health? . *Journal of Risk and Uncertainty* 27: 171–193.
- Li, Elizabeth H., 1986. Compensating Differentials for Cyclical and Noncyclical Unemployment: The Interaction between Investors' and Employees' Risk Aversion. *Journal of Labor Economics* 4: 277–300.
- Lillard, Lee A., 1981. Wage Expectations in Labor Supply and the Time-Series and Cross-Section Effects of State Unemployment. *Rand Corporation report n. R-2844* .

- Moretti, Enrico, 2000. Do wages compensate for risk of unemployment? Parametric and Semiparametric evidence from seasonal jobs. *Journal of Risk and Uncertainty* 20: 45–66.
- Murphy, Kevin, and Robert Topel, 1987. Unemployment risk and earnings: Testing for equalizing wage differentials in the labor market. In *Unemployment and the structure of labor markets*, edited by K Lang, and J Leonard, New York: Blackwell.
- Newey, Whitney K., James L. Powell, and Francis Vella, 1999. Nonparametric estimation of triangular simultaneous equations models. *Econometrica* 67: 565–603.
- OECD, 2003. OECD Economic Surveys Austria 2003. Paris.
- de Raaf, Shawn, Costa Kapsalis, and Carole Vincent, 2003. Seasonal employment and reliance on employment insurance: Evidence from the SLID. *SDRC Working Paper Series* .
- Reza, Ali M., 1975. Geographic Differences in Earnings and Unemployment Rates. *The Review of Economics and Statistics* 201–208.
- Rosen, Sherwin, 1974. Hedonic prices and implicit markets: Product differentiation in pure competition. *Journal of Political Economy* 82: 34–55.
- , 1986. The theory of equalizing differentials. In *Handbook of Labor Economics*, edited by Orley C. Ashenfelter, and Richard Layard, Amsterdam: North Holland, 641–690.
- Smith, Adam, 1776, *The Wealth of Nations*. Chicago: Random House, Inc.
- Stiglbauer, Alfred, Florian Stahl, Rudolf Winter-Ebmer, and Josef Zweimüller, 2003. Job Creation and Job Destruction in a Regulated Labor Market: The Case of Austria. *Empirica* 30: 127 – 148.

- Thaler, Richard, and Sherwin Rosen, 1975. The value of saving a life: Evidence from the labor market. In *Household production and consumption*, edited by Nestor Terleckyj, New York: National Bureau of Economic Research.
- Topel, Robert H., 1984. Equilibrium earnings, turnover, and unemployment: New evidence. *Journal of Labor Economics* 2: 500–522.
- Viscusi, W. Kip, 1979, *Employment Hazards: An Investigation of Market Performance*. Cambridge, Mass.: Harvard University Press.

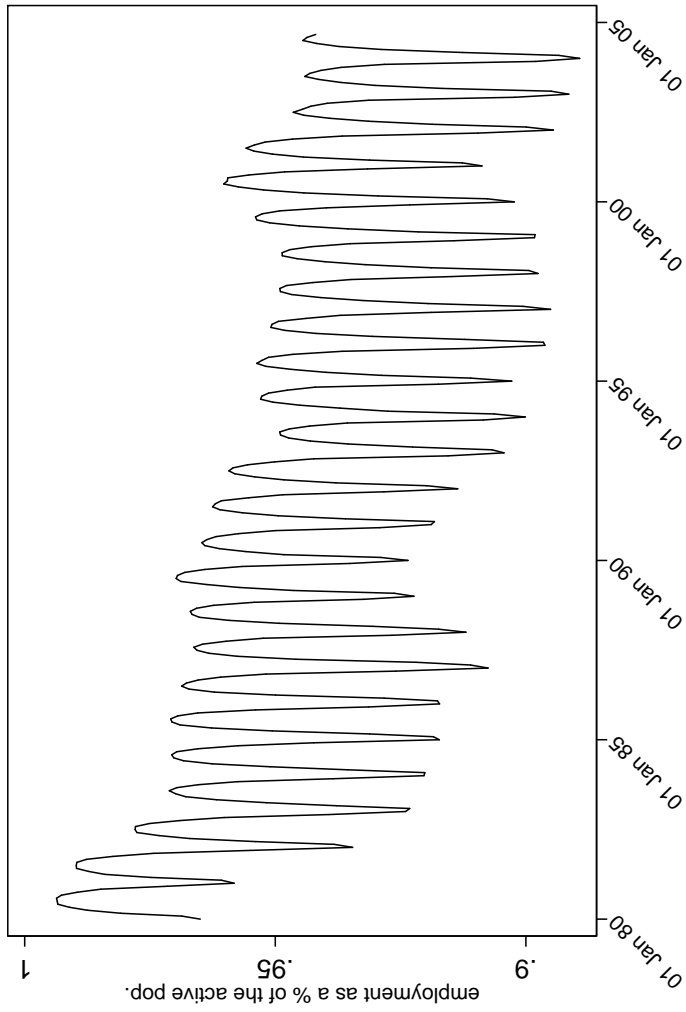


Figure 1: Total monthly employment over active population in Austria

SOURCE.— Statistics Austria.

