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Measuring Worker Flows

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Running Title: Measuring Worker Flows

Abstract

We explore differences between two measurement concepts of worker flows widely used in the literature referred to as the turnover and reallocation concepts. We find that measuring worker flows by the turnover concept leads to substantially (about 5% of total employment) higher worker flow estimates and slightly increases age, size and industry group effects on firm level worker flows as well as differences between growing and declining firms relative to the reallocation concept.

Introduction

A substantial body of economic research in the tradition of the "job and worker flow" literature (see: Burgess, Lane and Stevens, 2000, Abowd, Corbel and Kramarz, 1998, Tsou, Lju and Hammitt, 2002, Arai and Heyman, 2000, Bingley et al, 1999, Ilmakunnas and Maliranta, 2004) has recently shown that labour markets are characterised by substantial flows of workers in excess of what is needed to accommodate firm growth. In most economies analysed, worker flows (i.e. firm level hires and separations) exceed job flows (i.e. gross job creation and destruction) by a factor of 2 to 3 (see: Davis and Haltiwanger, 1995). Research has also documented that worker flows as a percentage of average employment decrease with firm size and age, are lower in manufacturing than in services (Burgess, Lane and Stevens, 1996 and 2000) and that growing firms have higher worker flows than declining firms (Abowd, Corbel and Kramarz, 1999).[1]

Despite this high interest, the potential issues involved in measuring worker flows at the firm level have so far received little attention (see: Davis and Haltiwanger, 1995 and 1999 and Dale-Olsen and Roningen, 2000 for exceptions). This is somewhat surprising, since as pointed out by Davis and Haltiwanger (1995) two different measuring concepts co-exist in the literature. In the first - referred to as reallocation measures by Davis and Haltiwanger (1995) - worker flows are defined as "the number of persons whose place of employment differs between t-1 and t". This concept has been used by inter alia Burgess, Lane, and Stevens (1996, 2000). The second concept – referred to as turnover measures by Davis and Haltiwanger (1995) - defines worker flows as "the number of accessions plus the number of

separations that occur during the interval from t-1 to t". This concept has been used amongst others by Anderson and Meyer (1994), Haltiwanger and Vodopivec (2002) and Lane, Isaac and Stevens (1993). As pointed out in Davis and Haltiwanger (1999) differences between these two concepts will arise due to the treatment of short term spells, which both start and end between t and t-1. These are missing in reallocation measures, but are included in turnover measures of worker flows.

This paper examines the differences between these two concepts, by measuring separations and hires according to both concepts for one and the same data set. We are particularly interested in estimating the quantitative differences between the two concepts and their potential implications for the effects of firm size, age and growth on firm level worker flows. Aside from providing quantitative estimates of the differences between the two concepts, this also allows us to draw inferences on the importance of short term spells – lasting for less than a quarter – in the Austrian labour market.

After an exposition of the two measuring concepts in the next section and a data description in section three, we gauge the impact of different measuring concepts on estimates of hiring and separation rates in section four. We find that turnover measures lead to estimates of worker flows that exceed reallocation measures by 5% of average employment. A substantial part of worker flows is thus due to short term spells. We also find that measures according to the turnover concept lead to stronger differences in worker flow estimates across industries and yield slightly higher estimates of the effects on firm size, age and growth on firm level worker flows.

Measuring Job and Worker Flows

We measure worker flows as separations (S_{it}) and hires (H_{it}), but use both measuring concepts used in the literature. First, we measure worker flows according to the turnover concept. In this, hires (H_{it}^T) are all persons who start employment at firm i in the time period between t and t-1 and separations (S_{it}^T) are all persons who terminate their employment at that firm in the same time period. Second, we consider the reallocation concept. In this, hires (H_{it}^R) are all persons employed at a firm at time period t but not at t-1, while separations (S_{it}^R) are all persons employed at a firm at t-1 but not at t.

These two concepts differ with respect to the treatment of short term employment spells, which both start and end in the time period between t and t-1. To see this consider Figure 1, in which we show three example careers of workers (w_1, w_2 and w_3) at a particular firm, for three time periods (t-1, t and t+1). In this figure, the lines denote time periods for which the respective worker was employed at this firm. For instance, worker w_2 starts working at the firm after t-1 and ends the employment relationship before t. Thus he/she both starts and ends employment at the firm in the time period between t-1 and t. According to the turnover concept this would imply counting a hire and a separation. The worker is, however, neither employed at t nor at t-1. In consequence, according to the reallocation concept, neither hires nor separations would be counted.

