Optimal Employee Turnover Rate: Theory and Evidence*

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Abstract

This paper investigates the quantitative effects of employee turnover on firms' productivity. The Australian Business Longitudinal Survey 1995-98, a unique survey providing firm level data on both production and employee turnover, is used as the data source. Theoretical studies have advocated that firm specific human capital and job matching to be the two major, but competing, mechanisms through which turnover affects productivity. Our results indicate that the effect of job matching dominates when turnover is "low," while the effect of firm specific human capital dominates when turnover is "high." We identify that the optimal turnover rate – the rate that maximises productivity, controlling for other factors – is about 0.3, well in excess of the sample mean. The finding suggests that further increasing the flexibility of employment arrangement for small and medium Australian enterprises could yield substantial productivity gains.

Key words: Employee turnover, productivity, firm specific human capital, job matching, panel data, unobserved effects, instrumental variable estimation.

1. Introduction

It is widely acknowledged in the business community that human resources are a valuable asset to firms (see, for example, Business Times, 2000, and Business Asia, 1999). Therefore, it is logical to assume that the flow of this valuable asset − employee turnover − plays a crucial role in firm performance. In fact, firms (and employees) are burdened with turnover problems in both good and adverse economic climates.

During economic upturns, employee churning represents one of the greatest difficulties in business management. For instance, during the "new economy" boom in the U.S., nearly a quarter of workers were reported to have average tenure of less than a year (Economist 2000).[1] On the other hand, during economic downturns, trimming operating costs through job retrenchment in order to maintain the firm's share value is a typical phenomenon. Nevertheless, downsizing is not a painless option for firms, as they are likely to suffer adverse consequences, such as low levels of morality and loyalty amongst the remaining employees. Moreover, firms also bear the risk of not being able to quickly re-establish the workforce should the economy rebound more swiftly than anticipated.

Given this, employee turnover has been extensively researched across a number of disciplines, including psychology, sociology, management and economics. Each discipline has its own focus and, accordingly, employs different research methodologies.

Psychologists and sociologists are generally interested in motivations behind quitting, such as job satisfaction, organisational commitment and job involvement (see, for example, Carsten and Spector, 1987, and Muchinsky and Tuttle, 1979). Empirical work in these fields typically involves case studies using survey data of individual firms or organisations.

In the discipline of management study, high staff turnover has been of great and continuous concern (see, for example, the symposium in *Human Resource Management Review*, 9(4) 1999, and Mok and Luk 1995). Similar to the practice in psychology and sociology, researchers heavily draw on event, or case, studies. Maintaining employee longevity appears to be especially difficult in the following sectors: information and communication; restaurant

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[1] The problem was experienced by high-tech industries as well as the low-tech ones, such as retailing, food services and call centres.

and catering; warehouse; and retail banking. While reducing employee turnover is a managerial objective for some firms, the converse is true for others. For example, legal restrictions and obligations in recruitment and dismissal could prohibit firms from maintaining a flexible workforce size. This situation is more common in unionised sectors (Lucifora 1998). The industrial reforms and privatisation in countries such as Australia were aimed, at least partly, at increasing the flexibility of labour markets.

In contrast, economists focus mainly on the implications of turnover on unemployment. A strand of matching theories has been developed extensively to explain equilibrium unemployment, wages and vacancies (Lilien 1982; Lucas and Prescott 1974). National aggregate time series data are typically employed in this line of research (For recent surveys on matching theories and their applications see Petrongolo and Pissarides, 2001, and the symposium in *Review of Economic Studies*, 61(3) 1994).

Despite turnover being considered crucial to human resource management and production, there is limited quantitative research on the effect of turnover on firms' productivity.[2] This omission is probably due to the lack of firm level data on *both* production and turnover. Moreover, firm level longitudinal data are typically restricted to individual organisations, prohibiting researchers from drawing general conclusions.[3] Utilizing a recently released firm-level panel data set, based on the Australian Business Longitudinal Survey (BLS), this paper is therefore able to provide a new dimension to the literature. The BLS data provide an objective measure of value-added, which is comparable across firms operating in a broad spectrum of industries. Using data on factor inputs, we can therefore estimate total factor productivity across industries, and thus investigate the impact of employee turnover on firms' productivity.

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[2] McLaughlin (1990) examines the relationship between turnover type (quit or layoff) and economy-wide general productivity growth, but not productivity of individual firms. Shepard *et al.* (1996) make use of survey data to estimate the total factor productivity of the pharmaceutical industry; nevertheless, their study is only concerned with the effect of flexible working hours and not turnover.

[3] For instance, Borland (1997) studies the turnover of a medium-size city-based law firm, Iverson (1999) examines voluntary turnover of an Australian public hospital, and Glenn, McGarrity and Weller (2001) focus on major league baseball in the U.S. However, all three studies do not cover the production aspect of the examined organisation.

Using this data set, we establish that employee turnover has a statistically significant and quantitatively large, but more importantly, non-linear, effect on productivity. We identify the optimal turnover rate – the rate that maximises productivity, keeping other factors constant – to be around 0.3. In this paper, the employee turnover rate is defined as the average of total number of employees newly recruited and departed within a period, divided by the average number of employees over the period. In other words, the highest productivity appears where about 30 per cent of total employees changed over the one-year period. The results also suggest that a substantial productivity gain could be achieved by bringing the employee turnover rate closer toward the optimal level. As an illustration, if the rate of turnover increases from the median value of 0.13 to the optimal level, productivity is predicted to increase by 1.6 per cent. These results could be instrumental in developing human resource and labour market policies. For instance, if the observed turnover rate is substantially below the estimated optimal rate, it might reflect the fact that the labour market is too rigid and deregulation may be warranted.[4]

The rest of the paper is structured as follows. Section 2 reviews two main contending theories about the linkage between employee turnover and productivity, and formulates the concept of the optimal turnover rate. In Section 3 the econometric model and the data are briefly described. Section 4 presents the empirical results and Section 5 concludes.