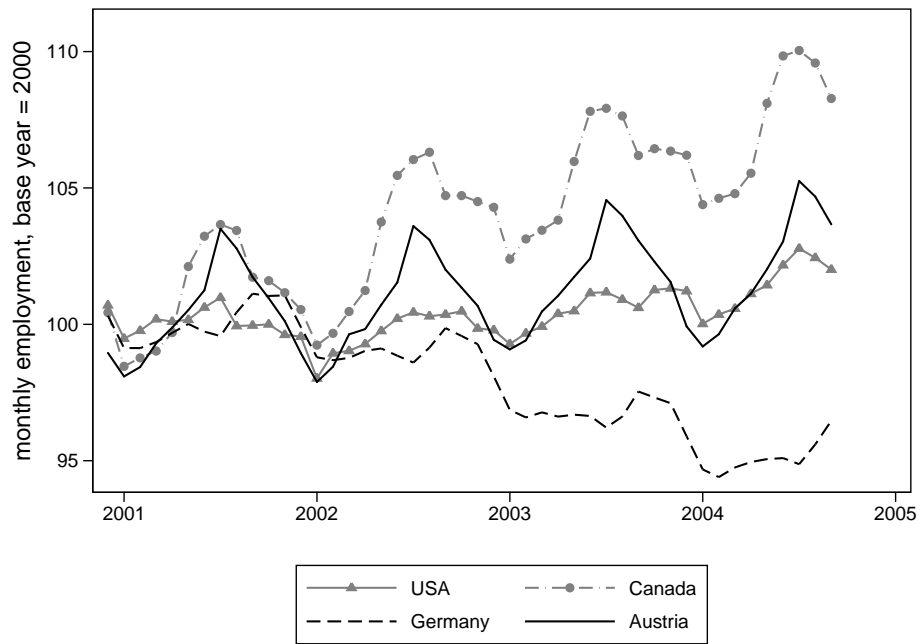


Figure 2: Seasonal variation in total monthly employment by country  
 NOTE.— Total monthly employment normalized at 2000. Series for Austria and Germany exclude self-employed. SOURCE.— OECD Main Economic Indicators, Statistics Austria, Statistics Germany.

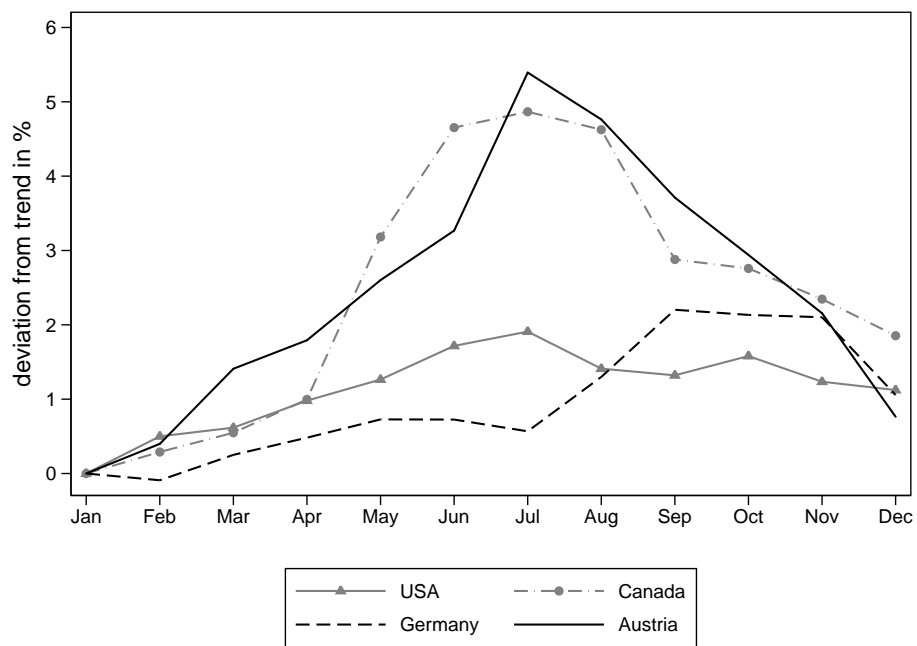


Figure 3: Amplitude of seasonal variation in total monthly employment by country

NOTE.— Average deviation of total monthly employment from one-year moving average. Series for Austria and Germany exclude self-employed. SOURCE.— OECD Main Economic Indicators, Statistics Austria, Statistics Germany.