Similar arguments apply to short term interruptions of employment spells at a firm such as would be caused by temporary layoffs. To see this consider worker w_3, This worker interrupts his/her employment spell at the firm for a short period between t-1 and t, but is employed at both t-1 and t. Thus according to the turnover

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concept both a hire and a separation would be registered, while according to the reallocation concept no worker flows would be measured. As a consequence as noted by Haltiwanger and Davis (1999), turnover measures of worker flows should be at least as high or higher than reallocation measures, and the difference between the two can be interpreted as a measure of the importance of such short term spells in an economy.

{Figure 1 around here}

The choice of measurement concept by researchers will thus depend on the importance of short term employment and unemployment spells for the respective research question addressed. If short term demand and supply changes, due to for instance seasonality, are irrelevant for the question under consideration, the reallocation concept may be better suited. On the other hand, if the goal is to measure the total extent of churning in an economy, turnover measures provide a more complete picture.

There are, however, other differences between the two concepts, which may make measures based on the turnover concept attractive. In particular, in contrast to measures based on the reallocation concept, frequency of measurement will play no role for these measures, since they are additive over time. To see this, consider worker w_1 in Figure 1. This worker is employed by the firm at time t-1 and t+1 but not at t. If worker flows are measured according to the reallocation concept at t-1, t and t+1, a separation between t-1 and t and a hire between t and t+1 would be counted. If by contrast worker flows are measured according to this concept at t-1

and t+1 only, neither hires nor separations would be counted (since the worker is employed at the same firm at both points in time). By contrast according to the turnover concept a hire and a separation will be measured irrespective of the frequency of measurement.[2]

Based on these two measuring concepts we derive the usual indicators used in the literature on job and worker flows. In particular, since employment changes at firm i are the difference between hires and separations, job creation (JC_t) can be measured as the difference between hires and separations in growing or newly founded firms :

$$JC_t = \sum_{i \in S^+} (H_{it}^{\ k} - S_{it}^k) \tag{1}$$

where S^+ is the set of all newly created or growing firms and $k \in \{T, R\}$ is an indicator for whether hires or separations are measured according to the turnover or reallocation concept.[3] Similarly, defining S^- as the set of all closing or declining firms, job destruction (JD_t) is given by:

$$JD_t = -\sum_{i \in S^-} (H_{it}^{\ k} - S_{it}^k) \tag{2}$$

Furthermore, total worker flows (WF_t) in period t can be presented as:

$$WF_t = \sum_i (H_{it}^{\ k} + S_{it}^k) \tag{3}$$

and excess worker flows, which are referred to as churning (CH_t) as:

$$CH_t = \sum_i (H_{it}^{\ k} + S_{it}^k) - JC_t - JD_t \tag{4}$$

Finally, it has become customary to measure all the above indices relative to average employment. This is given as:

$$N_t = \frac{E_t + E_{t-1}}{2} \tag{5}$$

Where N_t is average employment at time t and E_t is the employment level at point in time t. This has the advantage that growth rates of employment are defined for closing and newly created firms, where newly created firms have an employment growth rate of 2 and closed firms of -2 as well as approximating the logarithm of employment growth. Thus we define a relative indicator X^r of any of the above defined measures X as:

$$X^r_t = X_t / N_t \tag{6}$$

Data

The data we use stem from the Austrian social security files.[4] They contain a daily calendar of the starting and end (if employment spells are terminated before the end of 2002) date of an employment relationship of any individual at a particular firm for the time period from the first quarter of 1996 to the fourth quarter 2002. Furthermore, the data contain information on the industry and regional affiliation of the firm providing the employment relationship.

Before processing, the data were cleaned of a number of features, which could increase worker flow measures for purely administrative reasons. In particular this applies to interruptions of the employment relationships, which arise from short sickness leaves and fictitious firm turnover stemming from the fact that firms are given a new identification number when it changes location (see: Stiglbauer, 2003, Schöberl, 2004 for detailed descriptions). From this cleaned data we construct quarterly series of firm level employment as well as hires and separations according to both measurement concepts.

{Table 1 Around Here}

Table 1 presents descriptive statistics. As can be seen we have a total of over 6.5 million (over 200,000 per quarter) firm level observations. The average firm has just over 10 employees and average firm growth was about zero in the time period considered. Firms, however, vary considerably both in size and employment. The smallest firm had one employee while the largest had 51,160 and firm growth ranges from +11.000 to -7.000 within a quarter. Finally, we also have available an indicator on firm birth, which measures the first time a firm appears in our data set. Since recording started in 1971 this variable is left censored and the mean year of birth of a firm is 1983.