2. Theories of Turnover and Productivity

There are two main theories on how employee turnover affects firms' productivity. The first theory is the firm specific human capital (FSHC) theory, pioneered by Becker (1975). It is asserted that if firms need to bear the cost of training, their incentives to provide staff training will be lowered by high quitting rates. The incentive will be even weaker when firm specific and general training are less separable, as employees have lower opportunity costs of quitting (Lynch 1993). Therefore, firms' productivity falls as turnover increases. Even if FSHC is

[4] Recent theoretical studies indicate that employee turnover is important to individual as well as national welfare. Examples include Chang and Wang (1995) and Cooper (2001); the former emphasises on the channel of human capital investment, while the latter on that of R&D.

bred through learning-by-doing, its accumulation remains positively related to employees' tenure. As a result, a higher turnover rate will still lead to lower productivity.[5]

In addition to the direct loss of human capital embodied in the leavers, there are other negative impacts of turnover on productivity. First of all, a certain amount of output will be forgone during the vacant and training period. The administrative resources used in separation, recruitment and training could have been invested in other aspects of the production process.[6] Moreover, high employee turnover could adversely affect the morale of the organisation. Using a controlled experiment, Sheehan (1993) records that the leavers alter the perceptions of the stayers about the organisation and therefore negatively affect its productivity. As a consequence, warranted (from an employer's perspective) but involuntary job separation could trigger unwarranted voluntary employee departure – a snowball effect.[7]

On the other side of the debate, is the job matching theory established by Jovanovic (1979a; 1979b) and Burdett (1978). The key insight of this theory is that firms will search for employees and job seekers will search for firms until there is a good match for both parties. However, the conditions for an optimal matching may change over time, leading to continuous reallocation of labour. For instance, a firm that has upgraded its production technology will substitute skilled for unskilled labour (for a recent survey on this topic, see Ahn, 2001). Moreover, established firms also need 'new blood' to provide fresh stimulus to

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[5] One kind of FSHC is the standardised norm practiced in individual firms. Such organisational norm is a means to reduce transaction costs within firms as it provides a behavioural guidance to employees (Mintzberg 1979). If it takes a significant amount of time for new employees to learn the norm (*i.e.* the socialisation process is long), high turnover will increase the internal transaction costs and, thus, reduce productivity. A similar concept is suggested by Nelson and Winter (1982) in that organisational memories are maintained as routines, which is crucial to production efficiency. However, such memories will be damage d by turnover.

[6] It has been reported that the cost of losing an employee is between half to one and a half times the employee's annual salary (Economist 2000).

[7] During the economic downturn in the U.S. in 2001, executives in Charles Schwab and Cisco were reportedly cutting down their own salaries and setting up charitable funds for laid off staff in order to maintain the morale of the remaining employees (Economist 2001). Both companies' efforts were apparently well received. Fortune (2002) ranked Cisco and Charles Schwab as the 15th and 46th best companies to work for, respectively, during 2001 despite Cisco was reported to lay off 5,500 staff while Charles Schwab 3,800 staff.

the *status quo*. On the other hand, a worker who has acquired higher qualifications via education, training, or learning-by-doing may seek a better career opportunity.

Regular employee turnover helps both employers and employees avoiding being locked in sub-optimal matches permanently. For instance, a study by the U.S. Department of Labor estimates the cost of a poor hiring decision to be 30 percent of the first year's potential earning, and even higher if the mistake is not corrected within six months (Abbasi and Hollman 2000). Furthermore, Borland (1997) suggests that involuntary turnover can be used as a mechanism to maintain employees' incentives. In short, matching theory suggests that higher turnover adds to productivity.[8]

Although FSHC theory and job matching theory suggest opposite effects of turnover on productivity, one does not necessarily invalidate the other. In fact, there are empirical evidence supporting the coexistence of both effects, albeit the effect of FSHC appears to dominate (see Glenn *et al.* (2001) and the citations therein). The two theories essentially answer the question of how to balance the stability and flexibility of the labour force. It is our contention that, given that FSHC and job matching have opposite effects on productivity there is the distinct possibility that a certain turnover rate will maximise productivity. A scenario, in which such an optimal turnover rate exists, is where productivity is a non-linear – specifically quadratic concave function, of turnover. In the following, we formulate a number of possible scenarios, and investigate which one is supported by the data.

2.1. Optimal Turnover Rate

Suppose firms' total factor productivity π, is an additive separable function of employee turnover rate T, and a set of other variables $\boldsymbol{Z}$, (such as liquidity; degree of unionisation and so on) such that:[9]

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[8] Another factor that compounds the effect of turnover on productivity is knowledge spillover between firms (Cooper 2001). Knowledge spill over is more significant if human capital is portable across firms or even industries. For instance, Megna and Klock (1993) find that increasing research input by one semi-conductor firm will increase the productivity of rival firms due to labour migration.

[9] If there are feedback effects of productivity on the turnover rate, one should include lagged terms of T in the equation and/or set up a system of equations. For instance, using U.S. data, Azfar and Danninger (2001) find that employees participating in profit-sharing schemes are less likely to separate from their jobs, facilitating

$$\pi = f(\boldsymbol{Z}) + g(T);\ T \geq 0. \tag{1}$$

Suppose $g(T)$ is an additive separable function of FSHC and job matching effects:

$$g(T) = p(T) + q(T) \tag{2}$$

where $p(T)$ is a FSHC effect function, and $q(T)$ a job matching effect function. Both $p(T)$ and $q(T)$ are at least twice differentiable on an interval $\overline{T}$ of *T*.

For all *T* and $\tau \in \overline{T}$, we can express $p(T)$ around $T = \tau$ using Taylor series expansion:

$$\begin{aligned} p(T) &= p(\tau) + p'(\tau)(T-\tau) + p''(\tau)(T-\tau)^2/2 + ... \\ &= a_0 + a_1 T + a_2 T^2 + ... \end{aligned} \tag{3}$$

where $p'(.)$ is the first derivative of $p(.)$, $p''(.)$ the second derivative, and so forth. According to FSHC theory, π is a negative function of *T*. If terms with orders higher than two are negligible, for $p(T)$ to be a deceasing function around $T = \tau$, the necessary condition is $a_1 \leq 0$, $a_2 \leq 0$, and $a_1 + a_2 \neq 0$.

Similarly, $q(T)$ can be expressed as a Taylor series:

$$\begin{aligned} q(T) &= q(\tau) + q'(\tau)(T-\tau) + q''(\tau)(T-\tau)^2/2 + ... \\ &= b_0 + b_1 T + b_2 T^2 + ... \end{aligned} \tag{4}$$

According to job matching theory, labour productivity is a positive function of employee turnover rate. Again, if terms with orders higher than two are negligible, for $q(T)$ to be an increasing function around $T = \tau$, the necessary condition is $b_1 \geq 0$, $b_2 \geq 0$, and $b_1 + b_2 \neq 0$.

Substituting (3) and (4) into (2), and the subsequent result into (1), we can write

$$\begin{aligned} \pi &= f(\boldsymbol{Z}) + (a_0 + b_0) + (a_1 + b_1)T + (a_2 + b_2)T^2 + ... \\ &= f(\boldsymbol{Z}) + c_0 + c_1 T + c_2 T^2 + ... \end{aligned} \tag{5}$$

the accumulation of FSHC. However, the short time span of our panel data prohibits us from taking this into account in the empirical analysis.