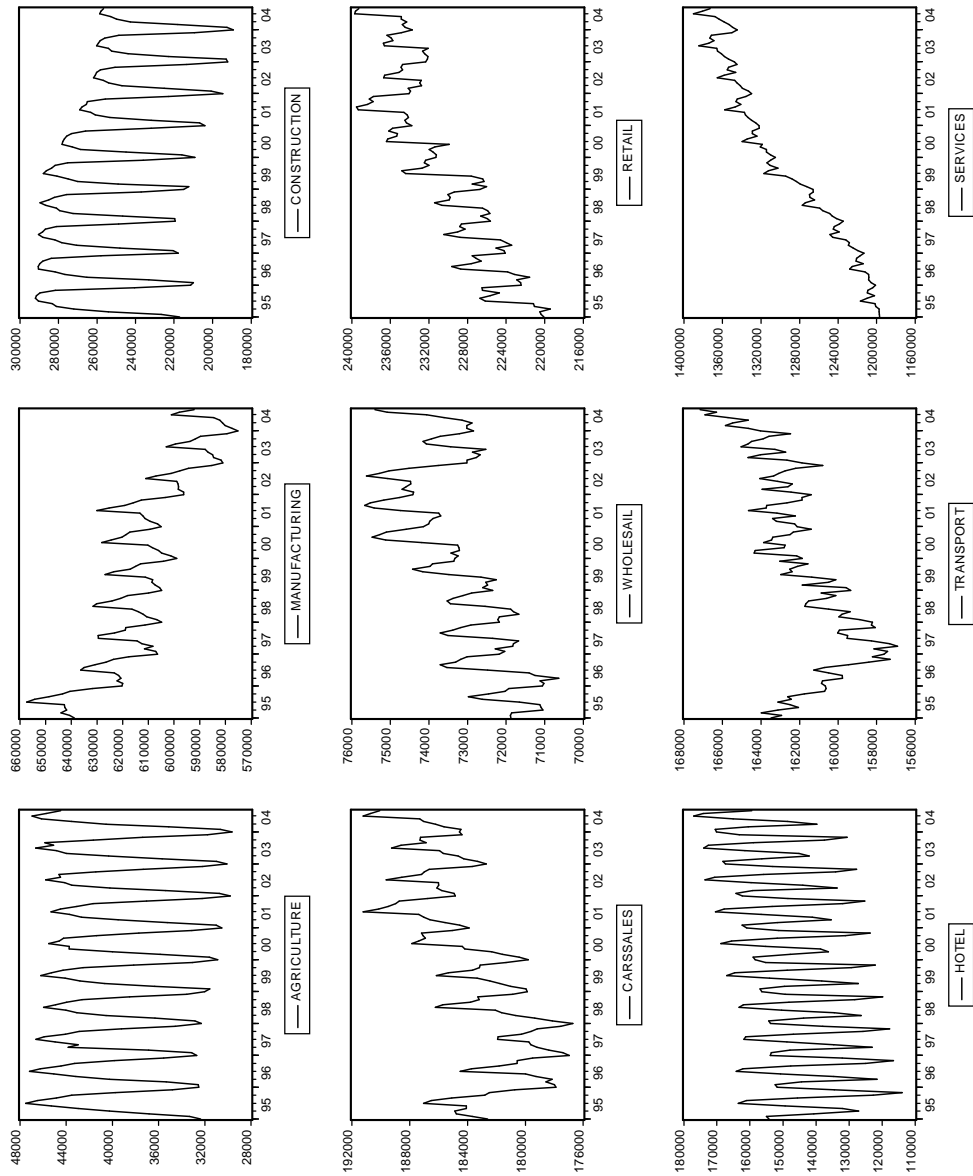


Figure 4: Total monthly employment in Austria by industry  
 SOURCE.— Statistics Austria.

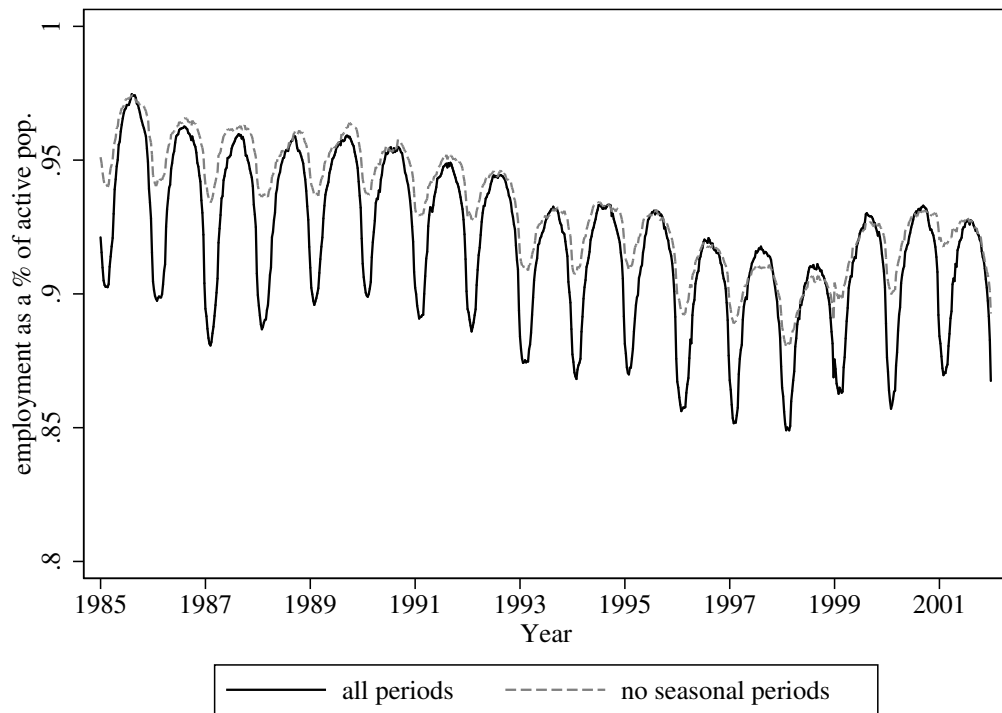


Figure 5: Proportion of male employment over active population by week of the year taking into account seasonal employment

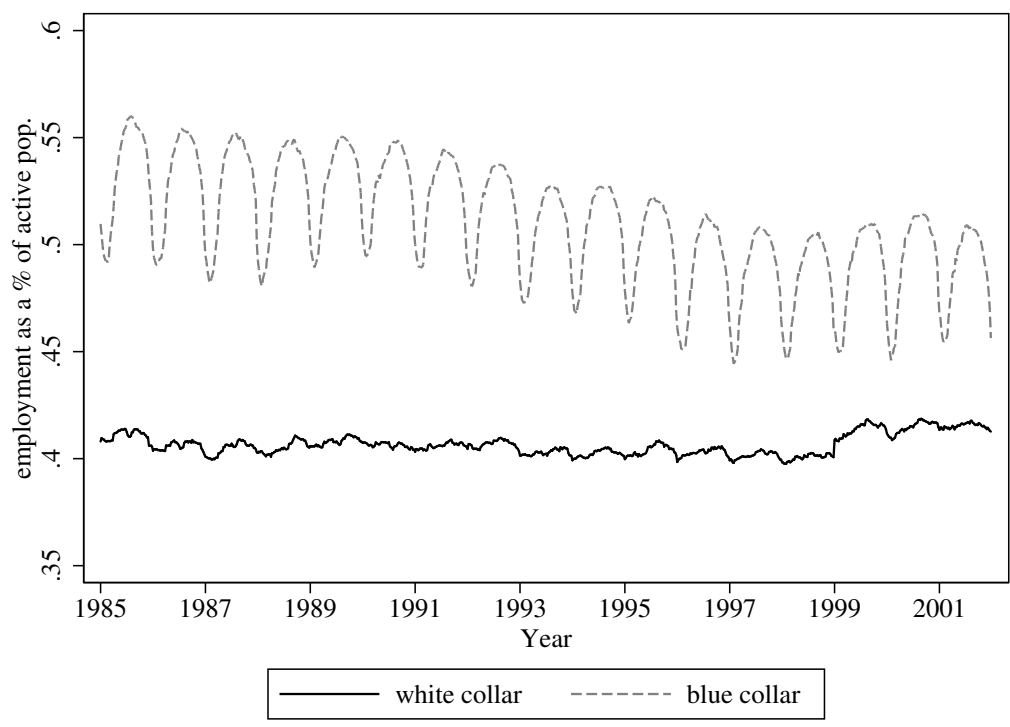


Figure 6: Proportion of male employment over active male population by week of the year and by occupational qualification