Relative to many of the data sets used in the literature, our data have the advantage of a wide coverage. We focus on the entire information in the time period from the first quarter 1995 to the fourth quarter 2002 thus covering employees of business units of all sectors except for public services and agriculture[5] and all sizes (starting from one employee upwards). This wide coverage will have an impact on measured worker flows; a number of authors (e.g. Burgess et al, 2000 and Bingley et al, 1999) show that focusing exclusively on manufacturing enterprises may underestimate economy wide worker flows, since both hiring and separation rates are substantially higher in construction and all service sectors except utilities. Furthermore, Dale-Olsen and Roningen (2000) show that measures of worker flows may by sensitive to the minimal size of the included firms. In particular they find that focusing only on firms with more than 5 employees reduces both hiring and separation rates by around 1 percentage point of average employment.

The wide coverage of our data, however, comes at the price that it is not entirely clear whether the business units reporting are enterprises or establishments, since the anonymous firm numbers listed are administrative accounts only, and it is left up to the individual firm, at which level it chooses to report.[6] Again this may have effects on the extent of turnover. Dale-Olsen and Roningen (2000) report, that differences between measuring worker flows according to the reallocation concept at the establishment and firm level are also around 1 percentage point of average employment for both hires and separations.

Results

Table 2 shows the average quarterly job and worker flow rates in the time period from 1996 to 2002 according to both measuring concepts. It suggests that the differences between turnover and reallocation concept are sizeable and exceed those in found in many cross country – comparisons as well as differences caused by other measuring issues treated in the literature. Overall turnover measures of quarterly worker flows are by 5 percentage points of average employment higher than reallocation measures. Interpreting this difference as an indicator of the importance of short term spells, this suggests that around five percent of the average stock of employment relationships last or are interrupted for less than a quarter. Thus, at least in Austria short term spells are an important aspect of worker flows, which would be missed when measuring worker flows according to the reallocation concept.[7]

Furthermore, relative to the differences between measuring worker flows at the establishment and enterprise level or omitting small firms, which are estimated at

around 1 percentage point each, when applying the reallocation concept by Dale-Olsen and Roningen (2000), differences between the two measuring concepts are large. This suggests that the choice of measuring concept has a more important impact on results than other measurement issues analysed in the literature.

{Table 2 Around Here}

Turnover measures also show higher variability across firms, which may be hard to explain by time invariant characteristics. This can be illustrated by following the suggestion of Burgess, Lane and Stevens (2000) to separately regress firm level hiring and separation rates on time, (four-digit) industry and firm level fixed effects and to compare R^2 values of these regression. Results reported in Table 3 suggest that while time and industry dummies alone explain very little of the variance in firm level hiring and separation rates (R^2 values of these regressions lie at less than 0.01), the highest R^2 values are obtained when including firm dummy variables.[8] Firm fixed effects, which may be considered controls for any time invariant firm characteristics, explain 8% of the variance in the data on hiring rates, but only 3% of the variance according to the turnover concept.[9] Thus firm level differences between worker flows are harder to explain by time-invariant firm characteristics, when using the turnover concept.

{Table 3 Around here}

Finally, the results in Table 2 suggest that differences between firms of different size, age and industry groups are more pronounced when applying the turnover concept relative to the reallocation concept. This implies that firms with higher worker flows also have higher shares of short term spells[10] and could have implications for the effects of firm size, growth and age on firm level worker flow rates. Thus we run regressions on hiring, separation and churning rates on firm size, age, growth and 4-digit industry fixed effects for both measuring concepts focusing on the cross-section of the second quarter of 2002 .[11] The results reported in Table 4 reconfirm the finding of a higher unexplained variance among firm level hiring and separation rates according to the turnover concept. The fit of the equations as measured by R^2 values decreases substantially when applying the turnover concept relative to the reallocation concept.