Conditional on ***Z***, equation (5) is a productivity-turnover (PT) curve. Provided that terms with orders higher than two are negligible,[10] there are five scenarios regarding the signs of c_1 and c_2 and, thus, the shape of the PT curve (Table 1).

Table 1. Various Scenarios of the Productivity-Turnover Curve

Scenario	Shape of PT curve ($T \geq 0$)	Interpretation	Optimal turnover rate
$c_1 = c_2 = 0$	Horizontal	FSHC and job matching effects cancel each other	Undefined
$c_1 > 0,\ c_2 < 0$	Inverse U-shaped	Matching effects dominate when T is small, while FSHC effects dominate when T is large	$-\frac{c_1}{2c_2}$
$c_1 < 0, c_2 > 0$	U-shaped	FSHC effects dominate when T is small, while job matching effects dominate when T is large	Undefined
$c_1 \geq 0, c_2 \geq 0,$ $c_1 + c_2 \neq 0$	Upward sloping	Matching effects dominate	Undefined
$c_1 \leq 0, c_2 \leq 0,$ $c_1 + c_2 \neq 0$	Downward sloping	FSHC effects dominate	0

Intuitively, an inverse U-shaped PT curve is the most likely scenario. This is because when turnover is low, the level of FSHC is relatively high, whereas job-worker matching is less likely to be optimal. Hence, the marginal benefit of increasing the labour market flexibility overwhelms the marginal cost of forgoing some FSHC. As a result, productivity rises with the turnover rate. Due to the law of diminishing marginal returns, the gain in productivity lessens as turnover increases. Eventually the two effects will net out and further increases in turnover will then lead to a fall in productivity.

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[10] This can be tested empirically and is satisfied for our data.

In the case of an inverse U-shaped PT curve, the optimal turnover rate is given by $-c_1/2c_2$. The rate is not necessarily optimal from the perspective of firms, as competent employees may leave for a better job opportunity. Neither is it necessarily optimal from the perspective of employees, as there may be involuntary departure. In essence, turnover represents the fact that firms are sorting workers and, reciprocally, workers are sorting firms. As a result, the estimated optimal rate should be interpreted from the production perspective of the economy as a whole. Moreover, the measurement does not take into account the hidden social costs of turnover, such as public expenses on re-training and unemployment benefits, and the searching costs borne by job seekers, and for that matter, hidden social benefits such as higher social mobility.

3. Data, variables description and empirical models

3.1. Business Longitudinal Survey (BLS)

The BLS is a random sample of business units selected from the Australian Bureau of Statistics' business register for inclusion in the first year of the survey. The sample was stratified by industry and firm size. The sample was selected with the aim of being representative of all businesses (excluding government agents, public utilities and public services). The focus is on a balanced panel of small and medium sized businesses. After excluding businesses with deficient data records, 2,435 businesses are left in our sample (Further details are presented in the Appendix).

This data source is unique in that it provides firm-level data, including an objective measure of value-added and structural characteristics. Moreover, individual firms are tracked over a four-year period from 1994/5 to 1997/8. The panel nature of the data allows us to investigate the correlation between firm characteristics and productivity, taking into account unobserved heterogeneity of firms. Although the panel is short, it has the advantages of being nationally representative and having information on objective measure of value-added and firm characteristics, which is excellent for our purposes.

3.2. The Econometric Model and Variable Descriptions

In the growth accounting literature, it is typical to use two-stage methods to identify the determinants of total factor productivity (TFP) growth. At the first stage, TFP growth is estimated as a residual from regressing value-added against factor inputs:

$$\ln V_{it} = \alpha + \beta \ln K_{it} + \gamma \ln L_{it} + \pi_{it} \tag{6}$$

where V_{it} is value-added of the *i*th firm in year *t*; K_{it} and L_{it} are capital and labour input, respectively; and π_{it} is the TFP residual. At the second stage, the TFP residual is regressed against other explanatory variables, as formulated in (5).

The two stages can be combined into one in that value-added is regressed against factor inputs and other explanatory variables together, which is the approach adopted in this paper. The econometric model therefore becomes:

$$\ln V_{it} = \alpha + \beta \ln K_{it} + \gamma \ln L_{it} + \delta_1 T_{it} + \delta_2 T_{it}^2 + \boldsymbol{Z}_{it}^{'} \boldsymbol{\varphi} + u_i + \varepsilon_{it} \tag{7}$$

where u_i is an unobserved individual effect and ε_{it} an idiosyncratic disturbance term. The unobserved individual effect accounts for any remaining unobserved entity heterogeneity, such as management style, competition level of output markets.

The dependent and explanatory variables are briefly described as follows:

- $\ln V_{it}$ (log value-added): Value-added is defined as *sales* − *purchase* + *closing stock* − *opening stock*, in financial year *t*.
- $\ln K_{it}$ (log capital): Capital is measured as the total book value of non-current assets plus imputed leasing capital. As reported in Rogers (1999), the importance of leasing capital relative to owned capital varies significantly with firm size and industry, suggesting that leasing capital should be included if we are to accurately approximate the total value of

capital employed in the production process. Leasing capital is imputed from data on the estimated value of rent, leasing and hiring expenses.[11]

- $\ln L_{it}$ (log labour): Labour input is measured as the number of full-time equivalent employees.[12] Since employment is a point in time measure, measured at the end of the survey period (the last pay period in June of each year), we use the average numbers of full-time equivalent employees in year *t* and year *t-1* for each business as their labour input in year *t*.[13]

- T_{it} (employee turnover rate): Employee turnover rate is measured by the average of new employees and ceased non-casual employees divided by average non-casual employees at the end of year *t* and *t-1*. The variables are only available from 1995/6 onwards.[14] As shown in Appendix A1, the maximum value of turnover rate is 41. The accuracy of this figure is questionable because the turnover rate is defined as turnover rate of non-casual employees only. There is no clear pattern on the characteristics of firms with very high turnover rate. We suspect that most of those firms with very high turnover rate may have included the number of newly hired and ceased "casual" employees in the figure of non-casual counterparts. In that case, considerable measurement errors would be introduced. Thus, we exclude observations whose labour turnover rates are in the top end of the distribution. Different cut-off points are experimented with as robustness check.

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[11] Leasing capital is imputed using the following formula: leasing capital = leasing expenses/(0.05+*r*). The depreciation rate of leasing capital is assumed to be 0.05. Ten-year Treasury bond rate is used as the discount rate (*r*). See Rogers (1999) for more detailed discussion.