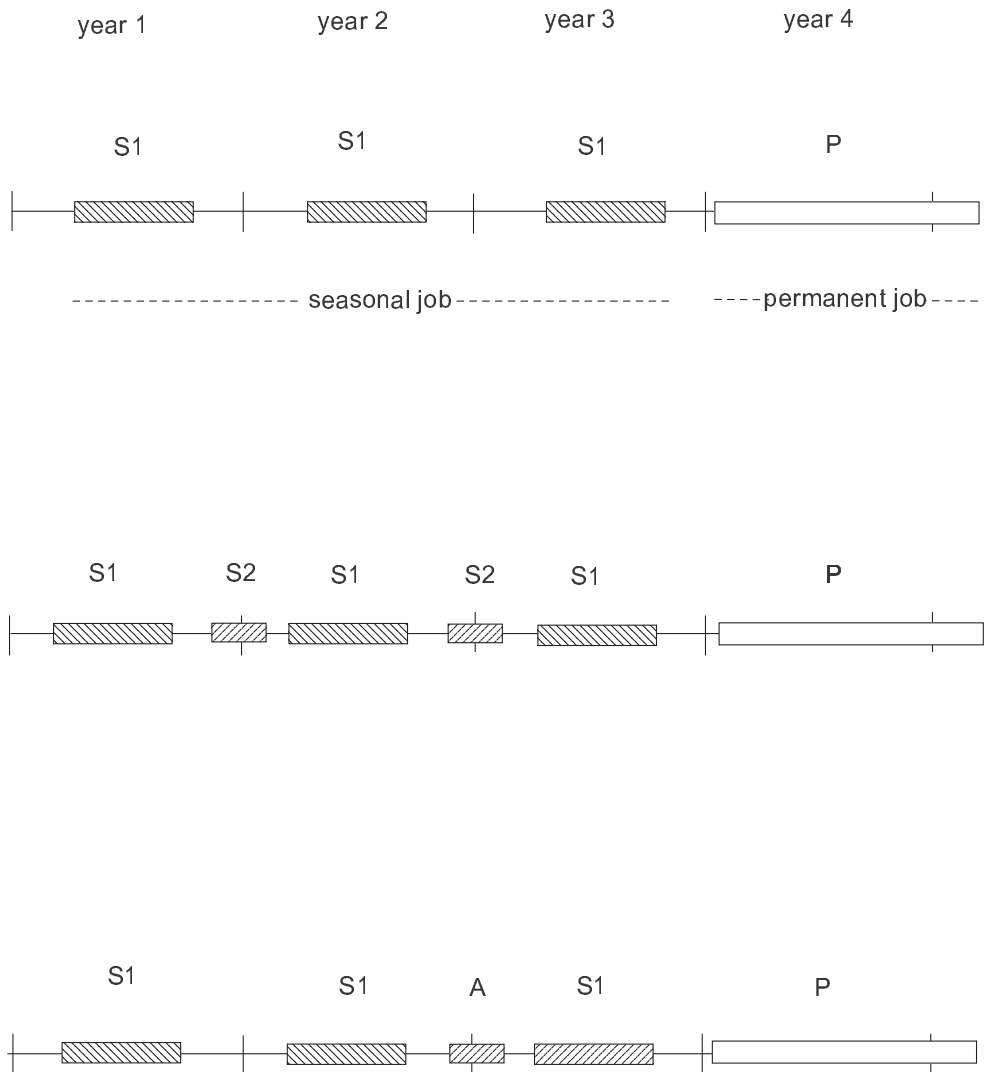


Figure 7: Definition of seasonal and permanent employment periods

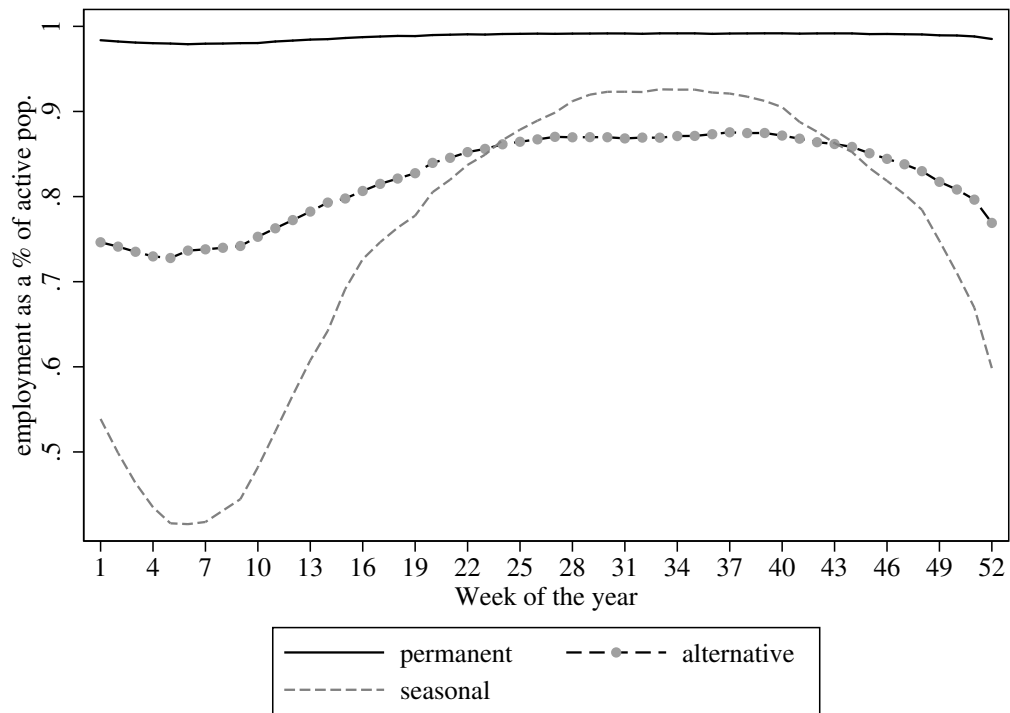


Figure 8: Proportion of male employment over active population by week of the year and by type of job