The estimated marginal effects of employer size, growth rates and age of separation and employment rates, however, are slightly higher when measuring worker flows by the turnover concept rather than the reallocation concept. According to our estimates increasing firm size by 1000 employees reduces separation and hiring rates by 0.04 percentage points, when measured according to the turnover concept, but by 0.03 percentage points in the reallocation concept. Furthermore increasing firm growth rates by 1 percentage point increases hiring rates by 0.57 percentage points and reduces separation rates by 0.43 percentage points, when worker flows are measured according to the turnover concept. The respective figures for the reallocation concept are 0.55 and -0.45 percentage points. Similarly, a ten year older firm has hiring and separation rates which are by 0.032

percentage points lower in the turnover concept and by 0.027 percentage points in the reallocation concept.[12]

{Table 4 Around here}

While these differences may seem small, they have important implications on the findings on churning rates. When measuring churning rates according to the reallocation concept, both firm age and growth rates have only a modest (although highly significant) impact on churning rates and firm size has a relatively large positive impact. By contrast when measuring churning rates according to the turnover concept the opposite applies. Firm size has a small negative and insignificant impact, while the coefficients of firm growth and age are larger in absolute values.

Conclusions

This paper explores the differences between two measuring concepts of worker flows widely used in the literature. Differences between these concepts are threefold: First, measuring worker flows by the turnover concept leads to substantially higher figures than when measuring worker flows by the reallocation concept. In Austria the differences between these two concepts are around 5% of average employment per quarter. Thus short term spells, which account for the difference between the two concepts, are an important aspect of the Austrian labour market for all groups of firms considered. Second, measuring worker flows by the turnover concept increases age, size and industry group effects on firm level

churning and increases differences between growing and declining firms relative to the reallocation concept. Thus, firms with high worker flows according to the turnover concept also tend to be firms with a high share of short term employment spells. Third, the turnover concept leads to firm level worker flow estimates which may be harder to explain by time-invariant firm characteristics.

There are a number of reasons why these findings may be important to researchers. Our results suggest that short term employment spells contribute substantially to worker flows. Their omission will thus underestimate total worker flows in an economy. Furthermore, our findings also imply that the choice of measuring concept may have an impact on the results of research on the determinants of firm level worker flows. Thus any such research should discuss the potential impact of the choice of measuring concept on the findings. Finally, results suggest that the reallocation concept of measuring worker flows may be better suited to uncover the long run (i.e. firm specific) determinants of worker flows.

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Figure 1: Illustrations of the differences in measuring Concepts
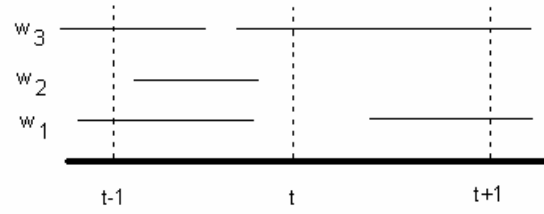
Note: This figure displays the three examples of employment records of workers at a particular firm in the time period t-1 to t+1. Lines denote episodes of employment at the firm

Table 1: Descriptive Statistics

Variable	Observations	Mean	Standard. Deviation	Minimum	Maximum
Employment	6541181	10.4	129.2	1	51160
Employment Growth	6541181	0.0	9.7	-7016	11407
Year of Birth	6541181	1984.	10.9	1971	2002

Table 2: Job Creation, Job Destruction, Hires and Separations in Austria, Quarterly Averages 1996 - 2002

	Job Creation	Job Destruction	Turnover Concept		Reallocation Concept		Differences[a)]	
			Hires	Separations	Hires	Separations	Hires	Separations
Total	5.51	5.52	14.56	14.58	9.39	9.40	5.18	5.18
Sector								
Manufacturing	3.03	3.41	9.01	9.38	5.77	6.14	3.24	3.24
Construction	8.94	9.46	19.19	19.71	12.84	13.36	6.35	6.35
Market Services	6.12	5.83	16.58	16.29	10.61	10.32	5.97	5.97
Firm Age								
less than 5 years	13.87	9.11	27.63	22.88	19.43	14.67	8.21	8.21
5 to 11	5.21	6.07	15.38	16.23	9.58	10.43	5.80	5.80
12 to 24	4.28	5.12	12.62	13.46	7.90	8.74	4.72	4.72
more than 24	3.81	4.35	11.28	11.82	7.06	7.60	4.22	4.22
Firm Size								
<50	8.23	6.98	17.58	16.33	12.15	10.90	5.43	5.43
50-249	4.42	2.94	14.44	12.95	8.87	7.39	5.56	5.56
250-499	3.07	2.02	12.19	11.14	7.13	6.09	5.05	5.05
500+	1.93	1.52	8.30	7.90	4.88	4.48	3.42	3.42
Firm Growth								
stagnating	0.00	0.00	6.79	6.79	3.51	3.51	3.28	3.28
growing	13.82	0.00	24.58	10.76	18.16	4.33	6.43	6.43
declining	0.00	14.44	8.54	22.98	3.59	18.03	4.94	4.94