[12] The BLS only provides data on the number of full-time and part-time employees while the number of work hours is not available. The full-time equivalent calculation is thus based on estimated average work hours of part-time and full-time employees for the workforce as a whole, as published by the ABS in its monthly Labour Force publication (cat. no. 6203.0).

[13] Capital is also a point in time measure. However, capital is far less variable than labour (especially when measured in terms of its book value), and hence the coefficient of capital is not sensitive to switching between flow and point-in-time measures.

[14] The questions for the calculation of labour turnover rate are slightly different in 1995/6 questionnaires. We have tried the estimation that includes only data from the last two waves. However, these results did not affect our conclusions. Since the panel is already very short, we included three years data in our main estimations.

- $\boldsymbol{Z}_{it}$ (the control variables):

  - employee coverage: there are three variables included in the regression — proportion of employees covered by individual contracts, by registered enterprise agreements, and by unregistered enterprise agreements. It is expected that the sign on these variables will be positive, because individual contracts and agreements tend to be more commonly used with more skilled workers, and also because such agreements tend to be used in tandem with performance-based pay incentives. Moreover, it is widely believed that enterprise agreements are positively correlated with productivity (Tseng and Wooden 2001).

  - Union dummies: we include dummy variables that indicate whether a majority of employees are union members and whether a minority of employees are union members, respectively. A majority is defined as more than 50 per cent and a minority being more than zero but less than 50 per cent. The reference category is businesses without any union members at all.

  - Part-time employee to total employee ratio and manager to total employee ratio: businesses with higher manager to total employee ratio may have higher productivity because their employees are better monitored. The effect of part-time to total employee ratio is ambiguous because part-timers may be more efficient due to shorter work hours, on the other hand, they may be less productive due to lesser accumulation of human capital.

  - A dummy variable that indicates whether a business was "innovative" in the previous year: Innovation potentially has a long lag effect on productivity. Since the panel is relatively short, in order to avoid losing observations, we include only a one-year lag. Moreover, the definition of innovation is very board in the BLS. The coefficient of innovation dummy is expected to be less significant that it should be.

  - Dummy variables that indicate whether a business is an exporter, a family business, or an incorporated enterprise. Exporters are likely to be positively correlated with productivity in two aspects. High productivity businesses are more likely to survive in highly competitive international markets. Secondly, trade may prompt faster absorption of new foreign technology.

- Borrowing rate (measured at the end of the previous financial year): this variable is used to measure how highly geared a firm is. The borrowing rate is expected to have a positive impact on productivity, as the pressure of paying back the debts will motivate greater efforts in production (Nickell, Wadhwani and Wall 1992).
- Firm age dummies: this variable is to control for any bias associated with the mismeasurement of capital, as well as to control for industry specific knowledge.[15]
- Industry dummies: industry dummies are included to control for industry specific factors that may not be captured by the above variables.

4. Empirical Results

4.1. Primary Results

Initial Feasible Generalised Least Squares (FGLS) estimation results show that the *t*-statistics of both the capital and labour variables are very large, indicating a strong possibility that these variables are endogenous. In other words, these variables may be correlated with the composite disturbance term through the unobserved individual effects. A possible contributing factor to this is the limited number of control variables available in the data set. For example, since only one-digit industry classification is available, some industry effects could be captured in the unobserved individual effect, which is likely to be correlated with both the capital stock and flow of labour. Moreover, export status may also be endogenous in that firms in export-oriented industries have higher productivity due to knowledge spillover, and productive firms are more likely to survive in the highly competitive global market (Clerides, Lach and Tybout 1998; Bee, Chun and Roberts 2000).

Given this, we consider various estimation techniques that account for such endogeneity. Firstly, write equation (7) generically as:

[15] A source of measurement bias is the use of the book value of non-current assets. Using the book value will, in general, lead to the underestimation of the true value of capital due to the treatment of depreciation. As firms get older, the book value of capital is generally depreciated at a rate greater than the diminution in the true value of the services provided by the capital stock.

$$y_{it} = \alpha + w_{it}'\phi + u_i + \varepsilon_{it}, \tag{8}$$

where w_{it} contains both time varying variables, x_{it}, and time invariant ones, f_i. Following Hausman and Taylor (1981), it is possible to decompose w_{it} into $w_{it} = \left(w_{1it}', w_{2it}'\right)$, where w_{1it} is a subset of w_{it} that is independent of the unobserved effect. Generalised Method of Moments (GMM) estimation can then be based on the orthogonality conditions:

$$E\left(z_{it}'u_i\right) = 0, \tag{9}$$

where z_{it} is based upon w_{1it}. Using the same partitions as for w_{it}, three versions of this GMM estimator exist. The Hausman and Taylor (H-T) (1981) estimator uses $z_i = \left(f_{1t}', \overline{x}_{it}'\right)'$ and the Amemiya and MaCurdy (A-M) (1986) uses $z_i = \left(f_{1i}', x_{1i1}', \ldots, x_{1iT}'\right)'$. Finally, provided that the correlation between w_{2it} and u_i is constant over time, one can use a further orthogonality condition that deviations from time means are also valid instruments (Breusch, Mizon and Schmidt 1989) (B-M-S).

In our base set of results, we include capital, labour and exports in w_{2it} for all three estimators. However, different sets of endogenous variables are used as robustness checks (see Section 4.2). Table 1 presents the results from the three different estimators (H-T, A-M and B-H-S, respectively) as well as the (inconsistent) random effect FGLS estimator for the sample with labour turnover rate less than 0.8. That is observations in the top 5 per cent of the sample distribution are excluded. As mentioned earlier, the labour turnover rate for some observations are questionably high, we therefore use this trimmed sample (trimmed at 0.8) as our base sample (Sensitivity test of different cut-off points are also reported in the next section). The coefficients of variables across the estimators are very similar and the signs are as expected. We briefly summarise these results before focussing attention on the labour turnover results.

The coefficient of log capital is very small although this is not surprising due to the use of non-current assets as a proxy of capital, as explained previously. Because of this, we are reticent to impose constant returns to scale on the regression. This argument gains support from the negative coefficients of firm age dummies in that the underestimation of capital is larger for older firms.[16] Since both capital and firm age variables are included as control variables, the mismeasurement of capital should not unduly bias the coefficient of labour turnover.

Enterprise bargaining is positively correlated with productivity. This is reflected in the positive and significant coefficients of the ratio of employees on registered agreements and individual contract, as well as of highly unionised firms. However, the productivity of firms with less than 50 per cent of employees unionised is not significantly different from completely non-unionised firms.