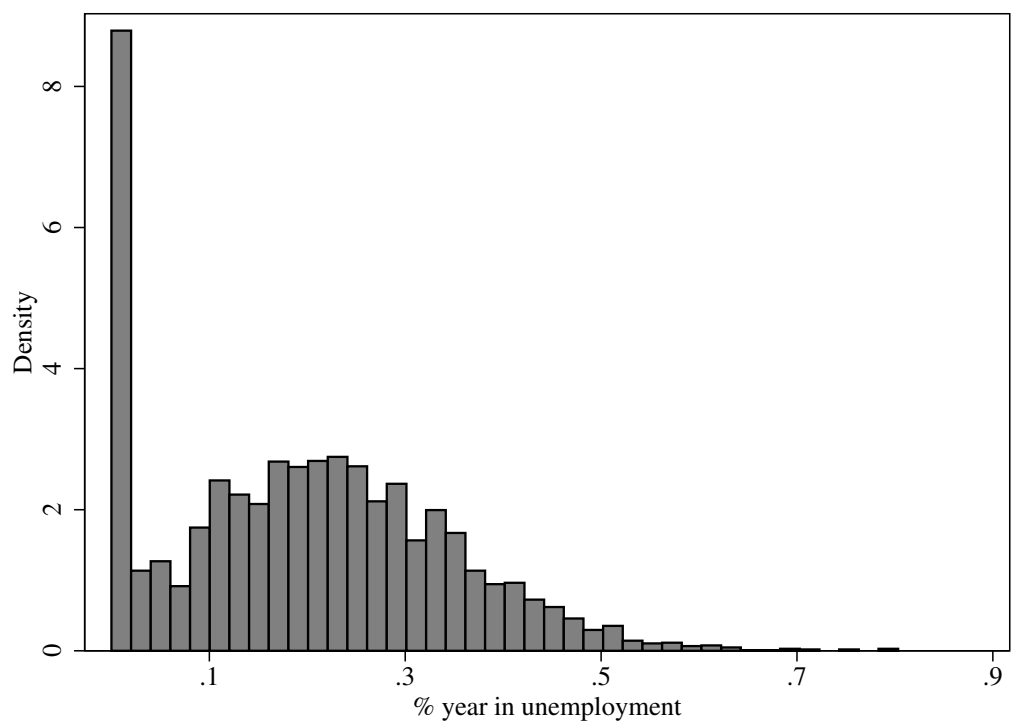
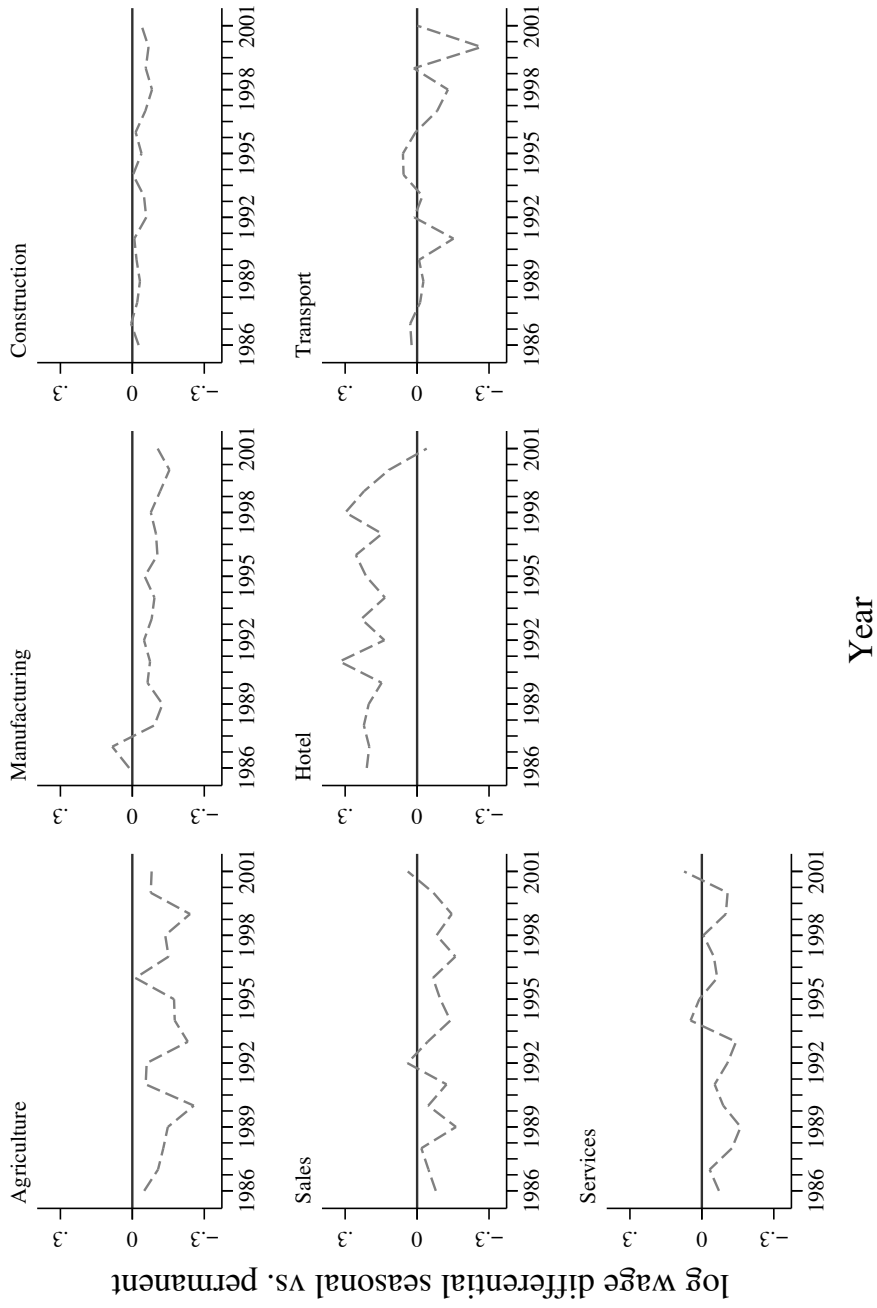