Notes a) differences between the measuring concepts in percentage points (all other indicators are in % of average employment)

Table 3: Components of Job and Worker Flows

	Job Creation	Job Destruction	Reallocation Concept		Turnover Concept	
			Hires	Separations	Hires	Separations
Industry	0.167	0.156	0.009	0.009	0.009	0.009
Time	0.028	0.004	0.004	0.004	0.007	0.007
Firm	0.315	0.167	0.083	0.083	0.028	0.028

Note: The table reports R^2 values of a regression of job and worker flow rates on time (in lines labelled time), 4 digit NACE industry (in lines labelled industry) and firm (in lines labelled firm) fixed effects.

Table 4: Estimation Results

Dependent Variables	Size (1000 employees)	Growth Rate	10*Age	R^2	Number of Observations
		Turnover Measure			
Hiring Rate	-0.039	0.567	-0.032	0.26	259086
	(0.009)	(0.002)	(0.001)		
Separation Rate	-0.039	-0.432	-0.032	0.16	259086
	(0.009)	(0.002)	(0.001)		
Churning Rate	-0.007	0.035	-0.015	0.10	259086
	(0.016)	(0.003)	(0.002)		
		Reallocation Measures			
Hiring Rate	-0.030	0.547	-0.027	0.61	259086
	(0.004)	(0.001)	(0.001)		
Separation Rate	-0.040	-0.452	-0.027	0.49	259086
	(0.014)	(0.001)	(0.001)		
Churning Rate	0.011	0.004	-0.004	0.20	259086
	(0.003)	(0.001)	(0.001)		

Notes: Results report cross section estimation for the 2nd quarter of 2002. Specifications include fixed effects for 496 four digit industry groups which are not reported in table 3. Values in bracket are standard errors of the estimate.

NOTES

[1] Further research adresses the effects of job and worker flows on wages and wage drift (e.g. Den Butter and Eppink, 2003), the effect of inovation on job creation and destruction (e.g. Vainiomaki,Laaksonen, 1999) and a number of further issues (see Davis and Haltiwanger, 1999 for a survey).

[2] As a consequence, differences between the two measuring concepts decrease with the frequency of measurement and the two concepts accord exactly when measured at a sufficiently high frequency (in our case on a daily basis).

[3] Note that the definition of job creation and destruction holds irrespective of how worker flows are measured.

[4] Data from this source has been widely used in both macro- as well as micro-econometric studies of the Ausrian Labour market (e.g. Hofer et al, 2001, Kratena, 2000 and Winter - Ebmer, 1995)

[5] Public services are excluded since we lack information on tenured public sector employees. Agriculture is excluded due to the high share of self-employment, on which we have no information.

[6] Stiglbauer (2003) argues that the data are mostly enterprise level, because enterprises lack incentives to increase administrative reporting burdens by choosing to report at establishment level. Unfortunately, since data are provided anonymously, we have no way to correct these deficiencies.

[7] This high share of short term employment spells which end in re-employment in the same firm is consistent with the high share of temporary layoffs in Austria found by Fischer and Pichelmann (1991).

[8] This should, however, be no surprise. R^2 values increase with the number of included variables and firm fixed effects increases the number of variables included by over 540.000. Information criteria, which correct for the inclusion of more dependent variables, such as the Schwartz or Akaike criteria, suggest that firm dummy variables do not always improve the model fit significantly.

[9] Time dummies, however, explain slightly more of the variance in the turnover concept. This can be attributed to the higher seasonality of turnover measures.

[10] While separation and hiring rates are highly correlated across measurement concepts (with correlation coefficients of 0.67 and 0.66, respectively), regressions of firm level separation (hiring) rates according to the turnover concept on separation (hiring) rates according to the reallocation concept, reconfirm this finding. We obtain a coefficient of 1.10 (1.05) which is significantly higher than 1 at all conventional significance levels in both cases.

[11] The specification of this regression is $Y_i = \alpha_j + \beta X_i + \zeta_i$ where Y_i is the dependent variable X_i the set of explanatory variables, α_j is an industry fixed effect and ζ_i an error tem.

[12] These results are robust to omission of industry fixed effects.