The coefficient of borrowing rate is, as expected, positive, albeit only significant at 10 per cent level. Manager to total employment ratio has no effect on productivity, whist the effects of part-time to full-time employee ratio is significantly negative. The coefficients of these two labour related variables vary considerably across the FGLS and the three consistent estimators.

The coefficient of innovation in the previous year is insignificant. This is not surprising as the effect of innovation generally has long lags. Export firms and incorporated firms have higher productivity. Family businesses, on average, are 21 per cent less productive than non-family businesses. Medium and medium large firms have higher productivity than small firms.

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[16] If there is no underestimation of capital stock, other things equal, older firms are likely to have higher productivity due to accumulation of experience.

Table 1 Estimation results from FGLS, H-T, A-M and B-H-S

	FGLS	HAUSMAN - TAYLOR	AMEMIYA-MaCURDY	BREUSCH-MIZON-SCHMIDT
Log Capital	0.1520** (0.0072)	0.0630** (0.0197)	0.0629** (0.0096)	0.0657** (0.0096)
Log Labour	0.7889** (0.0198)	0.6242** (0.0299)	0.6315** (0.0297)	0.6356** (0.0289)
Export	0.1014** (0.0192)	0.0540** (0.0249)	0.0565** (0.0249)	0.0565** (0.0248)
Turnover Rate	0.1688** (0.0831)	0.2678** (0.0868)	0.2648** (0.0871)	0.2630** (0.0866)
Turnover Rate squared	-0.2634** (0.1335)	-0.4043** (0.1396)	-0.4041** (0.1400)	-0.3970** (0.1393)
Union Dummy (1-49%)	0.0312 (0.0201)	0.0605** (0.0209)	0.0587** (0.0210)	0.0589** (0.0209)
Union Dummy (50%+)	0.0541* (0.0304)	0.0850** (0.0314)	0.0808** (0.0315)	0.0830** (0.0315)
Innovation (t-1)	0.0028 (0.0116)	0.0120 (0.0121)	0.0121 (0.0121)	0.0117 (0.0121)
Manager to total Emp. Ratio	0.1217* (0.0660)	-0.1168 (0.0732)	-0.1005 (0.0731)	-0.0982 (0.0723)
Ratio of Employment on Individual Contract	0.1031** (0.0200)	0.1281** (0.0209)	0.1267** (0.0209)	0.1271** (0.0208)
Ratio of Employment on Unregistered agreement	0.0237 (0.0226)	0.0227 (0.0236)	0.0228 (0.0237)	0.0230 (0.0235)
Ratio of Employment on Registered agreement	0.0808** (0.0371)	0.1171** (0.0385)	0.1175** (0.0386)	0.1143** (0.0387)
Borrowing Rate (t-1)	0.0081* (0.0042)	0.0083* (0.0044)	0.0086 (0.0044)	0.0084 (0.0044)
Ratio of Part time to total employees	-0.0267 (0.0333)	-0.1356** (0.0361)	-0.1220** (0.0362)	-0.1304** (0.0358)
Family business	-0.1897** (0.0237)	-0.2136** (0.0244)	-0.2132** (0.0243)	-0.2130** (0.0238)
Incorporated	0.1359** (0.0260)	0.1771** (0.0268)	0.1768** (0.0267)	0.1849** (0.0271)
Age (less than 2)	-0.1651** (0.0499)	-0.1983** (0.0512)	-0.1975** (0.0510)	-0.1954** (0.0513)
Age (2-5 years)	-0.0717* (0.0387)	-0.1351** (0.0401)	-0.1341** (0.0399)	-0.1295** (0.0397)
Age (5-10 years)	-0.0171 (0.0319)	-0.0476 (0.0327)	-0.0469 (0.0326)	-0.0501 (0.0325)
Age (10-20 years)	-0.0103 (0.0304)	-0.0310 (0.0309)	-0.0309 (0.0308)	-0.0274 (0.0308)
Medium	0.2575** (0.0365)	0.6183** (0.0475)	0.6097** (0.0472)	0.5983** (0.0460)
Medium-Large	0.3610** (0.0661)	0.9724** (0.0846)	0.9568** (0.0841)	0.9455** (0.0820)
Industry dummies	Yes	Yes	Yes	Yes
Adjusted R-squared	0.8496	0.8185	0.8190	0.8205
Number of observations	6428	6428	6428	6428
Number of firms	2380	2380	2380	2380

Note: "**" and "*" indicate significance at 5% and 10% level, respectively. Figures in parentheses are standard errors.

4.2. Labour Turnover and Productivity

We now focus on the impact of turnover on productivity.[17] The coefficients of labour turnover rate and its square are both significant and are positively and negatively signed, respectively. This implies an inverse U-shaped productivity-turnover profile. It indicates that, job matching effects dominate when turnover is low, whereas FSHC effects dominate when turnover is high. The imputed optimal turnover rates for different estimators lies between 0.32 and 0.33. The differences among the three GMM estimators are negligible. Although the estimated curvature of the productivity-turnover curve implied by the FGLS results is flatter than that implied by the three GMM estimators, the estimated optimal turnover rates are very close.

Two broad sets of robustness checks were carried out. The first set involved changing the variables that enter w_{2it}, the set of potentially endogenous variables. In addition to capital, labour and exports, we have experimented with turnover (and its square), union density and innovation. The second set of robustness checks, involves differing cut-off points for the turnover rate variable using the base specification (that is treating capital, labour and exports as potentially endogenous variables). In addition to these, we also ran the base specification on sub-samples split by manufacturing/non-manufacturing and also by firm size. The main results are reported in Table 2. [18]

The coefficients of labour turnover rate and its squared term remain significant and retain the same signs when we treat them as endogenous (although their magnitudes are smaller). Again, there is no significant difference across the three different GMM estimators (as was the case in all of the robustness checks).

For the second set of robustness checks, we tried a number of different cut-off points of the turnover rate, from 0.5 to 1.0. Here we only report the results for three different samples: the full sample, and the sub-samples with cut off points equal to 1.0 and 0.5, respectively.

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[17] Recall that the effects of turnover and turnover squared on productivity are essentially the same as those on value-added as we have controlled for factor inputs.

[18] We have also tried different combination of cut-off points, endogenous variables on full sample and industry or firm size sub samples. Results can be obtained from the authors on request.