Figure 9: Distribution of unemployment for seasonal jobs



Graphs by industry aggregate

Figure 10: Average wage differentials by industry and year

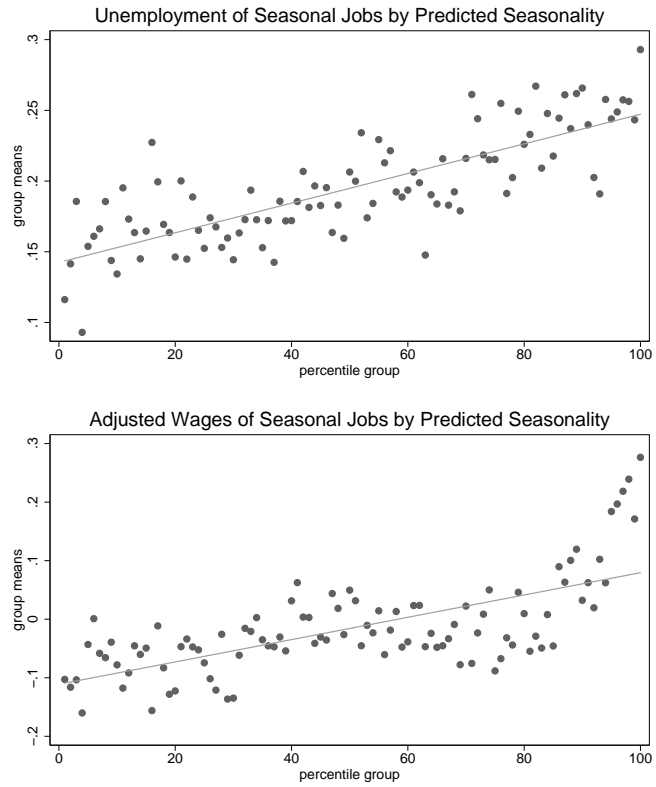


Figure 11: Graphical IV

NOTE.— The top graph plots mean unemployment rates for seasonal jobs (y-axis) on group percentiles obtained from the predicted probability of holding a seasonal job (x-axis). The bottom graphs plots mean wages for seasonal jobs (y-axis) on group percentiles obtained from the predicted probability of holding a seasonal job (x-axis).

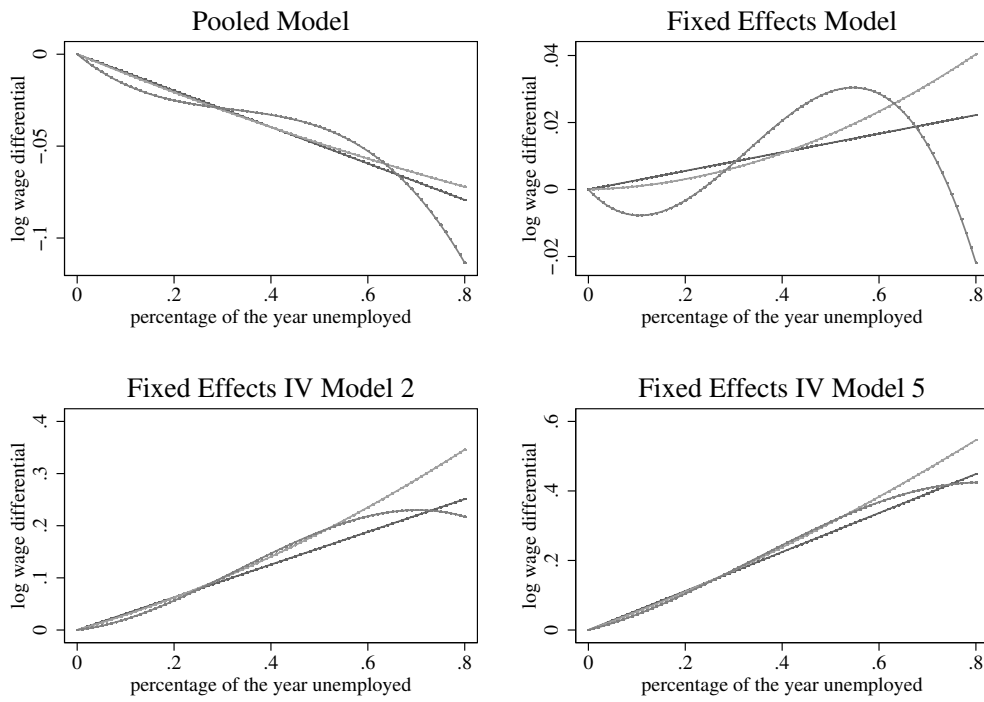


Figure 12: Results: functional form of the wage differential in unemployment  
 NOTE.— Each graph shows the implied functional form relationship between the wage differential and unemployment in a linear, quadratic, and cubic specification. Parameters correspond to estimates presented in table 4.