Table 2 Results for robustness checks

	HAUSMAN-TAYLOR		AMEMIYA-MaCURDY		BREUSCH-MIZON-SCHMIDT	
	turnover	turnover squared	turnover	turnover squared	turnover	turnover squared
Endogenous variables (A)	0.2678 (0.087)	-0.4043 (0.140)	0.2648 (0.087)	-0.4041 (0.140)	0.2630 (0.087)	-0.3970 (0.139)
Endogenous variables (B)	0.1948 (0.091)	-0.2656 (0.146)	0.1968 (0.091)	-0.2692 (0.146)	0.2019 (0.091)	-0.2702 (0.146)
Endogenous variables (C)	0.1956 (0.091)	-0.2617 (0.146)	0.1966 (0.091)	-0.2639 (0.146)	0.2011 (0.091)	-0.2651 (0.146)
Turnover rate < 0.5	0.4721 (0.140)	-0.9033 (0.337)	0.4509 (0.141)	-0.8485 (0.338)	0.4716 (0.140)	-0.8998 (0.336)
Turnover rate < 1.0	0.1558 (0.073)	-0.1810 (0.103)	0.1492 (0.074)	-0.1736 (0.103)	0.1503 (0.073)	-0.1780 (0.103)
All observations	0.0120 (0.014)	-0.0003 (0.000)	0.0139 (0.014)	-0.0004 (0.000)	0.0118 (0.014)	-0.0004 (0.000)
Manufacturing firms	0.2492 (0.113)	-0.4525 (0.181)	0.2409 (0.114)	-0.4458 (0.182)	0.2329 (0.113)	-0.4243 (0.181)
Non manufacturing firms	0.2744 (0.127)	-0.3622 (0.204)	0.2737 (0.127)	-0.3642 (0.204)	0.2665 (0.127)	-0.351 (0.204)
Small firms	0.3859 (0.120)	-0.6206 (0.200)	0.3872 (0.121)	-0.6281 (0.200)	0.3842 (0.120)	-0.6175 (0.200)
Medium firms	0.1150 (0.138)	-0.1720 (0.213)	0.1058 (0.140)	-0.1650 (0.215)	0.1026 (0.139)	-0.1624 (0.214)

Note: all coefficients are significant at 5 % or 10% level (mostly 5%), except those for full sample, and medium firms. Figures in parentheses are standard errors.
Endogenous variables (A) includes: log capital, log labour, export
Endogenous variables (B) includes: log capital, log labour, export, turnover, turnover squared
Endogenous variables (C) includes: log capital, log labour, export, turnover, turnover squared, union, innovation

Firms with a turnover rate higher than 0.5 are likely to be outliers as our definition of turnover excluded casual workers.[19] Altering this cut-off point does change the coefficients on the turnover variables significantly – becoming smaller as the cut-off point is raised. This is understandable because if the outliers were due to measurement errors and, thus, not correlated with productivity, incorporating them would weaken the estimated effect of employee turnover on productivity. It seems reasonable to assume that the measurement

[19] As a casual benchmark, policy advisers worked for the Australian Government has reportedly to have very high turnover, mainly due to long hours, high stress and lack of a clear career path (Patrick 2002). Their turnover rate was found to range from 29 per cent to 47 per cent under the Keating government (1991–1996).

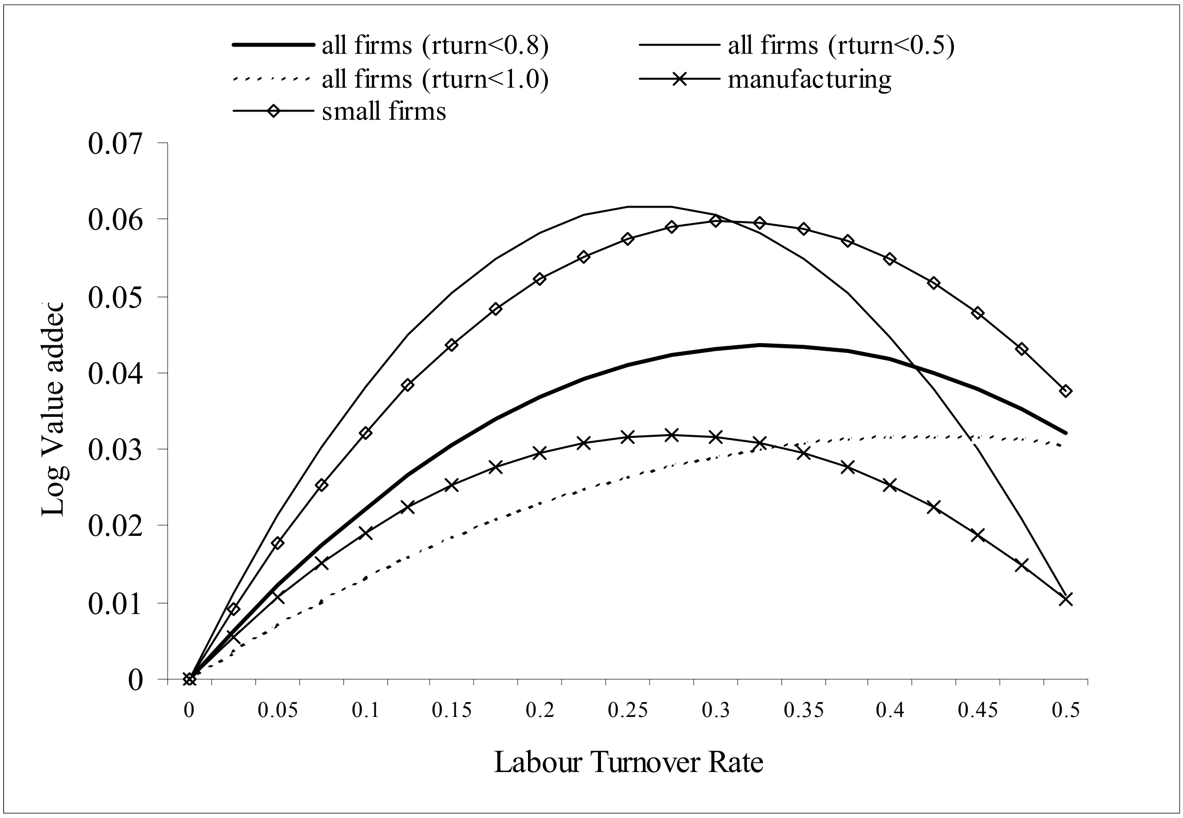
errors are larger at the top end of the distribution, so that the effect of labour turnover rate weakens as the cut-off point increases.

We also ran separate estimations for manufacturing and non-manufacturing, and small and medium sized firms, respectively. Due to sample size restrictions, we were unable to further divide non-manufacturing firms by industry classification. Medium-large firms are excluded for the same reason. The optimal turnover rate for non-manufacturing firms is 0.38, higher than the rate of 0.27 for manufacturing firms. Small and medium firms have similar optimal turnover rates, of around 0.31. However, small firms have higher productivity loss when moving away from the optimal point. An explanation may be that smaller firms deploy fewer resources in knowledge management and standardising work processes, so that the departure of experienced staff will cause a greater interruption on operation.

The effects of turnover rate on productivity for various samples using the B-H-S estimator are illustrated in Figure 1 (Since the results from the three different estimators are fairly similar, only one set of results are presented for simplicity of the graph). The diagram is a plot of log productivity against turnover rate. The turnover-productivity curve can be read as that, in the base case, increasing labour turnover rate from 0 to the optimal point (0.33), on average, raises productivity by 4.4 per cent. Excluding the result from the full sample, the optimal turnover rate ranges from 0.26 to 0.42 for the sub-samples reported in this paper.

The average turnover rate for the base sample is 0.18 and the median 0.13; both are well below the optimal rate. A possible explanation for the large gap between the estimated optimal rate and the sample mean and median is that agents (both employers and employees) are of bounded rationality. Without sufficient information about the possibility of finding a better substitute (either staff or job), agents will make changes at a rate lower than what would have been if information were fully revealed. Another plausible explanation is that there is enormous amount of friction in the dismissal and hiring process, such as legal restrictions. While the finding cannot pin down exactly what attribute to the gap, it indicates how much can be gained by bringing the turnover rate toward the optimal level. For instance, an increase in turnover rate from the sample mean (0.18) to the optimal level (0.33) will result in a 0.9 per cent rise in value-added, and 1.6 percent if from the sample median (0.13) to the optimal level. These figures underline the potential gain from further increasing the flexibility of employment arrangement for small and medium Australian enterprises.

Figure 1 Labour Turnover – Productivity Curve



Although the findings are largely consistent with theory, cautions should be taken in reading the results. Firstly, the analysis in this paper is based on small and medium firms. The optimal turnover rate may not be able to extrapolate to large firms. Those very large firms, particularly conglomerates or multinational enterprises, typically consist of many subunits, which each one of them can be considered a small firm. Therefore, within-firm mobility may substitute between-firm mobility.[20]. Secondly, the potential long-term effects of turnover on productivity are not able to tested here due to data restriction. For instance, unfavourable comments on a firm spread by its involuntarily separated employees may damage its corporate image and, thus, weaken its attraction to quality potential employees. Therefore, labour turnover may have slightly stronger negative effect in the long run. However, this reputation effect should not be significant for small and medium firms because of their

[20] In a case study, Lazear (1992) finds that the pattern of within-firm turnover from job to job resembles that of between-firm turnover.

atomic size in the labour market. The development of a long running panel is necessary for further analysis.

5. Conclusions

This paper sets out to quantify the impact of employee turnover on productivity. Between the two major theoretical arguments about the effect, FSHC theory asserts that high turnover lowers firms' incentives to provide staff training programs and, therefore, reduces productivity. On the other hand, job matching theory postulates that turnover can help employers and employees to avoid being locked in sub-optimal matches permanently, subsequently increases productivity. The conflict between retaining workforce stability on the one hand, and flexibility on the other, gives rise to the quest of an optimal turnover rate.

Using an Australian longitudinal data set, we establish that productivity is a quadratic function of turnover. The inverse U-shaped productivity-turnover curve is consistent with the intuition that job matching effects dominate while turnover is low, whereas FSHC effects dominate while turnover is high. The optimal turnover rate is estimated to be about 0.3. The result is very robust using various estimation methods, or using small and medium firms subsamples. However, the non-manufacturing firms subsample has a slightly higher optimal rate of 0.38, while the manufacturing firms subsample a lower one of 0.27.

The empirical results have significant implications to human resource and labour market policies. For instance, it is found that an increase in turnover rate from the sample mean of 0.18 to the optimal level of 0.33 will result in a 0.9 per cent rise in value-added; the gain for small enterprises is even higher. This suggests that further reforms to increase the flexibility of job markets will yield substantial productivity gains for the Australian economy.

Reference

Abbasi, S. M. and K. W. Hollman (2000). "Turnover: The real bottom line." *Public Personnel Management* 29(3): 333-42.

Ahn, S. (2001). "Firm dynamics and productivity growth: A review of micro evidence from OECD countries." *OECD Economic Department Working Paper* # 297.

Amemiya, T. and T. MaCurdy (1986). "Instrumental estimation of an error components model." *Econometrica* 54(869-81).

Azfar, O. and S. Danninger (2001). "Profit-sharing, employment stability, and wage growth." *Industrial and Labor Relations Review* 54(3): 619-30.

Becker, G. S. (1975). *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*. New York, National Bureau of Economic Research.

Bee, Y. A., S. Chun and M. J. Roberts (2000). "Productivity and the decision to export: Micro evidence from Taiwan and South Korea." *World Bank Economic Review* 14(1): 65-90.

Borland, J. (1997). "Employee turnover: Evidence from a case study." *Australian Bulletin of Labour* 23(2): 118-32.

Breusch, T., G. Mizon and P. Schmidt (1989). "Efficient estimation using panel data." *Econometrica* 57(695-700).

Burdett, K. (1978). "A theory of employee job search and quit rates." *American Economic Review* 68(1): 212-20.

Carsten, J. M. and P. E. Spector (1987). "Unemployment, job satisfaction and employee turnover: A meta-analytic test of the Muchinshky Model." *Journal of Applied Psychology*: 374-81.

Chang, C. and Y. Wang (1995). "A framework for understanding differences in labor turnover and human capital investment." *Journal of Economic Behavior and Organization* 28: 91-105.

Clerides, S. K., S. Lach and J. R. Tybout (1998). "Is learning by exporting important? Micro-dynamic evidence from Colombia, Mexico, and Morocco." *Quarterly Journal of Economics* 113(3): 903-47.

Cooper, D. P. (2001). "Innovation and reciprocal externalities: information transmission via job mobility." *Journal of Economic Behavior and Organization* 45: 403-25.

Economist (2000). "Employee turnover: Labours lost.".

Economist (2001). "Corporate downsizing in America: The jobs challenge.".

Fortune (2002). "The 100 best companies to work for.": 21-39.

Glenn, A., J. P. McGarrity and J. Weller (2001). "Firm-specific human capital, job matching, and turnover: Evidence from major league baseball, 1900-1992." *Economic Inquiry* 39(1): 86-93.

Hausman, J. and W. Taylor (1981). "Panel data and unobservable individual effect." *Econometrica* 49: 1377-98.

Iverson, R. D. (1999). "An event history analysis of employee turnover: The case of hospital employees in Australia." *Human Resource Management Review* 9(4): 397-418.