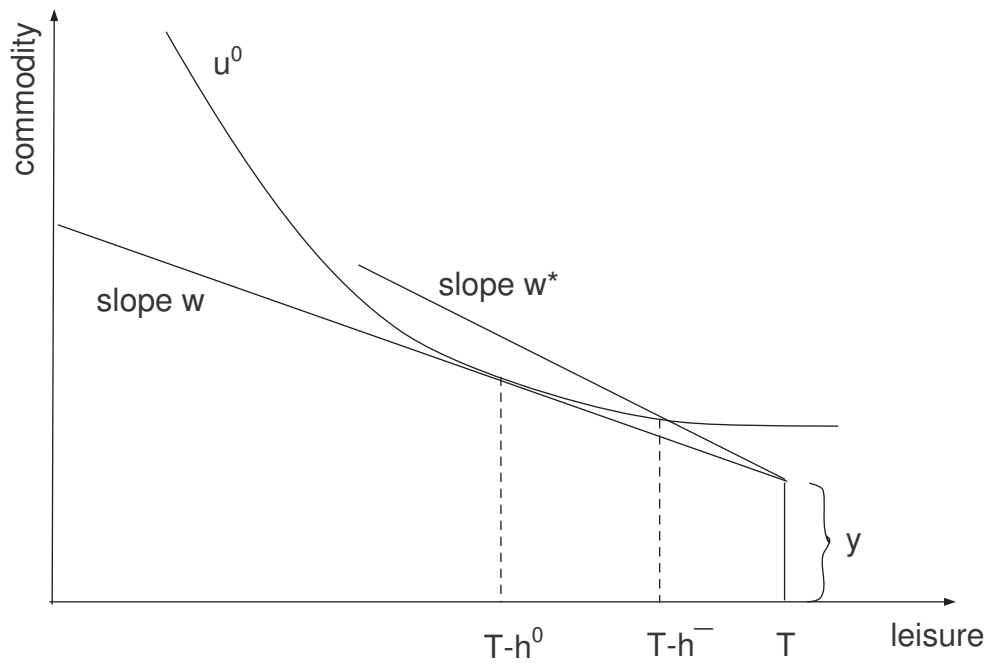


Figure 13: Construction of the compensating wage differential

**Table 1: Individuals and experience of seasonal employment**

	%	N
Total number of jobs	100.00	24,516
Permanent jobs	78.72	19,299
Seasonal jobs	21.28	5,217
Seasonal jobs:		
with recall to previous employer	64.27	3,353
with two seasonal jobs during the year	12.82	669
with an alternative job spell during the year	37.61	1,962
Total number of seasonal jobs	100.00	5,217
Total number of individuals	100.00	7,908
Average number of jobs held		3.10
Holding at least one permanent job	96.37	7,621
Holding at least one seasonal job	41.49	3,281
No transitions between permanent and seasonal jobs	62.14	4,914
Of which:		
always in a seasonal job	3.63	287
always in a permanent job	58.51	4,627
At least one transition between permanent and seasonal jobs	37.86	2,994
Of which:		
first transition from a permanent to a seasonal job	17.55	1,388
first transition from a seasonal to a permanent job	20.31	1,606

NOTE.— Male, blue collar, Austrian workers holding at least two jobs over the period 1986-2001, age 16-60.

**Table 2: Descriptive analysis of jobs per industry, region, and starting month**

	Seasonal		Permanent		Total	
	%	N	%	N	%	N
<b>Industry</b>						
Agriculture	3.93	205	2.72	525	2.98	730
Manufacturing	12.27	640	32.78	6,327	28.42	6,967
Constructions	42.00	2,191	26.21	5,058	29.57	7,249
Sales	6.73	351	13.70	2,643	12.21	2,994
Hotel	16.75	874	5.79	1,117	8.12	1,991
Transport	9.55	498	8.66	1,672	8.85	2,170
Services	8.78	458	10.14	1,957	9.85	2,415
<b>Region</b>						
Vienna	11.31	590	17.66	3,408	16.31	3,998
Lower Austria	15.41	804	19.18	3,702	18.38	4,506
Burgenland	3.57	186	2.35	453	2.61	639
Upper Austria	11.73	612	19.49	3,762	17.84	4,374
Styria	17.14	894	17.20	3,320	17.19	4,214
Carinthia	10.50	548	6.47	1,248	7.33	1,796
Salzburg	9.74	508	6.54	1,263	7.22	1,771
Tirol	16.89	881	8.24	1,590	10.08	2,471
Vorarlberg	3.72	194	2.87	553	3.05	747
<b>Starting Month</b>						
January	3.87	202	11.38	2196	9.78	2,398
February	7.72	403	9.25	1786	8.93	2,189
March	21.20	1,106	13.48	2,601	15.12	3,707
April	20.38	1,063	10.86	2,096	12.89	3,159
May	10.41	543	7.36	1,420	8.01	1,963
June	8.01	418	7.30	1,408	7.45	1,826
July	5.06	264	8.27	1,596	7.59	1,860
August	3.20	167	6.51	1,256	5.80	1,423
September	3.93	205	7.55	1,457	6.78	1,662
October	3.34	174	7.74	1,493	6.80	1,667
November	2.49	130	5.25	1,014	4.67	1,144
December	10.39	542	5.06	976	6.19	1,518
Number of Jobs	100	5,217	100	19,299	100	24,516

NOTE.— Male, blue collar, Austrian workers holding at least two jobs over the period 1986-2001, age 16-60.

**Table 3: Descriptive analysis of wages and unemployment**

	<u>Seasonal jobs</u>		<u>Permanent jobs</u>		<u>Total</u>	
	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
Log monthly wage	9.8096	.3038	9.8422	.3113	9.8353	.3100
% of top coded wage observations	.0035	.0586	.0040	.0634	.0039	.0624
% days in unemployment over the year	.1954	.1418	.0247	.0822	.0610	.1203
Number of jobs	5,217		19,299		24,516	

NOTE.— Male, blue collar, Austrian workers holding at least two jobs over the period 1986-2001, age 16-60. Statistics shown refer to second-year wage and unemployment.

**Table 4: Main Estimation Results - Full Sample**

	<u>Fixed Effects with Control Function</u>							
	Pooled	Fixed Effects	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Panel A: linear specification								
% year unemployed	-.097** (.019)	.027 (.015)	.188 (.109)	.314** (.088)	.336** (.114)	.337** (.093)	.561** (.138)	.539** (.132)
First stage residual			-.164 (.142)	-.295** (.111)	-.317** (.116)	-.322** (.095)	-.545** (.140)	-.523** (.134)
Panel B: quadratic specification								
% year unemployed	-.098* (.045)	.006 (.035)	.151 (.147)	.271* (.116)	.293* (.121)	.291** (.102)	.506** (.141)	.486** (.136)
% year unemployed <sup>2</sup>	.004 (.104)	.051 (.077)	.204 (.132)	.202 (.131)	.206 (.131)	.207 (.131)	.221 (.132)	.219 (.132)
First stage residual			-.176 (.142)	-.303** (.111)	-.326** (.116)	-.327** (.095)	-.548** (.140)	-.528** (.135)
First stage residual <sup>2</sup>			-.424 (.220)	-.395 (.222)	-.404 (.221)	-.418 (.226)	-.388 (.217)	-.377 (.217)
Panel C: cubic specification								
% year unemployed	-.206** (.079)	-.153* (.065)	-.013 (.160)	.108 (.133)	.131 (.138)	.13 (.120)	.349* (.161)	.328* (.156)
% year unemployed <sup>2</sup>	.553 (.380)	.866** (.288)	1.124* (.453)	1.088* (.450)	1.010* (.452)	1.074* (.446)	1.080* (.452)	1.091* (.452)
% year unemployed <sup>3</sup>	-.597 (.430)	-.891** (.303)	-1.174 (.606)	-1.105 (.599)	-1.111 (.602)	-1.063 (.586)	-1.067 (.609)	-1.08 (.608)
First stage residual			-.195 (.143)	-.317** (.111)	-.341** (.116)	-.339** (.096)	-.561** (.142)	-.544** (.137)
First stage residual <sup>2</sup>			-.562* (.221)	-.506* (.222)	-.515* (.221)	-.513* (.226)	-.486* (.219)	-.475* (.219)
First stage residual <sup>3</sup>			.851 (.855)	.693 (.852)	.701 (.839)	.601 (.872)	.616 (.810)	.612 (.810)
Exclusion Restrictions								
Starting Month Dummies			X	X	X (7mo)	X		
Starting Month Industry Interactions				X	X (7mo)	X		
Starting Month Region Interactions						X		
Predicted Seasonality							X	
Predicted Seasonality and Alternative Job								X
F-stat on Exclusion Restrictions			28.63	6.63	9.98	2.27	182.39	98.27
Number of jobs	24516	24516	24516	24516	24516	24516	24516	24516
Number of individuals	7908	7908	7908	7908	7908	7908	7908	7908