Jovanovic, B. (1979a). “Job matching and the theory of turnover.” *Journal of Political Economy* 87(5): 972-90.

Jovanovic, B. (1979b). “Firm-specific capital and turnover.” *Journal of Political Economy* 87(6): 1246-60.

Lazear, E. (1992). “The Job as a Concept” in *Performance Measurement, Evaluation, and Incentives*. J. William J. Bruns. Boston, Harvard Business School**:** 183-215.

Lilien, D. M. (1982). “Sectoral shifts and cycllical unemployment.” *Journal of Political Economy* 90(4): 777-93.

Lucas, R. E. and E. C. Prescott (1974). “Equilibrium search and unemployment.” *Journal of Economic Theory*(February): 188-209.

Lucifora, C. (1998). “The impact of unions on labour turnover in Italy: Evidence from establishment level data.” *International Journal of Industrial Organization* 16(3): 353-76.

Lynch, L. M. (1993). “The economics of youth training in the United States.” *The Economic Journal* 103(420): 1292-1302.

McLaughlin, K. J. (1990). “General productivity growth in a theory of quits and layoffs.” *Journal of Labor Economics* 8(1): 75-98.

Megna, P. and M. Klock (1993). “The impact of intangible capital on Tobin's q in the semiconductor industry.” *American Economic Review* 83(2): 265-69.

Mintzberg, H. (1979). *The Structuring of Organizations*. Englewood Cliffs, NJ, Prentice Hall.

Mok, C. and Y. Luk (1995). “Exit interviews in hotels: Making them a more powerful management tool.” *International Journal of Hospitality Management* 14(2): 187-94.

Muchinsky, P. M. and M. L. Tuttle (1979). “Employee turnover: An empirical and methodological assessment.” *Journal of Vocational Behaviour* 14(43-77).

Nelson, R. and S. Winter (1982). *An Evolutionary Theory of Economic Change*. Cambridge, Mass., Harvard University Press.

Nickell, S., S. Wadhwani and M. Wall (1992). “Productivity growth in U.K. companies, 1975-1986.” *European Economic Review* 36(5): 1055-91.

Patrick, A. (2002). “PM tightens grip on Canberra.” *The Australian Financial Review*: 6.

Petrongolo, B. and C. A. Pissarides (2001). “Looking into the black box: A survey of the matching function.” *Journal of Economic Literature* 39(2): 390-431.

Rogers, M. (1999). “The performance of small and medium enterprises: An overview using the growth and performance survey.” *Melbourne Institute Working Paper* (1/99).

Sheehan, E. P. (1993). “The effects of turnover on the productivity of those who stay.” *Journal of Social Psychology* 133(5): 699.

Shepard, E. M., T. J. Clifton and D. Kruse (1996). “Flexible working hours and productivity: Some evidence from the pharmaceutical industry.” *Industrial Relationship* 35(1): 123-39.

Tseng, Y.-P. and M. Wooden (2001). “Enterprise bargaining and productivity: Evidence from the business longitudinal survey.” *Melbourne Institute Working Paper* (8/01).

Appendix

A.1 Sample Selection

The first wave of BLS was conducted in 1994/5, with a total effective sample size of 8,745 cases. The selection into the 1995/6 sample was not fully random. Businesses that had been innovative in 1994/95, had exported goods or services in 1994/95, or had increased employment by at least 10 per cent or sales by 25 per cent between 1993/94 and 1994/95, were included in the sample. A random selection was then made on all remaining businesses. These businesses were traced in the surveys of the subsequent two years. In order to maintain the cross-sectional representativeness of each wave, a sample of about 800 businesses were drawn from new businesses each year. The sample size in the second, third and fourth waves are around 5,600. For detailed description of the BLS data set, see Tseng and Wooden (2001). Due to confidentiality considerations, the complete BLS is not released to the public, only the Confidentialised Unit Record File (CURF) is available. In the CURF, businesses exceed 200 employees and another 30 businesses that are regarded as large enterprises using criteria other than employment are excluded. This leaves around 4,200 businesses in the balanced panel.

We further reduced the number of cases available for analysis by deleting observations that had been heavily affected by imputation because including them would impose artificial stability. The cases where complete sections of the questionnaire had been imputed are discarded. Moreover, we excluded businesses in the finance and insurance industries because of substantial differences in the measures of value-added and capital.21 In addition, observations with negative sales and negative liabilities were dropped, as were a small number of cases where it was reported that there were no employees. In total, this left just 2,435 businesses in our sample. Summary statistics are presented in Table A1.

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[21] Since only around 1.6 per cent of businesses in the balanced panel is in the financial sector, it is not feasible to undertake a separate analysis on this sample.

Table A1. Summary statistics

	Mean	SD	Min	Max
Log value-added	7.086	1.458	-0.028	13.554
Log Capital	6.764	1.622	0	13.716
Log Labour	2.811	1.122	-0.979	5.263
Incorporated	0.715	0.451	0	1
Family business	0.515	0.500	0	1
Manager to total Emp. Ratio	0.254	0.170	0	0.889
rpart	0.216	0.289	0	1
rturn	0.254	0.670	0	41.000
Ratio of Employment on Individual contract	0.232	0.354	0	1
Ratio of Employment on Unregistered agreement	0.091	0.256	0	1
Ratio of Employment on Registered agreement	0.061	0.207	0	1
Export	0.269	0.444	0	1
Union Dummy (1-49%)	0.206	0.404	0	1
Union Dummy (50%+)	0.083	0.276	0	1
Innovation (t-1)	0.297	0.457	0	1
Borrowing Rate (t-1)	0.752	1.283	0.037	51.064
Firm size dummy: Medium	0.438	0.496	0	1
Firm size dummy: Medium-Large	0.065	0.246	0	1
Age dummy (less than 2)	0.063	0.243	0	1
Age dummy (2-5 years)	0.134	0.340	0	1
Age dummy (5-10 years)	0.251	0.434	0	1
Age dummy (10-20 years)	0.284	0.451	0	1
Age dummy (20 years+)	0.267	0.443	0	1
Mining	0.008	0.089	0	1
Manufacturing	0.428	0.495	0	1
Construction	0.043	0.203	0	1
Wholesale trade	0.182	0.386	0	1
Retail trade	0.106	0.308	0	1
Accommodations, cafes & restaurants	0.036	0.185	0	1
Transport & storage	0.030	0.170	0	1
Finance & insurance	0.012	0.111	0	1
Property & business services	0.118	0.323	0	1
Cultural & recreational services	0.018	0.132	0	1
Personal & other services	0.019	0.137	0	1
No of observations (n×T): 6756				