NOTE.— Dependent variable is log of gross monthly wage. Each model includes also a full set of industry, regional and year dummies. Standard errors in parenthesis. For Control Function Models standard errors are bootstrapped (1000 replications). Estimation is by fixed effects, unless otherwise indicated. The set of exclusion restrictions consists of: starting month dummies in Model 1; starting month dummies and their interactions with industry dummies in Model 2; starting month dummies restricted to 7 categories and their interactions with industry dummies in Model 3; starting month dummies and their interactions with industry and region dummies in Model 4. Model 5 and 6 are estimated via a three-step estimation procedure. Variables used in the prediction of the first step are the full set of starting month dummies and their interactions with industry and region dummies. The excluded variables from the second step are the predicted probability of having a seasonal job and its squared value in Model 5, plus the predicted probability of having an alternative employment spell if in seasonal job and its squared value in Model 6.

\*  $p < .05$ .

\*\*  $p < .01$ .

**Table 5: Main Estimation Results - Hotel Industry excluded**

	<u>Fixed Effects with Control Function</u>							
	Pooled	Fixed Effects	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Panel A: linear specification								
% year in unemployment	-.207** (.019)	-.015 (.016)	.181 (.125)	.191 (.110)	.206 (.109)	.235* (.096)	.260* (.126)	.259* (.123)
First stage residual			-.199 (.126)	-.211 (.112)	-.227* (.111)	-.259** (.098)	-.280* (.128)	-.241* (.126)
Panel B: quadratic specification								
% year in unemployment	-.270** (.044)	-.031 (.035)	.156 (.130)	.166 (.117)	.181 (.116)	.207* (.105)	.231 (.131)	.231 (.128)
% year in unemployment <sup>2</sup>	.156 (.108)	.040 (.077)	.126 (.136)	.118 (.135)	.119 (.136)	.129 (.135)	.138 (.136)	.137 (.136)
First stage residual			-.206 (.127)	-.217 (.112)	-.232* (.111)	-.263** (.098)	-.287* (.128)	-.287* (.125)
First stage residual <sup>2</sup>			-.226 (.226)	-.202 (.225)	-.203 (.225)	-.233 (.229)	-.235 (.223)	-.227 (.222)
Panel C: cubic specification								
% year in unemployment	-.304** (.079)	-.144* (.065)	.038 (.148)	.048 (.138)	.064 (.137)	.091 (.128)	.115 (.153)	.116 (.150)
% year in unemployment <sup>2</sup>	.33 (.376)	.620* (.292)	.789 (.466)	.768 (.467)	.767 (.467)	.765 (.464)	.801 (.469)	.804 (.468)
% year in unemployment <sup>3</sup>	-.187 (.424)	-.628* (.305)	-.839 (.632)	-.819 (.633)	-.813 (.633)	-.790 (.621)	-.857 (.642)	-.860 (.640)
First stage residual			-.219 (.128)	-.228* (.113)	-.243* (.112)	-.273** (.100)	-.302* (.130)	-.304* (.127)
First stage residual <sup>2</sup>			-.343 (.224)	-.313 (.223)	-.308 (.223)	-.332 (.227)	-.361 (.221)	-.353 (.221)
First stage residual <sup>3</sup>			.612 (.961)	.590 (.965)	.563 (.948)	.535 (.985)	.679 (.927)	.673 (.927)
Exclusion Restrictions								
Starting Month Dummies			X	X	X (7mo)	X		
Starting Month Industry Interactions				X	X (7mo)	X		
Starting Month Region Interactions						X		
Predicted Seasonality							X	
Predicted Seasonality and Alternative Job								X
F-stat on Exclusion Restrictions			29.02	6.52	10.48	1.84	155.11	83.07
Number of jobs	22271	22271	22271	22271	22271	22271	22271	22271
Number of individuals	7260	7260	7260	7260	7260	7260	7260	7260

NOTE.— Dependent variable is log of gross monthly wage. Each model includes also a full set of industry, regional and year dummies. Standard errors in parenthesis. For Control Function Models standard errors are bootstrapped (1000 replications). Estimation is by fixed effects, unless otherwise indicated. The set of exclusion restrictions consists of: starting month dummies in Model 1; starting month dummies and their interactions with industry dummies in Model 2; starting month dummies restricted to 7 categories and their interactions with industry dummies in Model 3; starting month dummies and their interactions with industry and region dummies in Model 4. Model 5 and 6 are estimated via a three-step estimation procedure. Variables used in the prediction of the first step are the full set of starting month dummies and their interactions with industry and region dummies. The excluded variables from the second step are the predicted probability of having a seasonal job and its squared value in Model 5, plus the predicted probability of having an alternative employment spell if in seasonal job and its squared value in Model 6.

\*  $p < .05$ .

\*\*  $p < .01$ .